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Table format	**:**	Font: Times New Roman, font size: 10 e.g. Table No. 1 (Font size 9)

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Real Time Data Acquisition System for Smart Home using LabVIEW

[1]*Mr. Mahesh S. Patil,*[2]*Mr.Sachin S. Nerkar*
[1,2]Govt.College of Engineering Jalgaon.

***Abstract*— Data acquisition systems, as the name implies, are products and/or processes used to collect information to document or analyze some phenomenon. A sample house environment monitor and control system that is one branch of the Smart home is addressed in this paper. The system is based on the LabVIEW software and can act as a security guard of the home. The approach combines hardware and software technologies.**

Keywords *-ATmega16, Data Acquisition, LabVIEW, Smart Home, GUI.*

I. INTRODUCTION

Communication-Baseddata acquisition products, those that interface with a computer through a communication port, can range from data loggers to remote intelligent control systems. The most common communication interface for short distances is RS-232. RS-232 defines serial communication for one device to one computer communication port, with speeds up to 115 K baud (bits per second). Typically 7 or 8 bits (on/off signal) are transmitted to represent a character or digit. At the simplest level, data acquisitioncan be accomplished manually usingpaper and pencil, recording readingsfrom a multimeter or any other instrument.For some applications this formof data acquisition may be adequate.However, data recording applicationsthat require large number of datareadings where very frequent recordingsare necessary must includeinstruments or microcontrollers toacquire and record data precisely(Rigby and Dalby, 1995). *Lab*oratory*V*irtual *I*nstrument Engineering *W*orkbench(LabView™) is a powerful andflexible instrumentation and analysissoftware application tool which wasdeveloped in 1986 by the NationalInstruments (National Instruments,2012). LabVIEW has become a vital tool in today's emerging technologies and widely adopted throughout academia, industry, and government laboratories as the standard for data acquisition, instrument control and analysis software.

II. SYSTEM CONFIGURATION

Design of data acquisition system is demonstrated for measurement of parameters like temperature, light, humidity etc. by acquiring data using different sensors at different locations and communicating with the user using ATmega16 AVR microcontroller. System description is divided into two parts, consisting of hardware and software description. Figure 1 shows block diagram of the system. It uses microcontroller unit(MCU) for acquiring parameters from sensor unit, then all the parameters like humidity, temperature, smoke etc are given to computer via serial port. Then we developed graphical user interface(GUI) in LabVIEW. Control mechanisms are carried out with the help of data acquisition card (NI DAQ).

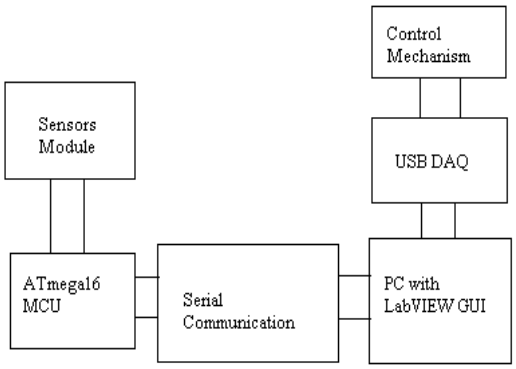

Fig.1 System block diagram

A. Software Implementation

LabVIEW is being used to design program codes to read, monitor and display process parameters for real time data acquisition system. LabVIEW provides a perfect scope to accomplish computer based research. The wired together icons to perform simple-to-understand tasks which makes operation given below possible.

Building an array
Parsing a string
Digitalizing an analog voltage

A LabVIEW program includes two windows, called the **Front Panel** and the **Block Diagram.**

The Front Panel

Once a program is developed, the front panel acts as the face of a laboratory instrument. Front panel includes controls and indicators, which are the

interactive input and output terminals of the VI, respectively. Controls are knobs, push buttons, dials, and other input mechanisms. Indicators are graphs, LEDs, and other output displays. Hence the **front panel** is the program's user-interface, which facilitates the interaction of: 1. Providing inputs to the program, 2. Monitoring outputs from the program as it runs.

The Block Diagram

The actual LabVIEW programming codeis exposed in the block diagram**.** It contains Lab View's well-stocked libraries of icons that we have selected during the program development. Each icon stands for a block of underlying executable code that does a particular useful function. The programming is done by wiring these icons properly, so that data flows amongst graphical images to achieve a desired function. LabVIEW enables us to carry out state of the art research including:

1. Instrument Control
2. Data Acquisition
3. Data Analysis
4. Data Presentation and Data Storage

Virtual Instruments (VI)

LabVIEW programs are called Virtual Instruments (VI) because their appearance and operation imitate physical instruments, such as oscilloscopes and multi meters. Every VI uses functions that manipulate input from the user interface or other sources and display that information or more it to other files or other computers.

B. Hardware Implementation

In the design of real time data acquisition system, we used several sensors like LDR, temperature sensor, and humidity sensors that will observe the different parameters.

Microcontroller

Microcontrollers are small and cost effective but self-contained computer chips used for embedded applications in industrial and consumer electronics products. In this system, we are using *ATmega16* microcontroller. The controllers are receiving the data from different sensors, placed at specific locations and sending the data to LabVIEW that communicating with the user. Outputs of the sensors can be provided to processer directly but in this case, distance is the constraint, means sensors cannot be placed at far distance from the processor. It is very important to keep a track of the working of almost all the automated and semi-automated devices, be it a washing machine, an autonomous robot or anything else. This is achieved by displaying their status on a small display module. LCD (Liquid Crystal Display) screen is such a display module and a 16x2 LCD module is very commonly used. These modules are replacing seven segments and other multi segment LEDs for these purposes. The reasons being: LCDs are economical, easily programmable, have no limitation of displaying special & even custom characters (unlike in seven segments), and so on. LCD can be easily interfaced with a microcontroller to display a message or status of a device.

Temperature Measurement

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage linearly calibrated directly in ˚ Celsius (Centigrade) i.e. Linear + 10.0 mV/˚C scale factor with 0.5˚C accuracy guarantee able (at +25˚C) and rated for full −55˚ to +150˚C range. It operates from 4 to 30 volts and draws less than 60 μA.

Light intensity measurement

A simple light intensity sensor can be constructed using light depended resistance (LDR) to measure the light, it will show different status of light based on the intensity of the light. When light intensity is very low it will show the status darkness or night, when intensity is dim it will show dim, when intensity is medium it will show normal status and for the high intensity it will show day or brightness on LCD.

Humidity sensor module-SY-HS-220

This module convert the relative humidity to the output voltage and can be used in weather monitoring application. The board conist of humidity sensor along with signal conditioning stages. It is capacitive type, comprising on-chip signal conditioner. The PCB consist of CMOS timers to pulse the sensor to provide output voltage. It is also consist of oscillator, AC amplifier, frequency to voltage converter, and precision rectifiers.

The humidity sensor used in this system is highly precise and reliable. It provides DC voltage depending upon humidity of the surrounding in RH%. This work with +5 Volt power supply and the typical current consumption is less than 3 mA. The operating humidity range is 30% RH to 90% RH. The standard DC output voltage provided at 250C is 1980 mV . The accuracy is ± 5% RH at 250C. As shown in the fig 3, it provides three pins recognized as B, W and R. The pin labeled W provides the DC output voltage, where as the pin labeled B is ground. The VCC of +5V is applied at the pin R. The humidity dependent voltage is obtained and subjected for further processing.

III. DATA ACQUISITION USING SERIAL PORT

The goal of this application is to demonstrate the usefulness of multifunction data acquisition boards for monitoring and control. This is achieved by using the LabVIEW environment to acquire and process signals, generating commands and displaying the progress of the process variables to the user.

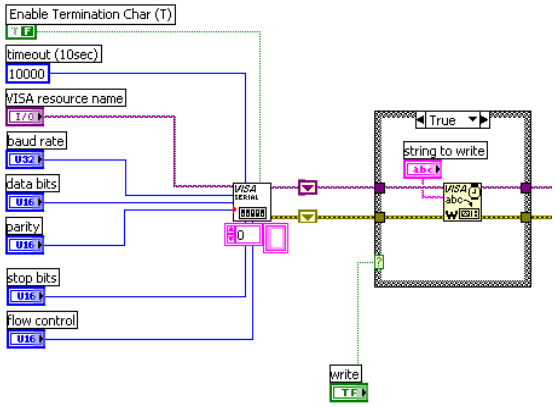

Fig.2 Serial Communication block diagram

Serial communication needs specification of four parameters: the baud rate of the transmission, the number of data bits encoding a character, the sense of the optional parity bit, and the number of stop bits. Each transmitted character is packaged in a character frame that consists of a single start bit followed by the data bits, the optional parity bit, and the stop bit or bits. Baud rate is a measure of how fast data is moving between instruments that use serial communication. RS-232 uses only two voltage states, called MARK and SPACE. In such a two state coding scheme, the baud rate is identical to the maximum number of bits of information, including "control" bits, which are transmitted per second. The start bit signifies the beginning of each character frame. It is a transition from negative (MARK) to positive (SPACE) voltage.

In transmission of data bits, inverted logic is used and the order of transmission is from least significant bit (LSB) to most significant bit (MSB). An optional parity bit follows the data bits in character frame. The last part of the character frame is a stop bit. These bits are always represented by a negative voltage.

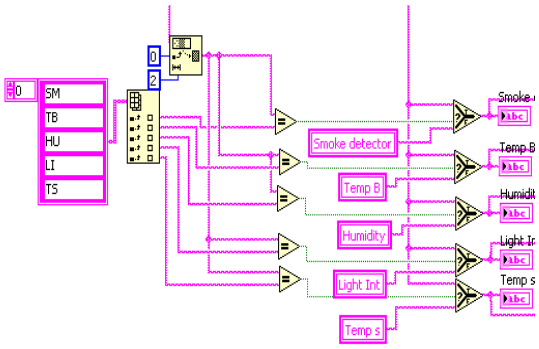

Fig.3 LabVIEW code for Parameters monitoring

The transmission of next character frame is followed by a start bit of positive (SPACE) voltage.

The VISA Configure Serial Port VI initializes the port identified by VISA resource name to the specified settings. Timeout sets the timeout value for the serial communication. Baud rate, data bits, parity, and flow control specify those specific serial port parameters. Serial port communication for read and write operation is shown in figure.

The LabVIEW code created to communicate microcontroller with LabVIEW and the data is displayed on LCD display.

In front panel we have an actual code for communication between microcontroller and LabVIEW.

First step is the configuration of serial port after that a string is generated for Write operation then for Read operation as shown in Fig. 6. Within this system implementation, we almost tried to replace high cost DAQ (Data Acquisition) card with microcontroller. Without DAQ card the system cost is effectively reduced. By writing easy LabVIEW code using VISA resource, the communication through external hardware is very easy. Serial communication uses a transmitter to send data, one bit at a time, over a single communication line to a receiver. We can use this method when data transfer rates are low.

We can use LabVIEW to to inspect the status of serial port. It is explained as follows.

1. Open All Functions>Instrument I/O>Serial>VISA Configure Serial Port.VI to the block diagram. To create a new I/O for one of input “COM port number”. To creat an indicator for output “error code”. Next to decide what number should be filled into this parameter of port number. We should go back to find how many communication ports we have. Right now we use COM1 or COM2 as activated port.
2. It will be generated a number to show the quality of COM1. If we press the execution

button and a number '0' is displayed which means everything O.K., the quality of COM1 is good. If we got the other number which means the communication port (COM1) does not work, it may make a mistake while installation. Please come back to check a system and set-up again.

IV. RESULTS AND ANALYSIS

The status of smoke detector, humidity and temperature is shown in figures.All the parameters are easily monitored and can be controlled using LabVIEW and microcontroller.
Humidity sensor module is easily interfaced to the microcontroller and it can be monitored in LabVIEW. Fig. 10 shows the variation of humidity with respect to the output voltage of module.

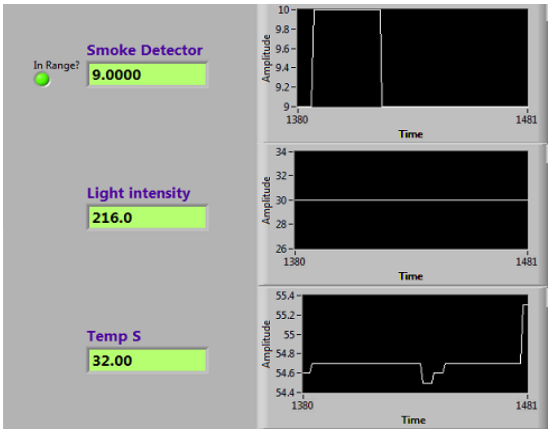

Fig. 4 Real Time Parameters Monitoring GUI for Smoke, Light Intensity and temperature.

Due to the linear characteristics curve and easy signal conditioning, it is very easy to interface the module with microcontroller and PC.

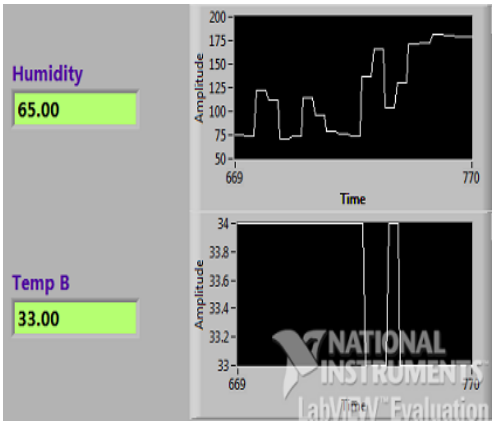

Fig. 5 Real Time Parameters Monitoring GUI for Humidity and temperature.

By using data acquisition card we can control each parameter with real time easy programming of LabVIEW.

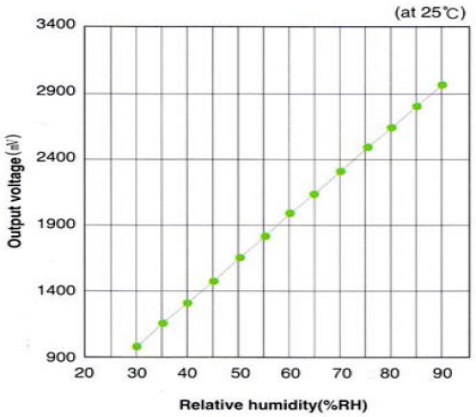

Fig. 6 Humidity and its respective output voltage

V. CONCLUSION

This paper represents importance of home parameters monitoring system for home security. Installing home security systems are not status symbols anymore but rather they have become a great necessity in today's environment.
We address a new smart home control system based on sensor networks to make home networks more intelligent and automatic. We implement the proposed system and develop related hardware and software. We suggest new ubiquitous home scenarios based on the proposed system. We expect that our work contributes towards the development of ubiquitous home networks. Energy savings and user happiness are two major design considerations for modern home automation systems.
The application was designed and developed to prove a couple of concepts about the data acquisition in general and some notions about the possibility of adding remote controlling/monitoring. This has a teaching purpose: it is being used for a series of experiments between several laboratories, at the moment. From one point of view one can process the experimental data gathered from a real process, but one can also see the result of one remote command sent to industrial equipment in the real time.

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A Review on use of Peltier Effects

Ajitkumar N. Nikam[1], *Dr. Jitendra A. Hole*[2]
Mechanical Engineering Department, Rajrashree Shahu College of Engineering, Pune, India.
ajitnikam88@hotmail.com[1], jahole2000@yahoo.com[2]

Abstract: The research and development work carried out by different researchers on development of novel thermoelectric R&AC system has been thoroughly reviewed in this paper. In recent years, with the increase awareness towards environmental degradation due to the production, use and disposal of ChloroFluoro Carbons (CFCs) and Hydro Chlorofluorocarbons (HCFCs) as heat carrier fluids in conventional refrigeration and air conditioning systems has become a subject of great concern and resulted in extensive research into development of novel refrigeration and space conditioning technologies. Thermoelectric cooling provides a promising alternative R&AC technology due to their distinct advantages. Use of Thermoelectric effect to increase the COP of existing cooling system has been also reviewed in this paper.

Keywords- *Peltier effect, COP, Air Conditioning, Refrigeration*

1. INTRODUCTION

The Peltier effect was discovered in 1834 by a French watchmaker and part time physicist Jean Charles Athanase Peltier. Peltier found that the application of a current at an interface between two dissimilar materials results in the absorption/release of heat as seen in Figure 1. At the subatomic level, this is a result of the different energy levels of materials, particularly n and p type materials. As electrons move from p type material to n type material, electrons jump to a higher energy state absorbing energy, in this case heat, from the surrounding area. The reverse is also true. As electrons move from n type material to p type material, electrons fall to a lower energy state releasing energy to the surrounding area.

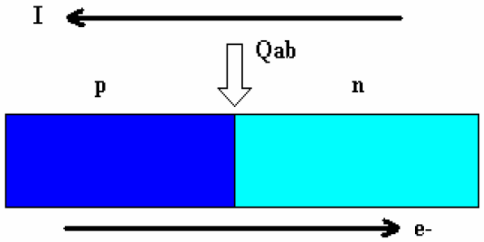

Figure 1- Peltier effect [1].

The relationship between the amount of current and heat absorbed/released at the junction of the two dissimilar semiconductors is given by the Peltier coefficient, (1.1).

$$\pi_{ab}(T) = \frac{\Delta Q_{ab}}{I} \quad (1.1)$$

2. METHODS TO USE THE PELTIER EFFECT

As we see in introduction Peltier effect can produce heating as well as cooling effect. We can use this effect as produce direct effect for cooling or heating and can use peltier module in existing system to increase the performance or COP of the system.

From above application w can subdivide the use of Peltier effect as Direct use & Integrated use of Peltier Effect.

2.1 Integrated Use of Peltier Effect
2.2 Direct use of Peltier Effect
2.1 Integrated Use of Peltier Effect

Thermoelectric systems show excellent efficiencies at small temperature lifts. While the applications of this advantage are limited, it can be used potentially quite beneficially in vapor compression systems [1]. In a conventional vapor compression system, with a traditional condenser that includes a subcooler, liquid refrigerant leaving the subcooler only can be cooled to the temperature level of the heat sink. Using a thermoelectric element for subcooling, the liquid refrigerant can now be subcooled significantly at a COP that exceeds that of the original vapor compression system. Figure 2 shows a schematic of the vapor compression cycle with the thermoelectric subcooling element indicated after the condenser. A performance evaluation based on a simple vapor compression cycle without pressure drop and 100% isentropic compressor efficiency yields an increase in COP for refrigerant R-134a of about 3.5% for 5 K degrees of subcooling in an air-conditioning application [1].

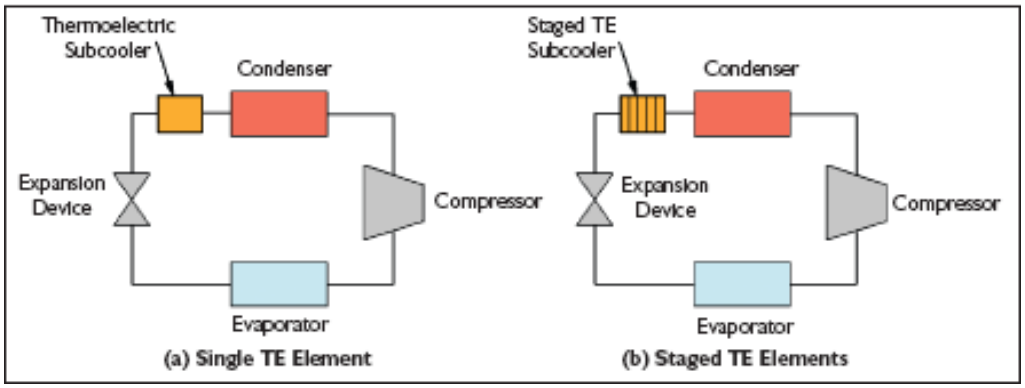

Figure 2- Schematic of vapor compression cycle with TE subcooler [1].

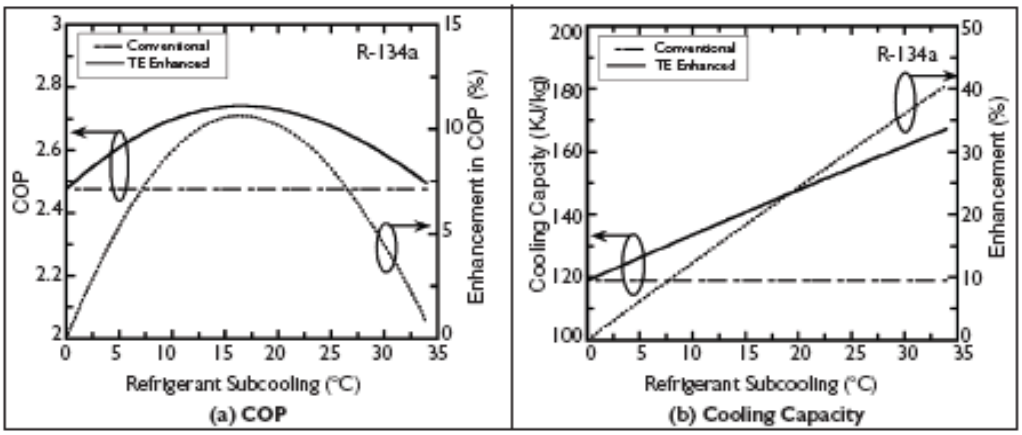

Figure 3- Performance enhancement with subcooling [1]

As result comes, from COP peaks according to *Figure 3a* at 15 K degrees of subcooling at about 20% capacity increase according to *Figure 3b*, the capacity keeps increasing to about 40% at 35 K degrees of subcooling [1]. Peltier effect also used in application of thermoelectric devices to enhance the performance of air-cooled heat exchanger [2]. Thermoelectric devices are capable of converting electrical energy into thermal heat-pumping at a very high efficiency [2].

In this application TE device in a part of a coil to investigate the improvement potential. A schematic of a TE enhanced air-cooled heat exchanger is shown in Figure 4. A half cross section of a tube-fin heat exchanger is shown in Figure 4 along with a TE element placed between the fins and the tube. The power supply connections for the TE element are not shown for simplicity.

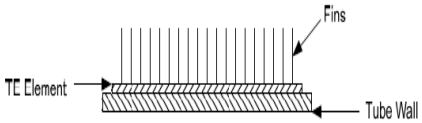

Figure 4- Schematic of a TE enhanced tube-fin heat exchanger [2].

From Figure 5 it can be seen that with relatively low power consumption the TE element is able to provide temperature lifts of more than 10K. Comparing the heat transferred per fin with the power consumption, it is possible to calculate a coefficient of performance for the TE device. From Figures 5a and 5b, an optimal value of temperature lift can be chosen for a given application.

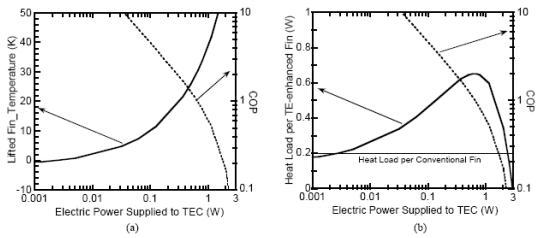

Figure 5- Simulation results - effect of TE device power consumption [2].

The experiments show that when a TE device is used as a dedicated subcooler at the condenser outlet, a 16.2% increase in system COP and over 20% increase in cooling capacity can be achieved. This also means when designing a system for a given capacity and application, it is possible to significantly reduce the heat exchanger sizes thereby reducing the cost of the system [2].

Thermoelectric (TE) modules have been integrated into a subcooler of an experimental CO_2 transcritical vapor compression cycle test system [3].The TE Subcooler was designed and fabricated to subcool CO_2 exiting the gas cooler to a temperature below ambient. The heat from the TE Subcooler was rejected to the ambient utilizing a separate thermosyphon refrigerant loop with a separate condenser. The thermoelectric modules operate at efficiencies greater than the baseline system, increasing capacity and the overall coefficient of performance (COP) of the entire system. Figure 6 shows the A small CO_2 transcritical vapor compression cycle was built to test the potential performance improvement of a TE Subcooler utilizing a prototype compressor with a cooling capacity of roughly 1 kW.

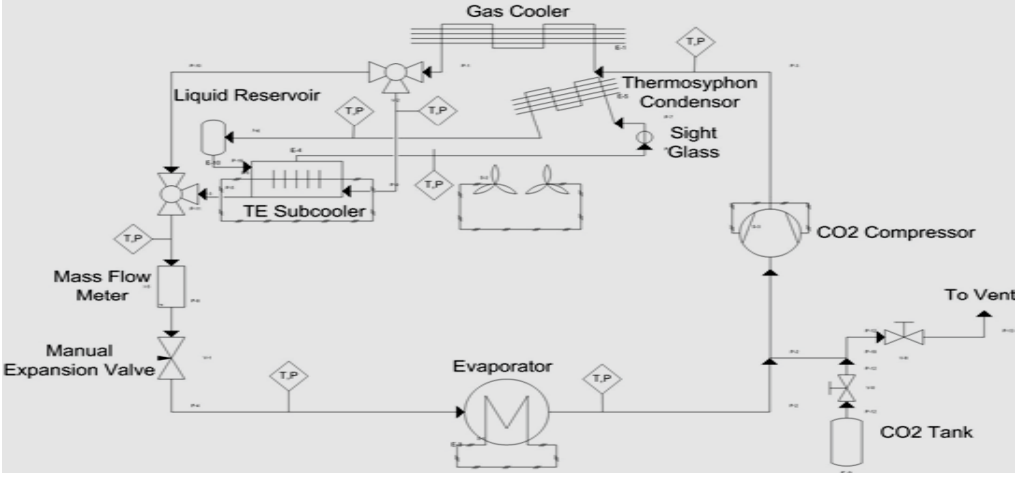

Figure 6 - Schematic of the experimental setup [3].

The TE Subcooler was aligned vertically, with CO_2 entering at the top from the gas cooler and exiting at the bottom to the expansion valve. The thermosyphon refrigerant, in this case R22, boils within the heat rejection microchannels. The vapor refrigerant travels upward to the thermosyphon condenser, where it condenses and travels back to the inlet of the heat rejection microchannels at the bottom of the TE Subcooler. In the original system setup the thermosyphon condenser was integrated into the gas cooler utilizing the same set of fans. Initial testing showed that this significantly reduced the capacity of the gas cooler and resulted in a negligible system performance improvement. In subsequent testing the thermosyphon condenser was separated from the gas cooler employing a second fan. For above experimental setup a listed system performance as shown in below table no. 1

System	Baseline System (Maximum COP)	TE System (Maximum COP)	TE System (Maximum Capacity)
System COP	2.354	2.476 (+5.2%)	2.379 (+1.1%)
System Capacity (kW)	1.44	1.569 (+9.2%)	1.657 (+15.3%)
Discharge Pressure (kPa)	9553	9042	9206
Compressor Power (kW)	0.61	0.591	0.601
Mass Flow Rate (g/s)	9.9	10.2	10.1
TE Supply Current (Amps)	-	4	6
Number of Modules	-	10	10
TE Capacity (kW)	-	0.204	0.256
TE COP	-	4.839	2.676
GC/TE Outlet Temperature (°C)	36.6	33.9	31.9

Table 1- Baseline and TE Subcooler system performance at a suction pressure of 4,198 kPa [3].

Performance improvement of a CO2 transcritical cycle utilizing a TE Subcooler was experimentally demonstrated. An increase in COP of 5% was achieved with a corresponding 9% increase in capacity. A capacity improvement of 15% was achieved at comparable COP as the baseline system [3].

2.2 **Direct use of Peltier Effect**

Refrigeration effect can be produce by direct use of Peltier Modules [5]. To obtain such effects thermoelectric refrigerator with an inner volume of 55 X 10^3 m^3 has been designed and tested, whose cold system is composed of a Peltier pellet (50 W of maximum power) and a fan of 2 W. An

experimental analysis of its performance in different conditions has been carried out [5].A thermal scheme of the thermoelectric refrigerator and a photograph of the prototype are respectively shown in Figs. 7 and 8. The Peltier pellet is supplied with a continuous current (Vmax = 12 V) so that heat is liberated by one side and absorbed by the other one. The firstlaw of thermodynamics for steady state (expressed by powers) applied to a refrigerating machine, is the following:

$$\dot{Q}_H + \dot{W}_e = \dot{Q}_c$$

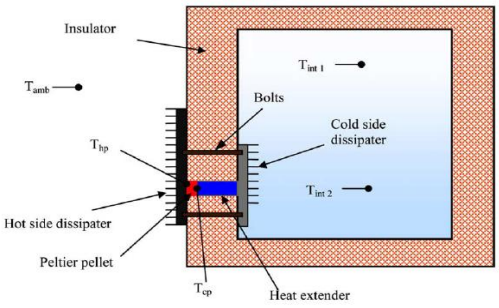

Figure 8- Photograph of the thermoelectric refrigerator [5]

Figure 7- Thermal sketch of the thermoelectric refrigerator [5].

For instance: lower level of noise and vibrations, a greater useful life, it does not use refrigerants and provides a greater control of temperatures. A thermoelectric refrigerator with an inner volume of 55 X 10^3 m^3 has been designed and built. It needs a continuous electric current (maximum 12 V) what makes it suitable for automobile industry applications, since it offers the following advantages with respect to vapour compression [5]:

- A more ecological system because it does not use refrigerants.
- More silent and robust since it minimizes the moving parts (it does not need a compressor).
- More precise in the control of temperatures, since it does not need to carry out start–stop cycles, making it possible to vary the supply voltage in a progressive way.

The main disadvantage is linked to the electricity consumption. The electric energy consumed by a thermoelectric refrigerator is higher in comparison with current compression refrigerators (approximately the same as a vapour compression one with an inner volume of 100 X 10^3 m^3). Peltier effect also has been used directly to produce the refrigeration Effect [6]. This can be experimentally shown by creating the setup as shown in fig. 9. The main body of the refrigeration chamber has a dimension of: 0.11x0.29x0.33 m^3 strongly insulated to minimize heat loss to the ambient air. In the cross section of this chamber, three layers exist: two walls of aluminum separated by an insulating material of 3 cm of thickness. Refer to figure 9

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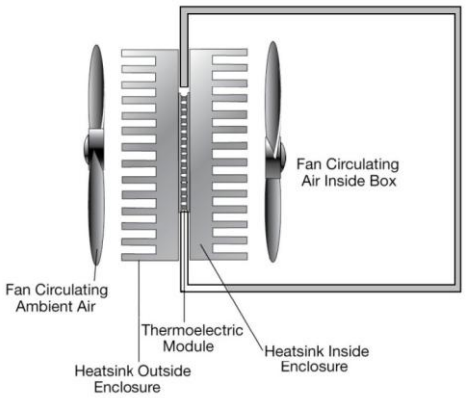

Figure 9- Main body of the refrigeration chamber [6].

High density heat sinks were specially fabricated for this project. They are made of Aluminum and are 350 x 75 x 39 mm^3, with 21 fins along their length and weight is 1500 Grams. Their specific heat is 0.963 J/g.°C. The "hot" surface of the thermoelectric heat pump must be attached to a heat sink that is a capable of carrying away both the heat pumped by the modules and the heat generated by the Joule effect [6]. The "cold" surface is also attached to another heat sink that will carry away the cold air, hence decreasing the temperature differential _T, and then making the thermoelectric more efficient. A "spacer block" is also put between the modules and the heat sinks. Its thickness, of 18 mm, separates the "hot" heat sink from the "cold" one, which yields to a maximum heat transfer. The refrigeration chamber was run for many values of input current. The temperature, time and input electrical power were measured. The obtained COP for the different current is shown in table 2.

Input Current (A)	Input Power (W)	Output Power (W)	COP(Experimental)
1	12.89	24.61	1.91
2	52.62	43.06	0.818
3	119.58	55.37	0.463
4	216.56	55.38	0.255

Table 2-Cooling Performance Results [6].

Peltier Effect can be directly use in Air conditioning Duct in supply & return way [7].

The design planning was conducted for an office space for personal use and used the acrylic board (height at 50cm, width at 100cm and height at 80cm) to make the personal office activity space, on which the single duct and double duct air adjusting devices were installed, as shown in Figure 10

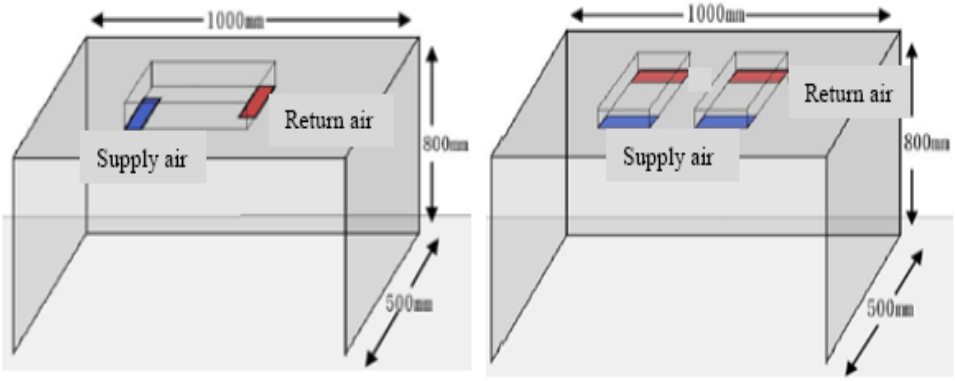

Figure 10- Single duct air-conditioning system and double duct air-conditioning system design [7].

In the channel, the return air inlet and air outlet were designed. The air inside the air-conditioning is driven by the cycling fan to enter from the return air inlet into the air adjusting devices and come out of the air outlet after temperature adjustment into the air-conditioned space. In the air adjusting device, four cooling chips were installed. On the cold side of the chip, heat exchanging fins are installed, by which the air can be cooled. On the hot side of the chip, water cooling component is installed to take away the high temperature heat by water cycling.

In this experiment , regarding the proposed single duct and double duct personalized air-conditioning systems, when the ambient temperature was 29℃, the air outlet temperature was 22℃, 24℃ respectively, and power consumption was 133W, 134W respectively[7].

Peltier effect can also use as thermoelectric radiant air-conditioning (TE-RAC) system, which employs the thermoelectric modules as radiant panels instead of conventional hydronic panels [8].As shown in Fig.11 Thermoelectric Modules is used directly for the space cooling purpose

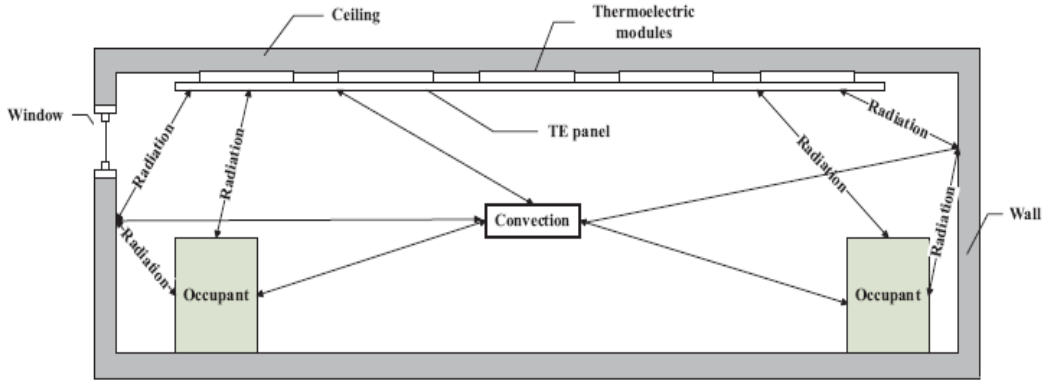

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Figure 11-Schematic of the virtual office space and its associated TE-RAC system [8]

In the above TE-RAC system, the thermoelectric modules work as radiant panels by taking electrical current. The novel system has a lot of advantages including Freon free, convenient installation, no complex water distribution pipes, convenient switch between cooling and heating modes, quiet and reliable operation due to no moving part, etc.[8]

A thermoelectric device was used to control the temperature of the car-seat surface: the warm temperature in the summer and cold temperature in the winter. The characteristics of the thermoelectric device for the car-seat were analyzed in relation to the input voltage and output temperature of the device [9].

Figure 12- Appearance of developed car-seat system [9].

We developed a car-seat system comprised of the air conditioning system utilizing the thermoelectric devices as shown in Fig. 12. The car-seat system is composed of two temperature control modules, each attached with two thermoelectric devices, as shown in Fig. 12. The two modules were placed in parallel, as shown in Fig. 12. In all, four thermoelectric devices HM3930 were placed at a sufficient distance to avoid mutual heat conduction. Temperature sensors were placed closest to the device since they cannot be placed on the plate, and the sensors were bonded at the thin copper plate to conduct the heat between the human body and the device. An insulating material was used to prevent heat conduction from the warm side to the cool side and human body.

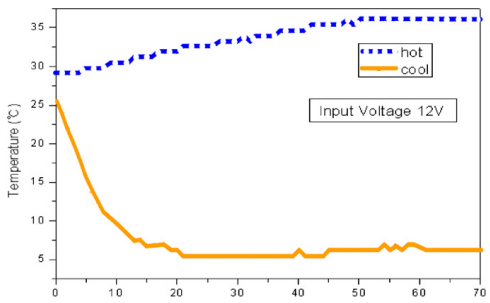

Figure 13- Performance test result of car-seat system [9].

Fig. 13shows the result of the temperature test on the car-seat system. Two thermoelectric devices were connected in series to supply 6 V to each device since the supply voltage from the car battery is 12 V. By the serial connection of two same devices, the supply voltage input to the device became 6 V. Although the temperature of the car-seat is balanced by the temperature control module using the air conditioning system, the temperature equilibrium can be upset, and without a robust temperature control system, the temperature can easily increased due to the external conditions.

In traditional way we use natural convection which gives the uneven cooling, leads to generate the hot pocket & results in reduction of the efficiency of the electrical system.

Following system shows direct use of peltier effect to reduce the temperature which is generated during the working of electronic devices. We can use this peltier module externally or internally as per requirement, shown in below figure 14.

Figure 14 - Single thermoelectric cooler mounted externally, internally [10].

CONCLUSION –

There are several different types of cooling devices available to remove the heat from industrial enclosures, but as the technology advances, thermoelectric cooling is emerging as a truly viable method that can be advantageous in the handling of certain small-to-medium applications. As the efficiency and effectiveness of thermoelectric cooling steadily increases, the benefits that it provides including self-contained, solid-state construction that eliminates the need for refrigerants or connections to chilled water supplies, superior flexibility and reduced maintenance costs through higher reliability will increase as well.

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Simulation & Parametric Finite Element Analysis for Sheet Metal FormingProcess

Dipak C. Talele[1], Dr. Dheeraj S. Deshmukh[2], Mahesh V. Kulkarni[3]
[1]Assistant Professor, S.S.B.T.'s, College of engineering & Technology, Bambhori, Jalgaon
[2]Professor & Head, S.S.B.T.'s, College of engineering & Technology, Bambhori, Jalgaon
[3]Assistant Professor, S.S.B.T.'s, College of engineering & Technology, Bambhori, Jalgaon
[1]taleledeepak190687@gmail.com, [2]deshmukh.dheeraj@gmail.com , [3]mvkmvk@gmail.com

***Abstract*—Finite element analysis (FEA) is successful in simulating complex industrial sheet forming operations, the accurate and reliable application of this technique to spring-back has not been widely demonstrated. Several physical parameters, as well as numerical, influence this phenomenon and its numerical prediction.**
In this paper, the effect of blank Thickness, blank holding force, Material, coefficient of Friction on the spring-back of specimens are discussed. The role that all the above parameters play in the spring-back is assessed through finite element simulations. Process conditions, such as Tool geometry, working temperature have an obvious effect on spring-back. Simulations are conducted with varying blank holding force, Materials, blank thickness, and coefficient of frictions to assess its role in spring-back of the formed part.

Keywords*— *blank holding force, coefficient of Friction, finite element analysis, simulations, spring-back,

INTRODUCTION

Spring-back is a phenomenon that occurs in many cold working processes. When a metal is deformed into the plastic region, the total strain is made up of two parts, the elastic part and the plastic part. When removing the deformation load, a stress reduction will occur and accordingly the total strain will decrease by the amount of the elastic part, which results in spring-back [1].

Spring-back describes the change in shape of a formed sheet upon removal from the tooling. It is more severe for materials with higher strength-to-modulus ratios (e.g., aluminium and high strength steel (HSS)). The finite element analysis (FEA) of spring-back is shown to be very sensitive to many numerical parameters, including the number of through-thickness integration points, type of element, mesh size, angle of contact per element on die shoulder, possible inertia effects and contact algorithm. Moreover, spring-back is also sensitive to many physical parameters including material properties, hardening laws, coefficient of friction, blank holder force (BHF) and possible unloading procedure. All these parameters make spring-back simulation very cumbersome [6].

Azraq et al. [2] verified the stamping process and the shape of the final component for studying spring-back of AHSS. With help of examples of analyzing spring-back using FEM, it was shown that the analysis enables to predict the influence of material strength. It was considered as it is possible to decrease the spring-back in future using the application of new FEM techniques. Tekaslan et al. [3] determined the amount of spring-back in sheet metals at different bending angles has been obtained by designing a modular 'V' bending die. Also he checked the spring-back for three kinds of materials of different thickness by using four different bending methods on eighteen different modular dies and a total of 720 experiments he did, at least 10 experiments belonging to each of the kinds. The results have shown that out of the four different bending methods used in the field most, two cannot be employed for spring-back. Also he concluded that (1) holding the punch longer on the material bent reduces spring-back (2) application time of the punch load is important to determine the spring-back value. (3) As bend angle increases spring-back angle increases. Liu et al. [4] used the optimized neural network model to predict spring-back and they found that smaller is the material yield strength, lower is the spring-back value. Also conclude that spring-back value is lower as bigger Young's modulus, smaller ratio of bending radius to sheet thickness, bigger ratio of bending height to sheet thickness, thicker sheet metal, and bigger ratio of tool gap to sheet thickness. De Souza et al [5] characterizes the effect of material and process variation on the robustness of spring-back for a semi-cylindrical channel forming operation as it shares a similar cross-section profile of many automotive structural components. With the help of experiments they analyzed that variation in the mechanical properties of the sheet material had the maximum influence on spring-back. Kim et al. [7] investigated the effect of temperature gradients on

spring-back in warm forming of lightweight materials. Also he analyzed the dependence of spring-back on blank holder force (BHF), friction condition, and forming rate.

Naceur et al. [8] invested a surface response method for the optimization of tools geometry in sheet metal forming in order to reduce the spring-back effects after forming. Verma et al. [9] predicted the effect of anisotropy on spring-back using finite element analysis for the benchmark problem of Numisheet-2005 [2005 Numisheet Benchmark 2, Spring-back prediction of a cross member]. He developed an analytical model to cross check the trends predicted from the finite element analysis. He observed that the effective stress has not been treated as a constant and the radial stress is considered in the present model. From both the models (FE and analytical), predicted that higher anisotropy gives higher spring-back. And Finite element analysis of the problem shows that spring-back is minimum for an isotropic material.

Vladimirov et al. [10] introduced the application of a finite strain model to predict spring-back in sheet forming. The concept combines both isotropic and kinematic hardening and utilizes a new algorithm based on the exponential map. A special focus is put on the simulation of the draw-bend test of DP600 dual phase steel sheets and the comparison of the numerical results with experimental data. Also, they investigated the sensitivity of the results with respect to geometry parameters such as the tool radius and the sheet thickness as well as the ratio between isotropic and kinematic hardening. He concluded that finite strain combined hardening model is very well suited for spring-back prediction. Panthi et al. [11] predicted the spring-back in a typical sheet metal bending process and to investigate the influence of parameters such young's modulus, strain hardening, yield stress on spring-back. The results of simulation are validated with his own experimental results. He concluded that Friction has negligible effect on spring-back. The spring-back increases with increase in yield stress.

PROBLEM DESCRIPTION

Let us start with a description of the problem we will study throughout this paper, namely the U-draw bending. It is very useful for our study since, on the one hand, it is very sensitive to many parameters from both the experimental and the numerical point of view and, on the other hand, spring-back can be quantified by three simple geometric measurements.

The schematic drawing of the U-draw bending is shown in Fig. 1. The Dimensions are given in table 1. The three geometric quantities that quantify spring-back are shown in Fig. 2. These consist of two angles θ_1 and θ_2 and the radius r.

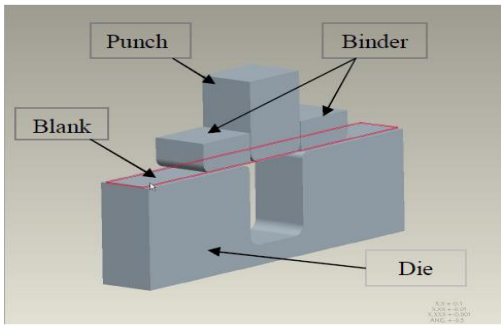

Fig.1. Schematic U-draw bending process

Dimensions	Die	Punch	Binders	Blank
Length (mm)	300	58	55	300
Height (mm)	80	80	10	0.9,1,1.1 (thickness)
Width (mm)	45	45	45	35
Corner radius (mm)	6	10	10	-

Table no. 1. Dimensions of the geometry

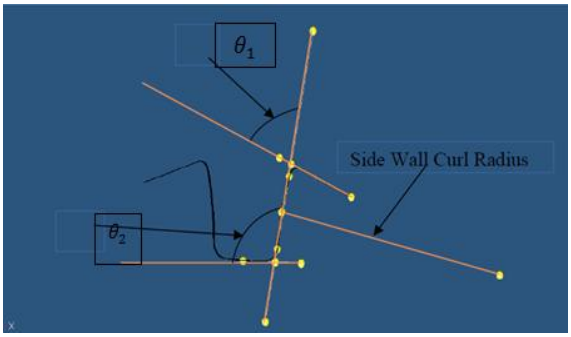

Fig.2. Description of the three quantities θ_1, θ_2 and r to quantify spring-back.

The main hypotheses used throughout this simulation are the following:

- Element type: 2D linear shell element.
- Time integration scheme: dynamic explicit and static implicit.
- Spring-back simulation: complete tool removal including contact interactions.
- Contact algorithm: kinematic pair method on analytically defined rigid bodies.

- Taking Isotropic hardening in to consideration.

Result of simulations will be shown for the three following materials: CRDQ Steel, DP Steel and HSLA Steel. Materials properties are given in Tables 2.

Table no. 2 Mechanical Properties of Material [12, 15]

Name of Material Properties	Dual Phase Steel	CRDQ Steel	HSLA Steel
Young's Modulus	205.35 GPa	210 GPa	210 GPa
Poisson's Ratio	0.3	0.3	0.3
Yield strength (0.2% offset)	358.7 MPa	185 MPa	586 MPa
r_{00} Lankford coefficient	0.79	1.6	1
r_{45} Lankford coefficient	1.03	1.6	1
r_{90} Lankford coefficient	1.01	1.6	1

- True Stress Vs Plastic Strain curve for materials are as shown in figure 3, 4 and 5.

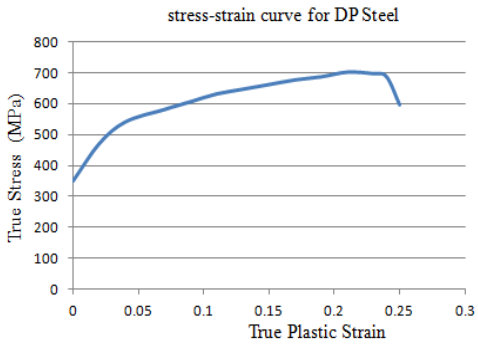

Fig 3 Stress Vs Plastic Strain curve for DP Steel [12]

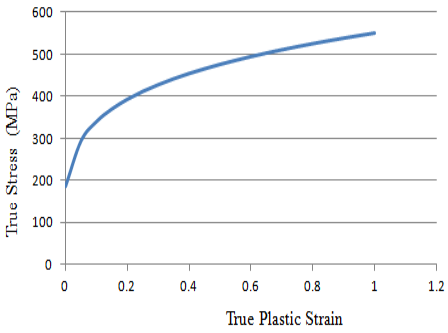

Fig 4 True Stress Vs Plastic Strain curve for CRDQ Steel [15]

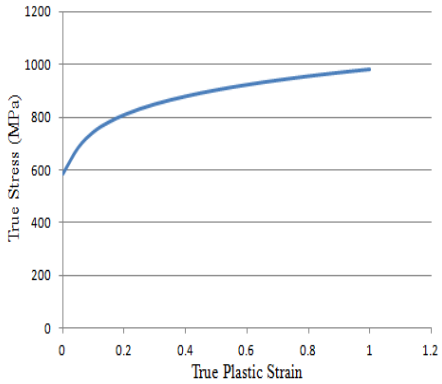

Fig 5 True Stress Vs Plastic Strain curve for HSLA Steel [15]

SIMULATION PROCESS

In the simulations performed, special attention is given in order to remain as close as possible to the physical process. Using a dynamic explicit and static implicit time integration scheme, we are able to simulate the whole process including both the loading and the unloading phases with the two time integration algorithm and with a frictional contact algorithm active all along the process. The start to end process is described in Fig. 6. Figure 7 represent the final condition of component after spring-back operation.

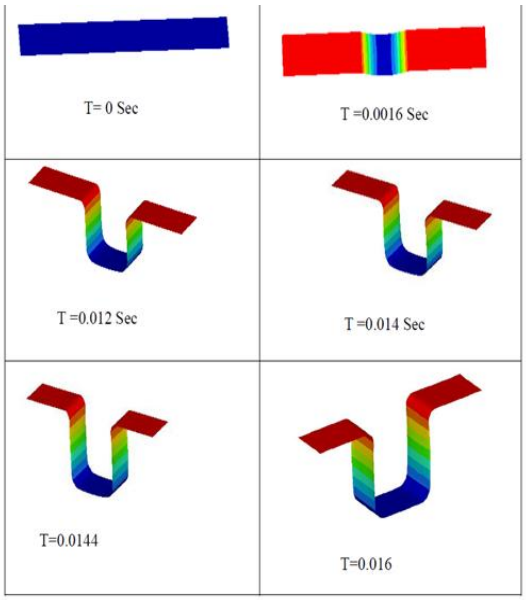

Fig 6 Deformed shapes before spring-back at different time

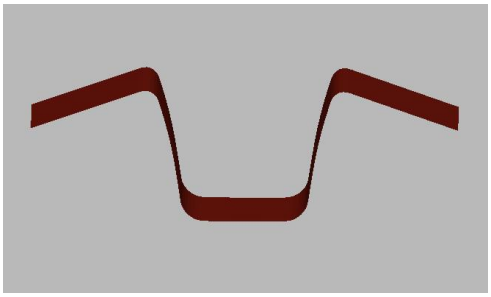

Fig 7 deformed shape after spring-back

RESULTS AND DISCUSSION

Different 81 simulation cases were done during analysis, taking different material, blank holding forces, coefficient of friction, and blank thicknesses to analyze their effect on spring-back.

➢ Effect of material on Spring-back:

From figures 8-10, it is observed that spring-back increases as the strength of material increases. This is because as strength of material increases elastic recovery increases which implies increase in spring-back.

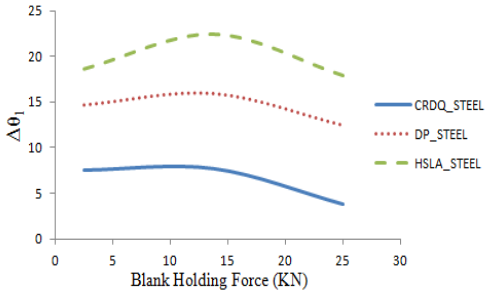

Fig.8 Blank Holding Force Vs θ_1

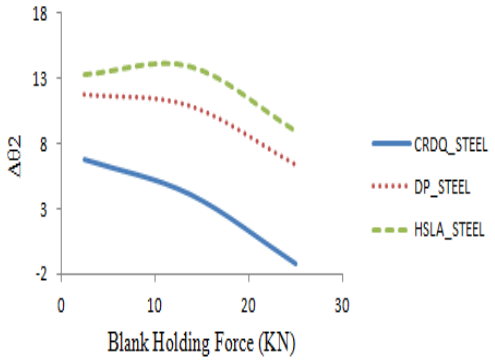

Fig.9 Blank Holding Force Vs θ_2

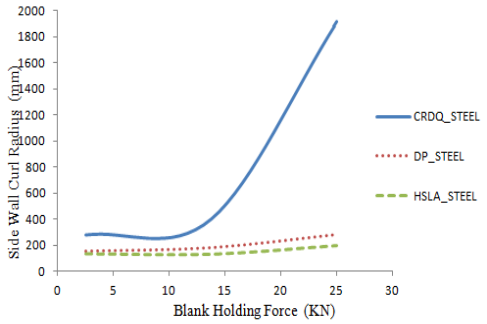

Fig.10 Blank Holding Force Vs ρ

➢ Effect of the BHF

We will now study the influence of several physical and numerical parameters on spring-back. The first of those is the BHF. It is experimentally observed that the spring-back increases with small forces, but decreases as the force increases for large force values. The same phenomenon is found in the FE simulation using different types of steel as shown in Figs. 8-10. The curves exhibit an extremum for some values of the BHF and one can also find a BHF value where the considered spring-back parameter almost vanishes. This phenomenon can be explained by the fact that with low BHF, the punch induces mostly bending stresses in the material, but as the blank holder holds the blank more severely, the stresses induced by the punching phase become mostly tensile stresses.

➢ Effect of the coefficient of friction

Friction is an important but not very well known factor influencing spring-back. Its modelling is difficult because this coefficient is probably different on the curved and flat parts of both the die and punch.

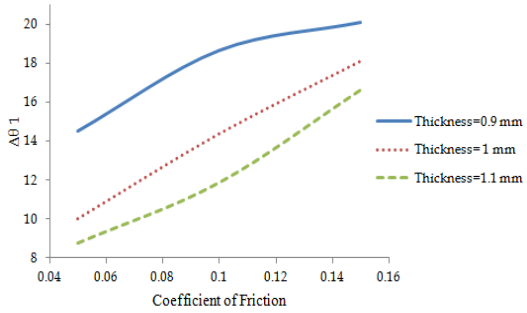

Fig. 11 Coefficient Of Friction Vs θ1

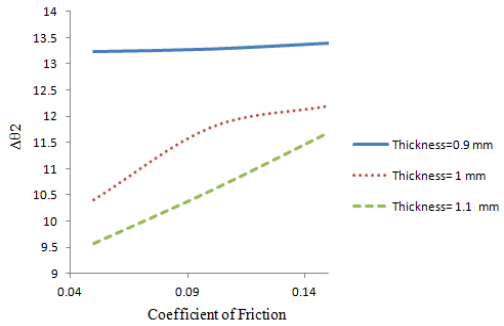

Fig. 12 Coefficient Of Friction Vs θ2

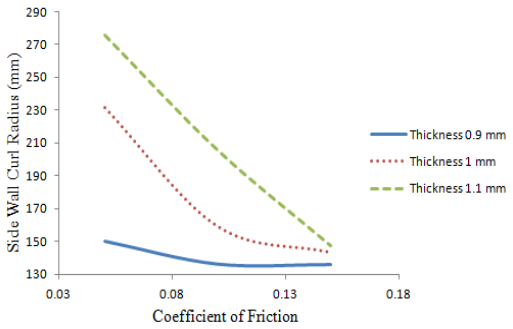

Fig. 11 Coefficient Of Friction Vs ρ

A. Moreover, it is very difficult to measure those coefficients experimentally. So, we have chosen to use the same coefficient on all parts of all the tools and study the results obtained for different values. Figs. 11–13 show that the same behaviour as for BHF is observed: spring-back curves also exhibit an extremum (we used different types of thicknesses for this case).

- Effect of the Material thicknesses

From figures 11-13, it is observed that spring-back increase with decrease in blank thickness. This is because as thickness of blank increases, plastic deformation of blank increases.

Conclusions

In this paper, a spring-back prediction is described using simulation and the results obtained are compared with experimental data. A simulation method describing the blank shape during the whole process is introduced. The influence on spring-back of several parameters such as BHF, coefficient of friction, Blank thickness, and Material used were studied in details.

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Effect of Biofilm in Waste Water Treatment by Using Bactericidal Activity of Nitrogen Doped Metal Oxide Nanoparticles

I. D. Patil *[1], *Yogita Patil*[2], *Mayur Ladole*[3].
[1]Department of Biotechnology SSBT's COET, Jalgaon-425001. India.
[2]Department of Biotechnology, Government College of Engineering, Jalgaon-425001. India.
[3]Department of Biotechnology, SSBT's COE, Jalgaon-425001. India.

Abstract
Background: Biofilm of different microorganisms can stabilize harmful components from waste water. It can be effectively use for the treatment of waste water.
Objective: Development of Rotating Drum Biological Reactor (RDBR) for the treatment of waste water and to study the effect of biofilm developed on RBDR for the reduction in BOD, COD and phenol concentration in waste water. Synthesis of TiO2 nanoparticles to study antimicrobial property against developed biofilm.
Results: Synthetic waste water with initial concentration of phenol as 50 mg/lit and with COD and BOD values 2080 mg/lit and 1600 mg/lit respectively was treated in RDBR. After 60 hrs of operation phenol concentration drops to 0.0028 mg/lit and COD, BOD values were reduced to 178 mg/lit and 71.2 mg/lit respectively. The reduction of phenol concentration was upto 99.7%.
Conclusion: Based on the experimental results we can conclude that rotating drum biological reactor (RDBR) technology is one of the promising technology for the treatment of waste water. After treatment of synthetic waste water in RDBR there was drastic reduction in the initial concentrations of COD, BOD and Phenol was observed. Results show the reduction in phenol concentration upto 99.7%. It has been also found that nitrogen doped TiO2 nanoparticles shows good antimicrobial activity over the biofilm developed.

INTRODUCTION

Water is the most important constituent for all the living things. Water contamination is now a major problem in the global context as a consequence of industrialization, globalization, population growth, urbanization and warfare combined with increased wealth and more extravagant lifestyles (UN- World Water Development Report, 2006). Eutrophication of lakes and the sea is caused by discharge of nutrients originating from of human activities, industries and agriculture, which threatens the maintenance of biodiversity and human health. Suspended, colloidal or dissolved degradable organic materials, quantities and ratios depend on the nature of the wastewater characteristics of wastewater are measured in terms of chemical oxygen demand (COD), Biological oxygen demand (BOD), and volatile suspended solid (VSS).
Biological wastewater treatment is therefore of utmost importance for the wellbeing of our water bodies. Biological treatment is one of the most widely used removal methods as well as for partial or complete stabilization of biologically degradable substances in wastewater and wastes. Most biological waste and wastewater treatment processes employ bacteria as primary micro-organisms; certain other micro-organisms may play an important role. Degradation of organic matter is effected by its use as food by micro-organisms to produce protoplasm for new cells during the growth process, population dynamics of bacteria is biological treatment depends on environmental factors which include pH, temperature, type and concentration of essential nutrients (e.g. Nitrogen, Phosphorous, Sulphur etc.), essential minerals, osmotic pressure, media toxicity, by-products and degree of mixing.A biofilm can be defined as a complex coherent structure of cells and cellular products, like extra-cellular polymers (Characklis, 1990), which either form spontaneously as large, dense granules (Lettinga et al., 1980), or grow attached on a static solid surface (static biofilms) or on suspended carriers (particle supported biofilms) (Heijnen, 1984). Biological wastewater treatment is mainly carried out by prokaryotes, even if fungi, protozoa, algae and rotifers may also be represented (Bitton G, 2005). Municipal wastewater is composed of organic material, i.e. proteins, carbohydrates, fats and oils; nutrients, mainly nitrogen and phosphorus; as well as trace amounts of recalcitrant organic compounds and Metals (Bitton G, 2005).

The most frequently found prokaryotes in biological wastewater treatment systems belong to the classes Alpha-, Beta- and Gamma proteobacteria, Bacteroidetes and Actinobacteria (Wagner M and Loy A, 2002).These bacteria in aquatic environments are predominantly not in a free-floating planktonic stage, but have a tendency to attach to surfaces and form multi-species communities called biofilms (Metcalf & Eddy,

1991; Syron & Casy, 2007). The microbes produce extracellular polymeric substances (EPS), which form complexes with the surface materials (Andersson S et al., 2009). A mature biofilm is a complex mixture of active and dormant or drying cells, inorganic and organic materials and tunnels filled with water, and the biofilm contains both aerobic and anaerobic niches (Korber et al., 1995; O'Toole et al., 2000).

The most commonly used process for the treatment of municipal and industrial waste water is activated sludge process, but increasingly biofilm technologies are utilized. Biofilm waste water treatment processes can be roughly divided into 1) the fixed-medium systems, and 2) moving-medium systems (Rodgers et al., 2003). In the fixed-medium systems (fixed bed bioreactor; FBBR) the biological reactions take place in the biofilm growing on a static medium. In the moving medium systems the biofilm media are kept in continuous movement by mechanical, hydraulic or air forces. Rotating bed bioreactors (RBBR) are an application of moving bed biofilm reactors with a higher filling rate of carrier elements.

Nanoparticles in waste water treatment:
The waste water treatment plant in which trickling filter, RBC, packed bed reactor are used involve formation of biofilm, which reduces the COD of treated water (Nicholas P. Cheremisinoff,2003). More recently, several natural and engineered nanomaterials have also been shown to have strong antimicrobial properties, including chitosan (Qi et al., 2004), silver nanoparticles (nAg) (Morones et al., 2005), photocatalytic TiO2 (Cho et al., 2005; Wei et al., 1994), fullerol (Badireddy et al., 2007), aqueous fullerene nanoparticles (nC60) (Lyon et al., 2006), and carbon nanotubes (CNT) (Kang et al., 2007).
The biofilm form during water treatment process can be stabilised/ degraded by using the metal oxide nanoparticles such as TiO2, the surface of TiO_2 crystal is occupied by O_2 atoms with high electron density. The bactericidal effect of TiO_2 is attributed to the decomposition of bacterial outer membranes by reactive oxygen species [ROS], primarily hydroxyl radicals [*OH] which leads to phospholipids peroxidation and ultimately cell death.

Nitrogen Doping Of Metal Oxide Nanoparticles:
TiO_2 is the most commonly used semiconductor photocatalyst.Among the different nanomaterials, it is the most studied. Activated by UV-A irradiation, its photocatalytic properties have been utilized in various environmental applications to remove contaminants from both water and air (Gelover et al., 2006; Murray et al., 2007; Salthammer and Fuhrmann, 2007). A wealth of information on TiO2 photocatalytic inactivation of bacteria has been acquired over the last 20 years (Matsunaga et al., 1985; Wei et al., 1994). TiO2 can kill both Gram-negative and Gram-positive bacteria, although Gram-positive bacteria are less sensitive due to their ability to form spores (Wei et al., 1994). More recently, nano-sized TiO2 was also reported to kill viruses including poliovirus 1 (Watts et al., 1995), hepatitis B virus (Zan et al., 2007), Herpes simplex virus (Hajkova et al., 2007), and MS2 bacteriophage (Cho et al., 2005). The concentration of TiO2 usually required to kill bacteria varies between 100 and 1000 ppm, depending on the size of the particles and the intensity and wavelength of the light used (Wei et al., 1994).
An attractive feature of TiO2 photocatalytic disinfection is its potential to be activated by visible light, e.g. sunlight. Metal doping has long been known to improve visible light absorbance of TiO2 (Anpo et al., 2001), and increase its photocatalytic activity under UV irradiation (Choi et al., 1994).

Materials and Methods

Materials:

Potassium Dichromate ($K_2Cr_2O_7$), Sulphuric acid (H_2SO_4), Sodium thiosulfate, Starch, Phosphate buffer solution and allylthiourea solution (0.5%) were purchased from Merck Specialties Private Limited (Mumbai, India). Titanium isopropoxide (Ti (OCH $(CH_3)_2)_4$) and ethanolamine were purchased from Sigma Aldrich. All the other chemicals used were of analytical grade with highest purity.

Organisms and culture maintenance:
Bacillus subtilis (NCIM 2549), *Pseudomonas putida* (NCIM 2847), *Nocardia hydrocarbonoxydance* (NCIM 2386), *Pseudomonas aeruginosa* (NCIM 2074) and *Rhodococcus terrae* (NCIM 5126) were obtained from National Collection of Industrial Microorganisms (NCIM), Pune, India. All microorganisms are maintained on nutrient agar slant at 4^0C and these are subcultured at regular interval in departmental laboratory.

Pure Culture and Mix Culture:
Each microorganism were grown in a nutrient broth separately and incubated for 24 hrs at 37^0C each in 100 ml conical flask. The inoculums were taken from each flask and mix culture was developed in 500 ml conical flask.

Biofilm development on different materials:

All the flasks from the above procedure were subjected to flask level study. In this strips of different material such as PVC, GI, Glass, and Nylon fiber was taken. The best optimum condition such as pH, temperature, dilution and material will be selected from above study and the selected material was used for fabrication of drums which was used in rotating drum biofilm reactor (RDBR).

Determination of Chemical Oxygen Demand (COD):
COD is a measure of the capacity of water to consume O_2 during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite .COD was calculated according to the method given in the book of S.S.Dara (1999).

Phenol estimation:
The standard brominating solution is a mixture of potassium bromide and potassium bromated ($KBr+KBrO_3$). The bromine (Br_2) liberated from these solution in the presence of concentrated HCL, phenol undergoes bromination to form 2, 4, 6 tribromophenol. The excess of bromine which is not used by phenol reacts with KI solution and liberate iodine. The liberated iodine was titrated against standard 0.1 N Sodium thiosulfate solution. Thus the phenol was estimated by calculating the amount of bromine consumed during the reaction in terms of 0.1 sodium thiosulphate solution.

Determination of Biological Oxygen Demand (BOD):
Biological oxygen demand or BOD represents the quantity of oxygen required by bacteria and other micro organisms during the biochemical degradation and transformation of organic matter present in waste water under aerobic conditions. BOD test is of great value in the analysis of sewage, highly polluted waters and industrial effluents. BOD was calculated according to the method given in the book by S.S.Dara (1999).

Biofilm development:
For the biofilm development different materials can be used as attachment surface but PVC (polyvinylchloride) gives good result for attachment of biofilm. The mix cultures of bacteria was taken and pour in rotating drum biological reactor (RDBR) which was made from one and half liter of PVC jar with provision of inlet and outlet and centrally located shaft carrying PVC drum with filter. A batch of 500 ml mix culture was run for 7 to 8 days at 2 rpm at room temperature.

Preparation of Synthetic Waste Water:
Synthetic waste water of following constituents was prepared. The constituent such as bacto-peptone, $MgSO_4.7H_2O$, $MnSO_4.H_2O$, $FeCl_3.6H_2O$, $CaCl_2$, KH_2PO_4, and K_2HPO_4 were used to enhance the bacterial growth (Table-1).

Constitute	Stock concentration (g/l)	Quantity used (ml/5l)	Final concentration (mg/l)
Bacto-peptone	32.25	27.3	352.75
$MgSO_4.7H_2O$	10.00	25.0	50.00
$MnSO_4.H_2O$	1.60	25.0	5.00
$FeCl_3.6H_2O$	0.175	25.0	1.00
$CaCl_2$	100	25.0	3.75
KH_2PO_4	52.25	33.4	349.4
K_2HPO_4	107.00	33.4	715.56
Phenol	-	-	50.00

Table-1. Concentration of different components in synthetic waste water

Preparation of TiO_2 nanoparticles:
Nanoparticles were synthesized according to the process shown in the Fig.1.
Chemicals- Precursor solution of 4 ml Titanium isopropoxide (Ti (OCH $(CH_3)_2)_4$) (Sigma Aldrich 97%), ethylene diamine (Strem, 99%) or ethanolamine (Sigma Aldrich, 99%) and 200 ml of anhydrous ethanol.
The precursor solution was refluxed for 24 hrs and hydrolyzed by adding drop wise 20 ml distilled water. The yellow precipitate then centrifuge and dry under vacuum. The resulting powder then sintered in the air at 200 ^{0}C for 1 hr.10ml of Ti (OCH $(CH_3)_2)_4$ and isopropyl alcohol (5:95 volume ratio) was slowly added into 100ml of distilled water at pH 2, adjusted by HNO3. The mixture was stirred for 12 hrs: and centrifuged. The precipitates then wash and dry under vacuum, and kept in plastic vials. Characterizations of these particles were done by using X-RD and particle size distribution.

Reflux 4 ml of precursor solution for 24 hrs

⇩

Hydrolyze by adding drop wise 20 ml distilled water

⇩

Yellow precipitate

⇩

Centrifuge and dry under vacuum

⇩

Powder sinter in the air at 200 °C (1 hr)

⇩

Kept in a plastic vials

Fig.1.-Fabrication of TiO_2 Nanoparticles.

Phospholipids peroxidation:

Bacterial cell suspension were kept at 4˚C prior to the photocatalytic experiments.10 ml of bacterial cell suspension was taken and 1 ml of 0.01 mg/lit aqueous solution of nitrogen doped TiO_2 particle was added. Then this suspension was kept in Petri dish under the light radiation for 6 hrs to facilate photocatalytic activity of TiO_2. Also simultaneously second Petri dish was prepared without N_2 doped TiO_2 solution.1 ml of suspension from each Petri dish was taken and spread on two different agar plate and label as Petri dish 1 and 2 respectively. Then these agar plates were incubated for 24 hrs at 37 ˚C and observed after 24 hrs.

Results and Discussions

Biofilm development:

After running the batch of 500 ml mix culture of bacteria's for 7 to 8 days at 2 rpm at room temperature, biofilm was observed after 8 days on the surface of drum and appears as transparent and sticky growth (Fig.2).

Fig.2-Developed biofilm on the surface of drum after 8 days at room temperature.

Treatment of Synthetic Waste Water:

Phenol and phenolic compounds found as major constituent in effluents of many chemical industries. 500 ml of synthetic waste water containing 50 mg/lit of phenol and other constituents such as K_2HPO_4, $CaCl_2$ etc. was treated in RDBR. Water was fed from inlet and batch was operated for 48 hrs, samples are taken from 12 hrs and concentration of COD, BOD and phenol was measured (Fig.3, 4 and 5). It was found that mix bacterial cultures were capable of degrading phenol by 99.70 % approximately in 60 hrs.

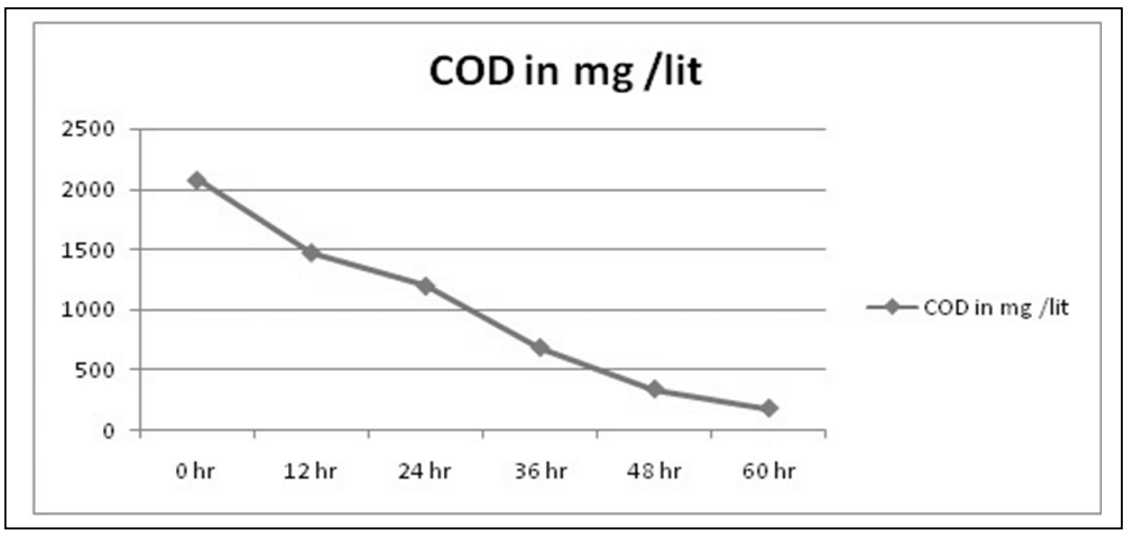

Fig.3 Reduction in COD value of synthetic waste water after treatment in RDBR.The initial concentration of COD which was 2080 mg/lit at 0 hrs was reduced to 178 mg/lit after 60 hrs.

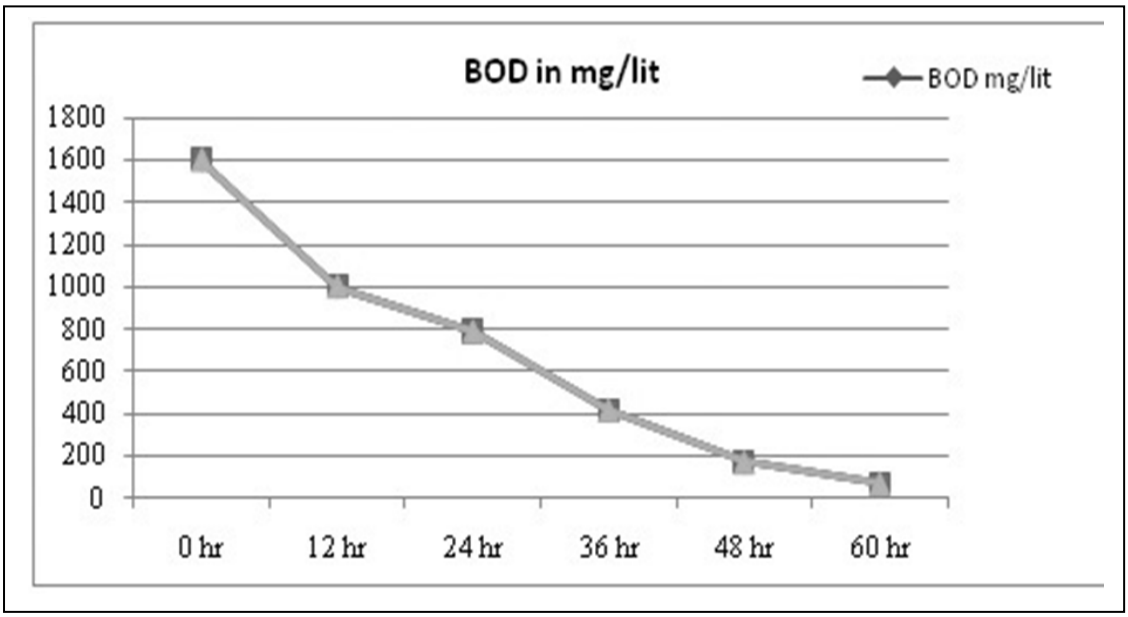

Fig. 4. Reduction in BOD value of synthetic waste water after treatment in RDBR .The initial concentration of BOD which was 1600 mg/lit at 0 hrs was reduced to 71.2 mg/lit after 60 hrs.

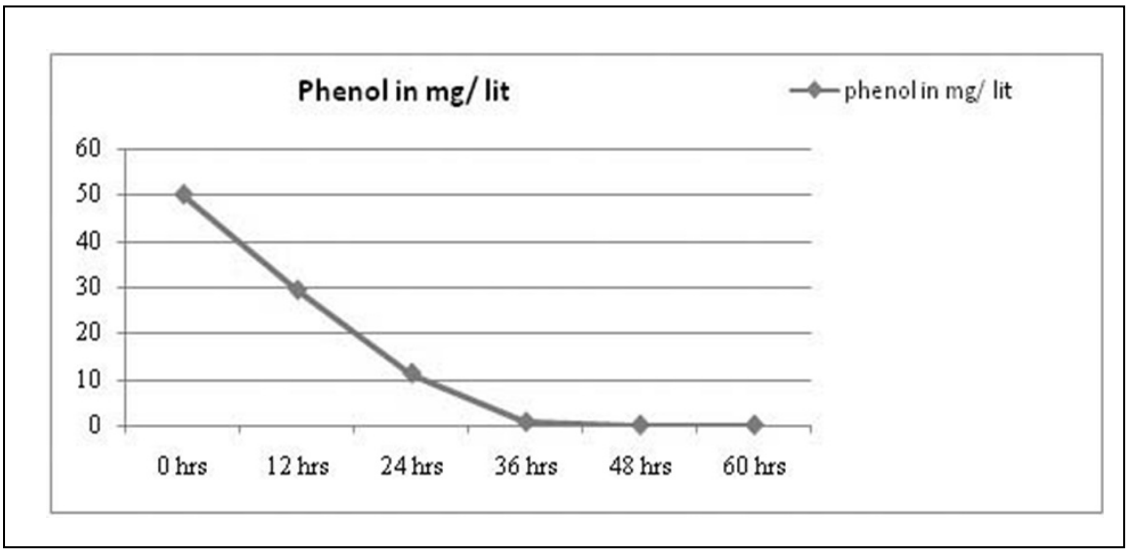

Fig. 5.Reduction in phenol concentration of synthetic waste water after treatment in RDBR .The initial concentration of phenol which was 50 mg/lit at 0 hrs was reduced to 0.0028 mg/lit after 60 hrs

Phenol Degradation study at flask level:

A flask level study was done for estimation of phenol concentration that can be treated by biofilm. For these four different samples 300 ml of synthetic waste water containing varying concentration of phenol like 0.1, 0.2, 0.3 and 0.4 ml/lit was taken in 500 ml conical flask and inoculated with mix culture of bacteria. Result shows that bacterial growth can occur satisfactory at about 0.4 ml phenol concentration and cannot survive concentration above 0.6 ml per liter phenol. (Table 2)

Sr. No.	Concentration (ml/lit)	After treatment (ml/lit)	Phenol degraded (ml/lit)
1	0.1	0.00150	0.0985
2	0.2	0.00125	0.1980
3	0.3	0.00183	0.2981
4	0.4	0.00470	0.3950

Synthesis of nitrogen doped TiO_2 nanoparticles

TiO_2 has strong antimicrobial activity and it can act on wide range of microorganism. Doping of TiO_2 particles with nitrogen enhances the anti-microbial activity and facilate use of TiO_2 under visible spectrum. Nitrogen doped TiO_2 particles were prepared by solgel method using titanium iso-propoxide as TiO_2 precursor and ethanolamine as doping precursor. 24 hr reflux method in ethanol can be used but vigorous mixing by stirrer can give TiO_2 nanoparticles within a 4 hrs.

Phospholipid peroxidation by Nitrogen doped TiO_2 nanoparticles:

Results shows bacterial growth was observed on Petri plate which was not treated with TiO_2 solution (Fig.5). On other hand TiO_2 treated suspension does not give any growth on second Petri plate (Fig.6).

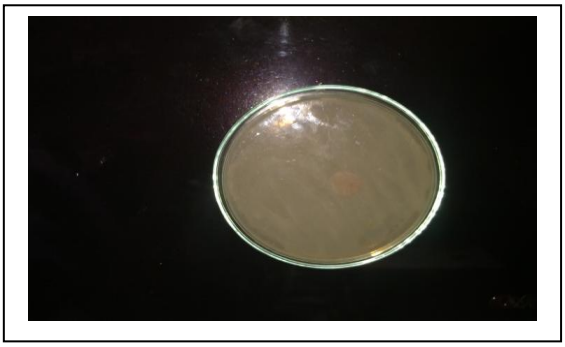

Fig.5. Appearance of bacterial growth on agar plate which was not treated with TiO_2 nanoparticles.

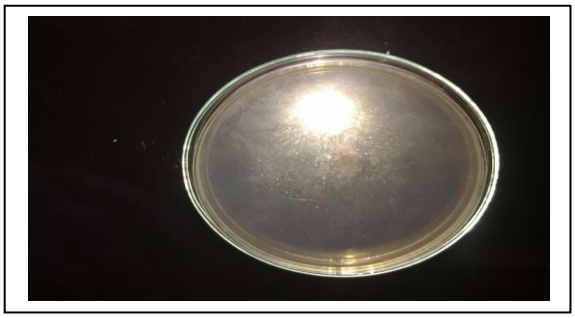

Fig.6. Agar plates treated with TiO_2 suspension indicating the absence of bacterial growth.

Conclusion

Based on the experimental results we can conclude that rotating drum biological reactor (RDBR) technology is one of the promising technology for the treatment of waste water. After treatment of synthetic waste water in RDBR there was drastic reduction in the initial concentrations of COD, BOD and Phenol was observed. Results show the reduction in phenol concentration upto 99.7%. It has been also found that nitrogen doped TiO_2 nanoparticles shows good antimicrobial activity over the biofilm developed.

Acknowledgements

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Performance Enhancement of Distillation Column by Optimizing the Geometry of Bubble Cap Trays

[1]Mr. Nilesh P. Patil, [2]Dr. V. S. Patil
[1.]Ph.D (Engineering & Technology) (Pursuing), M.Tech (Chemical Engineering), AIE, AMIIChE, Assistant Professor - Chemical Engineering,Division of Chemical Engineering,University Institute of Chemical Technology, N.M.U., Jalgaon.
Email – nileshppatil_21@yahoo.co.in
[2.] Ph.D (Engineering & Technology), M.Tech (Chemical Engineering), MIE, DBM Professor ,Chemical Engineering, Division of Chemical Engineering,University Institute of Chemical Technology, N.M.U., Jalgaon.

Abstract:
Distillation is by far the most important separation process in the petroleum and chemical industries. It is the separation of key components in a mixture by the difference in their relative volatility, or boiling points. In most cases, distillation is the most economical separating method for liquid mixtures. However, it can be energy intensive. Distillation can consume more than 50% of a plant's operating energy cost. There are alternatives to distillation process such as solvent extraction, membrane separation or adsorption process. On the other hand, these processes often have higher investment costs. Therefore, distillation remains the main choice in the industry, especially in large-scale applications.
In designing a distillation column, the sizing of the column is most important it includes understanding of thermodynamics of the vapor and liquid phases. The vapor-liquid equilibrium (VLE) determines the minimum number of stages required to achieve the degree of separation needed. The selection of column internals is very critical in distillation column design. There is a wide variety of trays and packing in the market. Each design has its strengths and weaknesses. First of all the process engineer has to decide which type of internals has to be opted & it solely depends on the fluids to which the column is going to be subjected.
The paper in detail elaborates the factors governing the performance of distillation column. The objective of the paper is to enhance the performance of distillation column by optimizing the geometry of bubble cap trays.

Introduction:

As far as distillation is concerned it is the most important separation process in the petroleum refineries and chemical industries. It is the separation of key components in a mixture by the difference in their relative volatility, or boiling points. Besides energy intensive process, in most cases distillation is the most economical separating method for liquid mixtures as compared to other separation methods. Being such a vibrant process, it is quite essential for us to look into the energy optimization of the column. There are various factors governing the performance of the distillation column. Even then the column internals / trays adopted in the column are the most influential factor governing the performance of distillation column. The parameters like pressure drop may vary because of the alteration of the type of trays employed.

Conventional fractionating trays consist of vapour / liquid contacting trays with segmented liquid down flow areas. Columns can contain any number of trays installed vertically above each other. Each set of trays needs to be individually designed for the specific process and mechanical requirements anticipated within the column. There are different types of trays such as sieve trays, valve trays, bubble cap trays etc. each of them has its own advantages & disadvantages. The performance of the column can be evaluated in terms of purity of the product obtained against energy consumption. Bubble cap trays are found to be the best performer amongst the available configurations of trays. The only disadvantage of the bubble cap trays is pressure drop. The attempt of minimizing this drawback of the bubble cap tray is done in the article.

Function of Trays:

Mass transfer columns in general operate with countercurrent vapour and liquid flow with the tray decks used to provide stagewise contact between the vapour and liquid resulting in light component as overhead product and heavy component as bottom product. The basic flow pattern on a cross-flow tray is liquid phase continuous and vapour phase dispersed through the liquid. This ensures maximum vapour contact with

the liquid but at the expense of creating a barrier to vapour flow that can result in a substantial pressure drop across the tray.

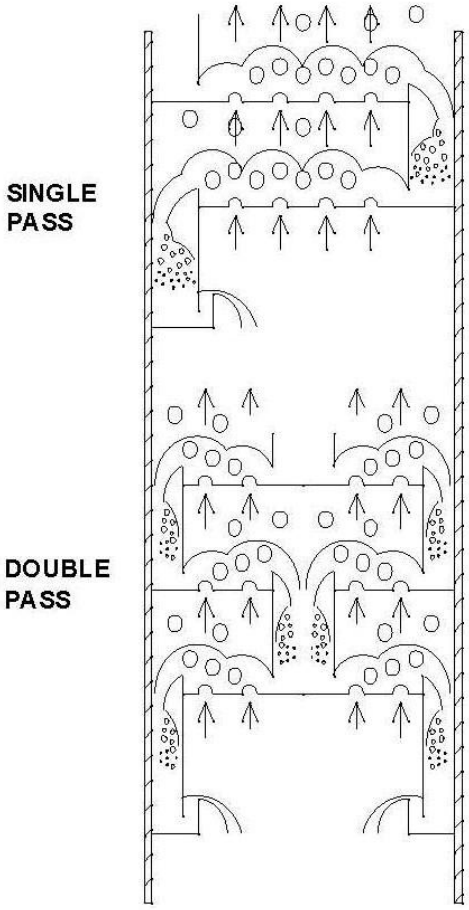

Figure 1. Tray Vapour & Liquid Flowpaths

The sketch shown in Fig.1 illustrates the operating principle of conventional 1-pass and 2-pass fractionating trays. In each case, clear liquid enters the tray deck area from under the downcomer apron. Simultaneously, vapour from the tray below passes through the open area (perforations, valves or bubble caps) where it must bubble through the liquid forming a 2-phase froth in which mass transfer takes place whilst the froth moves horizontally across the tray deck. Vapour continuously disengages from the froth and flows to the tray above. The froth discharges over the outlet weir into the tray downcomer which actsas a settling zone where vapour disengagement takes place thus allowing clear liquid to flow to the tray below.

Proper and efficient functioning of trays for each specific service requires a unique design configuration based on a careful balance and optimization of a number of interrelated and often opposing factors which in turn requires an accurate and reliable profile of the flowrates and properties of the internal column traffic.

Tray Configuration:

Listed below are the key tray design parameters which impact on column operation:Active Area / Bubble Area - is the deck area of the tray which may either be perforated or fitted with valves or bubble caps and is the area available for vapour/liquid contacting. The vapour handling capacity of a tray is proportional to the active area (i.e. inversely proportional to the approach to Jet Flood).

Downcomer Area - is the area available for the transport of liquid from one tray to the next tray below. Also a very important function of the

downcomers is to allow for the disengagement of vapour from the liquid which is a function of both residence time of the liquid in the downcomer. Undersized downcomers will result in downcomer flood.

Open Area / Hole Area - is the aggregate area available for vapour passage through the tray deck via perforations or valve and bubble cap slots. This is a critical factor in the tray operating range since high vapour velocity through the open area (hole velocity) will induce heavy liquid entrainment (as well as high pressure drop), but low hole velocity may allow liquid to "weep" or even "dump" through the tray deck to the tray below. The influence of open area on pressure drop also impacts on the liquid back-up in the downcomer.

Tray Spacing - is the vertical distance between adjacent tray decks. This effects both the height of spray that may be generated on the tray deck before liquid carryover and also the allowable head of liquid in the downcomers.

Downcomer Clearance - is the space below the downcomer apron allowing liquid to flow from the downcomer to the tray deck below. This must be sized to provide a balance between the minimum head loss required for good liquid distribution across the tray deck and avoiding excessive downcomer back-up.

Outlet Weir Height - The outlet weir is used to maintain a head of liquid on the tray deck as well as to ensure a positive vapour seal to the bottom of the downcomer.

Flow Path Length - is the span of tray deck between the downcomer inlet and the outlet weir and is the shortest path that the liquid takes in crossing the active area from one downcomer to the next. Particularly in small columns, it has a big influence on tray efficiency.

Number of Flow Paths - Larger diameter trays may be fitted with multiple downcomers to reduce the liquid load across each active area section. This reduces the weir load and liquid head on the tray deck resulting in higher vapour capacity, lower pressure drop and improved operating turndown range.

Tray Feeds & Draws:

All columns in commercial operations will have process streams feeding to the column as well as product draw points. However any interference with the normal vapour and liquid flows on well designed trays can easily cause tray malfunction so the location and configuration of column feeds and draws is critical to overall column performance. Tray feeds may be liquid, vapour or mixed. The generally preferred arrangement for liquid feed between trays is a perforated pipe which directs liquid onto the vapour side of the downcomer apron so that the feed liquid mixes with the reflux from the tray above at the downcomer outlet. If the feed liquid is hotter than the liquid on the tray, an insulation baffle (or target plate) should be fitted to the vapour side of the downcomer apron to prevent vaporization of liquid in the downcomer. A good rule-of-thumb (except for large size feed pipes) is that the perforated pipe should have a 200mm clearance above the tray deck and a 50mm clearance from the downcomer apron.

The preferred arrangement for liquid feed to the top tray is to feed into a "false downcomer". Typically the false downcomer would be 300mm high with half the normal downcomer clearance (minimum 25mm) to ensure sufficient head in the downcomer for good lateral distribution of liquid across the tray deck. Alternatively, an inlet weir may be installed in place of the "false downcomer". In most cases an open nozzle is adequate for vapour feeds between trays which should be located to provide at least 400mm disengagement space from the tray above (therefore increase tray space by at least 50%) and oriented perpendicular to the liquid flow on the tray deck.

The reboiler return should be located at least 300mm above the liquid level and must also avoid any interference with liquid flowing from the bottom tray seal pan.Side draw liquid product is drawn from trays by locating draw nozzles in tray draw sumps normally placed below downcomers. Both the draw nozzle and sump must be sized to avoid drawing vapour. Typically the draw nozzle would be sized to restrict liquid velocity to below 1m/s and the depth of the draw sump would exceed 2.5 x nozzle diameterwith the draw nozzle flush with the sump floor. The depth of the draw sump should not exceed 30% of normal tray spacing. Large volume draws and total draws may require chimney trays. A draw pan located below a seal pan may be used to draw liquid from below the bottom tray.

Tray Operating Limits:

The tray operating envelope shown in Fig. 2 illustrates the relationship between liquid and vapour rates and the normal tray operating limits. The absolute locations of the envelope boundaries are a function of the tray layout and so each tray design will result in a unique set of operating limits. Ideal tray designs have the full range of expected column operation located within the envelope.

The normal tray operating limits are defined as follows:-

Entrainment Limit - is reached when the velocity of vapour through the tray open area is high enough to project liquid droplets to the tray above.

Jet Flood - is the criteria used to predict the point at which massive liquid carryover will occur due to the height of spray on the tray deck exceeding the available tray space. It is normal practice to limit tray design to a maximum of 80% of jet flood to allow a safety margin on tower control, possible discrepancies of VLE data and also the limitations of the flooding correlation used.

Weeping - occurs when the velocity of the vapour through the tray open area is too low to prevent liquid from leaking through the open area thus by-passing contact area to the tray below. Most valve and sieve trays will weep in normal operation. Weeping is considered excessive when it is sufficient to cause loss of efficiency - usually 10 to 20%.

Blowing Flood - occurs at low liquid rates at which the tray operates in the spray regime resulting in massive entrainment of liquid to the tray above to the extent that the tray deck is essentially blown dry.

Downcomer Flood - occurs at high liquid loads when the downcomers are too small to allow effective vapour disengagement (either because the downward velocity or "inlet velocity" of the liquid is too high or else insufficient residence time) causing vapour entrainment to the tray below. The resulting increased aeration of the liquid in the downcomer may also cause premature downcomer back-up flood.

Downcomer Back-up Flood - occurs when the head of liquid in the downcomer backs up onto the tray deck. The head of clear liquid in the downcomer is a balance of the pressure drop across the tray plus the head loss through the downcomer clearance. However an aeration factor must be applied to estimate the actual height of aerated liquid in the downcomer.

Tray Pressure Drop - may also be limiting criteria particularly in low pressure services. The operating tray pressure drop is the sum of the dry pressure drop caused by the resistance to vapour flow through the tray open area and the head of clear liquid on the tray deck. The head of clear liquid on the tray deck is a function of weir height and weir length (as well as liquid and vapour rates and physical properties) and so pressure drop may be reduced by increasing the number of flow paths in high liquid rate services.

Process Design:

The proper design of the trays is essential to ensure that all tray design parameters can be fully evaluated to ensure optimum performance over the complete range of anticipated operation. Input data should preferably be generated from a commercial column simulation package that should include stage-by-stage liquid and vapour loads, densities and transport properties.

This is essential to ensure that the tray design takes account of the full range of loads across the each set of trays.

The following parameters must be considered whilst tray design:

- Jet flood
- Entrainment limits
- Pressure drop
- Downcomer back-up
- Downcomer inlet velocity
- Weir loadings
- Downcomer residence time
- Weeping

In addition, flagging of tray design parameters such as flow path length and balanced designs in trays with multiple flow paths ensure a tray design which is efficient and practical.

Design Input:

Accurate prediction of column internal traffic is essential to the evaluation of tray design layout and prediction of tray performance. The following is the minimum data required for tray design and evaluation:

- Vapour & liquid flowrates
- Vapour & liquid densities
- Liquid viscosities & surface tensions.

This information should be generated on a stage-by-stage (or tray-by-tray) basis using a commercial column simulation package (e.g. Process, Hysim or Aspen).

If an evaluation of existing trays is required then the following additional information should be provided either in the existing tray arrangement drawings or in tabulated form:

- Tray diameter
- Tray spacing
- Downcomer inlet and outlet widths
- Weir heights and downcomer clearances.
- Number and type of valves or perforations.

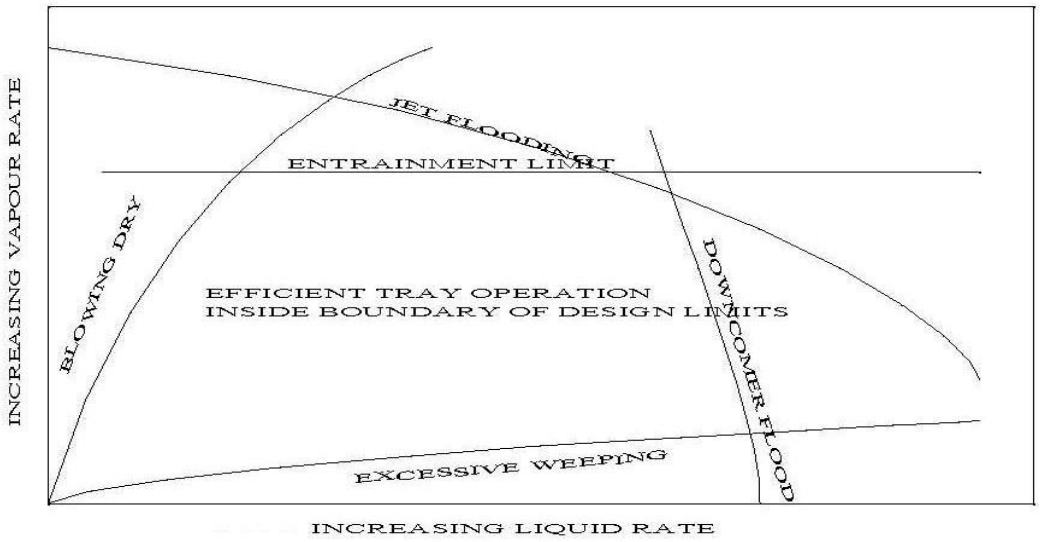

Figure 2. Typical Tray Operating Envelope

Tray Design – Mechanical:

The CAD/CAM system for tray design and manufacture is necessary to ensure good fit up of all tray parts. An added benefit from the accuracy of this system is that it allows for tray design with through-bolted panel joints that results in a more rigid structure than can be achieved by clamping tray panels together with friction washers. Trays drawings are produced from computer generated three-dimensional models of trays assembled in the vessel and include tray attachments and internal piping where relevant. The CAD models are subsequently used to program CNC machines for accurate fabrication of individual components.

Tray Installation:

To minimize installation time, trays are designed using the minimum number of individual panels that can be installed through the vessel man way and other access (and mass transfer) limitations.

Fractionating trays are supplied in "completely knocked down" (CKD) form in crates for final assembly inside the column. Therefore it only becomes a proper functioning fractionating tray when it has been properly assembled. No matter how well a tray has been designed and manufactured, sloppy installation will result in a tray which does not conform to the design specification and which may therefore not perform. The following are just a few common installation faults that would impact adversely on tray performance:

- Incorrect panel location - e.g. similar shape panels with wrong number of valves
- Poor panel fit-up / adjustment - possible large gaps in panel joints
- Incomplete or insecure bolting
- Incorrect use of peripheral ledge clamps - not properly overlapping tray ring
- Missing seal plates
- Trays decks not installed level
- Incorrect downcomer clearances - could result in premature downcomer flood
- Incorrect weir heights

Types of Trays:

1. Sieve Trays: Sieve trays have tray deck areas uniformly perforated with round holes. Vapour flow through the tray deck to contact the liquid is controlled by the number and size of the perforations. For efficient operation, the hole velocity must be sufficient to balance the head of liquid on the tray deck and thus prevent liquid from passing through the perforations to the tray below. On the other hand high hole velocities may cause severe liquid entrainment to the tray above. Consequently Sieve Trays have a narrow operating range, no more than 2:1.

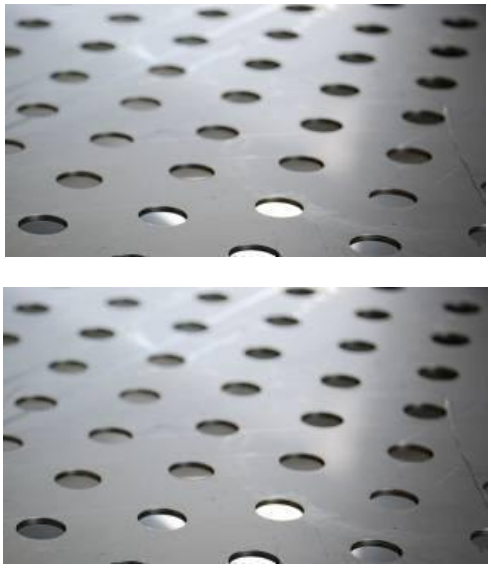

Figure 3. Schematic of Sieve Trays

2. Valve Trays:

Valve trays have perforated tray decks fitted with moveable discs (valves) to vary the tray open area with changing vapour load. There are numerous valve types which may either have legs fitted to the valve disc to restrict upwards movement or alternatively the valve disc movement is restricted by a "cage" fitted to the tray deck. At very low vapour rates, the valve discs rest on the tray deck to almost close off completely the tray deck perforations thus minimizing tray open area. As the vapour rate rises, the valve discs are lifted from the tray deck which increases the open area for vapour flow between the valve disc and the tray deck. The effective operating range of valve trays is dependent on specific service conditions as well as pressure drop limitations and can be as high as 10:1.

Figure 4. Schematic of Valve Trays

3. Fixed Valve Trays:

Fixed valve trays are manufactured by punching and forming integral valves over the tray deck. By punching the fixed slots in a parallel to liquid flow arrangement, the fixed valve tray gives higher capacity than the sieve tray with a greater availability for turndown.

4. Bubble Cap Trays:

Bubble cap trays consists of bell shaped caps fixed to cylindrical risers through which the vapour passes the tray deck. The caps divert the vapour flow below the level of liquid on the tray deck where it is jetted into the liquid either through slots at the bottom of the cap or else between the skirt of the cap and the tray deck.

Figure 5. Schematic of Bubble Cap Trays

Conclusion:

Considering all the facts associated with performance enhancement of the column, it is found that the geometry of the trays plays a major role. Besides having a higher pressure drop, bubble cap trays are found to be the most reliable, promising & offers a better vapour liquid contact which results into the desired separation than any other type of trays.

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Economic Study of Fermentation Kinetics for Production of Ethanol from damaged Sorghum and Corn grains: a Critical Review

Sheetal B. Gawande[1], *Dr. I. D. Patil*[2]
[1]Research Student, SSBT`s, COET, Bambhori, Jalgaon (MS), India
[2]Professor and Head, Department of Biotechnology, SSBT`s, COET, Bambhori, Jalgaon (MS), India
[1]sheetal_deshmukh11@rediffmail.com
[2]Idp72@yahoo.co.in

Abstract
Ethanol production from starchy raw materials by direct bioconversion is having high potential. Ethanol production from Corn and sorghum starch requires the use of amylase and amyloglucosidase for the pre-treatment starch before fermentation. Yeast ferments different sugars at different rates depends on the process conditions, several factors affect the production rate of ethanol by fermentation, and thus through the review of literature in this paper need to develop a suitable mathematical description of the fermentation process is identified. This reveals in interpreting fermentation measurements for early detection of poor fermentation performance. The ability to predict future fermentation behavior, application to design, advanced control of fermentation and optimization for economical ethanol production is possible. Because of rapid depletion of fossil fuel reserves, alternative energy sources that are renewable, sustainable, efficient, cheaper and eco-friendly options. Keeping this in view, improvements in the ethanol fermentation have been focused. From the review of literature it is observed that kinetic models describing the behavior of microbiological systems are very useful tool and it would reduce testing for elimination of possibilities.

Keywords: *Kinetic parameter, mathematical model, Ethanol, Fermentation, pre-treatment*

1. Introduction

In recent years, growing attention has been devoted to the conversion of biomass into fuel ethanol, considered the cleanest liquid fuel alternative to fossil fuels. Significant advances have been made towards the technology of ethanol fermentation. [1**].** Bioethanol is a form of renewable fuel that can be produced from agricultural feedstocks such as sugar cane [2], sorghum [3**,** 4, 5], organic and food waste (maize) [6] , banana peel waste [7,8], agro industrial byproducts [9], starch industy waste [10]. Ethanol production and fermentation efficiency vary depending on sorghum variety or crop and the amount and proportion of sugar in the sweet sorghum [4]. Sweet sorghum straw has a potential to be a source for the production of fermentative sugars that can be subsequently fermented to ethanol. The conversion of Sweet Sorghum Straw into fermentative sugars consisted of two steps, the acid pretreatment followed by enzymatic saccharification [11]. Simultaneous Saccharification and Fermentation (SSF) of corn flour [12], and various lignocellulosic woody (poplar and eucalyptus) and herbaceous (*Sorghum* sp. bagasse, wheat straw and *Brassica carinata* residue) materials [13] for ethanol production have been carried out. An economical bioprocess to produce the bio-ethanol from soybean molasses at laboratory, pilot and industrial scales using a strain of Saccharomyces cerevisiae (LPB-SC) have been developed[14]. Effect of various carbon sources such as glucose, fructose and sucrose on growth kinetics and ethanol productivity of Saccharomyces cerevisiae PTCC have been investigated. Growth kinetic parameters with Malthus, Monod and logistic rate equations have been determined. The computed maximum specific growth rates by Monod Growth kinetic model have been the highest [15]. A non-linear kinetic model to predict the consumption of different sugars (glucose, fructose and sucrose) as a substrate, during an apple wine yeast fermentation with *Saccharomyces cerevisiae* strain CCTCC M201022 have been proposed [16]. The kinetic parameters of the ethanol fermentation have been studied by fitting the experimental data with four different kinetic models, namely Monod, Contois, modified Monod and Teisser using MATLAB [17]. Two types of airlift fermenters, conventional (UT-ALF) and modified (CDT-ALF) have been investigated to evaluate their performance with respect to baker's yeast growth [18]. Various

concentrations of damaged wheat and sorghum starch from 10% to 30%W/V were used for simultaneous saccharification and fermentation to produce ethanol by utilising crude amylase preparation from *B. subtilis* VB2 and an amylolytic yeast strain *S. cerevisiae* VSJ4 [19]. Process optimization for production of sugar bioethanol from sorghum, a non conventional source of starch was carried out [20].

2. Mathematical Models

There are basic biological models that can be used to describe biochemical processes successfully. The experimental data were subjected to different kinetics models and the model that best fit the experimental data was adopted. These models are shown in Table 1.

Table1: Some biological Models Source: [8]

Sr. No.	Name	Model
1	Logistic Model	$y = \frac{a}{1 + \exp(b - cx)}$
2	Gompertz model	$y = a \exp[-\exp(b - cx)]$
3	Modified Gompertz model	$y = a \exp\left\{-\exp\left[\frac{\mu_m \exp(1)}{a}(\lambda - t) + 1\right]\right\}$
4	Richards Model	$y = a\{1 + v.exp[k(\tau - x)]\}^{\left(-\frac{1}{v}\right)}$
5	Stannard Model	$y = \alpha\left\{1 + exp\left[-\frac{(1 + kx)}{p}\right]\right\}^{-v}$
6	Schnute Model	$y = \left\{y_1^b + (y_2^b - y_1^b)\frac{1 - \exp[-a(t - \tau_1)]}{1 - \exp[-a(\tau_2 - \tau_1)]}\right\}^{1/b}$

Logistic model describes the kinetic of glucose biomass growth and modified Gompertz equation can successfully describe the kinetics of ethanol mass concentration with respect to fermentation time at the experimented temperature [9].

3. Biomass Kinetic Growth Model

A non structured, sigmoidal shaped model, especially logistic model is widely used to describe microbial growth. Quite a number of polysaccharide fermentation processes and biomass growth have been described by logistic equation. Under optimal growth condition and when the inhibitory effects of substrate and product were neglected, the rate of cell growth follows the well-known exponential relation as expressed in equation (1).

$$\frac{dX}{dt} = X\,\mu_m \quad \text{..... (1)}$$

Where, μ_m (h^{-1}) is maximum specific growth rate of cells in time (t), with respect to the fermentation conditions, X is biomass concentration (g/l) and; t is the time.

The equation above means that X increases with time regardless of substrate availability. In real life, the given hyperbolic relationship governs the growth of cell is given by equation (2) below.

$$\frac{dX}{dt} = \mu_m X\left[1 - \frac{X}{X_m}\right] \text{..... (2)}$$

Where $X_m$is the maximum biomass concentration in $g.l^{-1}$ and, X_0 is the minimum or initial biomass concentration $g.l^{-1}$.

This equation is known as the Riccati equation [7] , using the boundary condition at *t=0* then $X = X_0$, gives a sigmoidal variation of *X* as a function of time. Equation (2) can be easily integrated to give the logistic equation which may represent both an exponential and a stationary phase. The resulted equation is shown in equation (3)

$$X = \frac{X_m X_0 e^{\mu_m t}}{X_m - X_0 + X_0 e^{\mu_m t}} \text{..... (3)}$$

Further simplification gives equation (4) and (5):

$$X = \frac{X_m X_0 e^{\mu_m t}}{X_m - X_0 + X_0 e^{\mu_m t}} \text{..... (4)}$$

$$X = \frac{X_0 e^{\mu_m t}}{1 - \frac{X_0}{X_m} 1 - e^{\mu_m t}} \text{..... (5)}$$

The equation (5) above is generally known as logistic equation which can accurately describe the kinetics biomass growth with time. It may represent both an exponential and stationary phase, however, the logistic equation presented above, does not predict the death phase of microorganisms after the stationary phase. The use of unstructured models is completely adequate in those cases where the substrate concentration is high compared to the saturation constant in the major part of batch fermentation. The unstructured model includes the most fundamental observations concerning

microbial growth processes: (i) the rate of the cell mass production is proportional to biomass concentration and (ii) there is an upper (saturation) limit for growth rate on each substrate [10]

The Monod model is considered the basic equation of an unstructured model. This model introduced the concept of growth-controlling (limiting) substrate, relating the growth rate to the concentration of a single growth-controlling substrate [1 = f (S)] via two parameters, the maximum specific growth rate (μ_{max}), and the substrate affinity constant (Ks). This model exhibits the typical hyperbolic shape for growth rate express in function of substrate concentration.

$$\mu = \frac{\mu_{max} \cdot S}{Ks + S}$$

Where, μ is the specific growth rate (h^{-1}), S is substrate concentration (g/L), Ks is Monod constant and $\mu_{max}$is defined as specific growth rate. It has been observed that Monod model has a significant similarity with the Michaelis-Menten kinetics [11, 12]. Culture that grows on single substrate can be described by Monod model. Substrate in Monod model is known as growth-limiting substrate due to the dominant influence of a single substrate [11]. Batch fermentation mass balance for biomass generation rate, substrate consumption rate and product formation rate can be illustrated respectively as follows.

$$\frac{dX}{dt} = \mu X \frac{dS}{dt} = -\frac{\mu X}{Y_{x/s}} \frac{dP}{dt} = q_p X$$

Where, X is the biomass concentration (g/L); $Y_{x/s}$is the biomass yield (g biomass/g glucose); P is the product concentration (g/L) and q_p is the specific product formation rate (h^{-1}). The kinetic parameter such as $\mu_{max}$was calculated during the exponential phase from the slope of the graph of ln X vs time [12]. Ksvalue is the concentration of substrate when μis equivalent to half of μ_{max}[11]. The value of Ksis usually small.

Structured models describing culture kinetics are important in the control of bioreactors, as they provide a mathematical description of the mechanism of the process which are required for optimization and control. The objective of structured modeling is to obtain expressions that quantitatively describe the behavior of the process under consideration. A wide variety of models have been proposed for the kinetics of the process; these range from very simple models to more complex global models, which take into account the activating and inhibiting effects of the substrate (glucose and oxygen) and the product (ethanol and acetic acid). However, none of these studies have put forward a general model sufficiently well developed to permit the design of a good simulator which is capable of performing simulations with batch process. A developed mathematical model capable of predicting the cell, substrate, and ethanol concentrations during the continuous anaerobic fermentation is necessary. However, it cannot be expected that any kinetic model will be directly applicable to a real process situation. Therefore, mathematical modeling should start with the simplest type, but it must be reiterated, modified, and extended until it eventually leads to an adequate process kinetic model.

4. Ethanol Concentration Model

The modified Gompertz model successfully described the data of the fermentative production of ethanol from glucose biomass using a theremotolerant strain of *kluveromyces Maxianus* [9]. The double exponential Gompertz function Model is written as:

$$y = a \exp[-\exp(b - cx)] \text{..... (6)}$$

After modification, modified Gompertz model can be written as:

$$y = a \exp\left\{-\exp\left[\frac{\mu_m \exp(1)}{a}(\lambda - t) + 1\right]\right\} \text{..... (7)}$$

The kinetic parameters are:

y = the ethanol mass concentration (g/L),

a = the potential maximum ethanol mass concentration (g/L),

μ_m = the maximum ethanol production rate ($gl^{-1}h^{-1}$),

λ = the lag phase or the lag phase or the time to exponential ethanol Production (h).

t = fermentation time.

Equation (7) can be written as:

$$A_{EtoH} = A_m \exp\left\{-exp\left[\frac{Pr_m \exp(1)}{A_m}(\lambda - t) + 1\right]\right\}$$

Where:

A_{EtoH} = the ethanol mass concentration (g/L),

A_m = the potential maximum ethanol mass concentration (g/L),

Pr_m =the maximum ethanol production rate ($gl^{-1}h^{-1}$), or productivity

The kinetic parameters of the ethanol mass concentration of the experimental data were adopted and subjected to modified Gompertz model and the result was plotted alongside with the real life experimental data. Both of the results

show high level significance of correlation with an R square value of 0.996. The high value of the R square suggests that the modified Gompertz model can be successfully used to describe the fermentation process for the production of ethanol from glucose biomass.

5. Improvement of the Ethanol Fermentation Process

5.1 Two-Stage Bioreactor with Recycling for Continuous Ethanol Production

In order to achieve higher ethanol productivity, many researchers [12–16] used two or more bioreactors or packed columns in series with or without recycling the cells to maintain high dilution rates. Nishiwaki and Dunn [12–15] demonstrated a two-stage bioreactor with recycling the cells by a cell separator at each stage (Fig. 1). Chaabane et al. [17] studied a two-stage continuous bioreactor by recycling the cells where the first reactor was used for cell growth and the second reactor for ethanol production. Higher ethanol productivity (up to 41 g L^{-1} h^{-1}) was obtained with complete conversion of glucose to ethanol in the two-stage system. Bai et al. [18] observed high fluctuations in fermentation parameters in three tubular bioreactors arranged in series (Fig. 2). These fluctuations were attenuated when the tubular bioreactors were packed with Intlox ceramic saddle.

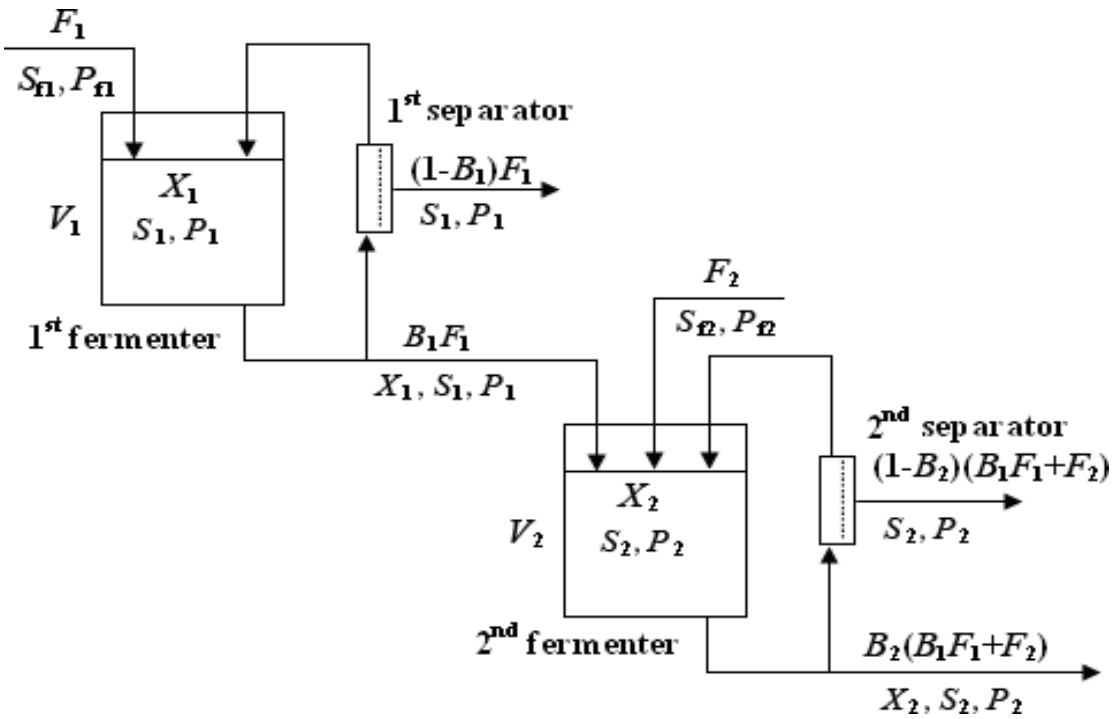

Figure1. Two-stage fermenter with cell recycling at each stage [13]

The kinetic parameters were obtained for a continuous glucose-to-ethanol fermentation with *Saccharomyces cerevisiae* in recycling of cells using the membrane fermenter by Groot [74–77].

For specific growth rate under product inhibition:

$$\mu = \mu_{m.}\frac{S}{k_s + S}\left(1 - \frac{P}{P_m}\right)^n$$

For specific glucose consumption rate:

$$q_s = \frac{\mu_m}{Y_{X/S}}$$

For specific ethanol production rate:

$$\upsilon = Y_{X/S}q_s$$

where $\mu$is the specific growth rate (h^{-1}), $\mu_{m.}$ is the maximum specific growth rate (h^{-1}), S is the substrate concentration (g L^{-1}), K_S is the saturation constant (g L^{-1}), P is the product concentration (g L^{-1}), Pm is the maximum product concentration (g L^{-1}), q_s is the specific consumption rate of the substrate (g g^{-1} h), $\upsilon$is the specific production rate of ethanol (g g^{-1} h^{-1}), and$Y$x/s is the yield of cells based on the glucose consumed (g g^{-1}).

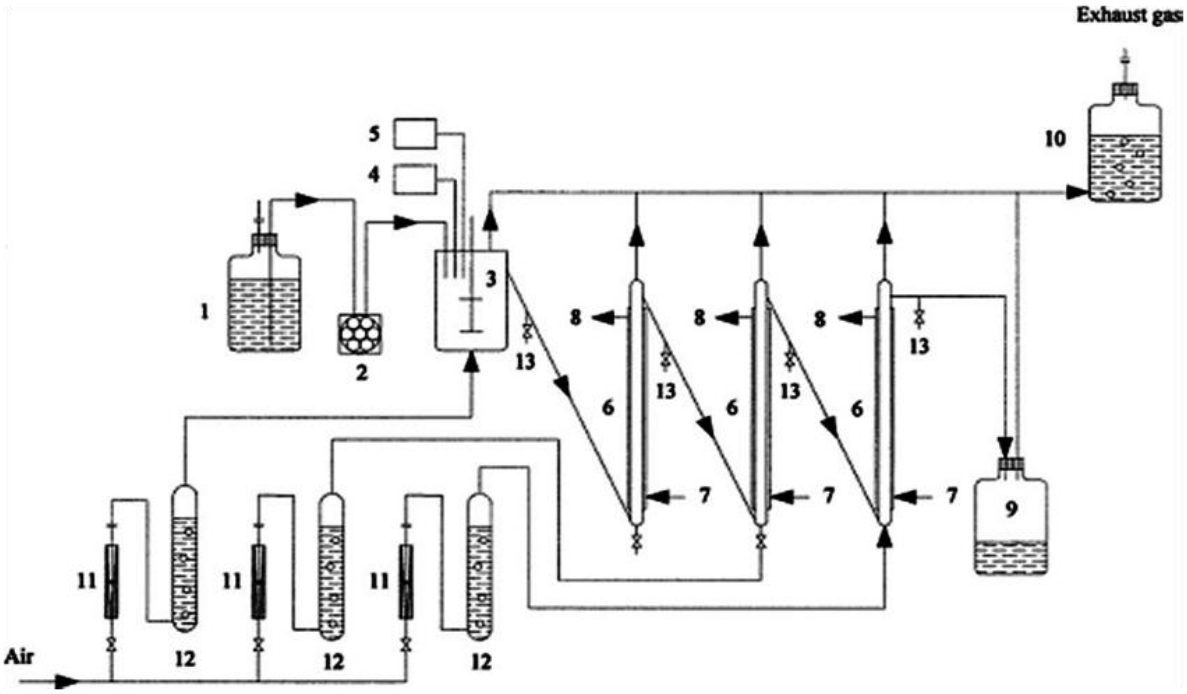

Figure 2 *Process diagram for continuous ethanol fermentation using a combined bioreactor system 1, substrate storage tank; 2, peristaltic pump; 3, stirred tank fermenter; 4, pH controlling unit; 5, temperature controlling unit; 6, tubular fermenters; 7, thermostat water inlet; 8, thermostat water outlet; 9, broth storage tank; 10, exhaust gas washing tank; 11, air flow meters; 12, air humidifiers; 13, sampling parts*

6. Conclusion

Generally, economic restrictions force industrial processes to work in a very small range of operating conditions. Mathematical models are effective tool for analyzing biological process and microbial growth phenomenon. The studied model shows more insight into the environmental conditions that is surrounding bio-process and can be used for further development and optimization of bio-processes. This paper reviews the various process options and kinetic models adopted towards resolving the technological challenges to develop a low-cost commercial process.

Optimization of the cost of ethanol production is the prime objective of the current research work. In this direction improvement of yield and productivity are the major achievements to reduce the cost of ethanol production per gallon. Kinetics of biomass production with respect to time could be illustrated by logistic models. Kinetics of ethanol mass concentration production at an operating temperature could be tested by modified kinetic models. Logistics model could be well fitted to the experimental data and could be regarded as sufficient to describe the biomass production. Also, the modified kinetic model fitted into the experimental data and could also be regarded as sufficient to illustrate the fermentation process for the production of ethanol from glucose biomass with a novel thermo-tolerant strains techniques. Experimental and mathematical modeling, results were compared by several researchers which shows no significant difference. Therefore, utilization of mathematical model would contribute to a better understanding of effects of various factors affecting the production of ethanol. In other words, models enable us to understand, design and control the fermentation process better and could be also be used for further process development.

7. Acknowledgment

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HARMONIC DISTORTION ANALYSIS BY ARTIFICIAL INTELLIGENCE TECHNIQUE

Bhagat Singh Tomar[1], *Bharti Drivedi*[2], *Anurag Tripathi*[3]
Research Scholar, Electrical Engg. Department,
Laxmi Devi Institute of Engg. & Technology, Alwar,(Rajasthan),India,[1]
Professor, Electrical Engg. Department,
Institute Of Engineering and Technology, Luck now (Uttar Pradesh), India[2]
Associate Professor, Electrical Engg. Department,
Institute Of Engineering and Technology, Luck now (Uttar Pradesh), India[3]
bhagatstomar@yahoo.co.in[1],bharti_dwivedi@yahoo.com[2], anurag.tripathi.aparna@gmail.com[3]

***Abstract*—Harmonic distortion in power systems is an old problem which continues to grow in importance due to the proliferation of non-linear loads and of sensitive electronic devices. Thus, the need of standards to limit such distortion is required. Due to the time-varying nature of the distortion more advanced techniques are required to properly quantify their impact.**

IndexTerms— ***non-linear loads, harmonic distortion, sensitive electronic devices, losses, sources, resonance, voltage levels, fuzzy logic.***

1. INTRODUCTION

Harmonics in electrical power system is becoming a major concern for electric utility company and consumers. It is produced by power electronics and other equipments which are called non-linear loads. Examples of nonlinear loads are computers; fluorescent lamp and television in residential while variable speed drives, inverters and arc furnaces are mostly common in industrial areas. Increasing numbers of these loads in electrical system for the purpose of, such as improving energy efficiency, has caused an increase in harmonics pollution. These loads draw non-sinusoidal current from the system. The waveform is normally periodic according to supply frequency which is either 50Hz or 60Hz depending on the country.

Research, in general, on harmonic distortion aims at characterizing the distortion, the behavior of the loads and the power system. Also the effects the distortion has on loads, the system and the environment are studied. The research presented in this thesis concerns the sources of distortion (loads) and the interaction between those and the propagation of the distortion in the power system. Effects on the power system are also studied, e.g. additional losses, harmonic resonance and related financial costs. Further, mechanisms affecting the harmonic active power flow, in a certain point, are shown. A new mechanism concerning harmonic current interaction in high voltage transmission systems, due to a difference in the fundamental voltage phase angle between two nodes, is addressed.

2. SOURCES OF HARMONIC DISTORTION

Non-linear equipment or components in the power system cause distortion of the current and to a lesser extent of the voltage. These sources of distortion can be divided in three groups:

a) Loads
b) The power system itself (HVDC, SVC, Transformers, etc)
c) The generation stage (Synchronous Generators)

Subdivision can also be made regarding the connection at different voltage levels. In general, loads can be considered connected at lower voltage levels, the power system exists at all voltage levels and the generation stage at low and medium voltage levels.

Electronic equipment, supplied from the low voltage power system, rectifies the ac power to dc power for internal use at different dc voltage levels. This is done, either with or without an ac step down transformer, and a diode rectifier.. The power range for each device is small, from a few W up to some kW. The total harmonic distortion, THD, of the line current is often over 100 % and consists of all odd multiples of the fundamental component. In some case the THD can be nearly 150%, mainly depending on the design of the DC-link and the crest factor of the supply voltage.

Harmonic producing equipments are found in varied locations from offices to manufacturing plants and they are becoming inevitable in daily life. Various harmonic producing equipments are:

(a) Personal computers
(b) Electronic lighting ballasts
(c) Variable and adjustable speed drives
(d) Industrial process controls
(e) Electronic test equipment
(f) Solid state controls
(g) UPS systems
(h) Medical equipment

3. How Non-linear Loads Create Voltage Distortion

By far the majority of the voltage distortion found in today's distribution systems is produced by the loads themselves, not the supply. Much of today's electrical load is non-linear, meaning they consume current in a non-sinusoidal manner. Since, by definition, a no sinusoidal waveform is composed of harmonic currents; non -linear loads are considered to be harmonic current sources. In other words, by consuming current in a non-sinusoidal manner, these non-linear loads produce harmonic currents that circulate through the power distribution system. Most voltage distortion is the result of the interaction of these harmonic currents with the impedance of the electrical distribution system. As the harmonic currents pass through the system's impedance, they produce voltage drops at each harmonic frequency in relation to ohm's Law - v h = I h x Z h . The voltage drops appear as harmonic voltages and the accumulation of these voltages at all the harmonic frequencies produces the voltage distortion.

The relationship is:

$$v_{TH} = (v1^2 + v2^2 + v3^2 + v4^2 + ... v_h^2)^{0.5} \quad (1.1)$$

where , vTHD =Total harmonic distortion of voltage.
v h=Voltage at harmonic h.
v1 =Fundamental voltage.

Distortion levels can be quite high when system impedance is high. A fatal combination is high densities of non-linear loads in systems with high impedance or low fault level. This situation is common when weak sources, such as UPS system or diesel generators, are used to service electronic equipment. The problem is magnified further when the equipment is serviced by long cable runs.

4. SIMULATION

4.1 *The Harmonic Distortion Fuzzy Model*

The fuzzy model for the harmonic distortion diagnostic was implemented in MATLAB using the fuzzy logic toolbox. This toolbox allows for the creation of input membership functions, fuzzy control rules, and output membership functions. To implement this system in Simulink the system will need to have two different inputs: the harmonic voltage and the temperature. These two inputs will then be processed by a fuzzy logic controller that will output a degree of caution. This degree of caution is then decoded into one of four possible outputs: No problem, Caution, Possible Problem, and Imminent Problem. A simple (two-variable example) diagnostic system was created as shown in Figure 1.

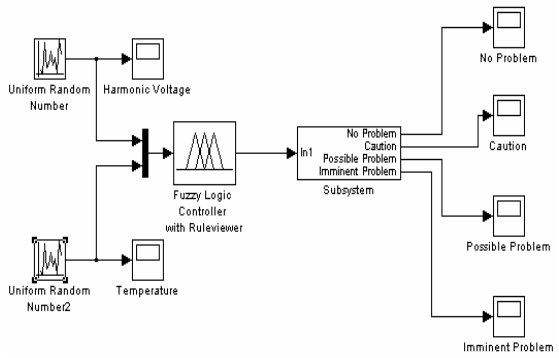

Figure 1 Harmonic Distortion Diagnostic Simulink Model

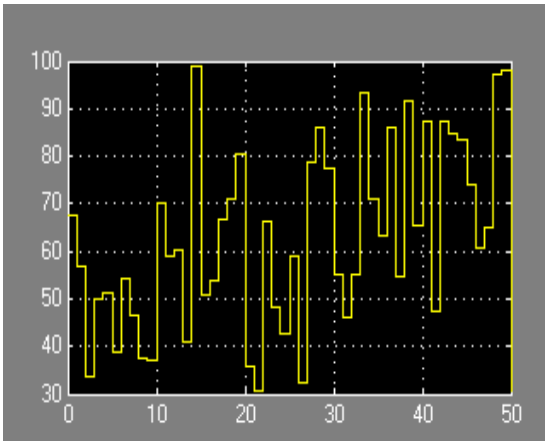

Figure 2 System Temperature Input

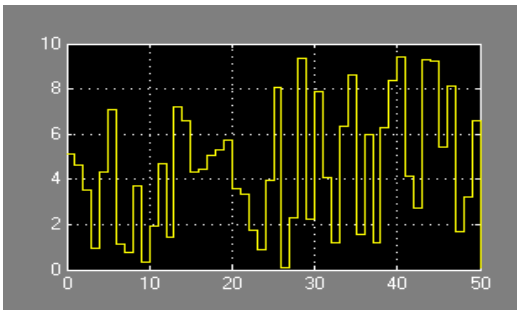

Figure 3 Harmonic Voltage Input

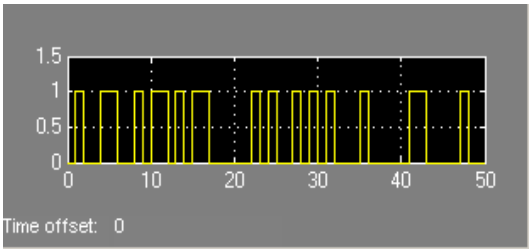

Figure 4 No Problem Output

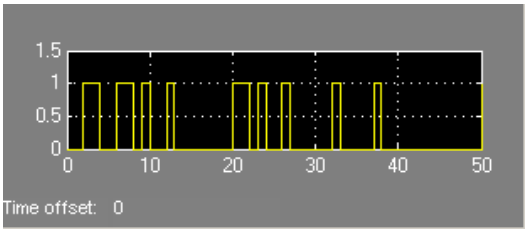

Figure 5 Caution Output

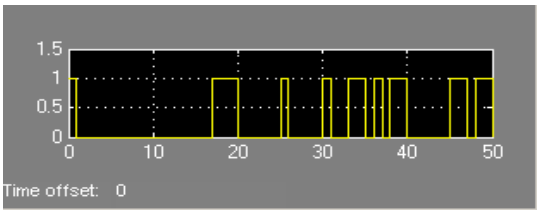

Figure 6 Possible Problem Output

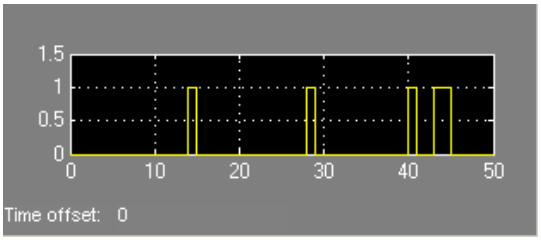

Figure 7 Imminent Problem Output

Table 1: Membership Rules

If Harmonic Voltage is	**And the temperature is**	**Then the Output is**
very_low	Below normal	no _problem
very_low	normal	no _problem
very_low	over_heating	no _problem
very_low	very_hot	caution
low	Below_normal	no _problem
low	normal	no _problem
low	over_heating	caution
low	very_hot	Possible _problem
medium	Below_normal	no _problem
medium	normal	caution
medium	over_heating	Possible_problem
medium	very_hot	Possible_problem
high	Below_normal	caution
high	normal	Possible_problem
high	over_heating	Possible_problem
high	very_hot	Imminent_problem
very_high	Below_normal	Possible_problem
very_high	normal	Possible_problem
very_high	over_heating	Imminent problem
very_high	very_hot	Imminent_problem

The inputs for this example system have been shown before; they are randomly generated data within a valid range. The system can be simulated using this data. The output signals generated are shown in Figure 5.3 through Figure 5.6. The Fundamental and the harmonics will have uniform random function generators as inputs. These function generators will generate a uniform distribution of inputs within the variances . The total harmonic distortion will be calculated depending on these inputs and so it will be in the range of 1% to 13%, these are the best and worst case scenarios. The temperature variation will remain the same as in the previous case. Using this input data and the basic model developed in the first case a Simulink model can be developed that processes all the input data and gives an appropriate indication for each harmonic, the fundamental, and THD. These indications will remain the same as in the previous case. Each indicator will have a fuzzy logic controller that implements one of three control topologies, one for the fundamental, THD, and the harmonics. The final Simulink model can be seen in Figure

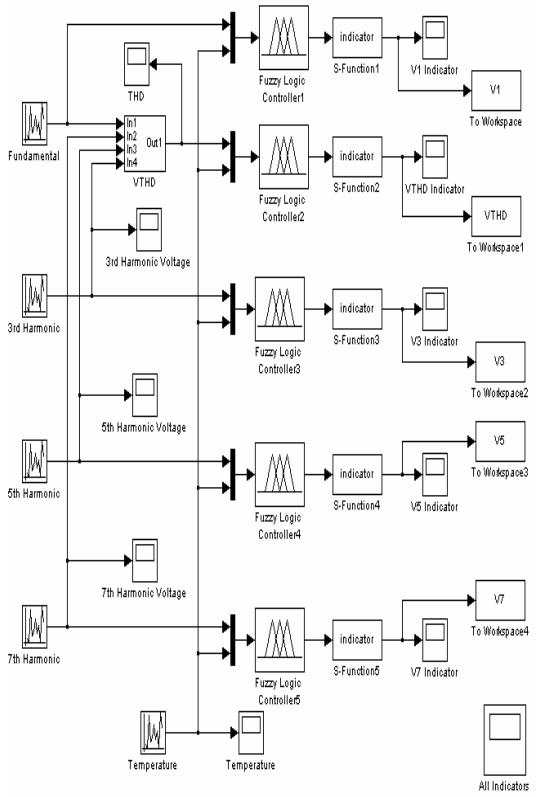

Figure 8 Final Simulink Model

4.2 .Results

The inputs for this example system have been shown before; they are randomly generated data within a valid range. The system can be simulated using this data. The output signals generated are shown in Figure 5.3 through Figure 5.6. The Fundamental and the harmonics will have uniform random function generators as inputs. These function generators will generate a uniform distribution of inputs within the variances given in Table 2. The total harmonic distortion will be calculated depending on these inputs and so it will be in the range of 1% to 13%, these are the best and worst case scenarios. The temperature variation will remain the same as in the previous case. Using this input data and the basic model developed in the first case a Simulink model can be developed that processes all the input data and gives an appropriate indication for each harmonic, the fundamental, and THD. These indications will remain the same as in the previous case. Each indicator will have a fuzzy logic controller that implements one of three control topologies, one for the fundamental, THD, and the harmonics. The final Simulink model can be seen in Figure.

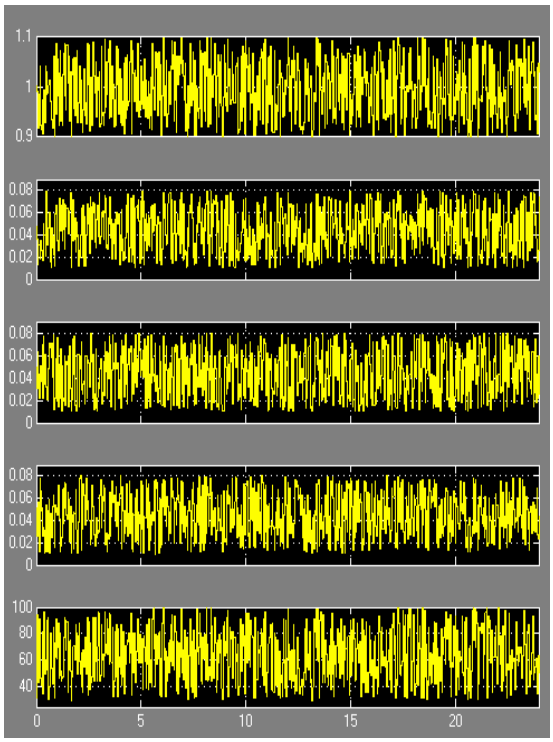

Figure.9 All System Inputs (top down): Fundamental, Third, Fifth, Seventh Harmonics and Temperature

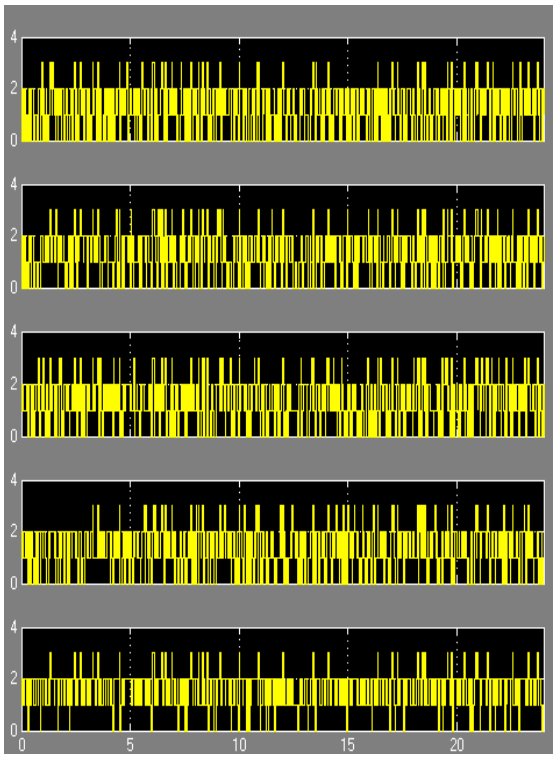

Figure 10 Output Indicators (Top down): Fundamental, Third, Fifth, Seventh Harmonics and THD.

5. CONCLUSION

The conclusions are that non-linear loads generate current distortion up to 200 % THD. The tendency for modern loads is a reduction of the lower order harmonics, below 1 kHz, and an increase of higher frequency components, up to 100 kHz. The current distortion decreases at higher voltage levels, around 5 % THD, mainly due to mixing with passive loads but also due to current interaction between single and three phase non-linear loads. The voltage distortion is also highest at low voltage levels, mostly below 6 % THD, and decreases down below 2 % at higher voltage levels. A dominating source of distortion, at all public voltage levels, is the use of television receivers at evening time with dominating 5:th and 7:th harmonics, up to 0.5 % of the fundamental component at 132 kV and 400 kV levels.

In this study harmonics modeling of office equipments is realized for harmonic analysis of modeled systems in Simulink with the help of measured real data, voltage-current values and harmonic current spectrums; proposed Simulink nonlinear resistance model and harmonics current injection model. According to Fig.6 and Fig.7 line current values acquired from nonlinear circuit (time domain) and harmonic current injection circuit (frequency domain) are very close and better than expected tolerances (<%0.1)

THD value of neutral current observed from Fig.7 and Fig. 8 is greater than %200, thus some harmonic mitigation options, such as oversizing conductors (especially neutral in three-phase circuits with shared neutrals), applying passive or active harmonic filters, must be carried out and detailed neutral harmonic analysis is needed for circuits mainly consisting of office equipments.

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Extracting Trustworthy Data from Multiple Conflicting Information using Semi-Supervised Approach

Priti R. Sharma[1], Manoj E. Patil[2],
[1]ME (CSE),SSBT's,COET Bambhori,Jalgaon,pritirsharma@gmail.com, India;
[2]Deptt of ComputerEngineering, SSBT's, COET Bambhori, Jalgaon, mepatil@gmaill.com, India;

Abstract –At the end of the last century the appearance of the World Wide Web (WWW) led to a rapid growth in the Internet and in the quantity of accessible information for users. The information that has accumulated on WWW represents huge knowledge base that may prove useful for various applications. Now day people depend on the Webfor everything.But information retrieved is not guaranteed trustworthy, not always trustable. Truthfinder is used to find trustworthy data using unsupervised approach. It is assumed that a fact provided by more sources is more likely to be correct. The proposed system based on the semi supervised approach. This uses some training data which will help for improving performance. Experimental analysis shows that the proposed algorithm is more effective than unsupervised approach and which help to resolve veracity problem.

Keywords:*Truth discovery, semi supervised;*

I INTRODUCTION

The World Wide Web has become a necessary part of our lives and might have become the most important information source for most people. Every day, people retrieve all kinds of information from the Web. For example, when shopping online, people visit websites concerned with required product and find product specifications. When they want to know the answer to a certain question, they go to Ask.com and google.com. Now days for getting updates, reading newspeople always take the help of websites. e.g. ifperson want to get the knowledge of 'C' language then also website play very important role."Is the World Wide Web always trustable?" Unfortunately, the answer is "no." There is no guarantee for the correctness of information on the Web. As website use is most popular then data copying on web also popular.Conflicting information present on web is the common thing now days. Usercannot get the relevant accuratedata most of the time. More problems has to face in searching data for facts changing with time, since out-of-date information often exists in more web sites than up-to-date information[9].

A new problem called the Veracity problem is recognized now a days, which is formulated as follows: Given a large amount of conflicting information about many objects, which is provided by multiple websites (or other types of information providers), how to discover the true fact about each object[1].The trustworthiness problem of the web. According to a survey on credibility of web sites[1]:1.54% of Internet users trust news web sites most of time.2.26% for web sites that sell products.3.12% for blogs
Existing system tried to resolve this problem with unsupervised approach. TruthFinder is used to resolve veracity problem. Truthfinder is used to get the true facts from conflicting information .But better solution is to go for some kind for supervision.i.e. result can be improved when we use semi supervise approach instead of unsupervised approach. Proposed system is based on semi supervised approach. We come to recognize that the even a small amount of training data also greatly help for improving the performance [9].

The remainder of the paper is organized as follows.The next section discusses the related work. Section III takes the overlook on existing system. In section IV, proposed system is discussed along with algorithm and UML diagrams. Section V gives the experimental analysis. Lastly conclude discussion in section VI.

II Related Work

Quality assessment is important is information retrieval.The research on Ranking algorithm is going on from many years. Some researchers used link analysis I their ranking algorithms. The popularity of link analysis and the assumptions about its role in search engine rankings has led to great efforts by search engines optimization professionals[3, 6]. Many links are set only to gain influence on the ranking of certain pages. The objective of these approaches is to ground the quality evaluation on a broader knowledge base. Not only the pages often cited by web page authors but also pages often visited should be regarded as being of high quality. The most popular algorithm is PageRank. The basic assumptionof PageRank and similar approaches is that the number of in- or back-links of a Web page can be used as a measure

for the popularity and accordingly for the quality of a page[5].PageRank assigns an authority value to each Web page which is primarily a function of its back links. Additionally, it assumes that links from pages with high authority should be weighed higher and should result in a higher authority for the receiving page. The algorithm is carried out iteratively until the result. However, link analysis has several serious shortcomings. The number of in-links for Web pages follows a power law distribution. In such a distribution, the median value is much lower than the average. This means, that many pages have few in-links while few pages have an extremely high number of in-links. This finding indicates that Web page authors choose the Web sites they link to without a thorough qualityevaluation. The PageRank technique, introduced by Page et al. [8], actually tried to mend this problem by looking at the importance of a page in a recursive manner: "a page with high PageRank is a page referenced by many pages with high PageRank". Drawback of pageranking: Any website having higher visits will be having higher pagerank irrespective of the content in data, so there will be problem if website having higher pagerank and giving wrong data, many user will get confused or blindly believe conflicting or wrong data from other website. Page ranking is use to find pages with high authorities. The user predicts the true information according to the ranking of page.

Finally comment is that it is not true that most popular website will provide the true fact. This assumption is totally wrong because out of date information is remain present on many websites.Hubs and Authorities (Kleinberg, 1999) gives each page a hub score and an authority score, where its hub score is the sum of the authority of linked pages and its authority is the sum of the hub scores of pages linking to it[2].After that the HITS algorithm is proposed by Kleinberg in 1988. HITS algorithm identifies two different forms of Web pages called hubs and authorities. Authorities are pages having important contents. Hubs are pages that act as resource lists, guiding users to authorities. Thus, a good hub page for a subject points to many authoritative pages on that content, and a good authority page is pointed by many good hub pages on the same subject. HITS algorithm is ranking the web page by using in-links and out-links of the web pages. The veracity problem i.e. the conformity of truth is not resolved in above algorithm. Research work was to find trustworthy data. Voting is the easiest way of computing the best fact related to an object is to choose the one with maximum number of votes. This method, however, does not provide good result.Yin, Han [7] first propose Truthfinder algorithm to find true facts. TruthFinder studies the interaction between website and the facts they provide and infer the trustworthiness of websites and confidence of fact from each other.

III Existing System

3.1 Unsupervised Approach:

Existing System uses unsupervised approach to resolve veracity problem. The first algorithm proposed to find true fact from false fact is TruthFinder which is unsupervised[7]. It is assumed that a fact providedby more sources (especially more trustworthy and more independentsources) is more likely to be correct. They all use iterativeapproaches, which start by assigning the same trustworthiness toall data sources, and iterate by computing the confidence of eachfact and propagating back to the data sources. The input of TruthFinder is a large number of facts in a domain that are provided by many websites specified in fig 1. There are five facts related to two objects. These five facts are from different four websites. There are usually multiple conflicting facts from different websites for each object, and the goal of TRUTHFINDER is to identify the true fact among them.

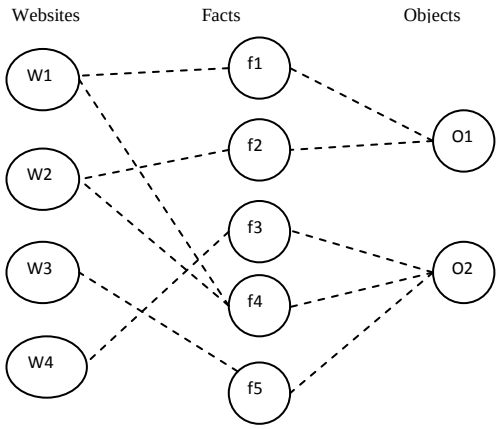

Fig1: Facts, Objects and Information Providers (Websites) [7].

3.2 Drawbacks of Truthfinder:

Truthfinder makes some assumptions.
Usually there is only one true fact for a property of an object.This true fact appears to be the same or similar ondifferent websites. It is assumed that an object isassociated with only one type of fact.
The above assumption does not true every time. Accuracy depends on these assumptions [7].

Drawback:

It is assumed that a provider either providesgood facts for every object or bad facts for everyobject. It is assumed that there is onlyone true value for an object. But often, multiple values(set) could be true sometimes with different degrees oftruth. It is assumed that number of providers providing the true facts are much more than the numberof providers providing the bad fact [11].

IVProposed System:

We can say that since TruthFinder is unsupervised approach there is some problem in finding true facts.Some level of supervision can help the iterative fact finding algorithm in right direction.Soit is better solution to go for semisupervised approach.

The approach is based on three principles:
(i) facts provided by the same data source should have similar confidence scores, (ii) similar (and therefore mutually supportive) facts should have similar confidence scores and (iii) if two facts are conflicting, they cannot be both true [9].

4.1System overview architecture:
Fig. 2 shows the system overview architecture. User has to enter the keyword he want to search and then it is processed to find the trustworthy information through semisupervised truthfinder.

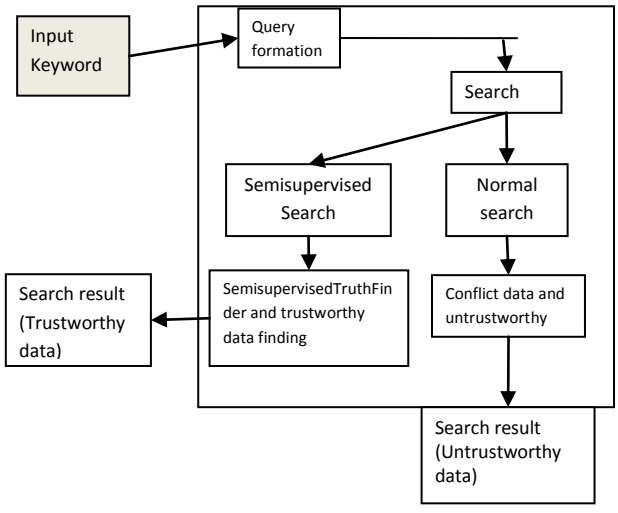

Fig 2: System overview architecture

SemisupervisedTruthfinder Algorithm:

1. Start
2. Take input i.e. search table, ground truth fact, nskeywords& additional keywords
3. If (search == normal search)
   Then List of sites by nskeyword.
4. else if(search == semisupervised search)
   Then list sites in descending order by confidence score.
5. Select url from search and fact table
6. If (url_search_table == url_fact_table)
   Then Update confidence scoredocheck nscount and display url across that greater countwhile(confidence score == 1)
7. Subsequently arrange url in descending order according to confidence score 0 and -1.
8. Stop.

In semisupervised TruthFinder, a confidence score is assigned to each fact, so that true facts have higher scores than false facts [9] Ground data are used to retrieve query result from Data Source.We maintain the ground truth data which contain set of websites.In normal search all related websites are listed without any priority.

In semi supervised search, we have to provide additional key words with the normal search keyword. The ranked websites are listed after comparing with the ground truth fact data set. Ground truth data contain a small set of highly confident fact and use them to infer the trustworthiness of data sources and confidence of facts.

For semisupervised search, the confidence score will be calculated by the site visited by the user. Comparing with the ground truth sites, if the visited site is same as the ground truth fact site it'll be consider as true fact site and its value is 1. if it is not same then it'll be considered as false facts site and its value is -1. If the user doesnot visit the site it'll be taken as unknown site and its value is 0.

4.2 UML Diagrams of System:

Use case diagram:
It shows the interaction between use cases & actors. Fig 3 shows use case diagram of system. Two actors normal_search & semisupervised_search initiates the number of use cases e.g read keyword, load database, listing from search table are perfomed by normal_search. Whereas read url from search table, check confidence score of url, check nscount of url, display url in descending order, update confidence score and nscount are perfomed by semisupervised search.

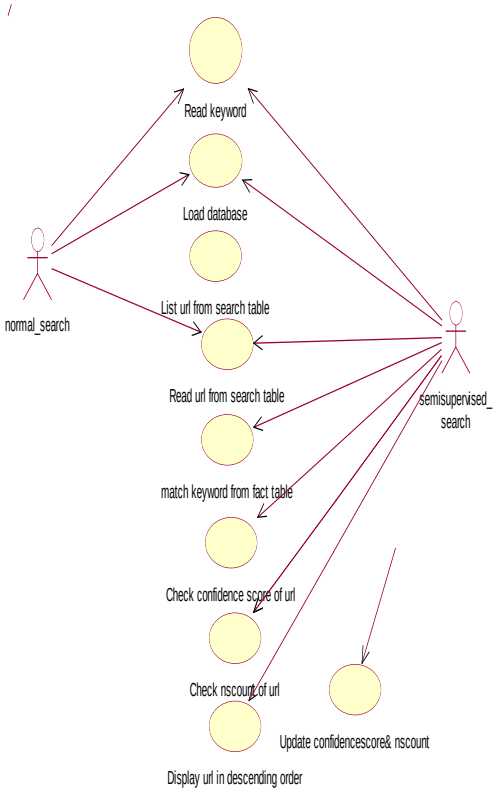

Fig 3:Use case diagram

Class Diagram:
It shows the interaction between classes in the system. Search class has attributes - search type and nsurl. Operations – geturl(), displayurl() are also used in child class normal_search and semisupervised_search. Fig 4 shows class diagramof system.

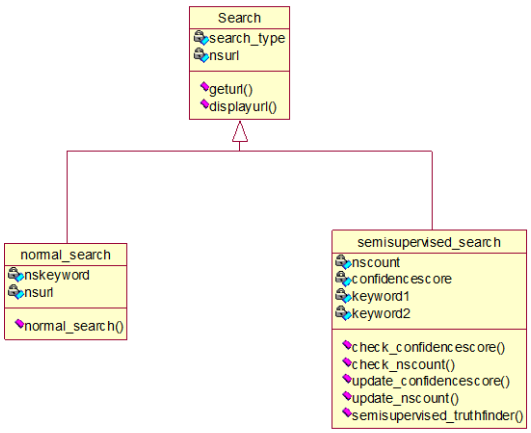

Fig 4: Class diagram

State diagram:
It provides way to model the various states in which an object can exist. Fig 5 shows state diagram of system. State diagram is drawn for semisupervised search. Fig shows more dynamic behavior of system.

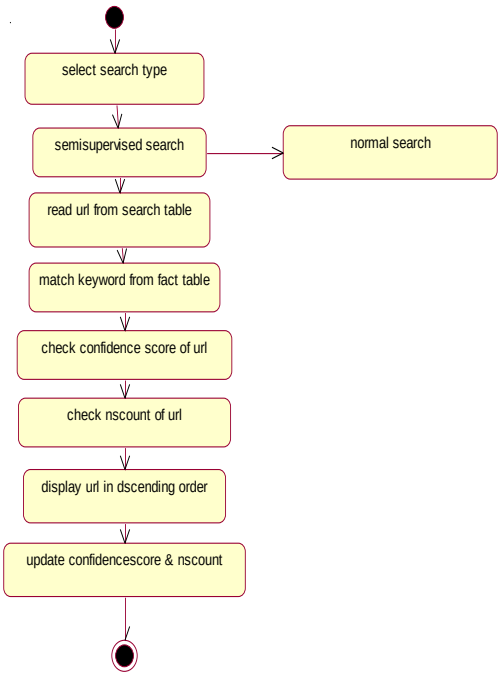

Fig 5: State diagram

Sequence diagram: It is used to show the flow of functionality.Fig 6 shows sequence diagram of system. It shows the flow of sequence of semisupervised search. How search query is processed.

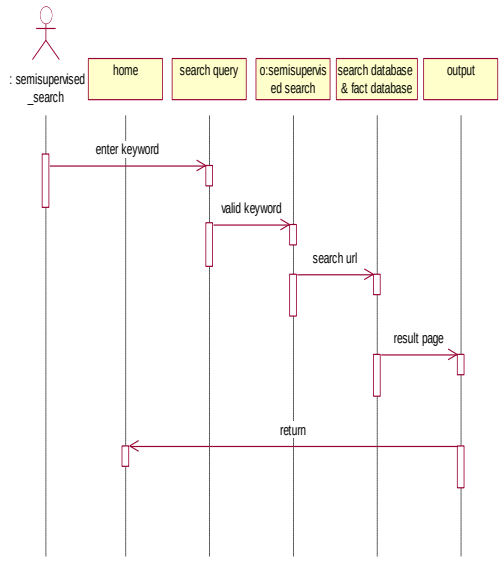

Fig 6: sequence diagram

Collaboration diagram:

It shows exactly the same information as the sequence diagram. However the collaboration diagram shows this information in a different way. . Fig 6 shows sequence diagram of system

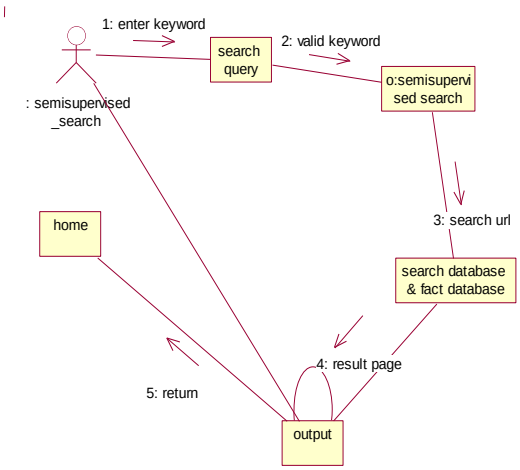

Fig 7: Collaboration diagram

V Experimental analysis:

In previous work [9], real world data set containing authors of computer science books is considered. Same data set is used in [1], [7]. We take the very small data set of different types. Our data set contains 500 websites. We include the different keywords in our experiment such as book author, weather, directors of films etc.

nsid	nsurl	nscount	confidencescore
32	http://www.accuweather.com/en/in/india-weather	1	-1
33	http://in.weather.yahoo.com/	0	0
34	http://www.weather-forecast.com/countries/India	0	0
35	http://www.timeanddate.com/weather/india	1	-1
36	http://www.bbc.co.uk/weather/1269750	0	0
37	http://www.mapsofindia.com/weather/	0	0
38	http://in.weather.com/national	3	1
39	http://www.imd.gov.in/	2	-1

Table1: search table for query ‘weather india’

Fact id	url	keyword1	keyword2
4	http://www.imd.gov.in/	weather india	weather report india
5	http://in.weather.com/national	weather report india	weather india

Table2: fact table for keyword ‘weather india’

First ground truth training database is used. The confidence score of the ground truth facts is manually set to 1 indicating that these websites are trustworthy [9]. The confidence score of website of false fact is set to -1.Additional keywords are used for semisupervised search. Semisupervised

Truthfinder list the url on the basis of confidence score and nscount. The result of semisupervised search for keyword 'weather india' is computed on the basis of confidence score and nscount.

Conclusion:

In this system, semisupervised approach is used. After analysis, it is observed that there is a big difference in normal search and semisupervised approach of TruthFinder.Since ground truth data is present, it helps to improve the performance of finding true facts from websites.

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Experimental Investigation of Backpressure Variation on a Single Cylinder C. I. Engine System Performance

Prashant P. Bornare[1],
[1]M.E. student, SGDCOE, Jalgaon, MS, India
[1]ppbornare79@gmail.com
Dr. D. S. Deshmukh[2]
[2]Professor & Head, Department of Mechanical Engineering, S.S.B.T.'s, C.O.E.T., Bambhori, Jalgaon
[2]deshmukh.dheeraj@gmail.com
Prof. R.Y. Patil[3],
[3]H.O.D. Mechanical, SGDCOE, Jalgaon, MS, India Jalgaon, (M. S.), India
[3]rypatil@gmail.com

***Abstract*— Research paper concentrates on backpressure phenomenon in case of compression ignition engines. Effective after treatment techniques utilization specifically for C.I. engines, requires critical analysis of the complete exhaust system employed. Search on After Treatment Devices as a modern technology is very active because particulate matter is designated as a major cancer material. Regeneration phenomenon in After Treatment Device is a subject of special interest for design and development of Particulate Matter emission control activities. The Backpressure acting on engine is most important factor which basically deteriorates the engine and emission control performance. In the present work, critical study of backpressure rise which is undesired for system performance view point and experimental study of the effect of back pressure generated on the C.I. engine, with and without the use of a specially designed After Treatment Device is done. To minimize the problem of back pressure rise because of after treatment techniques applications, some remedial actions are also suggested.**

***Keywords*—** *After Treatment Device, Backpressure, Exhaust Emissions, After Treatment Device, Compression Ignition engine.*

1) INTRODUCTION

The exhaust system routes exhaust gas from the engine and exhaust it into the environment, while providing noise attenuation and after treatment of the exhaust gas to reduce emissions. One of the most important sources of vehicle noise, the noise associated with exhausting combustion gases from the engine, is controlled using mufflers. A number of sound reduction techniques are employed in mufflers, including reactive silencing, resistive silencing, absorptive silencing, and shell damping. Exhaust gas properties which are important for the exhaust system design include its physical properties; exhaust gas temperature which depends on the vehicle duty and the exhaust gas flow rate. The most important of these engine technologies are advanced fuel injection systems, air intake improvements, combustion chamber modifications, and electronic engine control. Additionally, exhaust gas recirculation (EGR) was introduced on both light- and heavy-duty diesel engines to control NOx emissions. Exhaust emission from automobiles can be controlled in three different ways. One is to promote more complete combustion, so that there is less byproduct. The second is to reintroduce excessive hydrocarbons back into the engine for combustion, and the third one is to provide an additional area for oxidation or combustion to occur. Thus the after treatment techniques seem to be more feasible as compared to other alternative techniques for reducing exhaust emissions instead of going for engine and fuel modifications. Engine After treatment requirement changes in response to changing Pollution control norms or legislation, which usually requires new technologies to be introduced. Low emission engine design-combined with increased exhaust gas after treatment will continue to play important role in future diesel engines.

2) DIESEL EXHAUST EMISSIONS

Overview of the regulated and unregulated diesel exhaust emissions is discussed here.
It includes the regulated gaseous diesel emissions nitrogen oxides, hydrocarbons and carbon monoxide and some of the non-regulated emissions including sulfur dioxide and nitrous oxide. Diesel particulate matter is the most complex of diesel emissions. Diesel particulates, as defined by most emission standards, are sampled from diluted and cooled exhaust gases. This definition includes both solids, as well as liquid

material which condense during the dilution process.

3) EXHAUST AFTER TREATMENT SYSTEM DESIGN CRITERIA:-

Engine After treatment requirement changes in response to changing Pollution control norms or legislation, which usually requires new technologies to be introduced. New technologies place particular challenges on after treatment systems. A brief overview is given here, the main trends in after treatment system development have been, 1) A requirement for reduced backpressure in all types of C.I. engines in old, present & future engines using diesel or any alternate renewable fuel. Backpressure rise causes increase in fuel consumption. 2) A requirement for efficient exhaust energy recovery system and new improved Noble & Non-noble metal based economical catalyst technologies, to obtain maximum possible conversion efficiency for pollution control with durability issues.

4) BACKPRESSURE MINIMIZATION

The prime objective for design engineers is to obtainminimumbackpressure with durability. Each alternation in after treatment system or exhaust system causes variations in backpressure on C.I. engine. But after successful design also backpressure on a particular engine increases during its use because of following reasons –

A. Engine Design, Fuel and Lubrication Oil Modifications: In most of the C.I. engine applications lack of space availability needs compactness of after treatment devices, it creates restriction in exhaust flow. Exhaust flow area from engine exhaust valve or port near exhaust manifold should be critically analyzed and designed. Precautions should be taken during the design of complete exhaust system such that the backpressure just at the exhaust port or valve region must not increase. This requires extra volumes near exhaust valve or port for stabilization of exhaust flow. During exhaust process, engine cylinder works as convergent part, port or valve flow area as throat and manifold as divergent part, for nozzle like operation. This section must be designed for maximum mass flow rate and energy equation should be used for obtaining the minimum pressure at throat section so as to utilize maximum exhaust energy with specific objective of minimum possible back pressure on engine cylinder.

To ensure that lubricants provide all of the lubricating oil functions required in modern engines, a number of oil specifications have been developed in the USA, EU and Japan. One of the main drivers in the development of oil formulations for diesel engines with exhaust after treatment is the reduction of sulfated ash, phosphorous and sulfur. Highest performance from engine system requires unique engine design & after treatment system for optimal fuel energy conversion.

B. After Treatment System Modifications: Diesel after treatment strategies may include muffler, After Treatment Device or Catalytic Converter, Thermal reactor, Turbocharger, EGR system, etc., in the exhaust system for heat recovery & emission control activities. ATDs are designed to trap diesel particulate matter (PM) to achieve a net decrease in PM emissions. The device captures ash, but the accumulation of ash in the device is sufficient to cause a rise in back pressure. In practice, these devices will also need to regenerate quickly and relatively cheaply when they become blocked. The device can be fitted to both new and old engines. The failure of catalyst may be due to System component meltdown, Carbon deposit, Catalyst fracture, Deactivation of diesel catalyst etc. Improper regeneration or after treatment device component failure may cause Backpressure rise, mostly it happens because Particulate matter consists of noncombustible compounds, so 100% regeneration is not possible.

To address this concern, Considering automobile power plant as a complete system, it is a complex system made up of several other equally complex sub-systems, each is distinct from the others but they all share some common features and goals that allow them to work together. Backpressure reduction procedure requires that ATDs be installed with backpressure monitors that will alert the operator when the backpressure exceeds some pre-set level. With some insight into the state of the ATD, the operator can avoid potentially costly failures. Even when regenerating properly, adding a ATD to the exhaust system of a vehicle will increase the backpressure by some amount. If more work is required from the engine to push combusted gases out through the exhaust system, a fuel economy penalty results. Even though the backpressure caused by ATD is within the engine manufacturer's specified limits, it is noted in the test data that even a little bit of rise in backpressure show fuel economy penalty. Some active systems may collect and store diesel PM over the course of a full day or shift and can be regenerated at the end of the day or shift with the vehicle or equipment shut off. A number of the filters used in stationary like applications operator or driver can be trained to remove and regenerate

externally at a "regeneration station" for achieving complete regeneration with ease. Because they can have control over their regeneration and may not be much dependent on the heat carried in the exhaust.

5) EXPERIMENTAL SETUP

The engine used for experimentation has following specifications

1. Make: Kirlosker, single cylinder, four stroke compression ignition engine.
2. Rated power output: 5 H.P
3. Speed: 1500 R.P.M.
4. Stroke length: 110 mm
5. Bore diameter: 80mm
6. Loading type: Water resistance type load, with copper element and load changing arrangement
7. Moment arm: 0.2 meter
8. Orifice diameter (for air box): 25mm
9. Co-efficient of discharge of orifice: 0.64

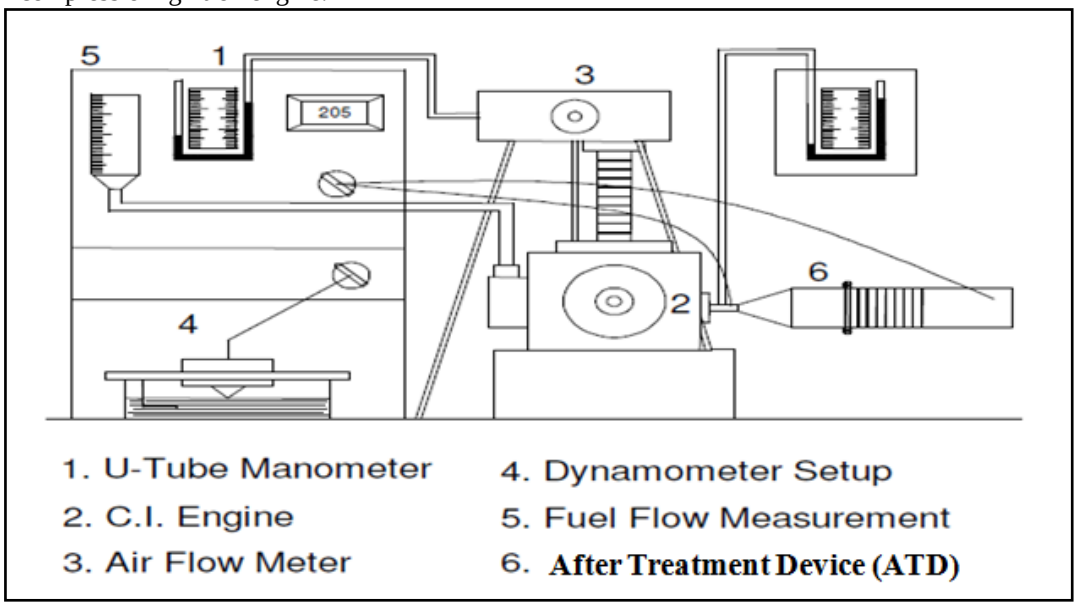


Figure: 1 Schematic view of experimental set up.

6) After Treatment Device (ATD):

1) Space velocity: 50,000 hr^{-1}
2) Catalyst used: copper based catalyst system
3) Circular perforated copper plates with 256 no. of holes per square cm and copper rings made up of 5 mm diameter rod.
4) Flange arrangement for dismantling and varying no. of perforated plates and no. of rings, more details are given in figures.

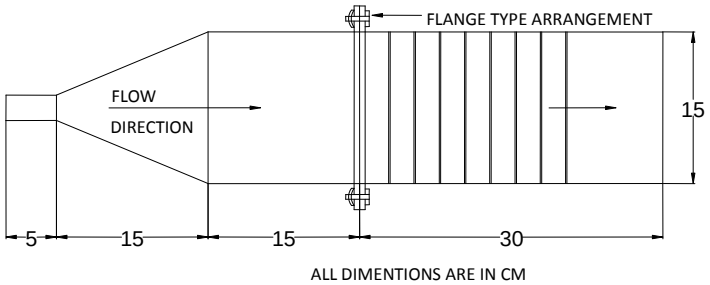


Figure: 2 View of After Treatment Device with copper plates

7) EXPERIMENTATION WORK

Development of practically feasible after treatment device can be considered as one of the most challenging tasks related to the after treatment technologies. But owing to the drawbacks in after treatment technique that even a small rise in back pressure adversely affects the

system objectives and high cost involved with it, these are uneconomical. Hence in present work an attempt is made to use perforated circular copper plate arrangement in After Treatment Device. Throughout the complete trials conducted, the speed of the engine is kept constant, at 1500 rpm and also engine jacket cooling water is kept constant at 0.1666 liters/sec, so as to provide ease in comparison of different parameters, in some cases by varying the load on the engine also. Further during the trials on ATD, each times the perforated plates and rings were cleaned by water and then by carbon tetra-chloride solution. While changing the number of plates and rings i.e. every times the fresh copper plates and rings were used. To reduce the backpressure on the engine, maximum no. of plates (i.e. 20 plates) provided with extra 8 no. of holes, of 5 mm diameter were used for determining the effect i.e. back pressure reduction mainly. The different parameters are compared with the values of same parameters without using ATD, for the same engine output conditions.

8) RESULTS AND DISCUSSIONS

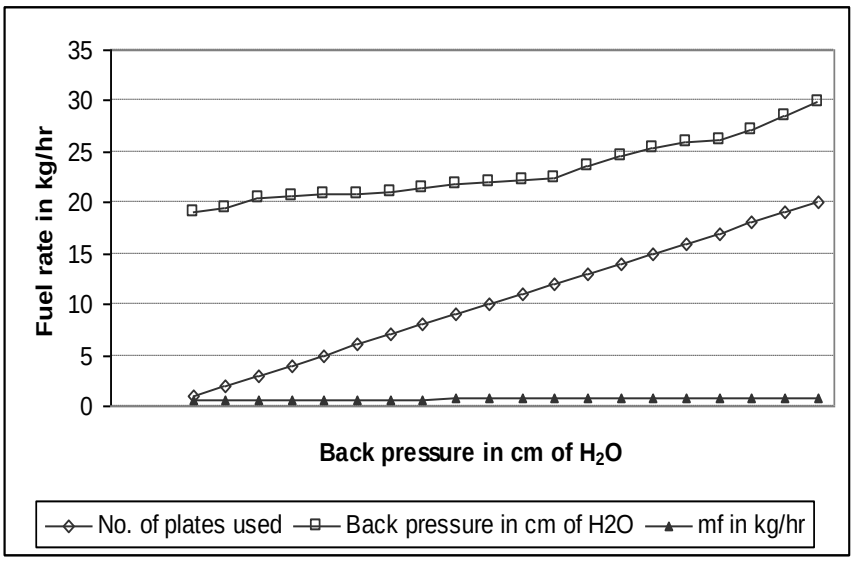
1) Backpressure is observed to be directly proportional to the number of plates used obviously because of increase in resistance to exhaust gas flow, at the same engine operating conditions. After Treatment Device is designed to achieve nozzle like operation to reduce exhaust back pressure, which shows potential remedial technique.

2) Fuel consumption is also observed to be directly proportional to the back pressure on the engine, at the same operating conditions. The desire for countries and automotive manufacturers to reduce emissions includes CO_2 emissions that arise from burning fuel in engines. There is a direct correlation between a vehicle's fuel consumption and the CO_2 emitted from that vehicle.

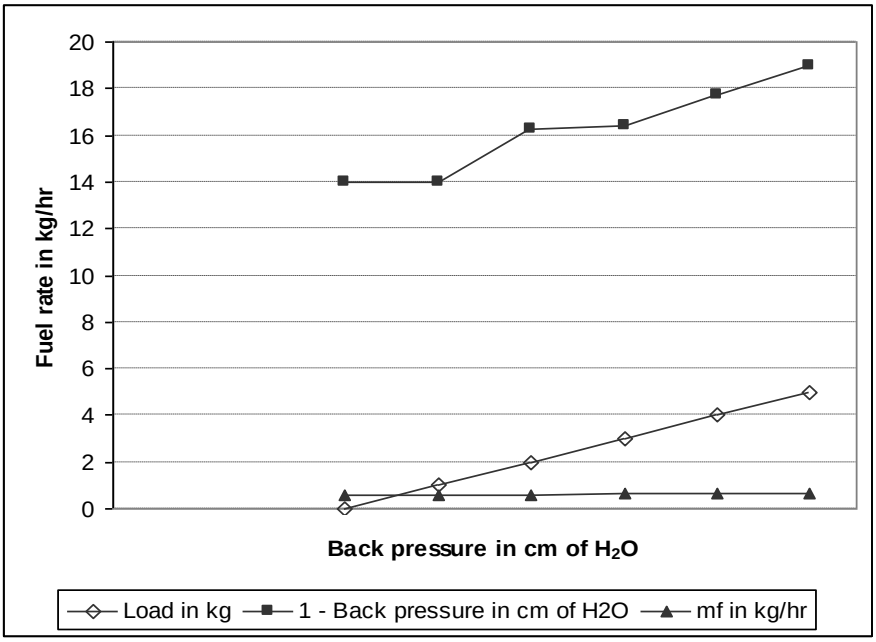
3) Effect of increased backpressure on engine performance: - Exhaust system components are a source of engine exhaust back pressure. An increased back pressure level causes increase in the pumping work requirement and hence it increases the specific fuel consumption thereby increased emissions and negatively affects engine performance.

4) Effect of increased backpressure on conversion efficiency of ATD: - Though it appears to be the same conversion efficiency of the ATD, the emissions actually at the exit are very high because of the increase in backpressure fuel consumption increases which ultimately increases the amount of pollutants at the feed stream of the ATD. Variations in exhaust emissions are compared at no load condition, using different no. of plates the conversions obtained are (NO_x -18.05 %, HC -56 %, C0 -8.33% and smoke density -11.11%) maximum using 8 no. of plates arrangement.

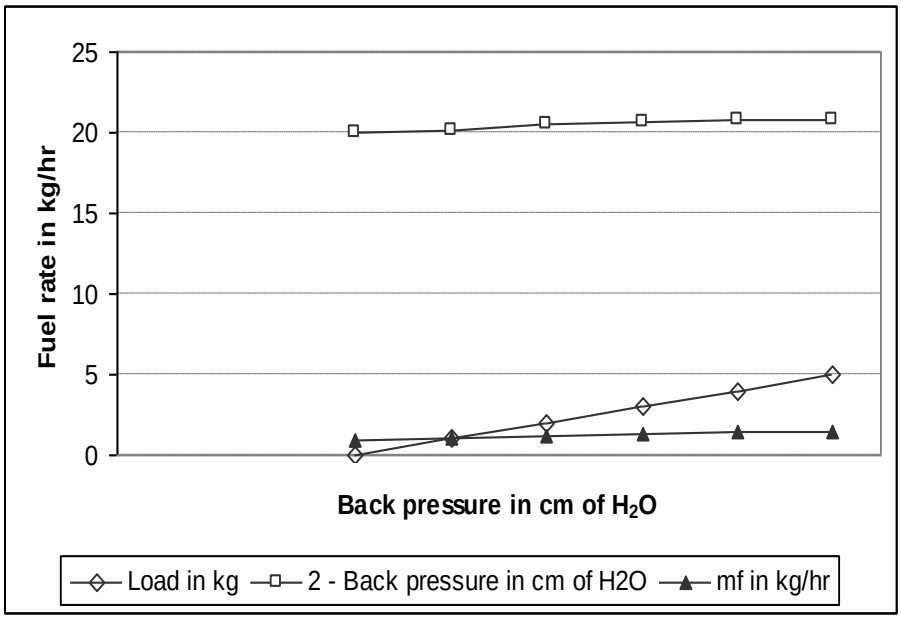
Performance Characteristics (at constant 1500 rpm)



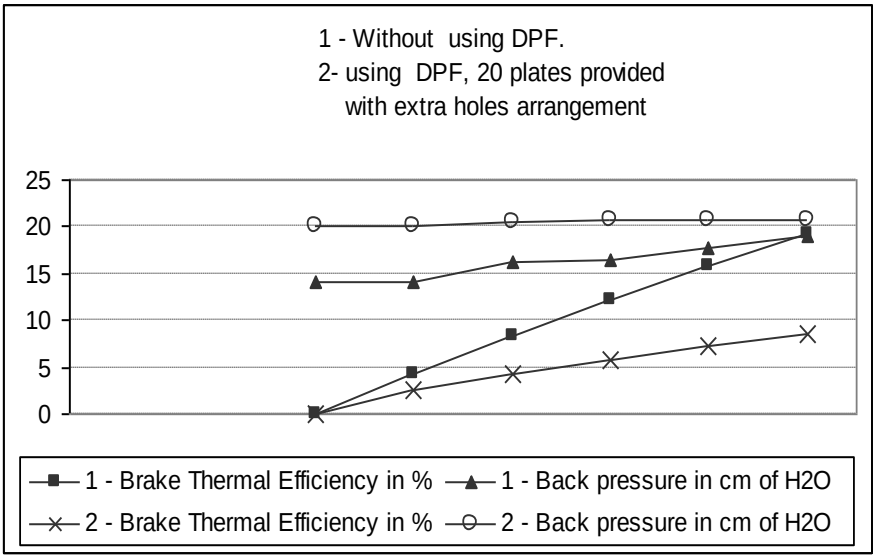
Graph-1 Variation in Fuel consumption and no. of plates Vs back pressure, using ATD with different no. of plates arrangement



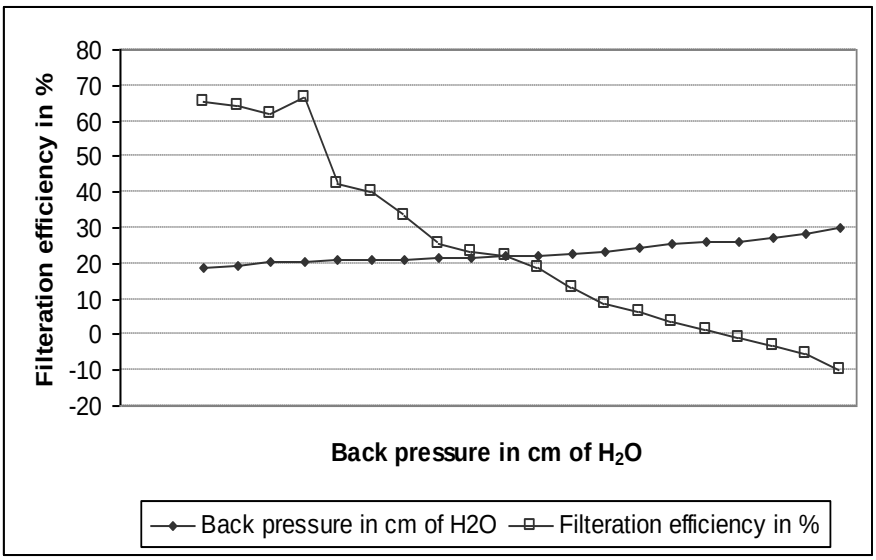
Graph-2 Variation in Fuel consumption and load Vs back pressure, without using ATD.



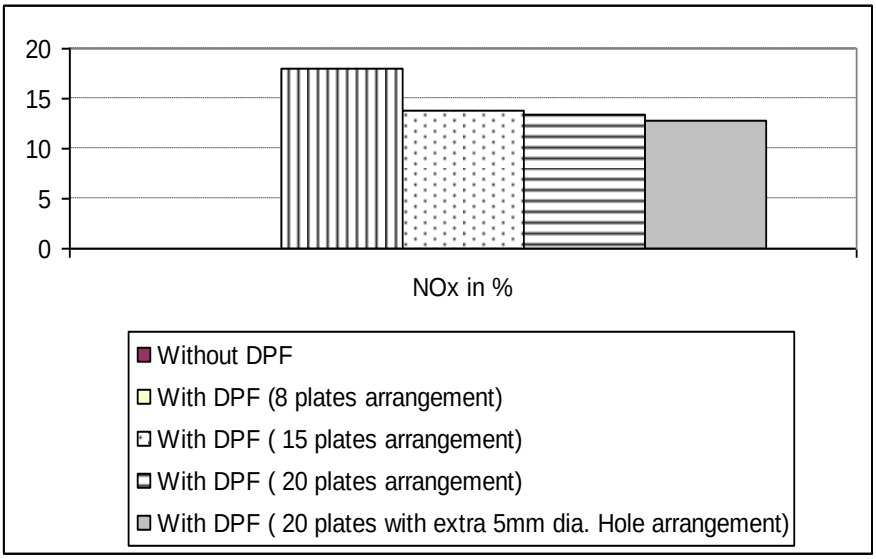
Graph-3 Variation in Fuel consumption and load Vs back pressure,using ATD, for 20 - plates provided with extra holes arrangement



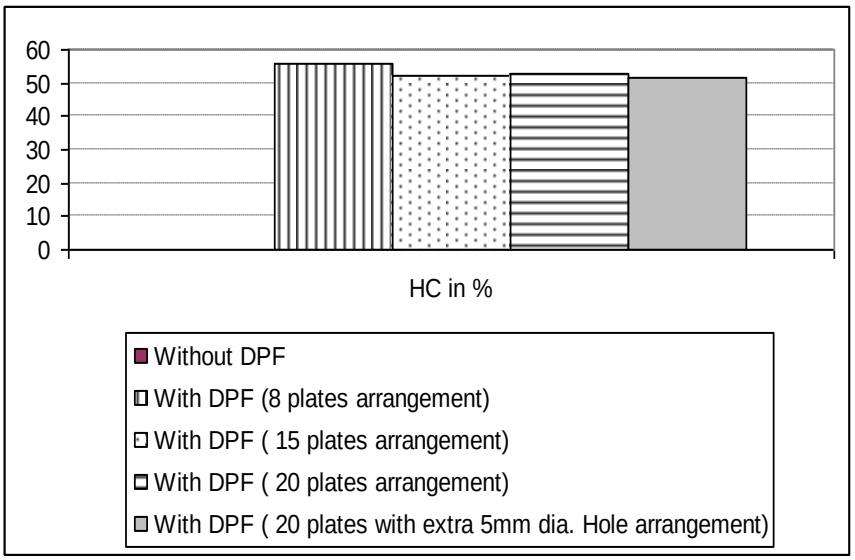
Graph-4 Variation in brake thermal efficiencies Vs back pressure, 1- without using ATD & 2- With ATD, 20 plates provided with extra holes arrangement at various load conditions.



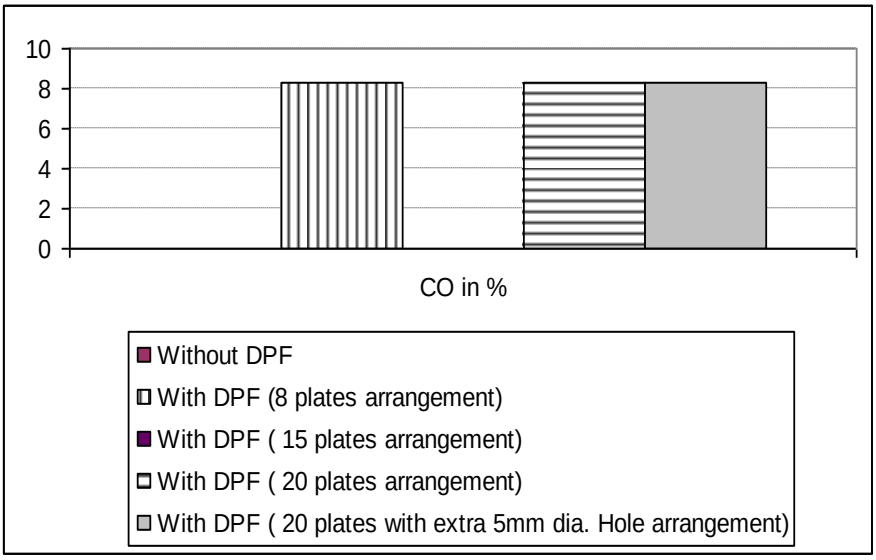
Graph-5 Variation in filtration efficiencies Vs back pressure, using ATD with different no. of plate's arrangement.



Graph-6 Comparison of NO_x emissions conversion efficiency at different exhaust conditions



Graph-7Comparison of HC emissions conversion efficiency at different exhaust conditions



Graph-8Comparison of CO emissions conversion efficiency at different exhaust conditions

9) CONCLUSIONS

To minimize the pumping work, the backpressure must be as low as possible for obtaining the maximum output from the engine. The backpressure is directly proportional to the pressure drop across the After Treatment Device or design of complete exhaust system components causes the back pressure. The reported regeneration technique infers good, quick and economical activity. Improvement of filter and engine exhaust flow area design is likely to make these low cost materials practically feasible.

It is necessary not just too adequately implement after treatment techniques in new technology, but also the older technology engines which are still on the road. Basic causes of increase in backpressure & remedial actions are suggested in this work. Regeneration phenomenon particularly in C.I. engine after treatment devices specifically requires attention because of noncombustible Particulate Matter constituent's accumulations.

ACKNOWLEDGEMENTS

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INTERLOCKING BRICK FOR SUSTANABLE HOUSING DEVELOPMENT

R. K. Watile[(1)],S. K. Deshmukh[1], H.C.Muley[1]
[1]Department of Civil Engineering, C.O.E. &T., Akola (MS), India.444104
E-mail: rahul_watile@rediffmail.com

Abstract:
The use of interlocking bricks masonry has gained rapid popularity in many foreign countries as an alternative to conventional bricks for sustainable housing. It is being always challenge for researchers to make interlocking brick light weight, low cost and improve the performance against aggressive environment. An experimental effort made in this concern. This paper gives the results of an experimental investigation in which the compressive strength, water absorption and density were investigated by using varying percentage of fly ash, stone dust, and sand with different mix proportion. A manmade fibre, glass fibre reinforce polymer (GFRP) utilize as reinforcing material to produce the interlocking blocks which gives appreciable results discuss in detail. The experimental results compared with that ordinary brunt clay brick and interlocking brick found durable in aggressive environments and have sufficient strength for their use in sustainable building construction.

***Key Words**: Fly Ash, GFRP, Compressive Strength, Water Absorption, Density*

1. INTRODUCTION

A very high amount of waste is being produced all around the world. The most common method of managing waste is through its disposal in landfills creating in that way huge deposits of waste. In this situation, waste recycling is gaining increasing importance [1]. At present in India, about 206 coals based thermal power plants are producing about 160 million tons of fly ash every year; the estimates prepared by Ministry of Power as well as Planning Commissions up to the year 2031-32 indicate that generation of fly ash during the year 2031-32 would be around 900 million tons per year [2-3]. Whereas the current annual production of fly ash worldwide is estimated around 600 million tones [4].The Government of India took policies initiative for utilization and disposal of fly ash [5]. In a tropical country like India the burnt clay brick is the most basic building material for construction of houses. It is reported that the requirement of bricks for construction activity amounts to be more than 140 billion numbers annually [6]. For fulfill such demand fly ash interlocking brick may be one of alternative for sustainable construction industry.

Much experimental research carried out for producing good quality brick with reduction of cost using industrial waste [7]. And also for reducing price and increasing the strength many natural and manmade reinforcing material used in the production of bricks. There are a wide range of natural fibres, namely sisal, bamboo, coir (coconut fibre), jute, and many others [8]. In this research work the manmade fibre GFRP introduce as a reinforcing material. The effect of GFRP with maximum percentage of fly ash in interlocking brick is studied. This advocate the use of fly ash as the supplementary material to soil by reducing the consumption of soil in brick manufacturing towards efforts of maintaining ecological balance through sustainable development of natural resources.

The dry stacked stabilized interlocking block masonry replaces the conventional burnt clay brick and mortar construction masonry. The use of interlocking bricks masonry has gained rapid popularity in many foreign countries as an alternative to conventional bricks for sustainable housing [9].Interlocking block masonryby Hydraform (or by others) is one such building system which almost full fills all such requirements of being a sustainable masonry [10-11].As per IS code bricks are designated based on their average compressive strength [12-13]. Indian masonry design standard does not deal with dry interlocking block masonry, hence does not prescribe the design values for this masonry like basic compressive, tensile and shear stressHowever the same code recognizes some other types of masonry and recommends that a prism test of different masonry may be done and these values may be accepted for designing the masonry [14]. Interlocking bricks in central India made with locally available raw materials have the density around 25-30 kN/m^3& avg. comp. strength is 2-4 MPa [15]. Due to this high weight & low compressive strength it is not possible to use this bricks in multistoried building. Density can be reducing with increase in compressive strength

through experiment which may provide the best solution for such type of bricks.

2. EXPERIMENTAL PROGRAMME

2.1 *Material*

For casting of interlocking bricks locally available raw materials like fly ash, stone dust, marble slurry and sand were used. Additional material GFRP was used to investigate the effect on properties of interlocking brick.

2.1.1 *Cement*

Ordinary Portland cement were used satisfying all the IS requirements was used in making the bricks [16]. The physical properties of cement listed in Table no.1

2.1.2 *Fly Ash*

The fly ash (see fig 1.a) was collected in dry state from the Paras Thermal power station and the chemical characteristics of the fly ash are given in Table 2.

Table 1

Material	Physical Properties	Value
Cement	Specific gravity	3.18
	Specific surface	2250 cm^2/gm
	Soundness	1 mm
	Initial setting time	35 min
	Final setting time	380 min.
	Compressive Strength (1:3 cement sand mortar)	19.2 MPa(3 days) 28.5 MPa(7 days)

Table 2

Material	Chemical Constituents	Percentage
Fly ash	Silica (as SiO_2)	64.23 %
	Alumina (as Al_2O_3)	25.82 %
	Iron (as Fe_2O_3)	4.06 %
	Sodium (as Na_2O)	0.40 %
	Sulphur Trioxide (as SO_3)	0.27 %
	Magnesium Oxide (as MgO)	0.78 %
	Loss of ignition (as I.OI)	0.39 %

2.1.3 *Fine Aggregate*

Sand i.e., fine aggregate obtained locally from nearest river passing through 4.75 IS sieve having fineness modulus (F.M)-2.61 and confirming to zone-III as per IS: 383-1970 [17] and its physical properties are enlisted in Table 3.

2.1.4 *Stone dust*

Powder form stone dust (see fig. 1.b) available locally used in moderate quantity for preparing the bricks. Its fine size make possible to retain proper shape of the bricks particularly maintaining the edges and corners.

2.1.5 *GFRP*

GFRP used as reinforcing material (see fig. 1.c); the physical properties are listed in Table 3.

Fig. No. 1.a Fly ash
1.b Stone Dust
1.C GFRP

Table 3

Material	Properties	Value obtained
Sand	Specific Gravity	2.48
	Water Absorption	1.05
	Bulking of Sand	26.84%
	Free Moisture	1.00%
	Bulk Density	1500 kg/m^3
Stone dust	Specific Gravity	2.68
	Water Absorption	0.32%
	Fineness Modulus	2.89
	Silt Content	2.1%
GFRP	Nominal dia.	0.09 mm
	Tensile strength	25 N/mm
	Type of wave	Plane

2.1.6 Water

Ordinary tap water was used for both mixing the constituents of the bricks as well as for the curing of bricks.

2.2 *Process operation*
2.2.1 *Casting of interlocking bricks*

For casting the Cement and other constituents were used randomly in varying proportions of 1:10, 1:11 and 1:12. In order to establish the feasibility of producing a binder that can impart adequate strength, three specimen bricks were casted for each mix proportions given in Table 4. A pan mixer and hydraulic machine used for casting the bricks (see fig. 2.a). Before casting the bricks, mixer was properly cleaned. Cement and stone dust were added in dry state, mixed thoroughly and then clean potable water was added to get a mix of desired workability. The mix so prepared for the bricks was then poured in hydraulic machine and bricks were then taken out of it and kept over level surface under the shed for drying purpose. The blocks have geometric size of 230mmx100mmx75mm (see.fig 2.b & c). This machine produces solid blocks of laterite composition mainly and stabilized with cement material.

Fig. No.2.a Hydraulic Machine 2.b Interlocking Brick (Ridge) 2.c Interlocking Brick (Bed)

2.2.2 Curing
The green bricks were allowed for surface dry for one day and cured normally for 28 days by spraying water four to five times in one day (see fig.3.a). After gaining sufficient strength they were submerged in water and sulphate solution at normal room temperature of 27 + 2^{o}C for different ages. Sulphate solution having sulphate (SO_4) concentration equal to 10000 ppm was prepared in laboratory by mixing 14.79 gm $NaSO_4$ in one liter of water.

2.2.3 Testing
The casted bricks were taken out from water one day prior to the testing and were tested for compressive strength after 14, 28 and 90 days and water absorption test as per IS 1077-1957 Code.

2.2.3.1 Compressive Strength Test Procedure
Compressive strength test should be done in compression testing machine. Blocks should be placed between the jaws and load should be applied gradually. Precaution should be taken such that load should be applied to the flanged portion of the blocks. For this cement mortar of proportion

1:3 are placed on top flange as well as at bed and gradual load is applied over the complete area till the failure occurs and not the maximum load at failure (see fig 3.b). The load at failure shall be the maximum load at which the specimen fails to produces any further increase is the indicator reading on compression testing machine (see fig 3.c).
The test report shall be given below:

Compressive strength = $\frac{\text{Maximum load at failure}}{\text{Avg. area at bed face}}$

The compressive strength of any individual block shall not fall below the minimum average compressive strength by more than 20% as per IS 1725-1982 [18].

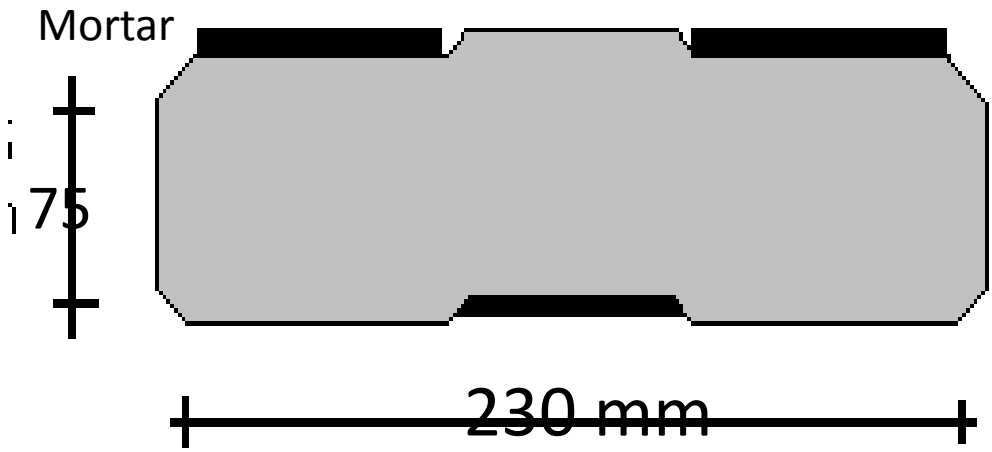

Fig. No. 3.a Curing 3.b Interlocking Brick 3.c CTM Testing

2.2.3.2 Water Absorption Test
Bricks have pores in them. Due to porosity, the dry bricks when come into contact with water absorb water through these pores. Smaller the porosity; lesser is the absorption. Formula to calculate water absorbed by the bricks, using following formula:
[(w2- w1) / w1] x100

2.2.3.3 Density

After 90 days of casting, these bricks were dried to a constant mass in an oven at 105°. They were cooled to room temperature and their density was obtained by dividing the mass of a brick by its overall volume. The shrinkage of the bricks was not measured. It may be relevant to mention that the cracks were not visible on these bricks with naked eye after 90 days of casting.

Table 4

Ratio	Mix Designation	Constituent materials (Percentage)			
		Fly Ash	Stone dust	Sand	GFRP
1:10	M1	45	35	20	--
	M2	55	25	20	--
	M3	60	20	20	--
	G1	60	20	20	0.10
	G2	65	15	20	0.10
	G3	70	10	20	0.10
1:11	M4	50	40	20	--
	M5	55	35	20	--
	M6	60	30	20	--
1:12	M7	60	45	20	--
	M8	65	40	20	--
	M9	70	35	20	--

3. EXPERIMENTAL RESULTS AND DISCUSSION

The experimental results are presented in Figs. 1 to 5. Figs. 1 to 3 show the compressive strength for mix ratio 1:10, 1:11, and 1:12 of bricks with increasing percentage of Fly ash and a constant sand content of 20 respectively. Fig 4 and Fig 5 shows the percentage of water absorption for mix proportions and density respectively for all mix proportion.

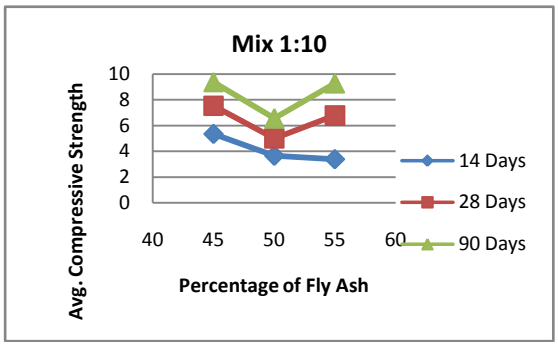

Fig 1. Compressive Strength for Mix 1:10

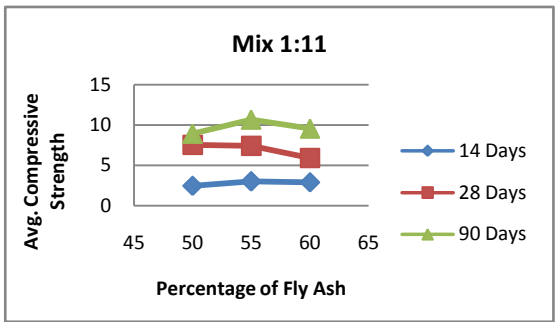

Fig 2. Compressive Strength for Mix 1:11

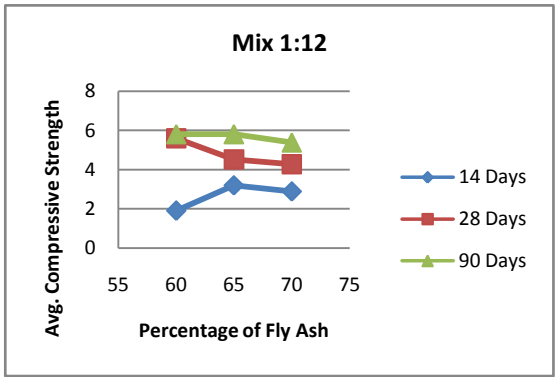

Fig 3. Compressive Strength for Mix 1:12

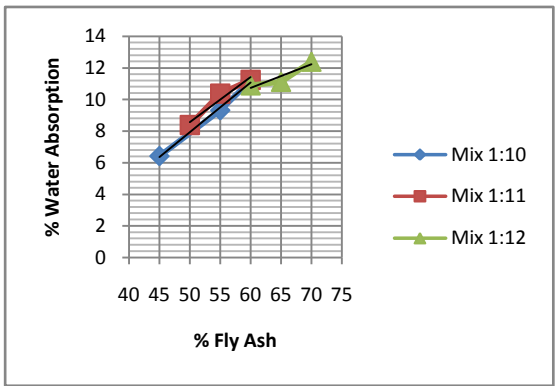

Fig 4.%Water absorption of interlocking bricks

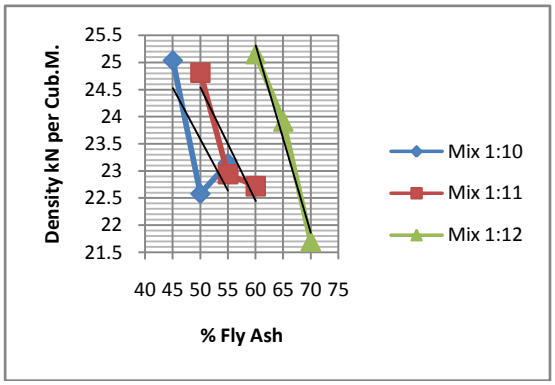

Fig 5. Density of interlocking brick

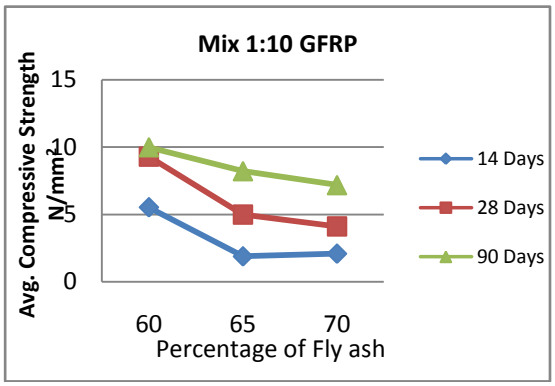

Fig 6. Compressive Strength for Mix 1:10 GFRP

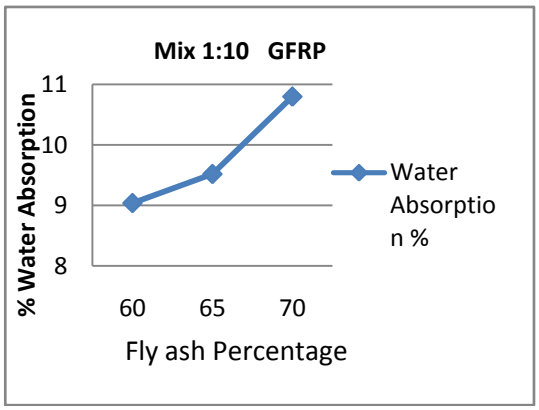

Fig 7. % Water absorption of Mix 1:10 GFRP

Fig 4.%Water absorption of interlocking bricks

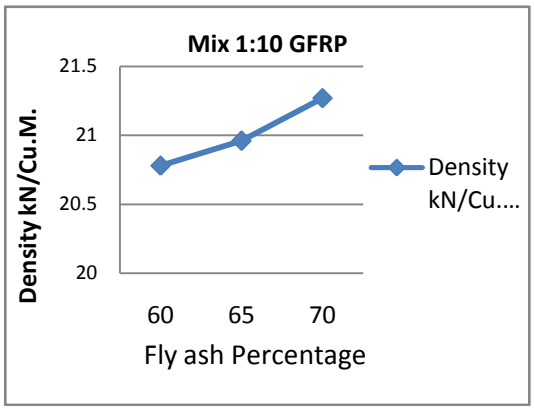

Fig 8. Density of Mix 1:10 GFRP

Figs. 1, 2 shows that the compressive strength of interlocking brick initially increases with the increase in fly ash content but fig.3 after attaining a maximum value it start decreasing with the further addition of fly ash. Fig 4 shows the water absorption of interlocking bricks. It is observed that in general, the water absorption of bricks increases with the increase in fly ash content replacing stone dust. On comparing interlocking bricks with ordinary burnt clay bricks it is observed that water absorption of interlocking bricks in the present investigation was obtained in between 6.42 to 12.4 percent whereas the water absorption of ordinary bricks shall not be more than 20 percent by weight. Density of interlocking bricks is shown in Fig. 5. It is observed that the water absorption and density are closely related to each other. The density of interlocking bricks was found to be 7.5 to 25 percent higher than that of the ordinary burnt clay bricks.

GFRP a reinforcing material plays vital role with increase in percentage of fly ash. Its influence make increase in compressive strength, lesser water absorption and density reduce up to 20

percent comparing with initial density of interlocking brick.

CONCLUSIONS

Based on the experimental investigation reported in this paper, following conclusions are drawn:

1. Strength of interlocking bricks with increasing fly ash increases with the age.
2. All mix proportions gives satisfactory higher values of compressive strength.
3. At some without GFRP mix ratio 1:11 gives the higher compressive strength greater than 10 N/mm$^{2.}$
4. Interlocking bricks with economically available fly ash in large proportion have sufficient strength for their use in low cost housing, non-load bearing construction and in regions where good quality burnt clay bricks are not available.
5. Water absorption of interlocking bricks without GFRP is found to be in the range of 6.42 to 12.4 percent, whereas the water absorption for ordinary burnt clay bricks should not be more than 20 percent. The water absorption of interlocking bricks increases with the increased fly ash content.
6. The density of interlocking bricks was found to be 7.5 to 25 percent higher than that of the ordinary burnt clay bricks.
7. Interlocking brick with reinforcing agent GFRP increases the compressive strength at maximum utilization of fly ash with the age.
8. The water absorption and density increase with increase in fly ash in GFRP interlocking brick.
9. As density concern the difference between ordinary clay brick and interlocking brick should be minimize with reinforcing agent.

Interlocking bricks require no skilled labour and can be moulded in any shape and size depending on the requirements. These bricks have better tolerances and no efflorescence as compared to conventional bricks. A number of other benefits also be ascribed for the prospect of interlocking bricks which includes no consumption of mortars, better efficiency in laying and low cost of finishing. It is further needed to develop the awareness among users, professionals and financial supporters for using these waste materials for solving the housing problems in addition to balance economy and achieve energy conservation. For reducing the density of bricks more experimentation requires with different wasted material with natural reinforcing fibre for considering economy and use for multistoried building.

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INTEGRATED RELIABILITY EVALUATION OF DISTRIBUTED POWER SYSTEM

Apeksha Narendra Rajput[1], *Bharti Drivedi*[2], *Anurag Tripathi*[3]
[1]Research Scholar, Indraprastha Engineering College
Electrical Engg.Deptt.Ghaziabad, (U.P), India,
[2]Professor, Electrical Engg. Department,
Institute Of Engineering and Technology, Luck now (Uttar Pradesh), India
[3]Associate Professor, Electrical Engg. Department,
Institute Of Engineering and Technology, Luck now (Uttar Pradesh), India
[1]apeksha_rajput@hotmail.com
[2]bharti_dwivedi@yahoo.com
[3]anurag.tripathi.aparna@gmail.com

***Abstract*—This various distribution system designs, including Distributed Energy Resources (DER), affect distribution reliability indices, System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) Furthermore, This presents an example for optimization of distribution maintenance scheduling of a recloser. It applies a risk reduction technique associated with maintenance of the equipment.Given a large and complex plant to operate, a real-time understanding of the networks and their situational reliability is important to operational decision support.**

IndexTerms*—reliability, distribution system, equipment, power quality, active power, reactive power.*

1. INTRODUCTION

Reliability of a power system is generally designated as a measure of the ability of the system to provide customers with adequate supply. It is one of the primary performance criteria of power systems. Major outages can have a significant economic impact on utility providers as well as the end users who lose electric service. The power system has been significantly affected by a wide range of outage events caused by incorrect planning, operational error, equipment failures, environmental conditions, adverse weather effects, and load conditions. Large-scale blackouts emphasize the importance of reliability issues.

The reliability evaluation of transmission or composite systems analyzes the system failure events and estimates the chances of loss of load at major load points . The reliability of distribution systems is based on individual customer service interruptions. Since the reliability studies described in this dissertation are customer service oriented, one of the analysis zones of the study includes the whole distribution system with extension to the sub-transmission lines and substations.

For some of the networks analyzed here, the dominant causes of customer power interruptions are problems in secondary networks and faults in sub-transmission systems. Therefore, just considering the distribution system itself is not enough to accurately estimate customer outages.

2. CHALLENGES IN SYSTEM MODELING AND RELIABILITY ANALYSIS

The modeling and analysis studies associated with reliability evaluation are challenging, not only because of some of the system characteristics of the above proposed analysis zones, but also for persistent problems that have lingered in the energy industry for decades.

(i) Size. The reliability evaluation of large utility systems can be daunting due to the sheer size of the model. Modeling the underlying distribution system, including each customer's service point, can result in a model containing millions of objects. Relatively scant attention has been given to distribution systems as compared to generation and transmission systems. However, as the distribution system could be 80% larger than the transmission system, and occupies as much as 40% of the overall capital outlay of the total grid , it should receive adequate attention.

(ii) Data. The modeling and reliability analysis of distribution and/or transmission systems involves a large volume of various types of data and multiple system analysis algorithms. Examples of data

include load, operation, planning, system design, system description, and reliability data. Examples of computer program algorithms include load flow, load forecast, network topology tracking and updating, and reliability analysis. Integrating the data into knowledge that is efficiently used by algorithms, and ensuring cooperation among algorithms are challenging tasks .

(iii) Load. The electrical load varies from hour to hour, day to day, and season to season. Each type of customer usually has different usage patterns. Residential, commercial, and industrial customers have different power demands and different peak demand times. This non-linear, time-varying characteristic has to be considered in order to obtain sound system evaluation results.

(iv) Uncertainty. The power system is vulnerable to many stochastic events. Random failures of control and protection devices, environmental disturbances such as high speed wind, lightning and severe storms, irregular load surges due to interruptions, and human errors all have impacts on customer outages.

3. INTEGRATED RELIABILITY EVALUATION OF POWER SYSTEMS

The reliability evaluation of hierarchical level I includes the generation system only. The generating capacity needs to be determined in order to satisfy the expected demand. The reliability evaluation of hierarchical level II includes generation and transmission systems, which is often referred to as the composite system or bulk power system. The transmission system has to be designed to ensure satisfactory energy transfer from generation plants to bulk load points. The reliability evaluation of hierarchical level III includes all the three systems, and is rarely done due to the enormity of the problem.

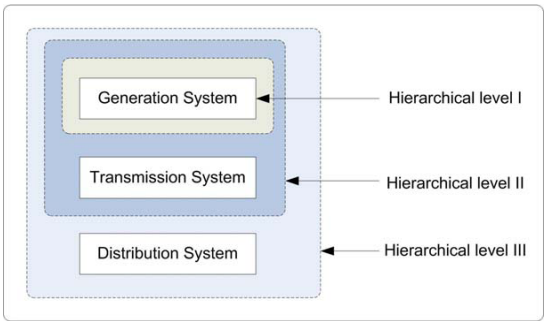


Figure1 Hierarchical levels of Power System for Reliability Analysis

During integrated system modeling, if transmission/sub-transmission systems are included, the boundaries of transmission systems are treated such that the generation capacity is not constrained. The reliability studies are then used to examine the energy delivery capability to bulk load points for a transmission system only study or, to end-customers if the study zones include distribution systems.

4. RELIABILITY ASSESSMENT METHODS OF POWER SYSTEMS

The methods used in reliability assessments of power systems determine the accuracy of the results. Analytical and simulation approaches are the two types of techniques used in power system reliability analysis. Each approach has its merits and limitations. In this section, the concepts, assumptions, and typical applications of the commonly used methods in both techniques are reviewed. The limitations of analytical approaches are summarized as the reason to select the Monte Carlo simulation to perform the reliability analysis in this study.

1. Analytical Approach

The analytical analysis methods use mathematical models to provide solutions to a reliability problem. Specific calculation results are obtained for a given set of system topology and input values. Some widely used methods are block diagram, event tree, cut sets, fault tree, state enumeration, and Markov modeling. Using reliability sets in calculation is also proposed in recent years. Their common problem is the frequent need to make simplifying assumptions and approximations.

2. Simulation Approaches

Compared with analytical approaches, the simulation or Monte Carlo approach is more universal. It provides a solution for complex problems that is not feasible for analytical methods. The Monte Carlo method is widely used to simulate the stochastic behavior of systems and actual processes. The random number generator of the Monte Carlo simulation creates random variants that follow the distribution functions, even non constant hazard rates. The simulation convergence is a fluctuating process, with the estimated outcome closer to the true value as sample size increases. The convergence criterion usually uses the coefficient of variation of the output.

3. Performance indices

The study zones of this study include detailed modeling of end-customer information, and the system evaluation goal is also customer service oriented. SAIFI and SAIDI are the two most popular system level reliability indices used for customer service oriented studies [36]. SAIDI is an abbreviation of System Average Interruption Duration Index. It represents the average interruption duration per customer served per year. SAIFI denotes the System Average Interruption Frequency Index. It is the expected number of interruptions per customer per year. The calculation of SAIDI and SAIFI are shown in (1.1) and (1.2) respectively.

$$SAIDISYS = \frac{\text{Sum of customer interruption durations}}{\text{Total numbers of customers}} \quad (1.1)$$

$$SAIFISYS = \frac{\text{Total number of customer interruptions}}{\text{Total numbers of customers}} \quad (1.2)$$

The subscript sys in the above equations denotes that individual reliability indices can be calculated for each aggregated network, and only considers the customers served by the network. There are a total of 18 aggregate networks defined in the secondary distribution system containers. The whole secondary distribution system can be viewed as the largest aggregate network, with the 120V and 480V networks as individual aggregated networks.

Instead of selecting SAIFI and SAIDI, CAIDI and CAIFI are chosen as the reliability indicators for this study, because they give details of the interruption statistics of each customer. CAIDI is abbreviation of Customer Average Interruption Duration Index. It represents the average interruption duration for those customers served by the same load bus per year. CAIFI denotes for Customer Average Interruption Frequency Index. It is the expected number of interruptions of customers served by a load bus per year.

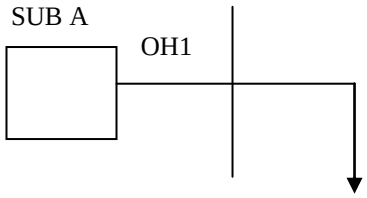
The calculation of CAIDI and CAIFI is shown in (1.3) and (1.4) respectively.

$$CAIDI = \frac{\text{Sum of Customer Interruption Durations}}{\text{Total Numbers of Customers Interruptions}} \quad (1.3)$$

$$SAIDI = \frac{\text{Total number of customer interruption}}{\text{Total numbers of customers Affected}} \quad (1.4)$$

5. CALCULATION AND RESULTS

5.1 Calculation of Reliability Indexes



NO.OF CUSTOMER=1500

Figure 2 Distribution model

The procedure and calculations to find SAIFI for a distributed model, as shown in Figure 2 , are provided in detail below. All required data to calculate SAIFI are given in Table 1.
In this example, it is assumed that the coordination failure rate of all over current devices (fuses and over current relays or OCRs) is 0.0. That is, in all fault situations, each fuse or OCR operates as required to clear the fault for all systems up line from the fuse or OCR.

TABLE 1 RELIABILITY DATA TABLE

Substation Data	Overhead Line Data	Other
Failure Rate (PR) = 0.1	Failure Rate (PR) = 0.2	Open Time = 0
Repair time (RT) = 5.0 hrs	Repair Time (RT) = 2 hrs	Time to Find Problem = 0
Close time (CT) = 0.5 hrs		Travel time = 0

In this example, 1500 consumers are connected to a Substation (SUB A) through an overhead line (OH 1). In the Figure 2, there are no switches or over current devices (fuses and OCRs) in this circuit. Any fault at SUB A or OH 1 will interrupt all 50 customers. Since only elements with non-zero customers contribute to the total customer interruptions, the mean failure rate can be calculated for line element only

Calculation of System Average Interruption Frequency Index (SAIFI):

MFR for OH 1 =FR of SUBA+FR of OH 1
= 0.1 + 0.2
= 0.3

TABLE 2 SAIFI CALCULATION TABLE

Element	FR	MFR	No. of customer Customer	Customer interruption Interruptions
SUB A	0.1	-	0	0
OH 1	0.2	0.3	1500	720
Total			1550	720

Total Customer Interruptions = 1440
Total Number of Customer served = 1500
Therefore
SAIFI = TotalCustomerInterruption
Total no. of Customers Served

Outage on Device	**Number of Customers Customer Interruption**	**Interruption Duration (hour)**	**Failure Rate (per year)**	**Customer Hours Per Year**
SUB A	750	5.5	0.1	1550
OH 1	750	2.5	0.2	1600
Total				3150
Total Customer Served: 1500				

= 1440/1500
= 0.90

Calculation of System Average Interruption Duration Index (SAIDI):
TABLE 3 SAIDI CALCULATION TABLE

ID (SUBA) =5+0.5

Therefore

SAIDI = Customer Hour/Year
Total Customer Served
= 3150/1500
=2.107

Verification of SAIDI, and SAIFI Using Reliability Evaluation Software

This section presents verification of the calculation of SAIDI and SAIFI for using commercial reliability evaluation software.

1. Select the Reliability Analysismodule from the Analysis Modes option.
2. Select the required equipment from the tool bar, and draw the distribution model.
3. Click the Graphical Analysis tool bar button or select Analysis/Graphical Analysis from the menu bar, which shows the following options. Reliability Analysis, b. Travel Time Calculation, c. Element Reliability Data
4. Use the Reliability Analysis tab for the Reliability analysis settings.
5. Use the Travel Time Calculation tab for the time setting,
6. Element Reliability Data tab provides a Reliability Data Quick Editor option, which allows setting reliability element data by element category.
7. After completing the model, click the Recalculate Analysis tab to run the reliability analysis.
8. After running the Reliability Analysis, click the DisplayCurrent Report tab for a summar report.

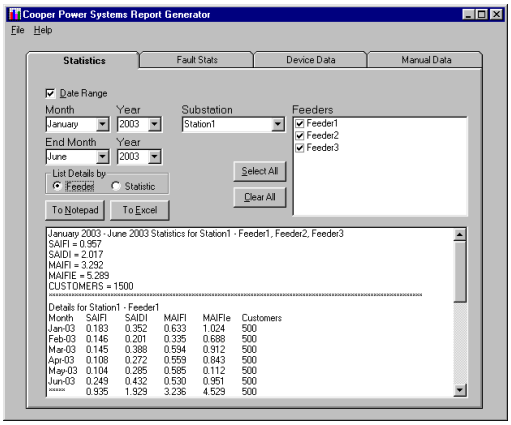
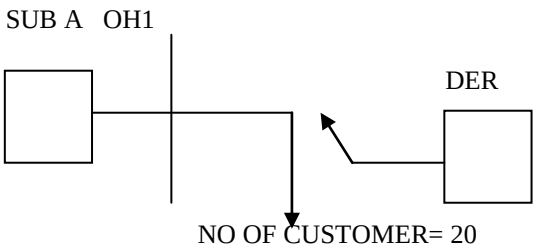


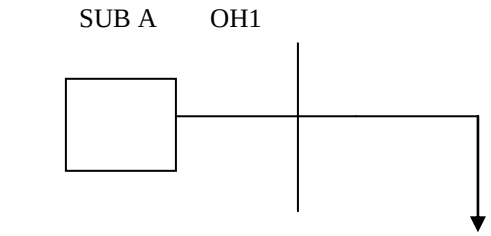
Figure 3 Result of analysis of SAIFI and SAIDI

From the above report, we can see that SAIFI is 0.957 and SAIDI is 2.01, which verifies that the prediction of SAIDI and SAIFI for is done properly.

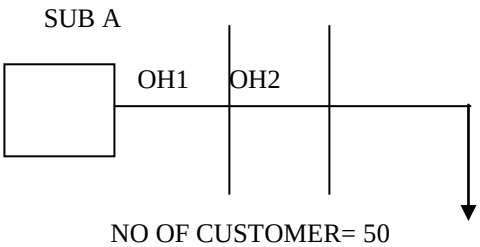
VARIOUS DISTRIBUTION MODELS USED IN ANALYSIS



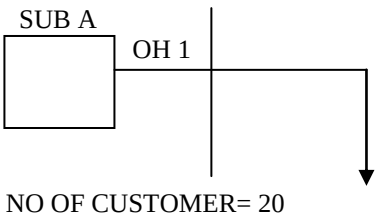
Model (a)



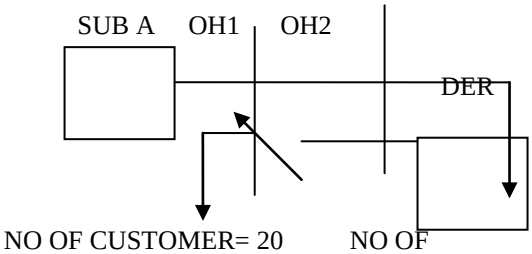
Model (b)



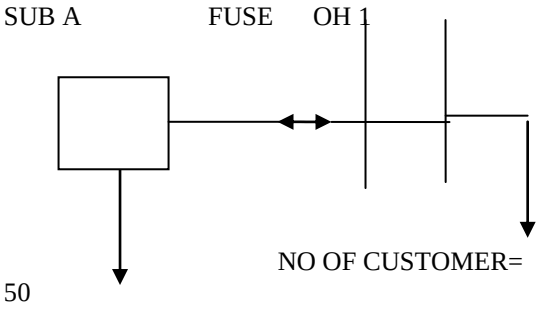
Model (c)



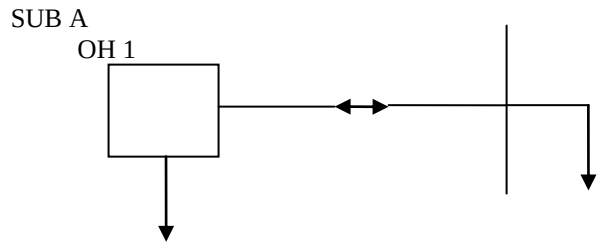
Model (d)



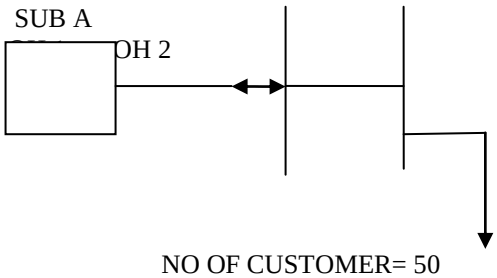
Model (e)



Model (f)



Model (g)



Model (h)

Model No.	System Description	SAIFI	SAIDI	Result	Reason
(a)	Customers supplied with a source SUB A. Has a DER as a backup or	0.3	1.05	Same value indices as in Figure 1	No protecting device between SUB A and OH 1. DER cannot connect if line is still connected to failed substation.
(b)	Similiar to model in Model 5.1 but with 20 additional customers.	0.3	1.05	Same value of indices as in Model (a)	Customers of SUB A added to OH 1 since no protection device to separate SUB A and OH 1. 11 OH1 fails, the substation must be disconnected
(c)	No DER. Customer supplied through	0.5	1.55	Poorer reliability indices than in Model (b)	Addition of OH 2 adds another component that can fail.
(d)	Same as previous model with DER.	0.5	1.55	Same value of indices as in Model (c)	No protecting devices between SUB A and DER to OH 1 and OH 2.
(e)	No DER. Customers are in each OH line of a radial system.	0.5	1.55	Same value of indices as in Model (c)	Acts like 70 customers at OH 2 since no protective devices between OH 1 and OH 2.
(f)	Customers supplied through an OH line that has an over current protecting device.	0.3	0.95	Improve - ment in both reliability indices	Protecting device fuse used between SUB A and OH 1. Now, OH 1 can be connected to DER.
(g)	similar to previous model (f) but 20 more customer added d a the source.	0.2428571	0.8357143	More improved Reliability over Model (f)	Better reliability. In Model (0, 50/50 customers are interrupted but in model (g),50/70 customer are

TABLE 4 SUMMARIES OF DISTRIBUTION MODELS USED IN ANALYSIS

CONCLUSION

Although much research has been performed on the reliability evaluation of power systems, how large-scale realistic systems should be analyzed is still under investigation. Various values of reliability models and analysis are described in Table 4.

This research makes efforts to move forward the past works towards the direction of addressing reliability needs directly from the consumer point of view. Previously, electric utilities use contingency and margin criteria for indirect reliability measures during planning and design. Generally, consumer oriented reliability evaluation indices such as SAIDI and SAIFI are not directly used in the design stage. However, given the complexity of the realistic system with constant facility additions and operating changes, directly use reliability values as numeric criterion on selecting a solution among potential alternative designs is expected to be a trend. In this research, the expected reliability behaviors of realistic systems are computed by utilizing detailed analysis of their configurations and equipment information.

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REDUCED DIFFERNTIAL TRANSFORM METHOD FOR GAS DYNAMICS EQUATION

Narhari Patil[1] *and Avinash Khambayat*[2]
[1]Professor & Head
Department of Mathematics
Shri Sant Gajanan Maharaj College of Engineering,
Shegaon, Maharashtra, INDIA.
[2] Department of Mathematics
Shram Sadhana Bombay Trusts College of Engineering &Technology,
Bambhori-Jalgaon, Maharashtra, INDIA
Email-avinashkhambayat@yahoo.com

Abstract: The purpose of this paper is to study the use of Reduced Differential Transform Method (RDTM) for gas dynamics equation and to obtain the series solution which is more appropriate. Here we have taken non linear gas dynamics equation to analyze and to illustrate the effectiveness of RDTM.

Keywords: *- Reduced Differential Transform Method, gas dynamics equation, and variational iteration method.*

1. Introduction

Reduced Differential Transform Method [3, 5, 6, 7] belongs to basic of Mathematical analysis. Theory of differential equations, approximation theory, integral transform theory, and many other area of pure and applied mathematics. Differential Transform Method theory is applicable to obtain solutions of problems in partial differential equations and ordinary differential equations, in multidimensional, with the concept of linear and non linear equations [10].

Many physical problems can be described by mathematical models that involve partial differential equations. The investigative of the exact or approximation solution helps us to understand the means of this mathematical models.Sevral numerical method [1],[2],[8],[9] were developed for solving partial differential equations with variable coefficient such as Homotopy perturbation method[4]. He's polynomials, modified variational iteration method.

The main goal of this paper is to apply the reduced differential transform method to obtain the exact solution. In many cases an analytical approximation, in rapidly convergent sequence for the Klein-Gordon equations. In One dimension, the in vicid equation of gas dynamics can be written as,

$$u_t(x,t) - u(x,t) + \frac{1}{2}u_x^2(x,t) + u^2(x,t) = g(x,t) \quad \ldots(1)$$

$$u(x,0) = f(x) \quad \ldots(2)$$

2. Reduced Differential Transform Method:
The basic definitions of RDTM are given below-

If the function u(x, t) is analytic and differential continuously with respect to time t and space x in the domain of interest, then let,

$$U_k(x) = \frac{1}{k!}\left[\frac{\partial^k}{\partial t^k}u(x,t)\right]_{t=0} \quad \ldots(3)$$

Where the t – dimensional spectrum function $U_k(x)$ is the transformed function. u(x, t) represent transformed function. The differential inverse transform of $U_k(x)$ is defined as follows

$$u(x,t) = \sum_{k=0}^{\infty} U_k(x)t^k \quad \ldots(4)$$

Then combining equations (3) and (4) we write

$$u(x,t) = \sum_{k=0}^{\infty}\frac{1}{k!}\left[\frac{\partial^k}{\partial t^k}u(x,t)\right]_{t=0} t^k \quad \ldots(5)$$

From the above definition, it can be found that the concept of RDTM is derived from the power

series expansion. The fundamental operation performed by RDTM can be readily obtained and are listed in table1

Functional form	**Transformed form**
$u(x,t)$	$U_k(x)=\frac{1}{k!}\left[\frac{\partial^k}{\partial t^k}u(x,t)\right]_{t=0}$
$w(x,t)=u(x,t)\pm v(x,t)$	$W_k(x)=U_k(x)\pm V_k(x)$
$w(x,t)=\alpha\ \ u(x,t)$	$W_k(x)=\alpha\ \ U_k(x),$, $\alpha\ \ is\ \ cons\tan t$
$w(x,t)=x^m t^m$	$W_k(x)=x^m\delta(k-n),\delta(k)=1,k=0$ $=0,k\neq 0$
$w(x,t)=u(x,t).v(x,t)$	$W_k(x)=\sum_{r=0}^{k}U_r V_{k-r}(x)$
$w(x,t)=\frac{\partial^r}{\partial t^r}u(x,t)$	$W_k(x)=(k+1).....(k+r)$ $.U_{k+r}(x)$
$w(x,t)=\frac{\partial}{\partial x}u(x,t)$	$W_k(x)=\frac{\partial}{\partial x}U_k(x)$
$w(x,t)=\frac{\partial^2}{\partial x^2}u(x,t)$	$W_k(x)=\frac{\partial^2}{\partial x^2}U_k(x)$

We write gas dynamic equation in the standard operator form

$$L(u(x,t))+R(u(x,t))+N(u(x,t))=g(x,t) \quad \ldots (6)$$

With initial condition $u(x,0)=f(x)$ ... (7)

Where $L(u(x,t))=u_t(x,t)$ is a linear operator which has partial derivatives.

$$R(u(x,t))=u(x,t),$$
$$N(u(x,t))=\frac{1}{2}u_x{}^2(x,t)+u^2(x,t)$$

and g(x, t) is in homogenous term .Using RDTM table, we construct the following iteration formula

$$(k+1)U_{k+1}(x)=G_k(x)-N(U_k(x))-R(U_k(x)) \quad \ldots (8)$$

Where $R(U_k(x)), N(U_k(x)), G_k(x)$ are transformations of the functions

$R(u\ (x,t)), N(u\ (x,t))\ \ and\ \ g(x,t)$ respectively.

$$N_0 = \frac{\partial}{\partial x}\left[\frac{U_0^2(x)}{2}\right] + U_0^2(x)$$

$$N_1 = \frac{\partial}{\partial x}\left[\frac{2U_0(x)U_1(x)}{2}\right] + 2U_0(x).U_1(x)$$

$$N_2 = \frac{\partial}{\partial x}\left[\frac{2U_0(x)U_2(x)+U_1^2}{2}\right] + 2U_0(x).U_2(x) + U_1^2(x)$$

From initial condition (2), we write $U_0(x) = f(x)$ … (9)

Substituting (9) in to (8) we get, following $U_k(x)$ values. The inverse transformation of the set of values $\{U_k(x)\}_{k=0}^{n}$ gives approximation solution as,

$$\bar{u}_n(x,t) = \sum_{k=0}^{n} U_k(x)t^k \quad \text{… (10)}$$

Where n is order of approximation solution. Therefore the exact solution of problem is given by

$$u(x,t) = \lim_{n\to\infty} \overline{u_n}(x,t) \quad \text{… (11)}$$

3. **Applications:-**

In this section, we use RDTM for solving gas dynamic equations.
Example 1

We consider the inhomogeneous non linear gas dynamic equations.

$$u_t(x,t) + \frac{1}{2}u_x^2(x,t) + (1+t)^2u^2(x,t) = x^2 \quad \text{… (12)}$$

With the initial condition u(x, 0) = x …(13)

By applying differential transform (12) and the initial condition (13) respectively, we get,

$$(k+1)U_{k+1}(x) = F_k(x) - N_k(x) \quad \text{…(14)}$$

Where $F_k(x), N_k(x)$ are transformed form of $\frac{1}{2}u_x^2(x,t) + (1+t)^2u^2(x,t)$ *and* x^2

The transformed initial condition $U_0(x) = x$, the equation (14) can be written as

$$U_{k+1}(x) = \frac{1}{k+1}\left[F_k(x) - N_k(x)\right]$$

Put k = 0, $U_1(x) = \frac{1}{0+1}\left[F_0(x) - N_0(x)\right]$

$$= \left[x^2 - \frac{\partial}{\partial x}\left(\frac{U_0^2(x)}{2}\right) - U_0^2(x)\right]$$

$$= \left[x^2 - \frac{\partial}{\partial x}\left(\frac{x^2}{2}\right) - x^2\right]$$

$$= -x$$

$$U_1(x) = -x$$

$$\text{Put } k=1,\ U_2(x)=\frac{1}{1+1}\left[F_1(x)-N_1(x)\right]$$

$$=\frac{1}{2}\left[2x^2-\frac{\partial}{\partial x}\left(\frac{2U_0U_1(x)}{2}\right)+2U_0(x)U_1(x)\right]$$

$$=\frac{1}{2}\left[2x^2-\frac{\partial}{\partial x}\left(\frac{2x\ (-x)}{2}\right)+2x(-x)\right]$$

$$=x$$

$$U_2(x)=x$$

$$\text{Put } k=2,\ U_3(x)=\frac{1}{2+1}\left[F_2(x)-N_2(x)\right]$$

$$=\frac{1}{3}\left[\begin{matrix}3x^2-\frac{\partial}{\partial x}\left(\frac{2U_0(x)U_2(x)+U_1^2(x)}{2}\right)-2U_0(x)U_2(x)\\-U_1^2(x)\end{matrix}\right]=-x$$

$$U_3(x)=-x$$

Similarly we can obtain $U_4(x)=x, U_5(x)=-x, U_6(x)=x$, . . .

Then the inverse transformation of the set values $\{U_k(x)\}_{k=0}^{n}$ gives n terms approximation solution as,

$$\bar{u}_n(x,t)=\sum_{k=0}^{n}U_k(x)t^k$$

$$=1-xt+xt^2-xt^3+.....+(-1)^n xt^n$$

$$=\frac{x}{1+t}$$

which is exact solution.

Example 2:- Consider non linear homogeneous gas dynamic equation,

$$u_t(x,t)-u(x,t)+\frac{1}{2}u_x^2(x,t)+u^2(x,t)=0$$

With initial condition $u(x,0)=e^{-x}$ where $u=U(x,t)$ is a function of the variable x and t.

The exact solution is $u(x,t)=e^{t-x}$, using the basic properties of RDTM we get transformed form of the equation (14) as,

$$(k+1)U_{k+1}(x)-U_k(x)+N_k(x)=0$$

$$U_{k+1}(x)=\frac{1}{k+1}\left[U_k(x)-N_k(x)\right] \quad \text{... (15)}$$

Where $N_k(x)$ is the transformed form of $\frac{1}{2}u_x^2(x,t)+u^2(x,t)$

Then the transformed initial condition is $U_0(x)=e^{-x}$, … (16)

Put k=0,

$$U_1(x)=\frac{1}{0+1}\left[U_0(x)-N_0(x)\right]$$

$$= \left[e^{-x} - \frac{\partial}{\partial x}\left(\frac{U_0^2(x)}{2} \right) - U_0^2(x) \right]$$

$$= e^{-x}$$

$$U_1(x) = e^{-x} = \frac{e^{-x}}{1!}$$

Put k = 1,

$$U_2(x) = \frac{1}{1+1}\left[U_1(x) - N_1(x) \right]$$

$$= \frac{1}{2}\left[e^{-x} - \frac{\partial}{\partial x}\left(\frac{2U_0(x)U_1(x)}{2} \right) + 2U_0(x)U_1(x) \right]$$

$$= \frac{e^{-x}}{2}$$

$$U_2(x) = \frac{e^{-x}}{2!}$$

Put k = 2,

$$U_3(x) = \frac{1}{2+1}\left[U_2(x) - N_2(x) \right]$$

$$= \frac{1}{3}\left[\frac{e^{-x}}{2} - \frac{\partial}{\partial x}\left(\frac{2U_0(x)U_2(x) + U_1^2(x)}{2} \right) - 2U_0(x)U_2(x) + U_1^2(x) \right]$$

$$= \frac{e^{-x}}{6}$$

$U_3(x) = \frac{e^{-x}}{3!}$ Similarly we can obtain $U_4(x) = \frac{e^{-x}}{4!}$, $U_5(x) = \frac{e^{-x}}{5!}$, $U_6(x) = \frac{e^{-x}}{6!}$, . . .

Then the inverse transformation of the set values $\{U_k(x)\}_{k=0}^{n}$ gives n terms approximation solution as,

$$\bar{u}_n(x,t) = \sum_{k=0}^{n} U_k(x)t^k$$

$$= U_0(x)t^0 + U_1(x)t + U_2(x)t^2 + U_3(x)t^3 + U_4(x)t^4 + ...$$

$$..... + U_n(x)t^n$$

$$= e^{-x}\sum_{k=0}^{\infty} \frac{t^k}{k!}$$

Therefore we obtain, $u(x,t) = e^{t-x}$, Which is exact solution.

Conclusions

In this research, reduced differential transform method has been applied for solving the gas dynamics equation. The method is applied in a directly without using linearization, transformation or restrictive assumptions. The result shows RDTM needs small size of computation divergent to other numerical methods. Finally it is found that RDTM is powerful and efficient technique for finding the exact solution.

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Earthquake Analysis of MDOF System Using Linear Fluid Viscous Damper

Sayed Anwar [1], S. P. Shakhawat[2], P.A.Shirule[3]
[1]Assistant professor, Civil Engineering Department, SSBTs COET Bambhori, Jalgaon
[2]Associate professor, Mechanical Engineering Department, SSBTs COET Bambhori, Jalgaon
[3]Associate professor, Civil Engineering Department, SSBTs COET Bambhori, Jalgaon

Abstract —

With advances in technology, it appears that the approach to the design of earthquake resisting structures takes a new direction, which allows engineers to design structures for a desired level of seismic protection. Designing structures to behave elastically or near the elastic range during strong ground motions is not economical, and in many cases is not feasible. Therefore enabling the structure to dissipate energy by means of mechanical devices appears very attractive. A rich variety of energy dissipation devices for passive control may be found in viscous dampers seem more appropriate in the case of rehabilitation. The main advantage of viscous dampers is that the forces they produce are out of phase with the column's forces due to displacements, and therefore, will not usually require column and foundation strengthening.

OVERVIEW ON DAMPING

Consider a building roof that has been pulled over horizontally a small amount and then released from rest .The roof will vibrate back and forth with amplitude that diminishes with time. Historically, structural engineers assumed that the reduction in motion was associated with the presence of viscous damping. The scientific quantification of the value of viscous damping in building has been the subject of research for over 50 years. This type of damping is called natural damping. This natural damping represents the energy dissipated by structural materials (e.g. concrete, steel and masonry) and non-structural elements (e.g. partitions, cladding) as the building moves with time.

The level of damping (natural damping) in a conventional elastic structure is very low, and hence the amount of energy dissipated during transient disturbances is also very low. During strong motions, such as earthquakes, conventional structures usually deform well beyond their elastic limits, and eventually fail or collapse. Therefore, most of the energy dissipated is absorbed by the structure itself through localized damage as it fails. The concept of supplemental dampers added to a structure assumes that much of the energy input to the structure from a transient will be absorbed, not by the structure itself, but rather by supplemental damping elements (manufactured damping). An idealized damper would be of a form such that the force being produced by the damper is of such a magnitude and function that the damper forces do not increase overall stress in the structure. Properly implemented, an ideal damper should be able to simultaneously reduce both stress and deflection in the structure. In the late 1960s, the structural engineers in Los Angeles and California installed instruments called accelerometers in building to measure building response during an earthquake. Usually these accelerometers are attached slab or a building floor. The recorded motion of the building can then be used to estimate the magnitude of the natural damping in the building. Building responses to earthquake and strong winds have been used to obtain these estimated of natural damping.

FLUID VISCOUS DAMPERS

In the 1990s, there was a virtual explosion in the use of new high-technology structural element that dissipates energy using a viscous damper. This type of damping is called *manufactured viscous damping* or simply *manufactured damping* because the damper is manufactured in plant under exacting quality control standards. These manufactured viscous dampers (or manufactured dampers) are then to sent the building site to be installed. Manufactured dampers are high-technology structural elements that have been used by the military and by the automobile and ship industries.

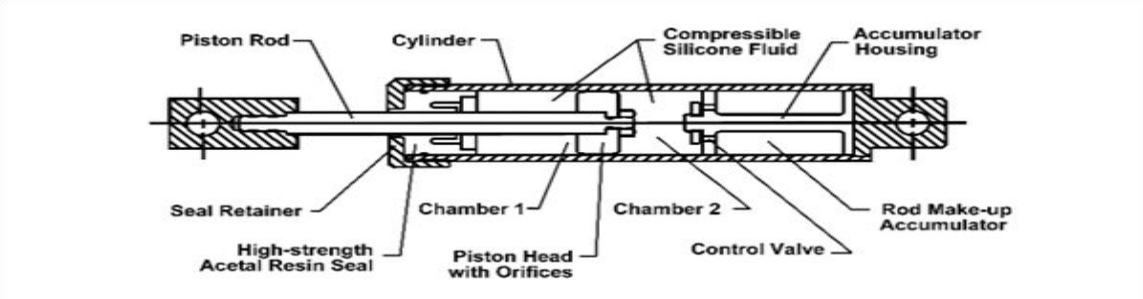

Fig.1.Fluid viscous damper (Taylor's device)

Fig.1 shows the schematic of a typical viscous damper. The scientific/engineering design varies among manufactures of viscous damper, but the basic performance from a structural engineering perspective is the same for all viscous dampers. The viscous damper is attached to the building structure either as a part of diagonal brace between the floors of the building or at the top of such a brace between the bracing unit and the floor. As the floor move, their relative velocity imparts a differential velocity to the ends of the viscous damper and therefore the damper exerts a viscous force to the floor.

LINEAR FLUID VISCOUS DAMPERS

The two ends of viscous damper experience different displacement, velocity and acceleration because of one end is attached to one building floor and other end to different floor. This difference in the motion results in the viscous damper producing a force and a source of energy dissipation. The force induced to the structure by the viscous damper at each of the attachment point of the viscous damper can be expressed as

$$F_{md} = c_{md} (\dot{u})^{\eta}$$

Where F_{md} is the damping force from the manufactured viscous damper, c_{md} is the manufactured viscous damper damping coefficient, $\dot{u}$ is the relative velocity between the ends of the viscous damper and η is a power law coefficient.
We are interested here only for linear systems. The first generation of manufactured viscous damper used a power law coefficient equal to one(1).structural engineers selected this value for η for design because for η=1 the manufactured damping force, is linear function of velocity.
Fig9. Shows the damping force is a linear function of velocity if the power low coefficient η=1. It means that the velocity of system or structure linearly varies with the damping force F_d ,here F_d is the total force of damping. Therefore, for a single degree of freedom system the total damping force is;

$$F_d = F_{nd} + F_{md}$$

Where F_d is the total damping force, F_{nd} is the force due to natural damping force, and F_{md} is the manufactured damping force. Where both the natural and manufactured damping forces are a linear function of velocity, it follows that,

$$F_{md} = c_{md} \dot{u} (t)$$
$$F_{nd} = c_{nd} \dot{u} (t).$$

EQUATION OF MOTION AND PROBLEM STATEMENT

PROBLEM STATE MENT

One of the most important application of the theory of structural dynamics is in analyzing the response of structure to ground shaking caused by an earthquake. We are interested in the response of linear systems.

Analytical solution of the equation of motion for a system subjected to any applied force P(t), or ground acceleration Ug(t) is not possible, because here the force or ground motion is the function of t, which is arbitrarily varies with time. The analytical solution if this type of problem is very rigorous. Such a problem can be tackled by a numerical time stepping methods. Some methods are listed below

1) Newark's method 2) Wilson θ-method

For this paper we accept the Newark's method for integrate the equation of motion. This method is

developed by N.M.Newmark in 1959. Parenthetically, the Newark's method is the time stepping method where we can define the discrete time instants Δ(t), and introduce the initial displacement(u), velocity($\dot{u}$), and acceleration($\ddot{u}$) is equal to zero. After that we can find out the response increasing by

$$\Delta(t) \text{ and } (u_{i+1}),\ (\dot{u}_{i+1}),\ (\ddot{u}_{i+1}) \text{ at } \Delta(t_{i+1}).$$

EQUATION OF MOTION

The dynamic equation of motion for an SDOF system subjected to an earthquake ground motion is

$$m\ddot{u}(t)+c_{nd}\dot{u}(t)+c_{md}\dot{u}(t)+ku(t)=-m\ddot{u}(t).$$

After dividing both sides of above equation my the mass (m), it becomes

$$\ddot{u}(t)+2\zeta_{nd}\omega_n\dot{u}(t)+2\zeta_{md}\omega_n\dot{u}(t)+\omega_n^2u(t)=\ddot{u}_g(t).$$

where $\omega_n=\sqrt{k/m}$, ζ_{nd} is the critical damping ratio from natural damping, and ζ_{md} is the critical damping ratio from manufactured damping. These damping ratios are defined using equation

$$2\zeta_{nd}\omega_n=c_{nd}/m$$
$$2\zeta_{md}\omega_n=c_{md}/m$$

The above equation can be written as

$$\ddot{u}(t)+2\zeta\omega_n\dot{u}(t)+\omega_n^2u(t)=\ddot{u}_g(t).$$

Where ζ represents the total critical damping ratio of the structure and it is

$$\zeta=\zeta_{nd}+\zeta_{md}$$

The modified equation is same as the above original equation of SDOF, with the critical damping ratio now being the summation of the natural and manufactured critical damping ratios. Therefore for the case where η=1, the structural system is the same as per the above system. It should be noted that, the introduction of manufactured damping to the structure does not introduce any new solution complexity.The earthquake acceleration in the above equation is very irregular and cannot be described by a closed form mathematical function; therefore a numerical solution is necessary. The numerical methods mentioned in above e.g. Newark's method or Wilson θ-method can be used to solve the equation of motion.

SYSTEM PARAMETERS

As indicated by above equation, the response of SDOF system with linear fluid viscous dampers is controlled by four parameters.

1. Damper linearity parameter η which controls the shape damper force in fig.2.
2. Supplement damping ratio ζ_{md}, which represents the represents the energy dissipation capacity of the fluid viscous dampers.
3. Natural vibration period of the system $T_n=2\pi/\omega_n$ and ,
4. Damping ratio ζ which represents the inherent energy dissipation capacity of the system.

The inherent damping of the SDOF system was fixed at ζ=5% and its natural vibration period T_n was varied from 0.05 to 5sec

INCREASE IN LINEAR MODAL DAMPING

We mentioned above there is no hard and fast rule for introducing a manufactured damping in the model. We can easily understand by an example…..

→ **e.g.** consider an SDOF system with only natural damping. If the value of natural damping is 5% of critical, then

$$\zeta_{nd}=0.05\%$$

let the mass of the structure be m=1kg and the period of vibration be T_n =1 sec, then

$$\omega_n=2\pi/T_n=2\pi \text{ rad/sec}$$
$$c_{nd}=2\zeta_{nd}\omega_n m=0.251 \text{ N-s/m}$$

Assume that the structural engineer wants to increase the damping of the structure to 15% of critical, that is

$$\zeta=0.15$$

then it follows that the manufactured damping should be

$$\zeta_{md}=\zeta-\zeta_{nd}=0.15-0.05=0.10$$

and therefore the manufactured viscous damping coefficient must be equal to

$$c_{md}=2\zeta_{md}\omega_n m=1.2566\text{N-s/m}$$

The selection of the damping coefficient c_{md} is a function of the desired damping ratio (0.10) and also the natural frequency of vibration and the mass of the structure.

When manufactured dampers are ordered, one critical design variable that must be specified is the maximum damping force. Usually the structural engineer will know from structural engineering calculations the maximum relative velocity that the design earthquake will induce on the two ends of viscous damper. Therefore, if the maximum velocity is $\dot{u}_{max}$ then the maximum force required for the manufactured damper is

$$F_{md}=c_{md}\dot{u}_{max}$$

EARTHQUAKE RESPONSE

Here we considered the one ground motion which is recorded at site in El Centro, California, during the imperial valley, California earthquake of May 18,1940.it should be noted that the ground acceleration with respective to time is highly irregular. How much irregular, it is not a problem.

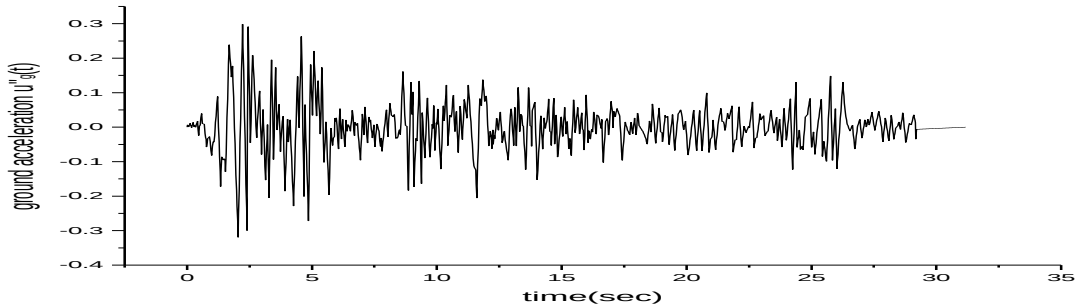

Fig.2.El-Centro ground motion (18 May 1940) California

The above figure shows the ground motion recorded at site El-Centro ground motion, the ground acceleration $\ddot{u}_g(t)$ defined at every 0.02 sec.

RESPONSE QUANTITIES

The response quantities of interest are:
1. Peak deformation (u_{max}) to which the peak lateral force $F=Ku_{max}$ and internal forces in the structure are related.
2. Peak damper force F_d.
3. Peak acceleration ($\ddot{u}$) of the mass.
4. Peak value of relative velocity $\dot{u}$ which is necessary to compute the exact forces in a linear fluid viscous damper and to verify the accuracy of its approximate value.

NUMERICAL EXAMPELS

→ Consider the SDOF system subjected to NS component of El Centro earthquake 1940(California), with natural period T_n =0.5sec, and natural damping coefficient ζ=5% , m=1kg.
→ Here we already know the variation of El-Centro ground acceleration is very irregular in the above fig.4. the graph representing the variation of ground acceleration ($\ddot{u}_g(t)$) with respective time. Hence the analytical solution of equation of motion is not possible or which required much more effort. So, we have to use the any numerical method mention in above literature to find out the response of structure, once the basic response displacement(u),velocity($\dot{u}$), acceleration($\ddot{u}$) is find out we are able to calculate the internal forces of structure easily by simple mathematical formulations.

RESPONSE ONLY WITH NATURAL DAMPING

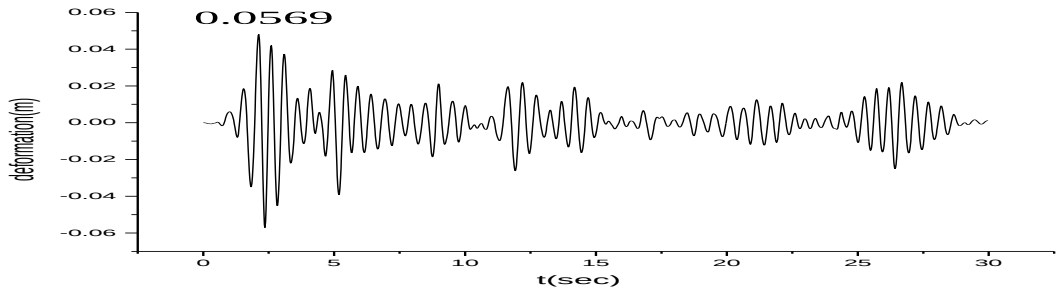

Fig.3.Deformation response of system subjected to El-Centro ground motion (Tn=0.5sec,ζ=5%)

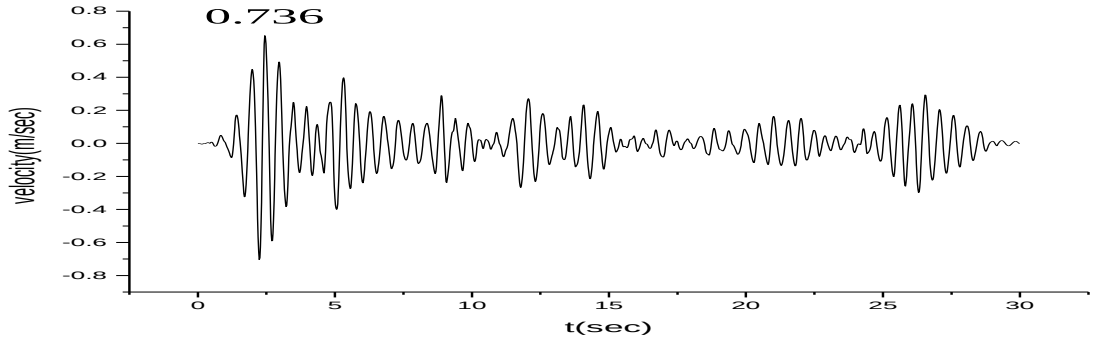

Fig.4.Velocity response of system subjected to El-Centro ground motion (Tn=0.5sec,ζ=5%)

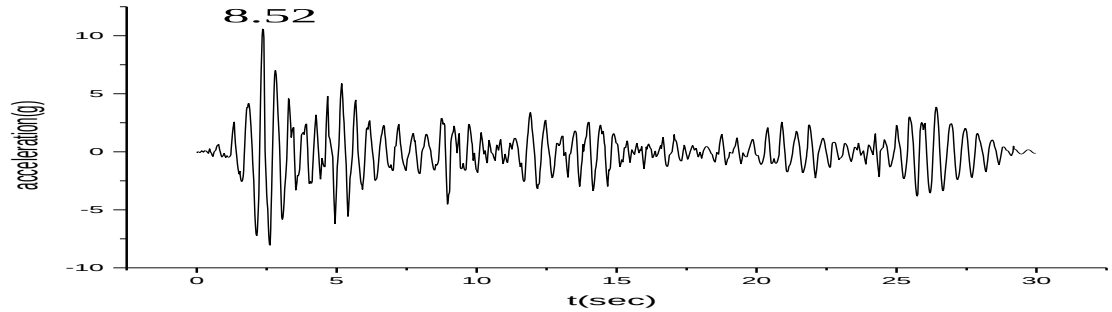

Fig.5.Acceleration response of system subjected to El-Centro ground motion (Tn=0.5sec,ζ=5%)
The above three figures shows the response of structure with natural damping only, means (ζ_{nd}=5%)

RESPONSE WITH NATURAL AND MANUFACTURED DAMPING

The introduction of manufactured damping to the structure does not introduce any new solution complexity. When manufactured damping is introduce the structural response will be decrease, here we will increase the manufactured damping with ζmd=10%, then after the response of structure will be as shown in figures.6,7,8.

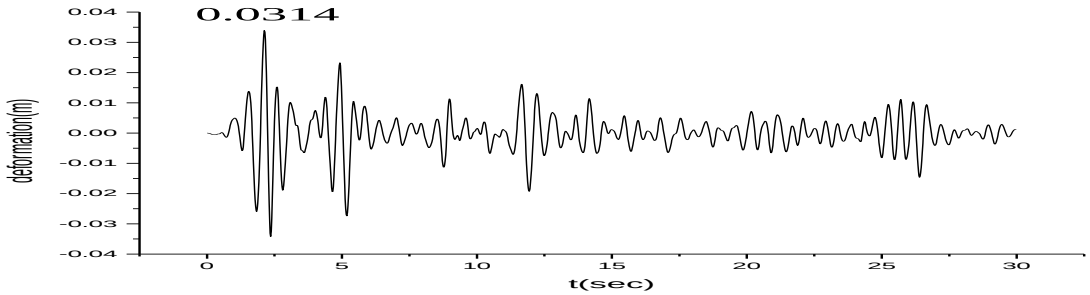

Fig.6.Deformation response of system subjected to El-Centro ground motion (Tn=0.5sec,ζ_{nd}=5% & ζmd=10%)

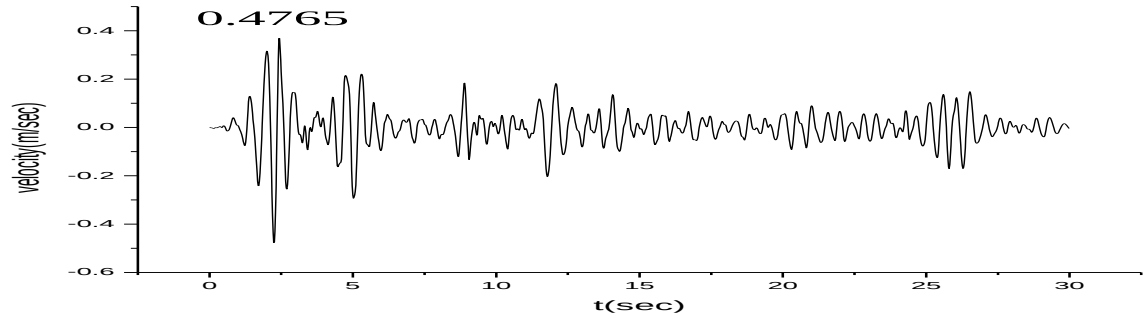

Fig.7. Velocity response of system subjected to El-Centro ground motion(Tn=0.5sec,ζ_{nd}=5% & ζmd=10%)

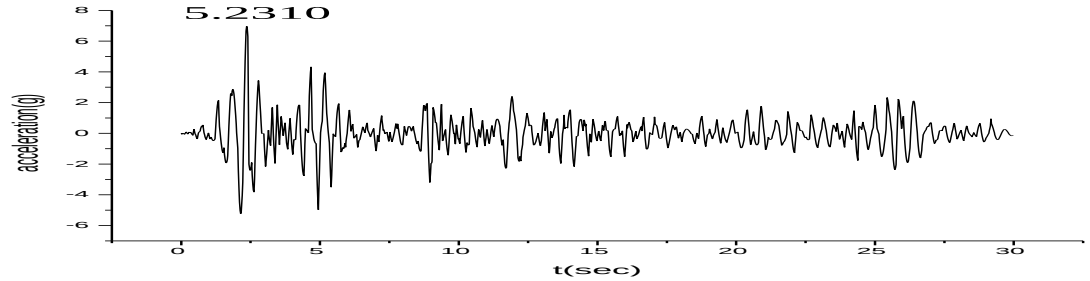

Fig.8.Acceleration response of system subjected to El-Centro ground motion(Tn=0.5sec,ζ_{nd}=5% & ζmd=10%)

The power law coefficient is η=1, because of this the system is linear we can also find the graph between velocity and damping force is linear. The damping force is..

$$F_d = c(\dot{u})^{\eta}$$

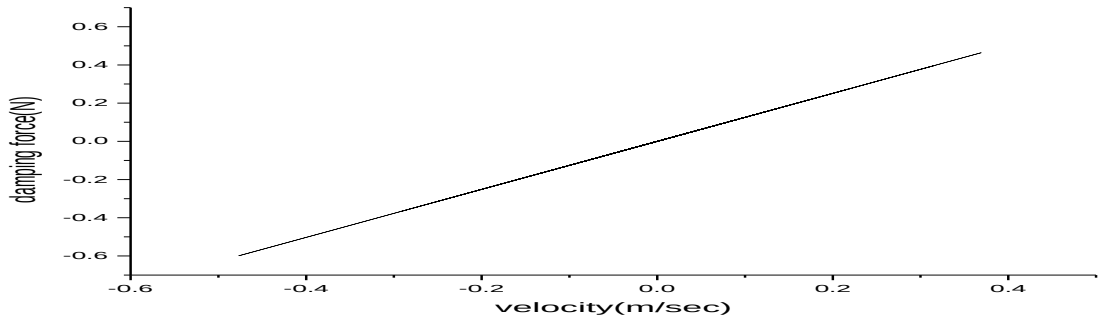

Fig.9.Damping force versus velocity

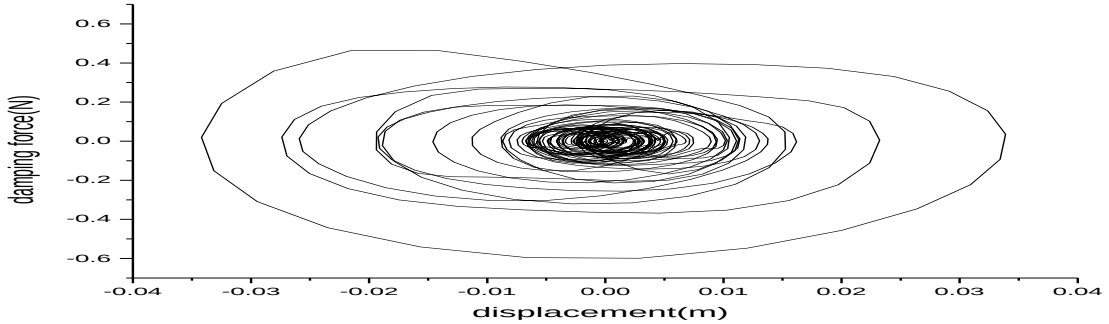

Fig.10.Damping force versus deformation

We will summarize the response in parenthetically in the table.

20%(manufactured)			30%(manufactured)		
u	$\dot{u}$	$\ddot{u}$	u	$\dot{u}$	$\ddot{u}$
0.0225	0.3536	4.102	0.01705	0.2777	3.587

Observe in the above table when the manufactured damping is increase in the system the response of system goes on decreasing. Here we calculate the response of structure whose natural time period Tn=0.5 sec, but the natural time of variation of structure will be changed for the different types of structures. The natural vibration period of structure generally defined in 0.05sec to 5 seconds. This wide range of natural time period will be defined in the one graph for design of new structures or retrofitted to existing structures.

RESPONSE SPECTRUM

The central concept in earthquake engineering, the response spectrum provides a convenient means to summarize the peak responses of all possible linear SDOF system to a particular component of ground motion. It also provides a practical approach to apply the knowledge of structural dynamics to the design of structures and development of lateral force requirement in building codes. A plot of the peak value of the system, or a related parameters such as circular frequencies ω_n or cyclic frequency f_n, is called the response spectrum for that quantity. Each such plot is for SDOF system having a fixed damping ratio ζ are included to cover the range of damping values encountered in actual structures. Weather the peak responses are plotted against f_n or T_n is a matter of personal preference. We have chosen the latter because engineers prefer to use natural period rather than natural frequency because the period of vibration is a more familiar concept and one that is intuitively appealing. The deformation response is a plot of u_{max} against T_n for fixed ζ. A similar plot for $\dot{u}_{max}$ is the maximum velocity response spectrum, and for $\ddot{u}$ is the acceleration response spectrum.

MDOF SYSTEM

The response of multi- degree of freedom system is obtained using the same method discussed above. Typically the system damping matrix is not proportional. Therefore the system response must be obtained using a numerical solution of the second order differential equation with the numerical methods mentioned above

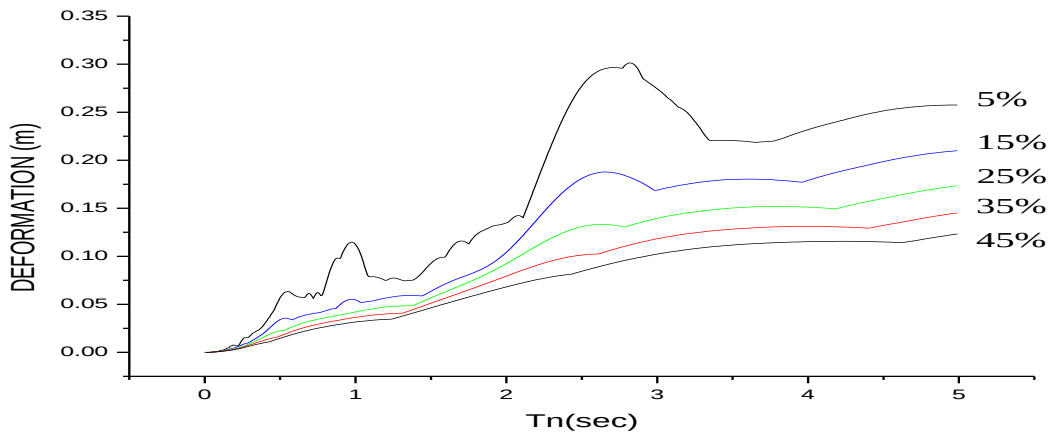

Fig.11.Displacement response spectra (values represents the critical damping ratio=ζ)

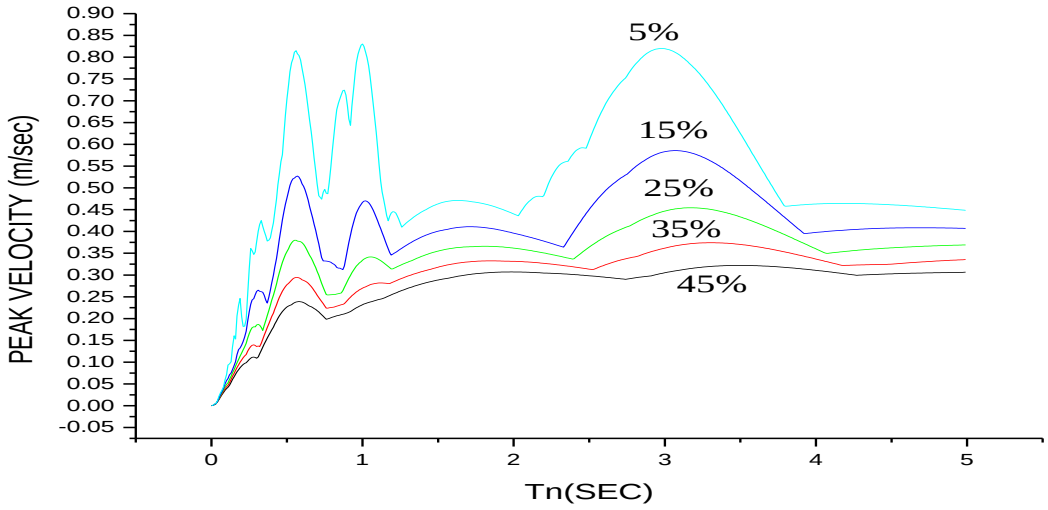

Fig.12.Velocity response spectra (values represents the critical damping ratio=ζ)

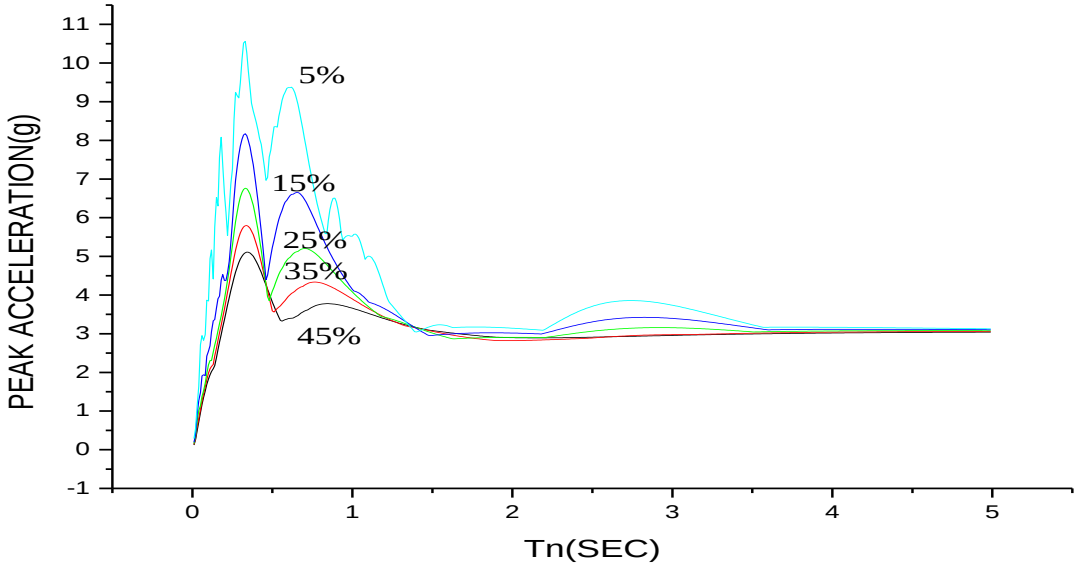

Fig.13.Acceleration response spectra (values represents the critical damping ratio=ζ)

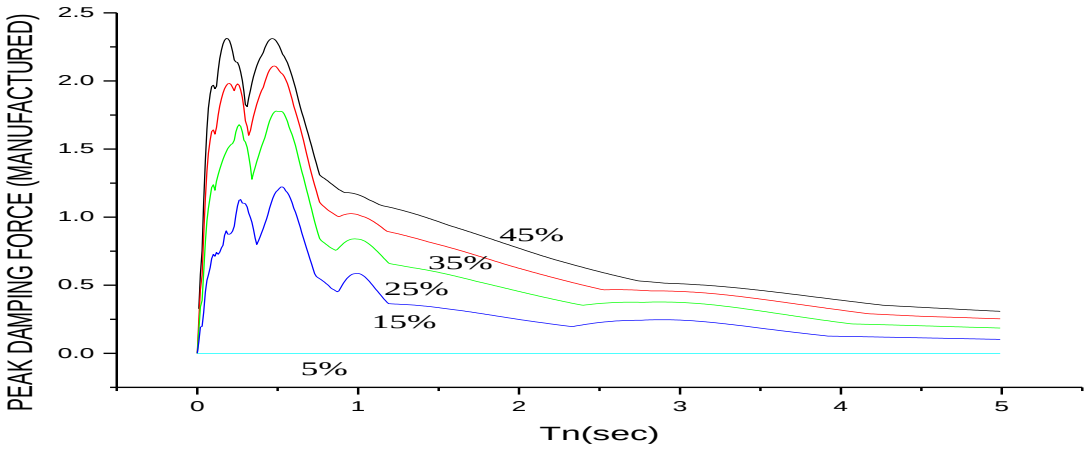

Fig.14.Damping force (manufactured) versus natural time period Fig.15.Damping force (natural) versus natural time period

CONCLUSION

This investigation for earthquake response of single-degree of freedom (SDOF) system with linear fluid viscous damper has leaded the following conclusions.

1. Supplemental damping reduces structural responses, with greater reduction achieved by increasing the damping.
2. Supplemental damping is more effective in reducing the structural deformation, and hence internal forces, compared to relative velocity and or total acceleration, the latter two responses are reduced to a similar degree.
3. The design values of structural deformation and forces for a system (period Tn and inherent damping ζ) with linear fluid viscous damper s can be estimated directly from the design spectrum for the period T_n and total damping.
4. The peak value of earthquake induced force in a linear fluid viscous damper can be estimated with reasonable accuracy from the peak damper force in the corresponding linear systems, its peak deformation and relative velocity.

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SYNTHESIS AND CHARACTREIZATION OF ZINC OXIDE NANOSTRUCTURES

Yogita S. Patil[1] and Dr.I.D. Patil[2]
[1:] Assistant Professor in Physics, Govt. College of Engineering, Jalgaon
[2:]Professor & Head, Department of Biotechnology,
SSBT's College of Engineering & Technology, Bambhori, Jalgaon

Abstract:
A wet chemical method has been employed to synthesize zinc oxide nanostructures. The synthesized nanostructure was structurally characterized using X-ray diffraction (XRD). The XRD pattern shows Zinc oxide Wurtize structure. The morphology of the nanostructure was studied using Field Emission Scanning Electron Microscopy (FESEM). The FESEM result shows flower like bundles of zinc oxide nanorods. The optical property of Zinc oxide nanostructure was studied using UV-visible spectroscopy. Thick films of nanopowder were prepared using screen printing method and I-V characteristics were studied.

Key words: *Zinc oxide nanorods, screen print.*

1. Introduction:

Zinc oxide (ZnO) is very well known II-IV semiconductor. ZnO is versatile material with a wide range of applications in sensors, optoelectronic and nanoelectronic devices. Due to wide band gap of 3.37 eV and large excitation binding energy of 60 meV[1], it exhibits stable UV emission. Researches reported that visible emission from the ZnO nanostructures originates because of the existence of various defects (Zn interstitial, Zn vacancy and oxygen vacancy) in ZnO nanocrystal. These emissions make ZnO, a very interesting material for optoelectronic applications. ZnO is now being used as UV absorbing material in sunscreens[2], transparent conductors in solar cells[3] and nanolasers[4]. Semiconductor metal oxide ZnO gas sensors have attracted great attention over several decades due to their unique advantages such as high sensitivity, low cost, fabrication ease and good compatibility to silicon microfabrication[5-7].

In the last few years, there has been growing research on the investigation of nanostructures. Progress has been achieved in the synthesis, structural characterization and physical properties investigation of nanostructures. These materials due to their peculiar characteristics and size effects often show novel physical properties compared to those of bulk. These potentialities can be exploited both for fundamental study and for potential nanodevice applications. The potential of these innovative structures is being exploited for gas sensing applications.

In this paper we report the fabrication of flower like bundles of zinc oxide nanorods by a simple wet chemical method. The fabrication is followed by few characterization results.

2. Experimental

All the chemicals used in this work are of AR grade. In preparation of ZnO nanorods, 0.45 M aqueous solution of zinc nitrate ($Zn(NO_3)_2.6H_2O$) and 0.9 M aqueous solution of sodium hydroxide (NaOH) were prepared in distilled water. Then, the beaker containing NaOH solution was heated at the temperature of about 55^0C. The zinc nitrate solution was added drop wise to the above heated solution under high speed stirring. The precipitation was started to obtain when about 7 mL of zinc nitrate solution was added to the heated NaOH solution. The complete zinc nitrate solution was added to NAOH solution in about 45 minutes. Then the beaker was sealed at this condition for 2 hours. After 2 hours reaction, the white precipitate deposited in the bottom of the flask was collected and was washed several times with absolute ethanol and deionised water. The ZnO samples were obtained by dehydration of the precipitate.

Reaction mechanism:

The zinc nitrate may convert into $Zn(OH)_2$ colloids firstly alkali solution, as shown in reaction 1. During the process, part of the $Zn(OH)_2$ colloids dissolves into Zn^{2+} and OH^- according to reaction 2. When the concentration of Zn^{2+} and OH^- reaches the super saturated degree of ZnO, ZnO nuclei will form according to reaction 3. The reactions are as follows:

$$Zn(NO_3)_2.6H_2O+2NaOH=Zn(OH)_2\ (gel) + 2NaNO_3+6H_2O \qquad (1)$$

$$Zn(OH)_2\ (gel) + 2H_2O = Zn^{2+} +2OH^-+2H_2O= Zn(OH)_4^{2-}+2H^+ \qquad (2)$$

$$Zn(OH)_4^{2-} = ZnO + H_2O + 2OH^- \quad (3)$$

For thick film preparation, a known amount of ethyl cellulose was taken (3%) and dissolved in known amount of turpinol (71%) by keeping overnight and mixing thoroughly to get agglomerate free high viscous solution. A known amount of the extracted ZnO was added (26%) and thoroughly mixed. This paste was screen printed onto glass substrate using screen printing setup. It was then dried under IR radiation.

3. Material characterization

The X-ray diffraction (XRD) patterns of the obtained samples were recorded by D8Advance, Brucker, Germany. FESEM with EDAX images were taken on Hitachi Hitechnologies corporation, Japan (Model No. S4800). Also optical absorption measurements of samples were recorded using a UV- VIS spectrophotometer for calculating optical band gap. The I-V characteristic was recorded using gas sensing system.

4 Results and discussion

4.1 X-ray diffraction(XRD):

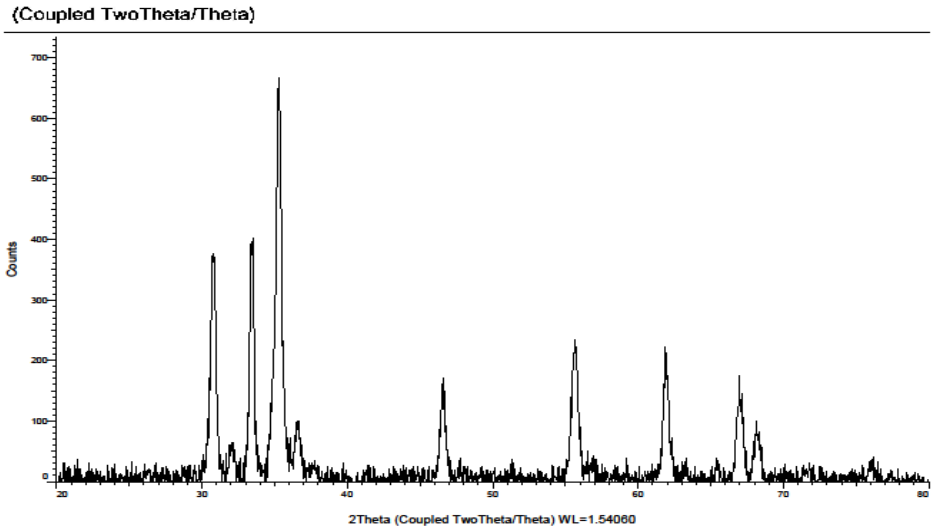
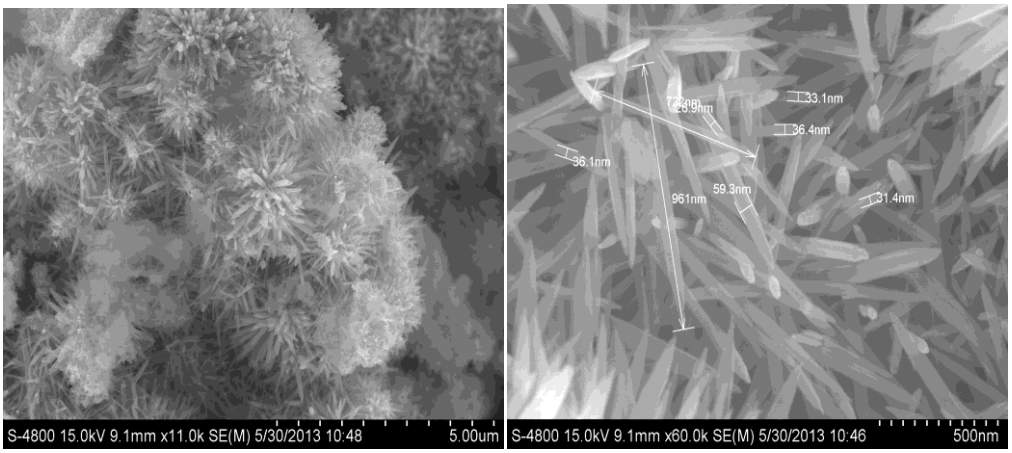


Fig.1 XRD pattern of ZnO nanorods

The fig. 1 shows XRD pattern of ZnO nanorods. The sharp intense peaks were obtained for ZnO corresponding to the planes (100), (002), (101), (102), (110), (103), (201) which are associated with the hexagonal wurtzite structure of ZnO. It seems that ZnO nanorods possess high crystallinity, since the peaks are very sharp. The crystallite size is found to 3.3nm.

4.2 FESEM of ZnO nanorods:



(a) **(b)**

Fig. 2. FESEM of ZnO nanorods

Fig.2 shows FESEM image of ZnO structure. The image (a) shows a bulk quantity of flower like bunches for 30K resolution. Each bunch is formed due to gathering of closely packed nanorods while for 60K resolution, the crystal structure is rod like. The nanorods are randomly distributed in the powdered sample. The diameter of the rod ranges from 30nm to 60nm and maximum length of the rod is found to be 961nm. The FESEM images are matched with XRD results.

4.3 UV-Visible absorption spectrum:

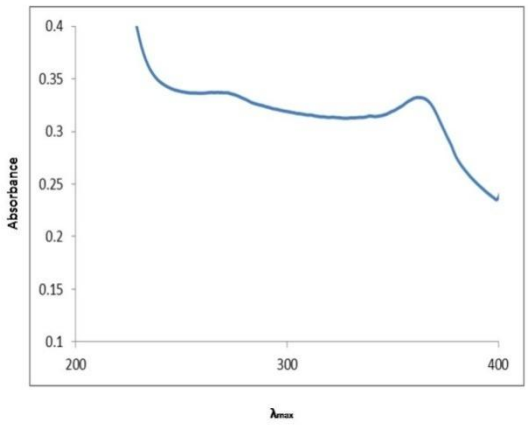


Fig.3 UV Visible absorption spectrum of ZnO nanorods

Fig. 3 shows UV-Visible absorption spectrum of ZnO nanorods. The absorption peak is observed at 368nm which is an indication of inherent property of ZnO. From UV—visible spectrum the band gap of ZnO nanorods is found to be 3.37 eV.

4.4 I-V Characteristic:

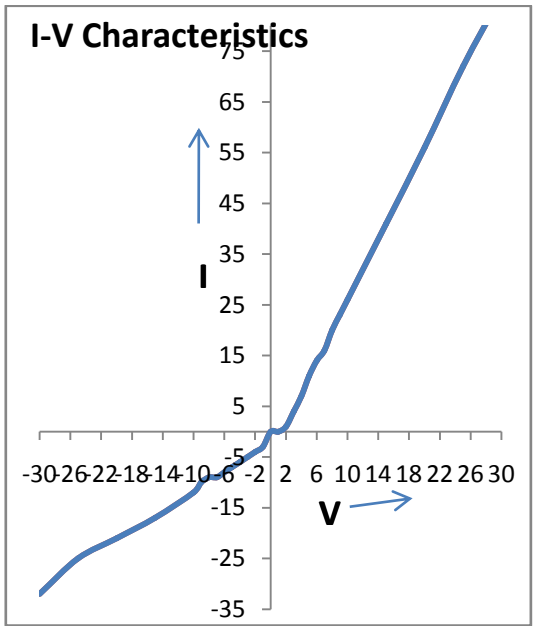


Fig4 .I-V curve of ZnO nanorods

Fig. 4 depicts the semiconducting nature of ZnO nanorods at room temperature.

Conclusion:

In this work, ZnO nanorods were synthesized by wet chemical method using zinc nitride as precursors and sodium hydroxide as reducing agent. The XRD peaks showed the hexagonal wurtzite structure and high crystallinity of ZnO. The FESEM showed the flower like bunches of ZnO nanorods for 30k resolution while for 60k resolution, crystal structure is rod like. The diameter of the rod ranges from 30 nm to 60 nm and the maximum length of the rod was found to be 961nm. From UV- visible spectra the band gap of ZnO nanorods were found to be 3.37eV. The I-V characteristic at room temperature conformed the semiconducting nature of ZnO nanorods.

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Effective Employee Engagement Programme to Enhance the Performance of Employee: A case study of Vivanta by Taj Blue Diamond, Pune

Dr.Vishal S.Rana [1] *,Yateen S.Nandanwar*[2]
[1] Asst Prof & Head, M.B.A Dept, S.S.B.T's College of Engineering & Technology, Bambhori, Jalgaon, MS (Corresponding Author)
[2] Student (MBA-II), Department of Business Administration, SSBT's College of Engineering & Technology, Bambhori, Jalgaon, MS, India.
Email: [1]vishal.rana1980@yahoo.com

***Abstract*— EmployeeEngagement is about creating opportunities for employees to connect with their colleagues, managers and wider organization. It is also about creating an environment where employees are motivated to want to connect with their work and really care about doing a good job. It is a concept that places flexibility, change and continuous improvement at the heart of what it means to be? Engagement is more than simply satisfaction or even commitment. Satisfied employees may be happy but make little contribution to the organization; yet committed employees may be focusing on the wrong objectives. Producing a satisfied and committed workforce is a worthwhile aim but on its own it is not enough. This discussion paper is aimed at senior HR professionals and others who are considering an employee engagement framework as part of their effective people management policies**.

Keywords*-Employee Engagement Programme, Training, Employee Motivation, Education Communication,*

I. INTRODUCTION

What motivates people to do a good job? How can organizations get the best out of their people? These questions are not new, but today many employers are answering them with a fresh conviction and sense of purpose. These employers are confident they have a practical framework that helps them build and maintain positive relations with their workforce. That framework is called 'Employee Engagement'.
Engagement is about creating opportunities for employees to connect with their colleagues, managers and wider organization. It is also about creating an environment where employees are motivated to want to connect with their work and really care about doing a good job. It is a concept that places flexibility, change and continuous improvement at the heart of what it means to be? Engagement ismore than simply satisfaction oreven commitment. Satisfied employees may be happy but make little contribution to the organization; yet committed employees may be focusing on the wrong objectives. Producing a satisfied and committed workforce is a worthwhile aim but on its own it is not enough. This discussion paper is aimed at senior HR professionals and others who are considering an employee engagement framework as part of their effective people management policies.

The paper focuses on:

- Outlines key elements of the business case that can help persuade top management of the contribution engaged employees make to organizational performance.
- Identifies the key factors driving employee engagement, as well as the possible barriers.
- Highlights responsibilities in workplaces for promoting employee engagement and suggests what employers and government should do to create an engaged workforce.

II. OBJECTIVES OF THE PAPER

- To focus on various Employee Engagement practice adopted by Vivanta by Taj Blue Diamond.
- To study training and development programmed used in Vivanta by Taj Blue Diamond.
- To know how the performance of the employees is being appraised.
- To study employee welfare policies.
- To identify the problem areas and submit reports/suggestions wherever necessary.

III. RESEARCH METHODOLOGY

This paper is mostly prepared with the help of primary data collection. For the study the primary data was collected through:-

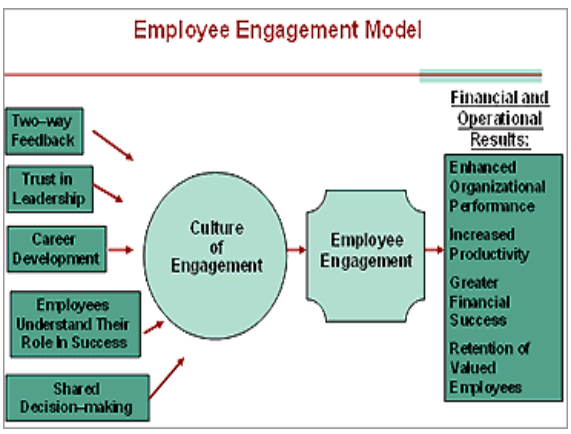
- Interaction with managers and departmental heads.
- Conversation with employees at all levels.

The Questionnaire of employee engagement program consisted of 16 questions which were collected from 50 employees. In present study, the researcher has collected primary data by filling structured questions from employee through deliberate sampling method. The primary data was collected from the respondent (employee) within organization.

IV. IMPORTANCE OF THE STUDY

Many studies have shown that investments in people (i.e., HR-related practices) have a reliable impact on the performance of organizations. The Bureau of Labor conducted a comprehensive review of more than 100 studies and found that people practices have significant relationships to improvements in productivity, satisfaction, and financial performance. Research has shown that when engagement scores are high, employees are more satisfied, less likely to leave the organization, and more productive.

Each organization is different and there are many factors that affect bottom-line outcomes; however, engagement scores can serve as meaningful predictors of long-term success. Some organizations use engagement scores as lead measures in their HR scorecards. When an organization can show the relationship between engagement scores and bottom-line outcomes, everyone pays attention to the engagement index. Establishing this critical link between people and performance helps HR professionals prove that people-related interventions are a worthwhile investment.



V. KEY PARAMETERS

- Engage Employees early and often: - Ensure employees have a voice in the program. Ask employees what question could be asked for a survey, have them participate in looking at the results, and give them an opportunity to generate strategies and interventions. We won't get everyone on the same page unless we give everyone a hand in authoring that page.
- Focus on Employee Engagement for all: - The employees should benefit from their engagement, the organization should see results, and customers should also experience the benefits of engaged employees. As you plan any program ensure you have declarative clarity on how everyone will benefit.
- Get connected: - Join the Employee Engagement Network. There are over 150 members interested in employee engagement. Join us to ask questions, find information, offer support, and stay current on the latest information in employee engagement. The glue of engagement is contribution and we welcome your contribution.
- Rewards as to motivate: - The employee should get the benefits of become Wall of Fame in terms of money which hotel is not providing to them.

VI. ANALYSIS OF STUDY

Q.1 Opportunity at Work place through Employee engagement programme

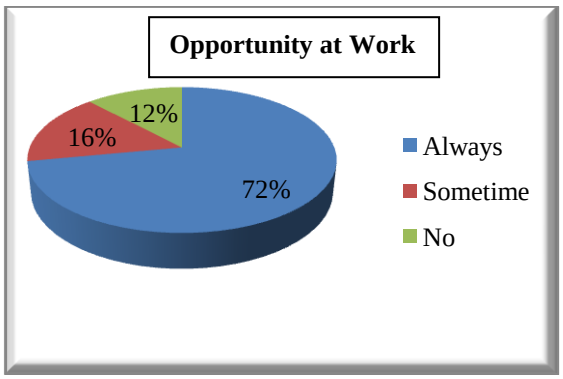


Chart 1.1

Interpretation:In every month, Hotel organizes training for their employee for further development of their knowledge and skill which is indirectly helpful for organization for achieving the goal. The above pie chart depicts that in view of 72 % employee there are opportunities at work place at Vivanta-Taj Blue Diamond, Pune through employee engagement programme.

Q.2 Does Employee Engagement Programme increase the morale of employees

Sr. No	Particulars	No. of Respondents	Percentage
1	Yes	48	96%
2	No	2	4%
3	Total	50	100%

Table 1.1

Interpretation: - From the above table it is found that 96 % respondents are completely agree that employee engagement programme enhances the morale of employee.

Q.3 Employee Recognition/Praise at work place for doing good work by Taj Blue Diamond

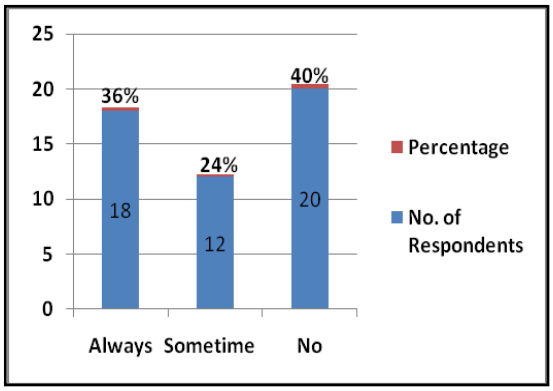


Chart 1.2

Interpretation: From the above pie chart it is observed that in view of 36 % employees, their work has always been appraised by Taj Blue Diamond at work place whereas 24 % employee felt that their work has sometimes appraised by Taj Blue Diamond at work place for doing good job.

Q.4 Most suitable employee engagement practice for increasing the motivation of employee.

Sr. No	Particulars	No.of Employee	%
1	Cultural Events	10	20 %
2	Sports Week	8	16 %
3	Recreational Tour	12	24 %
4	Annual Gathering	7	14 %
5	Movie Break	6	12 %
6	Festiwal Celebration	4	8 %
7	Wall of Fame	3	6 %
8	Total	50	100

Table 1.2

Interpretation: From the above table it is found that in view of 24 % employee, recreational tour is the most suitable employee engagement practice to motivate the employee whereas 16 % employee feel that organizing sports week for employee may motivate them.

Q.5 Rating the effectiveness of employee engagement practices adopted by Vivanta by Taj Blue Diamond on 1-5 scale.

Sr. No	Particulars	No.of Employee	%
1	Poor	3	6 %
2	Average	7	14 %
3	Good	10	20 %
4	Very Good	25	50 %
5	Excellent	5	10 %
6	Total	50	100

Table 1.3

Interpretation: From the above table it is revealed that the maximum i.e 50 % employee appreciated the employee engagement practices adopted by Vivanta by Taj Blue Diamond, Pune whereas in opinion of 10 % employees the employee engagement practices of Vivanta by Taj is excellent.

VII. FINDINGS

- It was concluded that most of employee feels that their supervisor take care of their and also taking feedback about their work and taking suggestions from them to increase the efficiency of employee. But few of the employee opinions are opposite to this they think so that their supervisor does not take care of their.
- The question was asked to employee that is their opinions which they have given to their supervisor are counted or not. The majority of the employee says that sometimes their opinions are counted by supervisors.
- It was revealed that, within organization employees are having best friend. The reason behind this is the activity which the hotel using to engage the employee and making them free with their colleague, peers and with supervisors. Very few employees were newly joined the hotel and having few friends at work place.
- Most of the employee got an opportunity to do their best every day in the organization. Because of freely atmosphere and culture in the hotel the employee feels that their opinions and suggestions are counted by the supervisors and with this they feels opportunity to grow. But few are not satisfied with this statement as we can see in the bar chart some respondents

feel little bit opportunity. Rest equal number of employee feel little bit and some does not.

- Disclosure of the study shows that, the respondents are very confused while choosing the option. Few employees want to select the entire options which have been provided to them. But from the analysis of the data, researcher found that most of the employees like the recreational tour a lot because they got different experience outside the hotel premises and follow with the cultural event which includes celebration of each festivals, sports week and annual gathering. The very less have selected wall of fame because they feel this is the Non-financial motivational schemewhich hotel are using for motivation of employee and for this lots of efforts they need to give along with work.
- Finally the researcher asked the overall rating about engagement practices which the hotel is carried out are well acceptable by the employee and make them happy while doing their job. Most of the employee marks V. Good because of good experience which they have got while participating in such events. Few of the employee stated as excellent which are completely satisfied and few has stated poor because of not participating in activities.

CONCLUSION

- After taking the feedback from the employees, it is observed that they are hardworking and dedicated towards their work. But a number of employees are not interested in schemes such as Wall of Fame and programs organized by the management of the organization. For Wall of Fame which is less likely by employee can be seen after analyzing the feedback which they have filled. The major reason behind this activity is Non Financial type of motivation which organization is providing and also a lot of efforts they need to give to achieve it.
- During the research, researcher has noticed that some of the employees are illiterate and they want to participate but they cannot because of less confident and less motivated.
- Employees want more facilities from managements such as gifts, incentives, bonus etc. when they participate in various programs and company also work on these ways to encourage their employees.

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SHRAM SADHANA BOMBAY TRUST's
COLLEGE OF ENGINEERING & TECHNOLOGY,
BAMHORI, JALGAON (INDIA)