

PRESSURE-DEPENDENT VISCOSITY AND FREE VOLUME IN LIQUIDS THROUGH MELTING TEMPERATURE APPROACH

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ABSTARCT

In the present paper, a model based on the melting temperature approach is purposed to study the viscosity in three liquids viz Benzene, n-Dodecane, and n-Octadecaneas a function of pressure. The calculated values of viscosity in all three liquids are found to be in good agreement with experimental data. The free volume activation, V_f is also computed as a function of pressure. Further it is observed that the curvature between $\ln\eta(P,T)$ and P can be attributed to the variation of the free volume associated with the flow of liquid.

Keywords : Free Volume Activation, Liquids, Melting Temperature, Viscosity, Pressure.

I. INTRODUCTION

The aim of the present paper is to develop a theory which may explain the pressure variation of viscosity in liquids. Although the temperature dependence of viscosity is well taken and there are two well-known types of viscosity – temperature behavior of liquids, namely Arrhenius and non-Arrhenius. In the higher temperature ranges the behavior usually Arrhenius but as temperature is lowered the behavior becomes non-Arrhenius. A number of empirical and semi-empirical relations are established¹⁻⁷ to explain separately both of these types of behavior but no much work has been done to explain the pressure dependence of viscosity.

Recently Kuchhal & Dass⁸ has been proposed a model to explain the correct pressure dependence of self-diffusion through melting temperature approach. The aim of present work is to extend the work of Kuchhal & Dass to predict the pressure dependence of viscosity of liquids along with free volume of liquids, V_f .

II. THEORY

In general, viscosity may be considered as the integral of the interaction forces of molecules, when the interactions among molecules are very strong, they tightly hold together and are unable to slide over each other and the

compound is called a solid. When energy or heat is applied up to a certain level, molecules can then slide over each other or become melted. Initially they slide over each other very slowly. If the amount of heat or temperature greatly exceeds the melting point, they move past each other very rapidly and the liquid becomes less viscous. The effect of temperature on the viscous flow or viscosity of liquid is discussed by (1) as

$$\eta(P, T) = \eta_0 e^{-E_a(P, T)/RT} \quad (1)$$

Where η_0 is a pre-exponential constant and E_a is the free energy of activation for flow.

In most of the liquids, the melting temperature is found to increase with increasing pressure. On the other hand, the viscosity is found to decrease with rising pressure, indicating that activation energy must decrease with increasing pressure. Therefore it is worthwhile to consider the linear relationship between activation energy and melting temperature which is also used by other workers in past [9-10].

$$E_a(P, T) = A(T)R T_m - E(T) \quad (2)$$

Where T_m is the melting temperature at pressure P, T is the ambient temperature at which $\eta(P, T)$ data are available as a function of temperature. $A(T)$ and $E(T)$ are pressure independent but temperature dependent parameters and R is the universal gas constant.

Equation (1) and (2) can be used to define the viscosity as

$$\ln \eta(P, T) - \ln \eta_0 = - \left[\frac{A(T)T_m}{T} \right] + \left[\frac{E(T)}{RT} \right] \quad (3)$$

Differentiating of equation (4) with respect to T_m/T keeping T constant gives

$$[\partial \ln \eta(P, T) / \partial (T_m/T)]_T = A(T) \quad (4)$$

Therefore the physical significance of $A(T)$ is that its represent the slope of straight line obtained by plotting $\ln \eta(P, T)$ versus T_m/T for a liquid at a given temperature T.

Further, at $P=0$ and temperature T, equation (3) can also be written as

$$\ln \eta(0, T) - \ln \eta_0 = - \left[\frac{A(T)T_0}{T} \right] + \left[\frac{E(T)}{RT} \right] \quad (5)$$

Eqs(3) and (5) can be combined to give

$$\eta(P, T) = \eta(0, T) \exp[-A(T)(T_m - T_0)/T] \quad (6)$$

The melting temperature as a function of pressure can be obtained from Simon's relation [11] given as

$$T_m = T_0 [1 + \beta P]^C \quad (7)$$

Where T_m and T_0 are the melting temperatures at pressure P and $P=0$, respectively.

Differentiating (2) with respect to pressure gives the free volume $V_f(P,T)$ as

$$[\partial E_a(P, T) / \partial P]_T = V_f = A(T)R \frac{dT_m}{dP} \quad (8)$$

Eq(8) can alternatively written as

$$V_f(P, T) = A(T)RT_0 C \beta (1 + \beta P)^{C-1} \quad (9)$$

with the help of (7).

III.CALCULATIONS AND DISCUSSIONS

The present model is applied in the case of Benzene [12], n-Dodecane [13] and n-Octadecane [13]. While the parameters involved in the (7) are taken from Babb [14].

Eqs(6) and (7) are used to obtain the values of adjustable parameter $A(T)$ in each liquid. The values obtained by least-square fitting along with other relevant parameters are reported in "Table 1". Once all the parameters become known, the values of viscosity, $\ln \eta(P,T)$ are computed as a function of pressure and plotted in "Figs.1-3" for all liquids. A very good agreement exists between the calculated and experimental data as is clear from reduced chi-square and "Figs.1-3". Actually the agreement is within $\pm 0.5\%$ which seems not to be unusual taking into account the experimental errors involved in the measurement of viscosity.

The combination of Eqs (2) & (9) give the values of free energy and free volume at different pressures. The computed result for free volume $V_f(P,T)$ in all liquids are plotted in "Fig.4". To the best of our knowledge no experimental or theoretical values of free volume for these liquids have so far been reported for comparison. But, it is clear from "Fig.4" that V_f decreases with the increase in pressure in all three liquids. These observations reveal that the free volume of activation may be responsible for the curvature in the plot of $\ln \eta(P, T)$ vs pressure.

Table-1 : Values of melting constants $A(T)$, β and C along with other relevant parameters

Liquid	T_0 (K)	T (K)	$A(T)$	β (MPa ⁻¹)	C	Reduced Chi-Square
Benzene	278.8	303.15	-8.55	0.00278	0.38	2.30

n-Dodecane	263.65	298.15	-13.36	0.00282	0.327	0.00297
n-Octadecane	300.95	323.15	-15.17	0.00289	0.295	0.004

IV. FIGURES AND TABLES

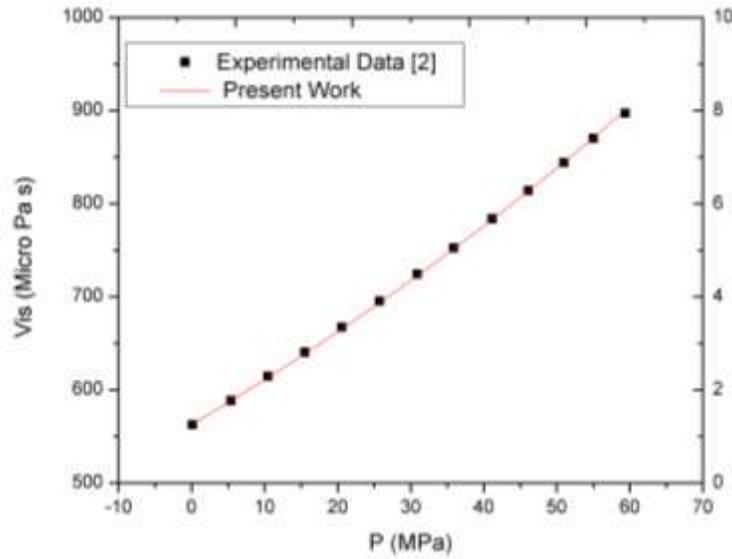


Fig.1: lnη(P,T) against P in case of Benzene at 303.15K

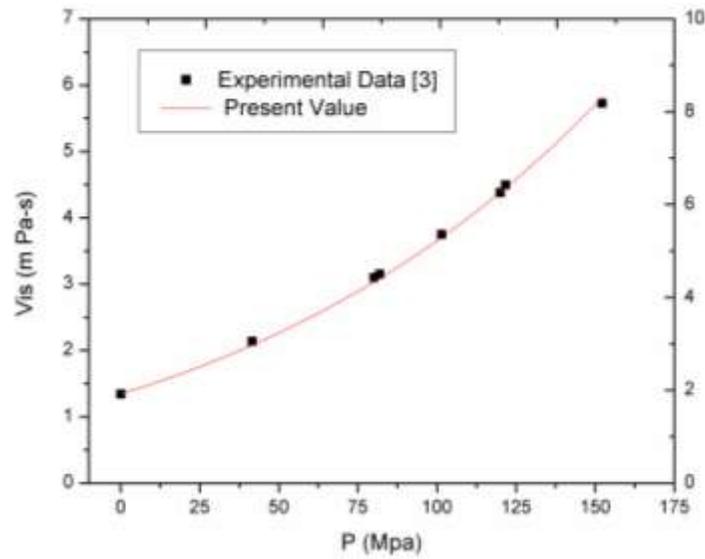


Fig.2: lnη(P,T) against P in case of n-Dodecane at 298.15K

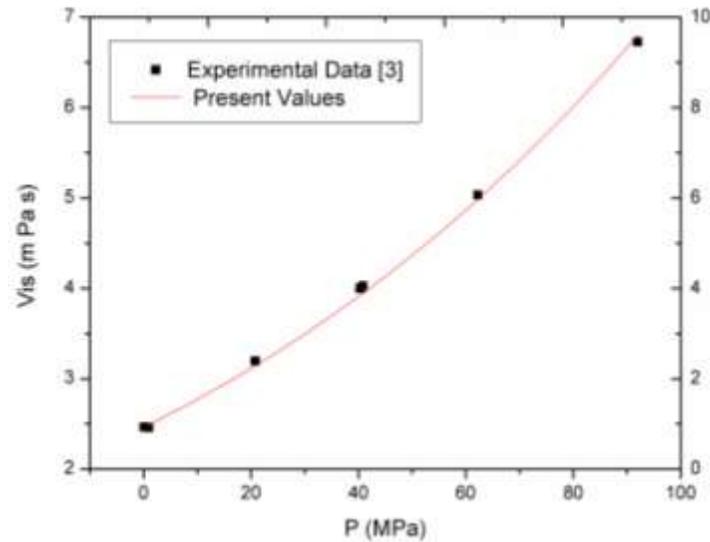


Fig.3: $\ln\eta(P,T)$ against P in case of n-Octadecane at 323.15K

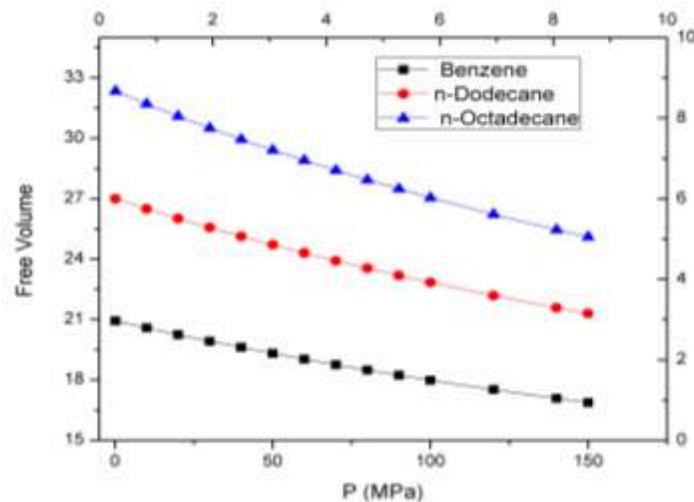


Fig.4: $V_f(P,T)$ against P in case of Benzene, n-dodecane and n-octadecane

V.CONCLUSION

In conclusion, it can be said that the melting temperature approach is successful in describing the viscosity, and free volume as a function of pressure in case of all three liquids. The present model may provide a basis on which a more profound and basic theory of viscosity of the liquid may be developed. Moreover, at present it provides a convenient means for representing the experimental data including interpolations and extrapolations.

VI. ACKNOWLEDGEMENTS

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AN APPROACH WITH INCREMENTAL CONDUCTANCE MPPT AND FLC BASED CHARGING CONTROLLER FOR EFFECTIVE BATTERY MANAGEMENT IN SOLAR-DIESEL HPS

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ABSTRACT

Demand for electricity today makes us to move towards the renewable energy. The effective utilization of power from renewable energy is more crucial than power generation. This paper proposes standalone solar power system for a rural area with uninterrupted power. The uninterrupted power is indispensable for many applications. In this proposed system Solar power systems with Battery Energy Storage System and Diesel Generator have contributed to the power system for continuous power. Effective utilization of solar power decides the efficiency of the power system. Effective Battery Management controller monitors and controls loading and discharging of BESS without any wastage of solar power so that the prospect of using DG gets reduced. The conventional PI controller can hold in the turning on. This paper proposes Fuzzy logic controller for a mandatory percentage of charging, which is more efficient than PI controller. Comparison of charging controller based on PI and fuzzy logic controller is analyzed in this paper. The added main feature in the proposed system is the supplement Battery Energy Storage System which may replace BESS when there is any failure in BESS, it is monitored and controlled by EBMC. The solar power source is effectively utilized and life of the battery is increased by EBMC. Dependability of the power system is increased by the battery fault management system. The integral scheme is simulated using MATLAB/Simulink.

Keywords - Battery fault management, Diesel Generator, Fuzzy Logic Controller, HPS, PI controller, PV

I INTRODUCTION

In the past decades, enormous amount of natural resources has been unlimitedly dissipated and our living environment has been severely polluted (BurriAnkaiah and Jalakanuru Nageswararao, 2013). With increasing concern about global warming and the depletion of fossil fuel reserves, many are looking at sustainable energy

solutions to bear on the land for the future generations. Other than hydro power, wind and photovoltaic energy holds the most potential to gather our energy needs. Wind energy alone is capable of supplying large quantities of power, but its availability in standard velocity is extremely unpredictable (Joanne Huiet al., 2010). The technical and functional characteristics of wind-diesel hybrid systems are found various disadvantages like power generation only in remote areas, the high price for its complicated and heavy mechanism of gears. Another vital renewable energy of solar energy is present throughout the daytime. It has emerged in the last decades since it has the aforesaid advantages and less maintenance, no wear and tear. The primary applications of PV systems are stand-alone systems such as water pumping, domestic and street lighting, electric vehicles, military and space applications (Sam C. M. Hui and Miss S. C. Chan, 2011- Chandrashekhar Lavania *et al.*, 2013) or grid-connected configurations like hybrid systems and power plants (Achim Woyte *et al.*, 2006). The solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc. It necessitates the integration of diesel generator with the solar power system for uninterrupted power supply. The energy storage systems play an important role in a hybrid system to perform both functions of storing and releasing energy at an adequate time. The battery stores the electric energy in DC form and it requires rectifier circuits (AC-to-DC converters), charging circuits, and DC-to-AC inverters to exchange energy with the AC system. The effective charging control increases the utility of the battery. This paper proposes Fuzzy logic controller for effective charging. The reliability of the system is uninterrupted supply of electricity. This paper proposes an embedded based automatic battery replacement in case of any failure in the main battery bank. This paper proposes uninterrupted power with very less pollution.

II SOLAR-DIESEL HYBRID POWER SYSTEM

The basic block diagram of solar-diesel hybrid power system is shown in Fig.1. The power generated by the PV panel is DC power and variable voltage because of the varying radiance of the sun. The Buck boost converter in the sequence of the source changes it as a constant voltage supply suitable for different applications. The MPPT, maximum power point tracking controller senses continuously the voltage and power produced by panel and controls the DC-DC converter with proper positioning of PV panel. The DC powers from Solar panels and battery are converted into AC with the help of inverter. The transformer placed after inverter helps in levelling the voltage as well as for a sine wave. The battery energy storage system is monitored and controlled by EBMC. The source selector is embedded based controller and it selects sources to grid based on availability of power and load demand. The Diesel generator is activated only when both solar and battery are incapable of supplying the load. Meantime, it charges the battery and it is deactivated while battery reaches 95 % of SOC (Raju.P and Vijayan.S, 2013). It minimizes the usage of diesel generator.

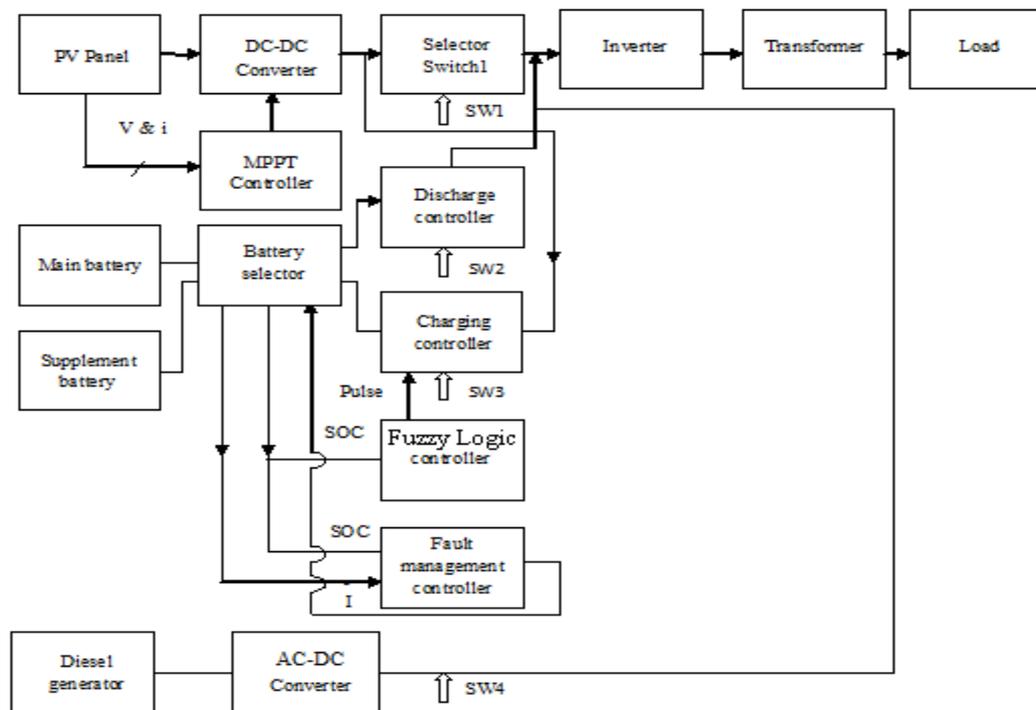


Fig.1: Block Diagram of HPS.

2.1. PV panel

The solar photovoltaic –PV cell modules generate DC electricity whenever sunlight falls on solar cells. Solar radiation sustains all forms of life on earth. According to estimates, the sun radiates 1.74×10^{17} W of power per hour to earth, the daily solar energy radiation varies from 4-7 KWh per m^2 and there are 270-300 sunny days in a year. The Single PV cell produces a rather small voltage that has a less practical use. The real PV panel always uses many cells to generate a large voltage.

2.1.1 Incremental Conductance Mppt

In this paper Incremental Conductance algorithm is proposed for MPPT. It decides duty ratio based on the power deviation. In incremental conductance method the array terminal voltage (Snyman D *et al*, 1993)(M.Lokanadham and K.VijayaBhaskar, 2012) is always adjusted according to the MPP voltage it is based on the incremental and the instantaneous conductance of the PV module. The Flow chart of incremental conductance MPPT is shown in Fig 2.

In this method the peak power of the module lies at above 98% of its incremental conductance. This method is easy to implement.

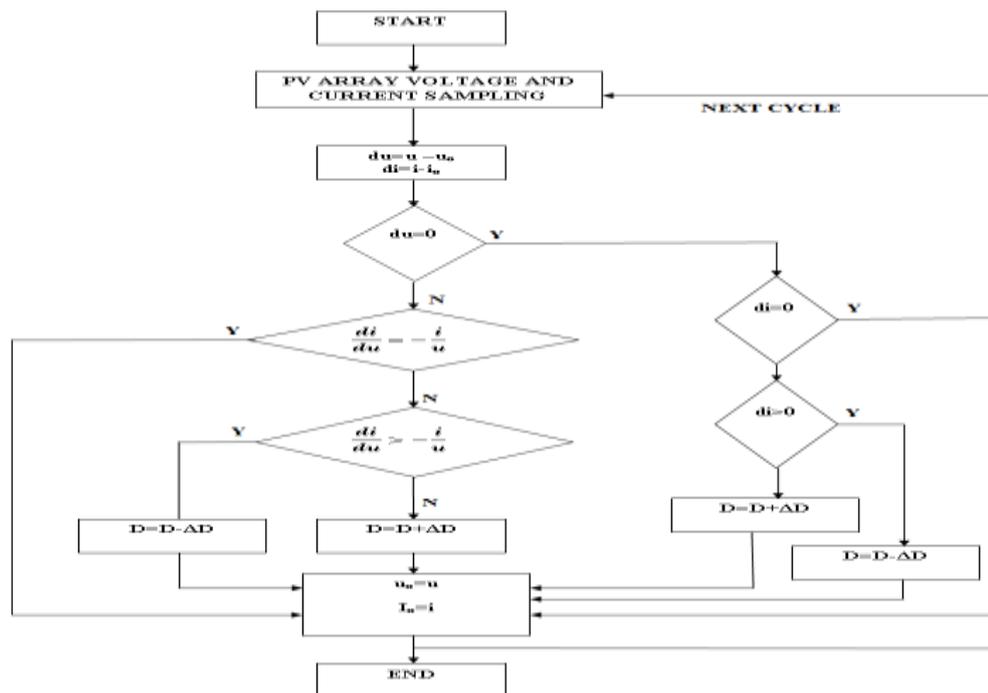


Fig. 2: Incremental conductance MPPT Flow chart.

2.1.2 DC–DC buck-boost converter

In buck–boost, step-down/up or bi-directional converters, the output voltage magnitude may be lower or higher than the input voltage magnitude (Jain S *et al.*, 2007), so this topology can be used in connecting nearly-matched battery or load and module voltages. A negative output also results from the common terminal of the input current. It is a class of switched-mode power supply (SMPS) containing at least two semiconductor switches (a diode and a transistor) and at least two energy storage element, a capacitor and an inductor. The switch is typically of a MOSFET, IGBT or BJT. Buck–boost topology can be achieved through a cascade connection of the two basic converters (buck converter and boost converter). The output–input voltage conversion ratio is the conversion ratio of the two converters in cascade when the switches in both the converters have the same duty cycle.

Battery Energy Storage System

BESS plays vital role in renewable power system to store the energy generated as well as to supply the load. The lead-acid battery is proposed in this paper for energy storage. It has two modes of operation charging and discharging modes. Based on the direction of current flow into the battery or from the battery modes are desired (Raju.P and Vijayan.S, 2013). Different parameters were used for modelling the battery (M. Kalantar and S.M. Mousavi G, 2010).

2.1.3 Effective Battery Management Controller

This paper proposes an embedded system based EBMC for fault management. EBMC continuously monitors the SOC (state of charge) of battery whenever the SOC of the battery is not raised as per defined conditions it is noted as a fault. Then EBMC replaces main battery with supplement battery to the system. Also the main advantage of EBMC is to control the charging with the help of Fuzzy logic controller for effective charging. The effectiveness of proposed charging is analysed with the conventional PI controller.

2.1.4 PI controller

Proportional plus Integral Controller is the simple control and widely used in industries. It increases the speed of response (Govind Anil) (HeberttSirra Ramirez, 1991) and produces very low steady state error. In this paper error of SOC is given as input to PI controller and output is taken to the charging controller. PI controller produces a duty ratio for MOSFET in charge controller. In this paper Ziegler Nichols' method of tuning is implemented to find the optimum value of K_p & K_i values. The Output of the PI controller is compared to the saw tooth and produces triggering pulses for charging controller and produces pulsed DC for battery charging.

2.1.5 Fuzzy Logic Controller

To determine the duty ratio of the charging controller, Fuzzy logic controller is proposed in this paper. Fuzzy logic is the mathematical technique for dealing with imprecise data and problems have multiple solutions rather than one. Linguistic, non numerical, variables are used, making it similar to the way humans think. Fuzzy control methodology is considered as an effective method to deal with disturbances and uncertainties in terms of ambiguity. In this paper Fuzzy Logic Controller (FLC) is implemented to reduce overshoot and settling time. Fig.3 shows the basic block diagram of fuzzy logic controller (Zadeh. L.A, 1965).

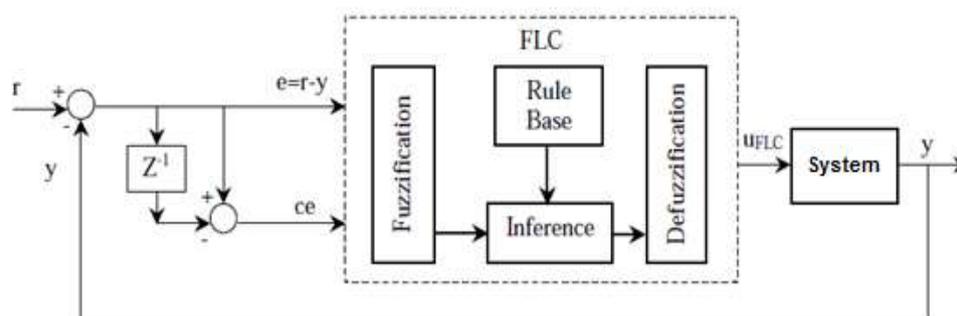


Fig. 3: Fuzzy Logic controller.

Fuzzy inference system is the overall name for a system that uses fuzzy reasoning to map an input space to an output space. There are several ways to define the result of a rule; this paper implies max-min method of inference. Here, Mamdani type of fuzzy has been implemented. It has two inputs such as Battery SOC error (e), change in error (ce) and one output ΔD which decides the duty ratio of charging controller (Raju.P and

Vijayan.S, 2013). Both input and output have five membership functions such as NB-negative big, NS-negative small, Z –zero, PS-Positive Small and PB-Positive Big. Defuzzification is the mathematical procedure to convert fuzzy values into crisp values. Many methods of defuzzification are available. In this study we have selected centroid method of defuzzification. Table-I shows the fuzzy rules. Fig.4Shows the membership functions of inputs and output.

Table-I: Fuzzy Rules.

e	ec	NB	NS	Z	PS	PB
NB		NB	NS	NS	Z	PS
NS		NB	NS	NS	PS	PB
Z		NB	NS	Z	PS	PB
PS		NB	NS	PS	PS	PB
PB		NS	Z	PS	PS	PB

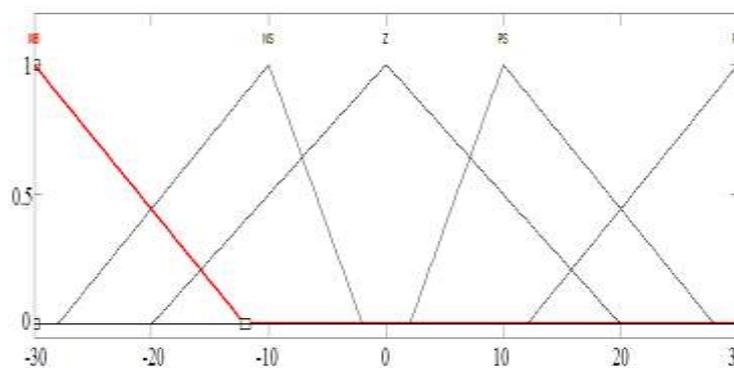
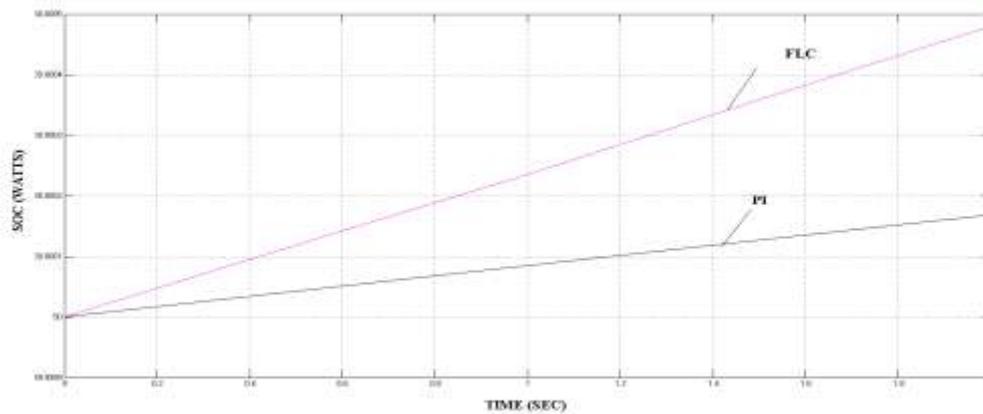


Fig.4: Membership Functions of e, ce and ΔD.

The output of the fuzzy controller is compared to the saw tooth and produces pulses for charging controller. The comparison of the SOC of batteries using PI and FLC based charging controller are shown in Fig.5

Fig. 5: Comparisons of SOC of batteries using PI and Fuzzy logic controller (FLC)



III SOURCE SELECTION CONTROLLER

Source selection controller continuously monitors the power of solar panel, SOC of BESS and load power. Based on the available power and load it selects sources to the grid. The sources may select individually as solar power or BESS or combination of Solar and battery or Diesel generator. It activates the power system in 5 modes of operation based on sources and load demand. The different modes are Solar alone Supplies load when solar power is greater than load power, Solar Supplies load and battery when solar power is very greater than load power, Solar and Battery Supplies load when solar power is lesser than load power, Battery alone Supplies load when solar power is very lesser than load power and DG alone Supplies load when solar power and battery power is very lesser than load power. The source selector effectively selects the sources based on load demand and available power. This controller minimizes the usage of Diesel Generator.

IV SIMULATION RESULTS AND DISCUSSION

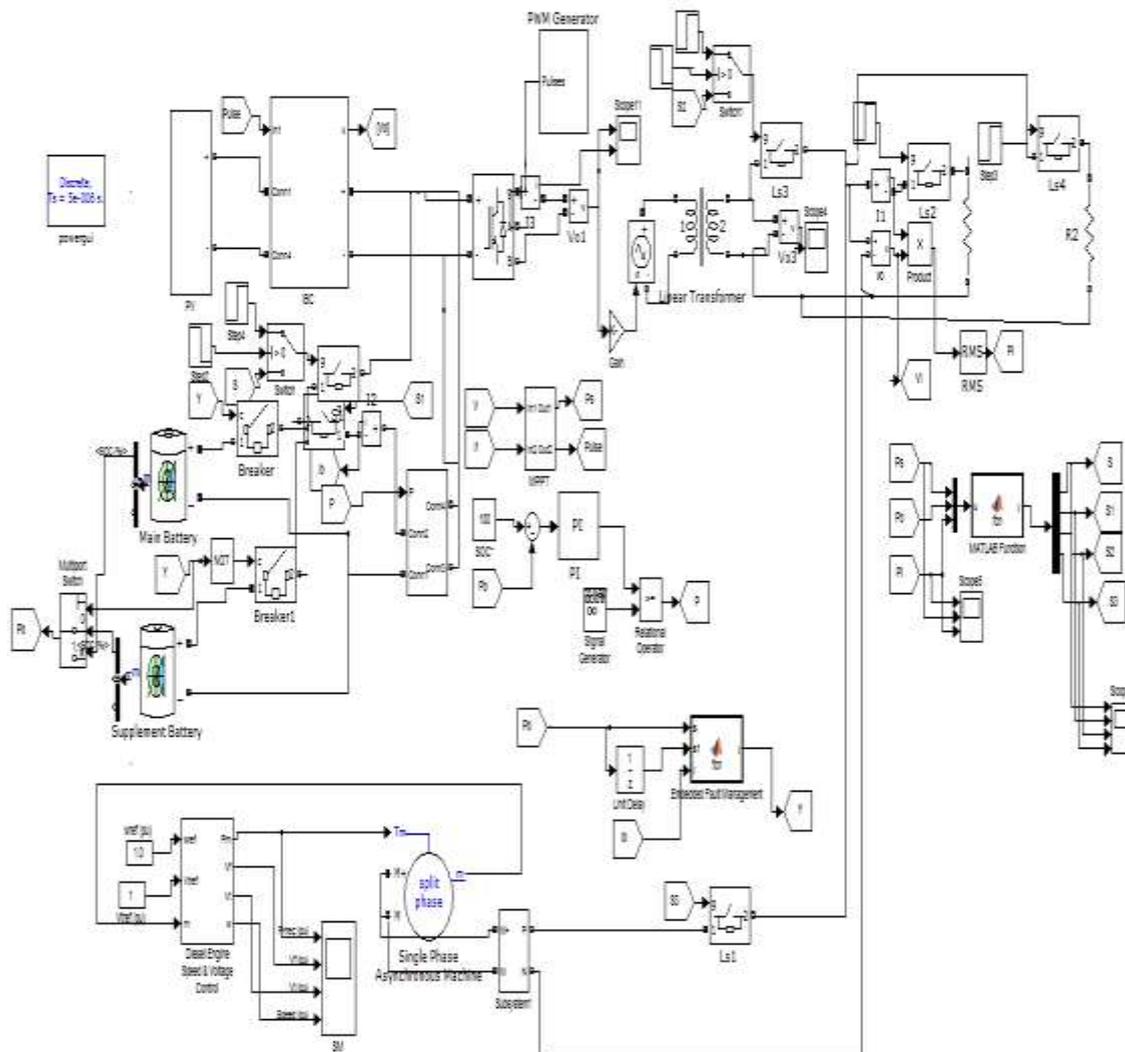


Fig. 6: Simulation model of the HPS.

Simulation model of HPS with the energy management controller is developed using MATLAB/ Simulink R2011b. Rating of the HPS is given below

Solar power plant : 3 KW

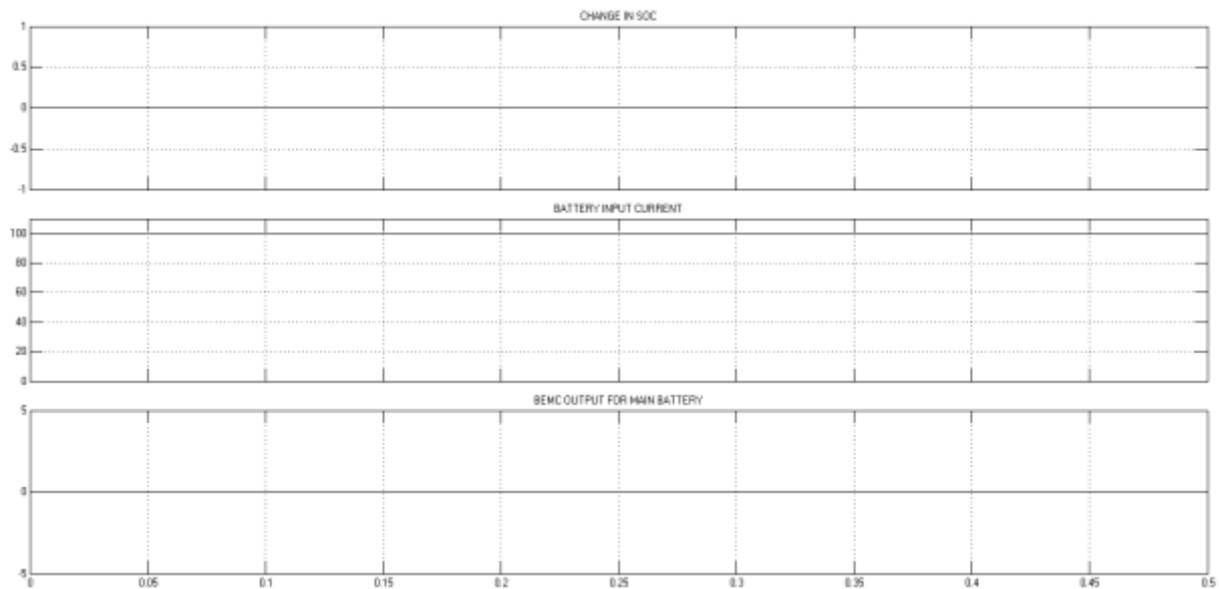
Battery : 3 KW

Diesel Generator : 6 KW

Load (AC) :3KW, 230 V, 50Hz, 1 Phase

The comparison of the SOC of batteries using PI and FLC based charging controller shows that proposed Fuzzy logic controller is more efficient than PI controller. The addition of supplement Battery Energy Storage System which may replace BESS when there is any fault in BESS is the added advantage; it is monitored and controlled by EBMC. In general the solar power source is effectively utilized and life of the battery is increased by EBMC also the usage of Diesel generator gets reduced. Simulation model of the HPS is shown in Fig. 6. Operation of EBMC in case of failure of the main battery is shown in Fig. 7.

Fig. 7: Operation of EBMC in case of failure of main battery.



IV CONCLUSION

Green energy is the essential power today for its pollution free process of power generation. Demand of electricity and fossil fuel also necessitates it. The PV power resource is advantageous than any other resources as it is suitable for any individual application or for grid. The effective utilization of energy is proposed in this paper with the help of Embedded based source selector. Reliability of the power system is increased by using automatic replacement of the battery in case of any fault by EBMC. Lifetime and efficiency of batteries are increased with the help of Fuzzy logic controller based charging controller. The FLC based charging controller reduces the charging time compared to PI controllers. Uninterrupted power is delivered by solar-diesel hybrid power system. The proposed system reduces utilization of diesel generator which results in reduction of cost for fossil fuel and reduced pollution.

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PERFORMANCE OF PIGEONPEA (CAJANUS CAJAN L. MILLSP.) VARIETIES UNDER NUTRIENT MANAGEMENT GROWN IN KHARIF SEASON

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ABSTRACT

The field experiments were conducted at Agronomy Department Farm, College of Agriculture, Dapoli. Dist. Ratnagiri during *Kharif* seasons 2012 and 2013 to study the “Response of pigeonpea (*Cajanus cajan* L. Millsp.) varieties to nutrient management grown in *Kharif* season”. The experiment was laid out in a split plot design with three replications. The main plot treatments were four varieties, namely, Konkan Tur-1, ICPL-87, Vipula and BSMR-736. The sub plot treatments comprised six nutrient management treatments *viz.*, Control (F₁-No application of nutrients), RDF (F₂-25:50:00 NPK Kg ha⁻¹), RDF + Biofertilizers - *Rhizobium* + PSB (F₃), 75 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - *Rhizobium* + PSB (F₄), 100 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - *Rhizobium* + PSB (F₅) and application of major and micronutrients based on soil test (NPK through soil + micronutrients (Cu, Zn, B and Mn) through foliar spray) + Biofertilizers - *Rhizobium* + PSB (F₆). Results revealed that BSMR-736 variety of pigeonpea produced maximum and significantly higher grain and stalk yields during individual years as well as in pooled data as compared to rest of the varieties. The grain and stalk yields of pigeonpea during individual years as well as in pooled analysis were significantly higher when the crop was supplied with major and micronutrients based on soil test (25:75:00 N:P₂O₅:K₂O kg ha⁻¹ through soil and micronutrients 0.075 : 0.75 : 0.25 : 0.50 % Cu:Zn:B:Mn through foliar spray) along with seed inoculation of *Rhizobium* and PSB @ 25 g each kg⁻¹ seeds. (F₆) as compared to other treatments.

Keywords : Pigeonpea, Nutrient Management, Growth, Yield

I INTRODUCTION

Pigeonpea (*Cajanus cajan* L. Millsp.) is one of the important pulses crop of India and ranks second after chickpea in area and production. It is commonly known as 'Redgram' or 'Arhar'. Endowed with several unique characters, pigeonpea finds an important place in the farming systems adopted by the farmers in the large number of developing countries including India. It is grown on a wide range of soil with varying physical and chemical properties. Pigeonpea being a legume, it fixes atmospheric nitrogen. The leaf fall at maturity adds organic matter to the soil. The outstanding deep root system allows for optimum moisture and nutrients utilization which enables it to tolerate drought, the deep root system breaks the hard pans and hence it is often called as "biological plough". The yield of any crop depends on the production potential of the cultivar and climatic, edaphic and management practices to which the cultivar is exposed. The cultivars recommended earlier in the region or in different agro-climatic conditions be tested with newly introduced or developed cultivars so as to understand the production potential of different cultivars to that region. The main reason for low productivity of pigeonpea is its cultivation in marginal and sub marginal lands under poor management. Yield is the manifestation of various physiological processes occurring in plants and these are usually modified by management practices in an environment. Among the management practices fertilization is the most important factor in determining yield of pigeonpea. Low production of pigeonpea attributed to the facts that, the crop is usually grown during rainy season on marginal and less fertile soils. Further, lack of proper nutrient management is one of the major causes of low yield. The decline in application of seed treatment of Biofertilizers nutrients and foliar spray of potassium nitrate, DAP and boron that can regulate the nutrient availability and sustain the productivity along with numerous other known advantages need to be refocused in conjunction with micronutrients (Cu, Zn, B, Mn). The use of micronutrients in pigeonpea is one of the way to boost up the productivity and to improve the seed quality parameters. Since pigeonpea crop is selected for the study, the knowledge of cost, returns and its profitability useful for the farmers who want to substitute this crop for the traditional crop grown in the area, the finding of study would be helpful to economic management of pigeonpea. It will also provide the probable combinations of chemical fertilizers, biofertilizers and micronutrients on the basis of soil test approach. The information on nutrient requirements of pigeonpea to be supplied through inorganic fertilizers is available, however, the information on differential response of pigeonpea varieties to integrated nutrient management is lacking.

II MATERIAL AND METHODS

The field experiments were conducted at Agronomy Department Farm, College of Agriculture, Dapoli. Dist. Ratnagiri during kharif seasons 2012 and 2013 to study the Response of pigeonpea (*Cajanus cajan* L. Millsp.) varieties to nutrient management grown in Kharif season. The experiment was laid out in a split plot design with three replications. The main plot treatments were four varieties, namely, Konkan Tur-1, ICPL-87, Vipula and BSMR-736 to evaluate their response to nutrient management. Whereas sub plot treatments comprised six nutrient management treatments viz., Control (F1-No application of nutrients), RDF (F2-25:50:00 NPK Kg ha⁻¹), RDF +

Biofertilizers - Rhizobium + PSB (F3), 75 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - Rhizobium + PSB (F4), 100 % RDF + Two foliar sprays of nutrients (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) + Biofertilizers - Rhizobium + PSB (F5) and application of major and micronutrients based on soil test (NPK through soil + micronutrients (Cu, Zn, B and Mn) through foliar spray) + Biofertilizers - Rhizobium + PSB (F6). The sub- plot treatments within the main plot were allotted by using random number table. The experiment was conducted at the same site during both the seasons without changing the randomisation of the treatments. The soil analysis indicated that the soil of the experimental plot was sandy clay loam in texture, moderately high in organic carbon (0.95 %), medium in available nitrogen (376.80 kg ha⁻¹), low in available phosphorus (9.20 kg ha⁻¹), medium in available potassium (309.74 kg ha⁻¹), high in available copper (1.89 mg kg⁻¹), low in available zinc (0.44 mg kg⁻¹) and boron (0.25 mg kg⁻¹), medium in available manganese (56.04 mg kg⁻¹) and slightly acidic in reaction (pH 5.80).

The quantity of major nutrients, foliar spray of nutrients and micronutrients dose was calculated and applied in the plots as per the treatments. Nitrogen and phosphorus were applied in the form of urea (46 % N) and single superphosphate (16 % P₂O₅), respectively as per the treatments as a basal dose at sowing. The foliar application of nutrients was done at flowering and 20 days after first spray as per the treatments. Sowing of different varieties of pigeonpea was done on 8th June 2012 and 2nd June 2013 by using the seed rate of 18 to 20 kg ha⁻¹ as per the treatments during both the years. Required quantity of healthy, bold, unbroken and fully developed seeds of pigeonpea varieties was inoculated with Rhizobium + PSB biofertilizers @ 25 g each kg⁻¹ seeds as per the treatments before sowing of the crop. Rows were marked on the field with the help of marker and biofertilizers treated and untreated seeds were sown at the spacing of 60 x 30 cm as per the treatments. Two seeds were dibbled at each spot at about 3 cm depth. To assess the effect of treatments on the growth and development of crop plants, periodic observations were recorded.

III RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

3.1 Effect on growth

Performance of pigeon pea varieties

Variety BSMR-736 produced significantly taller plants, produced significantly more number of branches plant⁻¹, recorded maximum and significantly higher root nodule count plant⁻¹ and accumulated significantly higher dry matter plant⁻¹ as compared to Vipula, Konkan Tur-1 and ICPL-87 at harvest during both the years. The reason for high dry matter accumulation in BSMR-736 may be traced to the significant increase in morphological parameters

viz., plant height, number of branches plant⁻¹ and number of root nodules plant⁻¹ which are responsible for the photosynthetic capacity of an individual plant. Similar results were also reported by Johansen *et al.* (1992), Bhongle *et al.* (2005).

3.2 Effect of nutrient management

Application of nutrients recorded maximum and significantly higher plant height, number of branches plant⁻¹, root nodule count plant⁻¹ and higher dry matter plant⁻¹ of pigeonpea over no application of nutrients (F₁- Control) at harvest during both the years.

Among the nutrient management treatments application of major and micronutrients based on soil test (NPK through soil + micronutrients through foliar spray) along with biofertilizers (F₆) produced maximum and significantly higher plants, number of branches plant⁻¹, root nodules plant⁻¹ and accumulated maximum and significantly higher dry matter plant⁻¹ over rest of the treatments at harvest during both the years may be attributed to the supply of balanced nutrition in available forms of essential primary, secondary and micronutrients in sufficient quantities through soil pool and foliar sprays to the crop due to this nutrient management treatment. Further, the effect observed with the dual inoculation of both the bioinoculants alongwith inorganic sources of nutrients might be due to the fixation of nitrogen by *Rhizobium* and possible solubilization of fixed P (as alumina and iron phosphates) as well as applied P besides synthesis of growth promoting substances like auxins, gibbrellins and produced vitamins which augmented plant growth by phosphorus solubilizing species, might have improved vigour and resulted in recording higher values of morphological parameters which increased photosynthetic capacity of plants thereby increasing the biological yield in terms of dry matter production plant⁻¹. Foliar sprays of copper, zinc, boron and manganese micronutrients might have been used more efficiently by the plant resulting in enhanced growth and development of plants because of their active role in plant metabolic processes such as photosynthesis, respiration and carbohydrate and amino acid synthesis which contributed for increase in various growth parameters. These results conoborates the findings of Abd-El-Lateff *et al.* (1998), Sharma *et al.* (1999).

3.3 Effect on yield

Performance of pigeonpea varieties

Variety BSMR-736 produced maximum and significantly higher grain yield, stalk yield and harvest index as compared to rest of the varieties during both the years as well as in pooled data.

On the basis of pooled data the grain yield (16.08 q ha⁻¹) of BSMR-736 was 19.77, 26.92 and 33.89 per cent higher over Vipula, Konkan Tur-1 and ICPL-87, respectively. On the basis of two years pooled data, the stalk yield (61.21 q ha⁻¹) of BSMR-736 was 8.47, 9.87 and 33.82 per cent higher over Vipula, Konkan Tur-1 and ICPL-87, respectively. These increased yield attributes of BSMR-736 might be due to increased growth parameters. Similar results have been reported by Reddy *et al.* (1985).

3.4 Effect of nutrient management

Application of nutrients produced significantly higher grain yield, stalk yield and harvest index than no application of nutrients (F_1 - Control) during both the years and in pooled data.

Pigeonpea supplied with of major and micronutrients based on soil test (NPK through soil + micronutrients through foliar spray) along with biofertilizers (F_6) produced maximum and significantly higher grain yield, stalk yield and harvest index over rest of the nutrient management treatments during both the years. Further, 100 % RDF + Two foliar sprays (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) with biofertilizers (F_5) produced significantly higher grain yield, stalk yield and harvest index over RDF alone (F_2), RDF along with biofertilizers (F_3) and 75 % RDF + Two foliar sprays (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) with biofertilizers (F_4) during both the years. Application of RDF along with biofertilizers (F_3) and 75 % RDF + Two foliar sprays (Potassium nitrate 1% + DAP 1% + Boron 500 ppm at flowering and 20 days after first spray) with biofertilizers (F_4) were at par with each other and both the treatments recorded significantly higher grain yield, stalk yield and harvest index than RDF alone (F_2) during both the years. However, when the data were pooled over the seasons, all the nutrient management treatments *viz.*, F_6 , F_5 , F_4 , F_3 and F_2 differed significantly from one another in descending order.

On the basis of two years pooled data the grain yield (16.99 q ha^{-1}) obtained under F_6 treatment was 11.53, 21.07, 25.48, 39.78 and 48.67 per cent higher over F_5 , F_4 , F_3 , F_2 and F_1 , respectively. Similarly, in the pooled analysis the increases in grain yield due to F_5 was 10.77, 15.76, 31.99, and 41.98 per cent higher compared to F_4 , F_3 , F_2 and F_1 , respectively. The marked improvement in yield attributes was due to the significant improvement in growth parameters which favourably reflected on the yield attributes of the pigeonpea due to the application of major and micronutrients based on soil test (NPK through soil + micronutrients through foliar spray) along with biofertilizers (F_6). Further, foliar application of micronutrients at flowering and 20 days after first spray would have helped for reducing flower drop and contributed more for reproductive parts resulting in increased number of pods plant^{-1} . The results are in agreement with those of Chittapur *et al.* (1994), Dixit *et al.* (2007).

IV CONCLUSION

Pigeonpea variety BSMR-736 be grown to obtain higher grain and stalk yields in lateritic soils of south Konkan conditions. To obtain higher grain and stalk yields from pigeonpea, the crop be fertilized with application of major and micronutrients based on soil test (25:75:00 N:P₂O₅:K₂O kg ha⁻¹ through soil and micronutrients 0.075 : 0.75 : 0.25 : 0.50 % Cu:Zn:B:Mn through foliar spray) along with seed inoculation of Rhizobium and PSB @ 25 g each kg⁻¹ seeds.

Table 1. Mean growth parameters of pigeonpea as influenced by different treatments

Treatments	plant height (cm)		number of branches plant ⁻¹		root nodules plant ⁻¹		dry matter accumulation plant ⁻¹ (g)	
	2012	2013	2012	2013	2012	2013	2012	2013
Variety								
V ₁ - Konkan Tur- 1	186.41	184.40	21.82	19.73	28.76	27.97	112.51	109.89
V ₂ - ICPL- 87	124.03	121.95	20.50	18.56	29.14	27.47	73.49	70.82
V ₃ - Vipula	187.63	185.58	22.78	20.71	29.42	28.12	113.30	110.66
V ₄ - BSMR-736	193.96	192.88	25.50	23.06	38.56	36.28	124.08	121.86
S.Em. ±	0.36	0.37	0.29	0.33	0.11	0.15	0.24	0.23
CD at 5%	1.26	1.29	1.02	1.14	0.37	0.51	0.83	0.78
Nutrient management								
F ₁ - Control	167.29	165.45	18.14	16.02	27.03	25.63	101.34	98.74
F ₂ - RDF	171.08	169.28	21.08	18.97	29.41	27.85	103.72	101.38
F ₃ - RDF + Biof.	172.62	170.81	22.34	20.24	30.94	29.39	105.34	102.76
F ₄ - 75 % RDF + 2 FS + Biof.	173.99	172.19	23.42	21.32	32.06	30.59	106.45	103.88
F ₅ - 100 % RDF + 2 FS + Biof.	175.62	173.82	24.81	22.64	33.73	32.19	108.22	105.66
F ₆ - STCR approach + Biof.	177.47	175.68	26.13	23.90	35.65	34.11	110.01	107.46
S.Em. ±	0.51	0.53	0.44	0.41	0.40	0.51	0.46	0.48
CD at 5%	1.45	1.52	1.25	1.18	1.13	1.46	1.31	1.36
Interaction								
S.Em. ±	1.02	1.06	0.88	0.83	0.79	1.02	0.92	0.95
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
General mean	173.01	171.20	22.65	20.51	31.47	29.96	105.84	103.31

Table 2. Mean grain, stalk yield and harvest index of pigeonpea as influenced by different treatments

Treatments	Grain yield (qha ⁻¹)			Stalk yield (qha ⁻¹)			Harvest Index (%)	
	2012	2013	Pooled	2012	2013	Pooled	2012	2013
Variety								
V ₁ - Konkan Tur- 1	12.27	11.22	11.75	56.16	54.32	55.24	17.54	16.63
V ₂ - ICPL- 87	11.14	10.13	10.63	41.48	39.64	40.56	20.89	20.02
V ₃ - Vipula	13.33	12.47	12.90	56.94	55.10	56.02	18.72	18.17
V ₄ - BSMR-736	16.53	15.64	16.08	62.10	60.31	61.21	20.92	20.47
S.Em. ±	0.34	0.37	0.50	0.34	0.39	0.52	-	-
CD at 5%	1.16	1.28	1.73	1.18	1.36	1.80	-	-
Nutrient management								
F ₁ - Control	9.27	8.17	8.72	49.73	47.88	48.81	15.61	14.44
F ₂ - RDF	10.73	9.73	10.23	51.96	50.11	51.04	17.01	16.09
F ₃ - RDF + Biof.	13.14	12.18	12.66	53.67	51.83	52.75	19.70	19.04

F ₄ – 75 % RDF + 2 FS + Biof.	13.89	12.94	13.41	54.79	52.95	53.87	20.22	19.61
F ₅ – 100 % RDF + 2 FS + Biof.	15.51	14.55	15.03	56.57	54.73	55.65	21.58	21.04
F ₆ – STCR approach + Biof.	17.35	16.62	16.99	58.31	56.55	57.43	22.96	22.73
S.Em. ±	0.49	0.52	0.14	0.57	0.54	0.15	-	-
CD at 5%	1.40	1.48	0.39	1.64	1.54	0.43	-	-
Interaction								
S.Em. ±	0.98	1.04	0.56	1.14	1.08	0.61	-	-
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	-	-
General mean	13.32	12.36	12.84	54.17	52.34	53.26	-	-

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OBSERVATION ON LENGTH – WEIGHT RELATIONSHIP AND RELATIVE CONDITION FACTOR

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ABSTRACT

The present study deals with the analysis of length – weight relationship and relative condition factor of a rare minor catfish- *Amblyceps mangois*, collected from river Mandal a tributary of Ramganga in Garhwal Himalaya. The length-weight relationship of males and females were analyzed separately by grouping them into sex-wise and season-wise. Analysis was also made for pooled data. The analysis showed that the total length of *Amblyceps mangois* was positively correlated to its weight ($r=0.6029$) in case of pooled data. The correlation was also positive for male ($r = 0.5890$) and female ($r = 0.6354$) sexes separately. The regression coefficient for sex wise and pooled data varied from a minimum of 0.4035 for pooled data to a maximum of 0.6152 for the male. For season and sex wise it ranged from a minimum 0.1135 ($r = 0.7358$) during autumn to 0.8197 ($r = 0.4124$) during monsoon (maximum) for male and from 0.0936 ($r = 0.7378$) in autumn (minimum) to 1.0986 ($r = 0.8366$) in monsoon (maximum) for female fish. The value of relative condition factor (K_n) was calculated for each fish and finally the average K_n value for different sexes during different month was calculated. The maxima during monsoon and winter can be correlated to sexual maturity (Monsoon) and the suitability of environment for food availability (winter) in the river Mandal.

Keywords- *Amblyceps manggois*, river mandal, length, weight and relative condition factor.

I. INTRODUCTION

The study of length - weight relationship has its applied value in fish biology as it is an indicative parameter to determine the growth of fish in different environments. Data pertaining to length and weight of body in relation to age can give information on the stock composition, health status, life span, mortality, growth and productivity. Length-weight relationship has been commonly used for two different purposes. Firstly, to describe the mathematical model between length and weight so as to derive one parameter from the other. It is highly valuable in cases where weight can be determined from length already known and vice versa. Secondly, the length weight relationship is used to compute the deviation from the expected weight for length of the

individual fish or a group of fishes as indications of fatness or degree of well-being of fish, this relationship is called “condition factor”.

Statistical relationship between length and body weight provides an opportunity to calculate an index known as relative condition factor (K_n), which is commonly used by fishery biologists to know the well-being of a fish. Fish with high value of K_n are heavy for its length, while fish with low K_n value are lighter which has been calculated as the ratio between the observed weight and that of the expected weight from the observed length (regression analysis). It was also aimed to collect some important information through statistically analyzing the regression coefficient that might have the important implication towards its conservation and management

Present study is an attempt to study length weight relationship and relative condition factor of *Amblyceps mangois*. It is for the first time that this species is being studied from Garhwal region. May be it is first attempt on this species as I could not find any reference on detailed biology of this rare species.

II. MATERIALS AND METHODS

The total length and weight of fish were recorded in fresh condition. However, the other parameters were measured within a fortnight of collection. The length-weight relationship of males and females were analyzed separately by grouping them into sex-wise and season-wise. Analysis was also made for pooled data. The equation for the length-weight relationship was computed by using the formula for general parabola:

$$W = a L^n \text{ (Le Cren, 1951 [11]),}$$

Where:

W = weight of fish

L = length of fish

a and n are the constants

The linearity of regression was tested by the analysis of variance. Based on the data collected and computed for length-weight relationship.

The Relative condition factor (K_n) was calculated for different sexes, month wise and season wise to know the well-being of the fish by the formula:

$$K_n = W / W \bar{}$$

Where

K_n = Relative condition factor

W = observed weight

$W \bar{}$ = calculated weight

III. OBSERVATIONS

3.1 Length- Weight Relationship

Data related to regression analysis and coefficient of correlation on length-weight relationship for *Amblyceps mangois* sex wise, season wise and pooled data is presented in Table 1. The analysis showed that the total length

of *Amblyceps mangois* was positively correlated to its weight ($r=0.6029$) in case of pooled data. The correlation was also positive for male ($r = 0.5890$) and female ($r = 0.6354$) sexes separately.

The fish samples were also grouped for different seasons and sex wise which showed a close relationship between their length and weight. The regression coefficient for sex wise and pooled data varied from a minimum of 0.4035 for pooled data to a maximum of 0.6152 for the male. For season and sex wise it ranged from a minimum 0.1135 ($r = 0.7358$) during autumn to 0.8197 ($r = 0.4124$) during monsoon (maximum) for male and from 0.0936 ($r = 0.7378$) in autumn (minimum) to 1.0986 ($r = 0.8366$) in monsoon (maximum) for female fish.

3.2 Relative Condition Factor (RCF)

The value of relative condition factor (K_n) was calculated for each fish and finally the average K_n value for different sexes during different months was calculated and presented in Table 2. It showed that the relative condition factor was minimum 0.6675 ± 0.5442 during April in male, and 1.0004 ± 0.0179 (December) in female. The maximum value of 1.006 ± 0.0065 was observed for male (July) Fig 4.4 and 1.0019 ± 0.092 for the female (July) fig 4.5.

The average K_n values for male and female fish during different seasons were also calculated (Table 3). The values were maximum during Monsoon (1.0713 ± 0.7033) for males and 1.2079 ± 0.1372 during winter for females. The maxima during monsoon and winter can be correlated to sexual maturity (Monsoon) and the suitability of environment for food availability (winter) in the river Mandal.

IV DISCUSSION

It was generally observed that the relation between length and weight is expressed by the hypothetical cube law, $W=CL^3$. This cubic relationship holds good only in the ideal fish where the specific gravity and form remains unaltered as they grow. As pointed out by Le Cren (1951) [11] since fishes normally do not remain of the same shape or body outline, throughout their life time and since the specific gravity of the tissues also may not remain constant, the actual relationship may sometimes deviate significantly from this cubic relationship. In such fishes it is better to fit general parabolic equation, $W=aL^b$. The study of length –weight relationship have been made by Le Cren (1951) [11] in *Precafluviatilis* who reviewed the cubic parabola into a general parabola. According to Hile (1936) and Martin (1949) the value of “b” may vary from 2.5 to 4.0. If fish retains the same shape it grows isometrically and length exponent “b” has the value 3.0. A value significantly larger or smaller than three, shows that fish becomes heavier or lighter for its length as it grows. .

Significantly low values of regression coefficient (b) were observed in the present study. It was maximum 1.0986 of female fish and 0.8197 for male in monsoon. It shows that the fish doesn't gain weight with the increment in length. This high value in monsoon may be due to sexual maturity. In other months the values were rather less than one. The second highest value was recorded in summer which is best feeding time of fish. .

Narasimha (1970) [13] reported that the value of b was 3.4169 and 3.4369 for male and female of *Trichiuruslepturus*. Chondar (1972) observed the exponent value as 3.1586 in case of *Labeogonius*. Hossain et.al

(1975), while studying the length weight relationship of the fish *Barbodesgonionotus*, observed that the values of 'log a' and regression co-efficient 'b' were -2.34636 and 3.380 respectively and for *Pangasiussutchi*, the equation was $\log W = -2.10098 + 3.0507 \log L$. The correlation co-efficient (r) between log of total length and that of body weight was 0.991 for *B. gonianotus* and 0.998 for *P. sutchi*. Soni and Kathal (1979) [19] reported the higher value of b as 4.36 for *Cirrhinamrigala* and concluded that it was due to the presence of large quantities of sand and mud in the stomach, resulting in an increase in the total weight. According to Pathani (1979) [14], the length weight relationship of *P. conchoniuis* for whole sample was calculated and found a curvilinear regression line, where it can be expressed as: $-\log W = 0.2255 + 0.70 \log L$. This relationship was highly significant as coefficient of condition (r) was obtained 0.97089.

Lal (1980) [8] while working in the fish *Rita rita* reported that the length weight relationship does not differ significantly between the sexes, seasons and year. He reported a parabolic relationship in all these cases and the regression coefficient in between 2.7 to 3.0. Thakre and Bapat (1984) [20] observed that the value of "b" was 3.1524 for female and 3.2190 for the male *Rosboradaniconicus*. They stated that these values were slightly greater than 3, thus clearly if not perfectly, supported the cube law. Tripathi (1984) [21] noticed in *Bariliusbendelisis* that male and female fishes has significant different rates of growth in length and weight respectively. He calculated the "n" value of *Bariliusbendelisis* as 3.0 for males and 2.99 for females. Reddy and Rao (1992) [15], observed a 'n' value (3.028509) more than '3' indicating a good growth of weight in relation to length of *Puntius sophore* from Hussainsagar lake. Abdollah (2002) [1], recorded b values between 2.5 to 3.44 for the fishes studied in different marine body. Ali et.al (2002), recorded value of b as 2.9 for site 1 and 2.29 for site 2. They concluded that *Channa punctatus* of both sites were growing with negative allometry. Bali and Sharma (2002) [4] studied the relationship in *T. puitora*, from Beas river and observed low regression coefficient (2.5) in the male fishes. Zafar et.al (2003) [23], worked on *Catla catla* and observed that weight of fish increases as the cube of length. The value of $b=3.02$ showed that the fish is growing isometrically in relation to length.

Saran and Mohan (2004) [18] observed that the value of "b" was 3.1262 for the pooled data of fish *Cyprinus carpio*. Uniyal et.al (2004), found that the *Tor chelynoides* had high regression coefficient 'b' which was 3.83 for male (r = 0.96), 6.15 (r = 0.891) for female and 5.03 (r = 0.903) for pooled data. The higher values were either due to maturation of gonads during summer (4.12 for males and 6.94 for females) or due to favorable feeding environment in winter (3.05 for males and 4.65 for females). According to Nagesh et. al (2004) [12], the three Indian major carps follow cubic law very closely indicating isometric growth as 'b' value of the three species did not differ significantly from the theoretical value of 3. This is also supported by high correlation co-efficient (r) values i.e., 0.9865, 0.9778 and 0.9466 for *Rohu*, *Catla* and *Mrigal*, respectively.

Salam et.al. (2005) [16], observed regression coefficient as 2.80 in *Puntius chola*. According to Fafioye and Oluajo (2005), the values of b were 2.790 and 2.880 recorded for *Clarias gariepinus* and *Uisha africana* respectively. They concluded that the rate of increase in body length is not proportional to the rate of increase in body weight. This is a negative allometric growth. The values of "b" for *Chrysichthys wolke* (3.114) *Chrysichthys nigridigitatus* (3.042) and *Ethmalora fimbriate* (3.210) show positive allometric or an approximate isometric growth.

In the present investigation on *Amblyceps mangois* the relative condition factor for male fish was observed in a range from 0.6675 ± 0.5442 in April to 1.006 ± 0.0065 in July. For female fish it was maximum 1.0027 ± 0.0641 in November and minimum 0.8568 ± 0.3759 in August. Seasonal fluctuation in the values were from 1.0002 ± 0.2445 (summer) to 1.0713 ± 0.7033 (monsoon) for males and from 0.9993 ± 0.0928 (spring) to 1.2079 ± 0.1372 (winter) for females.

According to Hart (1946), the inflexion point on the K_n value curve is good indicator of size at first sexual maturity. Le Cren (1951) [11] maintained that the condition factor is affected by length as well as several other factors like environment, food supply and degree of parasitism. He suggested that the effect of length and its correlated factors may be eliminated by using a relative condition factor (k_n) which is based on the empirical (observed) and calculated length weight relationship. The value of $K_n > 1$ points toward good health of the fish and $K_n < 1$ opposite. In his work on *Perch fluviatilise* indicated that k_n was function of fatness and condition of gonads. He also observed that there is a regular seasonal cycle in the relative condition, which is its peak in September and minimum in early spring. The different seasonal changes in condition between mature and immature fish can largely be accounted for by the cycle in gonad weight of the former. He also discussed the superiority of relative condition (K_n) over the condition factor (K). According to him, the former measures all variations (i.e. Variations associated with food supply, sexual conditions etc.) not connected with length, while the latter fails to do so unless the exponent value (b) is equal to 3, which is rarely the case.

According to Zafar et.al (2003) [23] the conditions factor (k) appears to remain constant with increasing length or weight in *Catla catla*. Uniyal et.al (2004) [22] also related relative condition factor with better feeding period due to favorable ecological parameters in *Tor chelynoides* from river Western Nayar. According to Nagesh et.al (2004) [12], the average K_n values for *Rohu*, *Catla* and *Mrigal* were found to be 1.02, 1.022 and 1.03 respectively. The K_n values for three species indicate that all three species exhibit healthy and robust condition showing good compatibility with the environment. Saran and Mohan (2004) [18] reported that the value of condition factor was in between 0.78 to 1.69 and relative condition value was from 0.58 to 1.28 in *Cyprinus carpio*. The condition factor and relative condition factor were not showing an increasing trend with the increase in body length. Salam et.al (2005), stated that the condition factor (K) appears to remain constant with increasing length and weight in *Puntius chola*. Laskar et al (2005) noticed on average value of K_n being 1.005 in *N. hexagonolepis* from Arunachal Pradesh.

Bahuguna (2007) [7] studied the relative condition factor of *Puntius conchoniis* and reported that it was maximum in the month of May (1.006 ± 0.058) and minimum in the month of August (0.970 ± 0.001) for male and high in May (1.0020 ± 0.081) and least in August (0.911 ± 0.228) for female. Seasonal values of K_n reported by Bahuguna (Op.cit.) were maximum in spring for male (1.0012 ± 0.064) and summer for female (1.0091 ± 0.071). Krishna Rao (2007) [18] studied the relative condition factor in *Mystus cavasius* from Hemavati reservoir in Karnataka and reported the value in a narrow range of 1 to 1.02. Sanwal et.al. (2010) studied both the relative condition factor (K_n) as well as Condition factor (K) for chocolate mahseer *Neoleoscheilus hexagonolepis* and found the values almost similar in between 0.885 to 1.019. The value of K_n was always slightly more than the value of K.

Table-1: Regression analysis and coefficient of Correlation on length weight relationship of *A.mangois* based on the fish collected from January 2008 to December 2010.

S. No	CONDITION	PARABOLIC EQUATION	CORRELATION COEFFICIENT (r)
1.	Sex wise and Pooled data		
	Male	$W = -3.2894 L^{0.6152}$	0.5890
	Female	$W = -1.6987 L^{0.4135}$	0.6354
	Pooled data	$W = -1.6165 L^{0.4035}$	0.6029
2.	Season and Sex wise		
	Male		
	Winter (Dec.–Feb.)	$W = -0.3681 L^{0.15803}$	0.7427
	Spring (Mar.–Apr.)	$W = -0.7312 L^{0.2741}$	0.9273
	Summer (May –Jun.)	$W = -0.9754 L^{0.4826}$	0.5364
	Monsoon (Jul. – Aug.)	$W = -3.8264 L^{0.8197}$	0.4124
	Autumn (Sep.–Nov.)	$W = -0.3735 L^{0.1135}$	0.7358
	Female		
	Winter (Dec. – Feb.)	$W = -0.0224 L^{0.1187}$	0.9030
	Spring (Mar. –Apr.)	$W = -0.3058 L^{0.2183}$	0.7638
	Summer (May – Jun.)	$W = -1.9461 L^{0.5360}$	0.6264
	Monsoon (Jul. – Aug.)	$W = -6.2310 L^{1.0986}$	0.8366
	Autumn (Sep. – Nov)	$W = -0.3435 L^{0.0936}$	0.7378

Table 2: Monthly fluctuation in relative condition factor (Kn) for different months for *A.mangois* (Ham.-Buch.) from January 2008 to December 2010.

Months	Male				Female			
	Range				Range			
	Min.	Max.	Average	S.D.	Min.	Max.	Average	S.D.
Jan	0.9348	1.3896	1.0010	0.0314	0.9905	1.0106	1.0009	0.0083

Feb	0.9674	1.0273	1.0005	0.0949	1.0005	1.0020	1.0013	0.0008
Mar	0.8928	1.0616	1.0023	0.0251	0.8972	1.0602	1.0014	0.0576
Apr	0.9284	1.0420	0.6675	0.5442	0.9640	1.0477	1.0002	0.0348
May	0.9686	1.0482	1.0006	0.0290	0.9813	1.0104	1.0004	0.0165
Jun	0.7637	1.1394	1.0044	0.1430	0.9135	1.0481	1.0006	0.0448
Jul	0.9962	1.0076	1.0060	0.0065	0.8160	1.1056	1.0019	0.0920
Aug	0.8301	1.1439	1.0050	0.1337	0.9944	1.8219	0.8568	0.3759
Sep	0.4785	1.0424	0.8996	0.2380	0.9761	1.0481	1.0008	0.0409
Oct	0.8752	1.0386	0.9625	0.0678	0.9452	1.0782	1.0023	0.0507
Nov	0.9660	0.9937	0.9844	0.0159	0.9276	1.0833	1.0027	0.0641
Dec	0.9721	1.0092	0.9965	0.0208	0.9878	1.0268	1.0004	0.0179

Table 3: Seasonal fluctuation in Relative condition factor (K_n) for different Sexes in *A.mangois* (Ham. – Buch.) during January 2008 to December 2010.

Season	Male				Female			
	Min.	Max.	Average	S.D.	Min.	Max.	Average	S.D.
Winter (D, J, F)	0.7017	1.2818	1.0174	0.2183	0.8792	2.2533	1.2079	0.1372
Spring (M, A)	0.8030	1.1859	1.0006	0.1391	0.8376	1.1530	0.9993	0.0928
Summer (M, J)	0.7058	1.3473	1.0002	0.2445	0.6537	1.2022	1.0026	0.2331
Monsoon (J, A)	0.1507	1.3708	1.0713	0.7033	0.0686	1.6434	1.1814	0.6075
Autumn (S, O, N)	0.7307	1.4916	1.0061	0.2396	0.6242	1.4290	1.0058	0.2132

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CLUSTER HEAD FAULT TOLERANCE MECHANISM USING DUAL CH FOR WIRELESS SENSOR NETWORK

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ABSTRACT

Wireless Sensor Networks (WSN) have become a critical research issue for a wide range of applications such as environmental monitoring, medical, habitat monitoring, surveillance and tracking systems with the improvement of wireless communication and VLSI technology. WSN is consisted of a large number of sensor nodes to collect the information and dispatch information. . As power is a limiting factor in a WSN, the major challenge in deploying a WSN is to enhance the network life time. So, it becomes inevitable to devise an efficient method of conserving the power. Wireless Sensor Networks have many nodes are connected to the network to calculate the network performance like transmission power. The power consumption is directly related to the size and weight of the nodes. It gains low cost and also to detect shortest path to transmitted the power through the network. The major design challenge for WSN is to extend the lifetime of sensor nodes longer and reduce power consumption important issue to prolong the lifetime of WSN.

Keywords: *Graph Theory, Transmission Power, Shortest Path*

I. INTRODUCTION

Wireless sensor networks (WSNs) have become a hot research topic in recent years. Wireless sensor network is one of the pervasive networks which sense our environment through various parameters like heat, temperature, pressure, etc... [1] Since sensor networks are based on the dense deployment of disposable and low-cost sensor nodes, destruction of some nodes by hostile action does not affect a military operation as much as the destruction of a traditional sensor, which makes the sensor network concept a better approach for battlefields. [2]. The transmission between the two nodes will minimize the other nodes to show the improve throughput and greater than spatial reuse than wireless networks to lack the power controls. Transmission Power technique to improve the Network Life Time in Wireless Sensor Networks [3]. Wireless sensor networks (WSNs) are emerging as an effective means for environment monitoring to improve the quality of life and safety in emergency situations. Sensor networks are equipped with energy limited batteries, energy conservation in such networks is prolong the network lifetime. Advances in wireless sensor network (WSN) technology has provided the various types of physical and environmental conditions, data processing, and wireless communication and

the characteristics of wireless sensor networks require more effective methods for data forwarding and processing.

II. GRAPH THEORY

Graph theoretical ideas are highly research areas of computer science such data mining, image segmentation, clustering, image capturing, networking etc., Modeling of network topologies can be done using graph concepts. The shortest spanning tree in a weighted graph, obtaining an optimal match of nodes and distance and locating the shortest path between two vertices in a graph.

Some algorithms are as follows:

1. Shortest path algorithm in a network
2. Finding a minimum spanning tree
3. Finding graph planarity
4. Algorithms to find adjacency matrices.
5. Algorithms to find the connectedness
6. Algorithms to find the cycles in a graph
7. Algorithms for searching an element in a data structure (DFS, BFS) and so on.

III. RELATED WORK

Many algorithms and techniques have been developed that utilize power in an efficient manner. Some of the techniques and methods that are used to design the proposed algorithm are discussed here to know how power is dynamically reconciled to meet the constraint of power depletion in nodes of the network.

Sorooshyari et.al. have addressed the problem of adjusting the transmission power level at each wireless radio interface on a per packet basis, based on user and network applications. They have put forth a power control policy that enables a user to address various user – centric and network – centric objectives. The proposed power control policy is optimal with respect to users dynamically allocating transmit power.

Correia et. al. in have devised two transmission power control protocols for WSNs, which can be embedded into any existing MAC protocol. The first, called Hybrid,

calculates the ideal transmission power using a closed control loop that iterates over the available transmissions powers in order to maintain a target link quality. The second, called AEWMA, employs calculations to determine the ideal transmission power based on the reception transmission power and average noise.

Arnab Nandi et. al. have propose power based transmission scheme for WSN where transmit power is adapted depending on node density and channel conditions so as to maintain a desired level of signal detection probability at a receiving node as demanded by sensing range. They have compared the energy level performance and the proposed transmit power schemes. With respect to energy consumption, they have shown that the proposed scheme consumes less energy than FTPS in moderate and high node spatial density region.

Jasmine Norman in their paper have developed Random Geometric Graphs a very influential and well-studied model of large networks, such as sensor networks, where the network nodes are represented by the vertices of the RGG, and the direct connectivity between nodes is represented by the edges. This assumes homogeneous

wireless nodes with uniform transmission ranges. In real life, there exist heterogeneous wireless networks in which devices have dramatically different capabilities. The connectivity of a WSN is related to the positions of nodes, and those positions are heavily affected by the method of sensor deployment. As sensors may be spread in an arbitrary manner, one of the fundamental issues in a wireless sensor network is the coverage problem. study connectivity and coverage in hybrid WSN based on dynamic random geometric graph.

B. Baranidharan in their paper have energy efficiency in wireless sensor network [WSNs] is the highly sorted area for the researchers. Number of protocols has been suggested for energy efficient information gathering for sensor networks. These protocols come under two broad categories called tree based approach and clustering techniques. In these techniques clustering is more suitable for real time applications and has much more scalability factor when compared with its previous counterpart. It presents the importance and factors affecting the clustering. Surveyed the different clustering algorithms with its extensions till date and proposed the clustering technique using Minimum Spanning Tree [MST] and shortest path concept with its strength and limitations.

IV. PROPOSED WORK

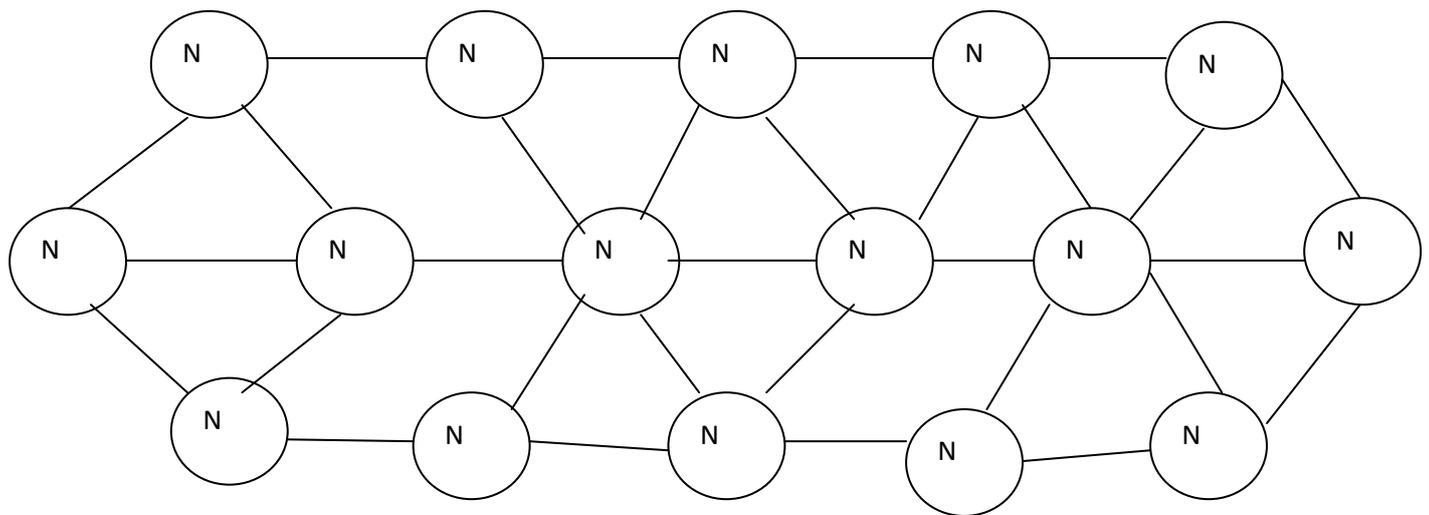


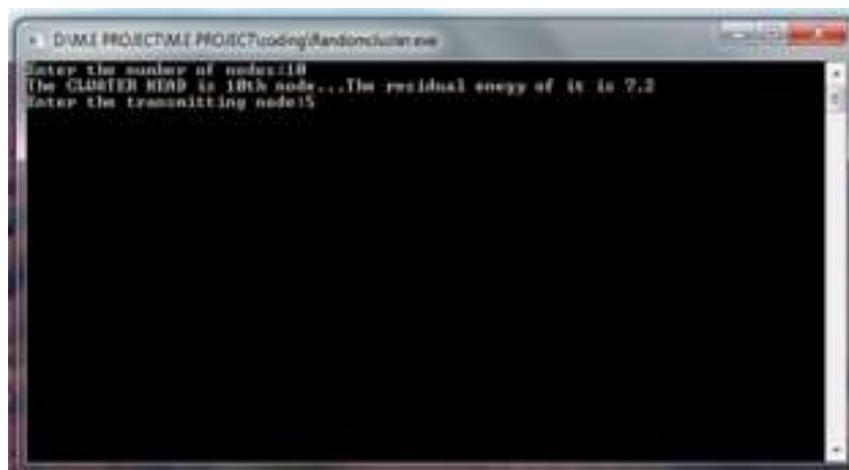
Figure 1: Network Structure

The main objective of the paper is to develop a transmission power technique using graph approach. The Graph based Transmission Power is developed to prolong the lifetime of WSN by reducing the communication mechanism with reduced processing and network power consumption. The basic ideology behind this novel method is to reduce the transmission power of the node automatically so that the communication happens on a one to one basis. The concept of the transmission technique is best implemented with Graph Theory. In Graph Theory, the nodes are treated as vertices and the links between them are considered as edges of the graph. Consider the network shown in Figure 1.

The sensors are deployed randomly in a WSN. The distance between the sensors nodes need to be calculated to know the neighboring nodes of a particular node. Calculating the distance from the node also helps in finding

the amount of power required to reach the next neighbor node. Network nodes are represented by the vertices and also direct connectivity between the nodes by the edges. Sensor nodes are maximum flow from one node to the other node to calculate the distance. The Combinatorial Structure is called as network structure. The Number of vertices are connected to the source node in a network is called its neighbor node and the number of edges are its size. Two or more edges of a network joining the same pair of vertices are called multiple edges. The distance calculation and the neighborhood discovery form the basis for finding the shortest path that can be taken to communicate between the source and the destination with reduced power requirement thereby prolonging the life time of the network.

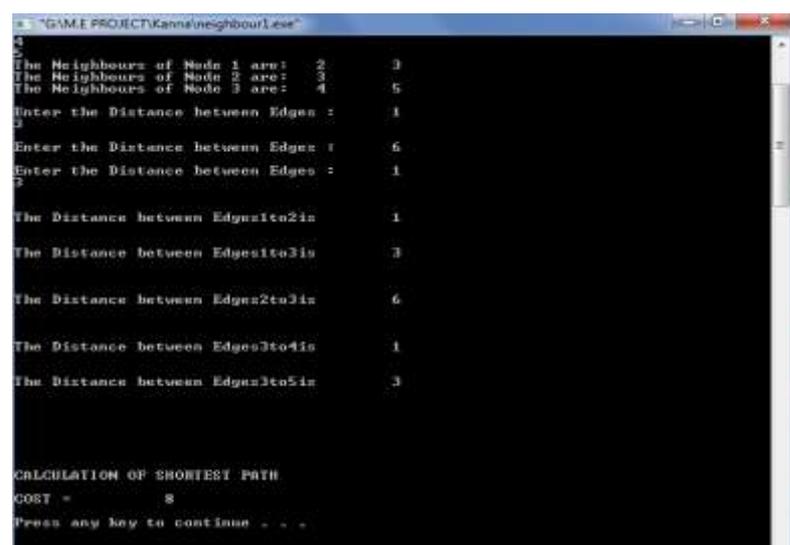
V. RESULT AND DISCUSSION



```
GAME PROJECT\Kanna\RandomCluster.exe
Enter the number of nodes:18
The CLUSTER HEAD is 18th node...The residual energy of it is 7.2
Enter the transmitting node:5
```

Figure 2: Node Result

Figure 2 shows the Number of nodes results in the given network of the wireless sensor networks.



```
GAME PROJECT\Kanna\neighbourList.exe
4
2
The Neighbours of Node 1 are: 2 3
The Neighbours of Node 2 are: 3 5
The Neighbours of Node 3 are: 4 5
Enter the Distance between Edges : 1
Enter the Distance between Edges : 6
Enter the Distance between Edges : 1
The Distance between Edges1to2is 1
The Distance between Edges1to3is 3
The Distance between Edges2to3is 6
The Distance between Edges3to4is 1
The Distance between Edges3to5is 3
CALCULATION OF SHORTEST PATH
COST = 8
Press any key to continue . . .
```

Figure 3: Shortest Path Result

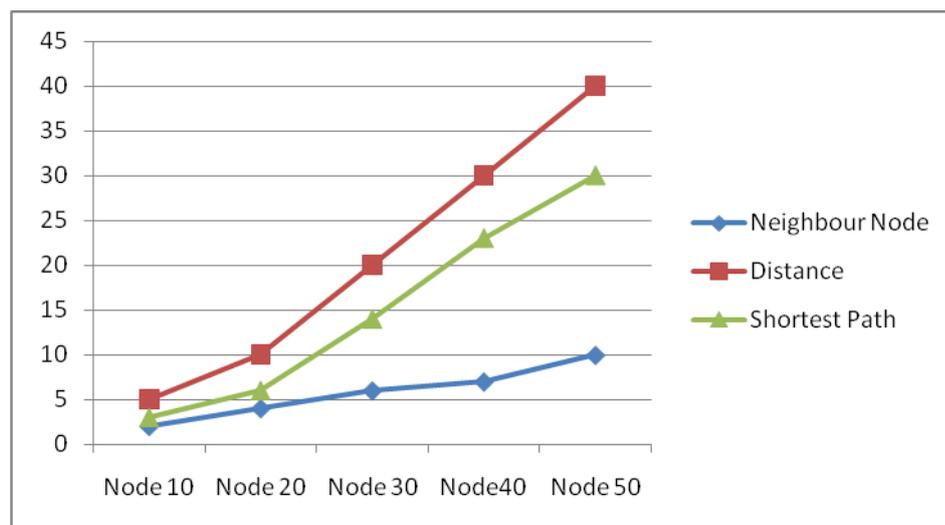


Figure 4: Comparison of Various Nodes

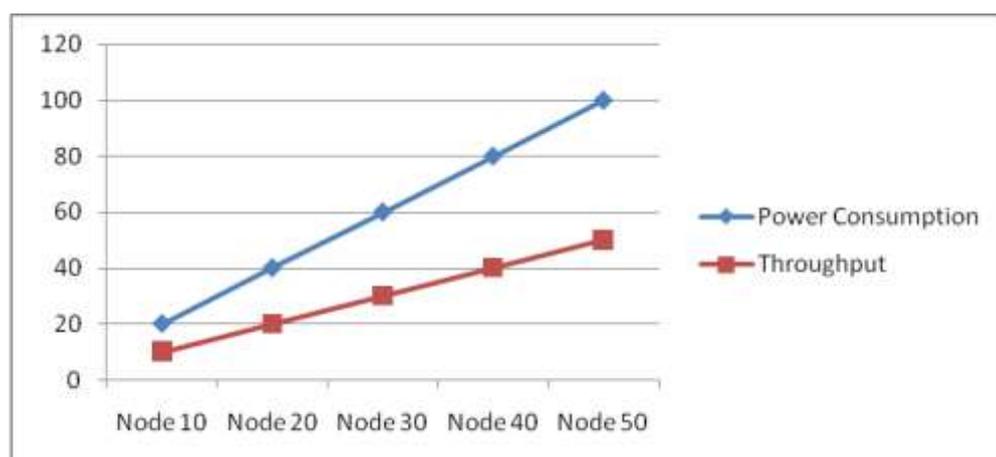


Figure 5: Power Consumption of various Nodes

Figure 3 shows that shortest path of given network based on the distance of the neighbouring node. Figure 4 shows the comparison of various node based on the distance, shortest path and neighbouring node of the given network. Figure 5 shows that power consumption of various nodes.

VI. CONCLUSION

The proposed system of Transmission power technique is to enhance the lifetime of the entire sensor network. The eligible sensor nodes are chosen depending on their power levels and association with number of nodes in transmission area. The efficiency of the proposed model is experimented and evaluated in C++ and the results

accomplished showed that in this technique, sensor nodes utilize extremely less power and stay in the network for a greater period of time.

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HYDROGEN AS AN ALTERNATIVE FUEL FOR AIRCRAFTS

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ABSTRACT

The present article reviews the prospects and opportunities for using alternative fuels in different applications. Different alternative fuels have been compared with the conventional fuels, and clearly the consumption of the latter can be significantly decreased by the use the blended fuels. Most of the alternative fuels have properties similar to those of the existing fuels, and therefore the technology required to handle them is already well known. We want to discover about the alternative fuel for the aeronautics field by working on the chemical composition of a lighter fuel. In getting this fuel then many such fuels can be used in the working models. Air traffic today contributes about 3% to the anthropogenic greenhouse effect. This number may change due to increase of air traffic and the decrease of the major CO₂ producers of the day. LH₂ could be an alternative to the hydrocarbon fuel like cheap kerosene or any other designed hydrocarbon fuel. It could be fuel suitable for aircraft to be produced from renewable energy and offering extremely low emissions (zero CO₂, very low NOX). It has the potential to eliminate the dependency of aviation upon dwindling crude oil resources and to reduce dramatically, the contribution of aviation to the anthropogenic greenhouse effect. Use of liquid hydrogen hence could allow sustainable growth of aviation at high rates(typically 4-5% per year) with an extreme low impact on the environment.

Keywords : *Hydrogen , Environment, Aviation., Combustor , Octane Number.*

I INTRODUCTION

Petroleum products have always been the preferred transportation fuels because they offer the best combination of energy content, performance, availability, ease of handling and price. However, the recent increase in the price of oil has prompted the industry to look at alternatives. Besides price, other factors must be taken into account when considering alternative fuels. Of course, safe and reliable operation of the engine and aircraft must not be compromised in anyway. Alternative fuels for aviation have been considered since the early days of turbine engines. By using liquid-hydrogen, there is a potential to create aircraft that are capable of the same missions as current aircraft, but use less energy, use less natural resources, have smaller environmental impact, and are as safe as or safer than current aircraft. Natural occurring hydrocarbon fuels will rise in demand and cost as developing countries

require more energy, while at the same time oil reserve diminish. There are several alternative fuels to hydrogen, however hydrogen is the only fuel which avoids all emissions except water vapor and nitrous oxide

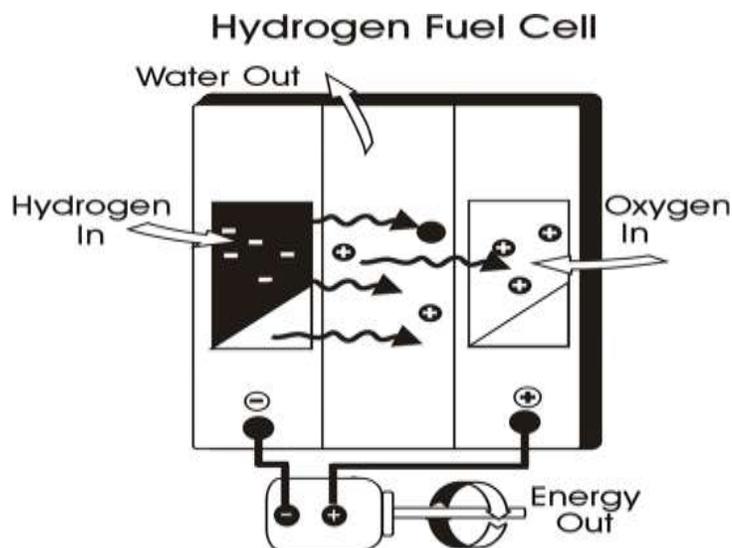


Fig 1 Hydrogen Alternative Fuel

- **Aviation Fuel**

Aviation fuel is specialized type of petroleum-based fuel used to power aircraft. It is generally of a higher quality than used in less critical applications such as heating or road transport, and often contains additives to reduce the risk of icing or explosion due to high temperatures, amongst other properties. The general aviation fuels in use are Jet A/Jet A-1, Kerosene, FT Synthetic Fuel, Methane, Gasoline and Bio-fuel.

- **Alternative Aviation Fuel**

Fuels derived from feed stocks such as coal, natural gas, bio-oils and cellulose matter were widely used during WW-II. The most pervasive method of conversion includes reforming the feed stocks through heat and catalytic reactions to syngas (CO and H₂) followed by conversion of the syngas into synthetic crude via the Fischer-Tropsch (FT) process. The synthetic crude is further hydro fractured to synthesize paraffin with a small percentage of non-paraffin. Plant derived fuels include feed stocks derived from soya bean oils, palm oils, corn, switch grass and algae. These resources are considered renewable, but most would require large areas of plant nurturing. As such, bio-derived fuels offer a reduction in life cycle CO₂ and many can be very attractive fuel candidates. The potential alternative fuels are discussed in detail below:

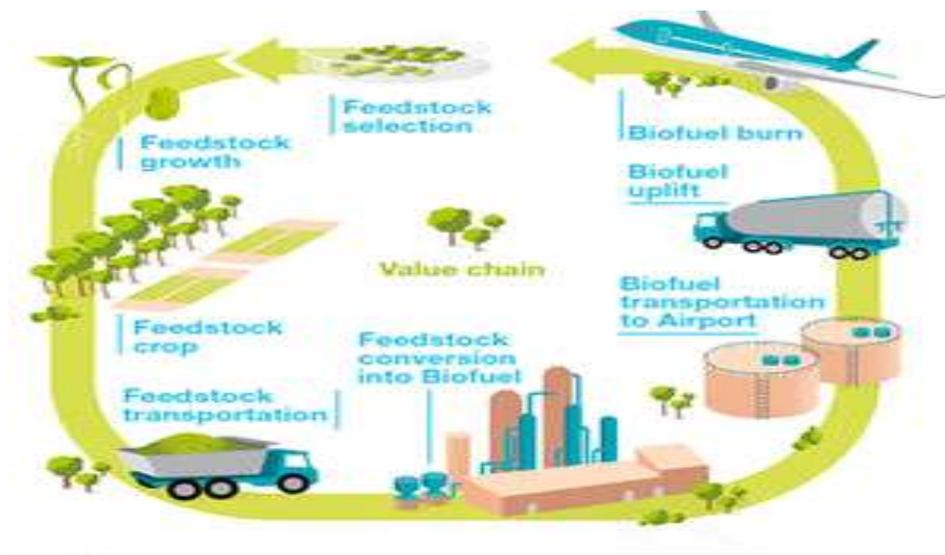


Fig 2 Sustainable Aviation Fuel

- **Jet Fuel**

Jet fuel is a type of aviation fuel designed for use in aircraft powered by gas-turbine engines. It is cleared to straw-colored in appearance. The most commonly used fuels for commercial aviation are Jet A and Jet A-1 which are produced to a standardized international specification. The only other jet fuel commonly used in civilian turbine-engine powered aviation is Jet B which is used for its enhanced cold-weather performance. Jet fuel is a mixture of large number of different hydrocarbons. The range of their sizes is restricted by the requirements for the product, for example: freezing point or smoke point. Kerosene type jet fuel has a carbon number distribution between about 8 and 16 carbon numbers; wide-cut or naphtha-type jet fuel between about 5 to 15 carbon numbers. Turbine engines can operate with a wide range of fuels and jet aircraft engines typically use fuels with higher flash points, which are less flammable and therefore safer to transport and handle. The first jet fuels were based on kerosene or a gasoline-kerosene mix and most jet fuels are still kerosene-based.

- **Cryogenic Fuels**

The term cryogenic fuel refers to materials that are gasses at normal ambient conditions that have been cooled to their boiling point and stored as low temperature liquids. Examples are liquid hydrogen and liquid methane. Both of these fuels have very high gravimetric energy content, but their low density leads to low volumetric energy content. Both fuels are fundamentally different from jet fuel and would require a new fuel infrastructure in addition to new engines and airframes.

II. EXPERIMENTAL WORK

A. Contreras, *, S. Yiğit†, K. Özay†, T.N. Veziroğlu†, (1997) has proposed hydrogen will be replacing fossil fuels is air transportation, an area that has been under research for several decades. Hydrogen as an energy carrier for use

in airplanes has some unique attributes like global availability, safety, minimum pollution and light weight, making it an ideal fuel. C.-J. Winter, (1990) has proposed use of hydrogen in aviation, which is centered on plans for supersonic/hypersonic aircraft using hydrogen as a fuel. A more complex challenge includes achieving environmental compatibility for this technology, which is well possible in the areas of producing and handling hydrogen fuel. Another formidable precondition is achieving an international political consensus that a transition from the established global hydrocarbon energy economy to a potential global hydrogen energy economy, in which aviation could have a trail-blazer function, is necessary, achievable and urgent.

III PROPOSED WORK

Performance of hydrogen combustion and effluent emissions can be compared with data's of other aviation fuels used at present. A 2-D combustion chamber model is designed in GAMBIT and then the analysis of various aviation fuel flows into the chamber is to be carried out well using FLUENT 6.3. The properties and behavior of LH2 are discussed in this paper as an alternative fuel in commercial operation and compare the performance of Hydrogen with all other aviation fuels.

3.1 Physical Property

1) Density: Density is measured as the amount of mass contained per unit volume. Density values only have meaning at a specified temperature and pressure since both of these parameters affect the compactness of the molecular arrangement, especially in a gas. The density of a gas is called its vapor density and the density of a liquid is called its liquid density.

Table 1: Density of comparative fuels

Fuel	Energy Density (LHV)
Hydrogen	270 Btu/ft ³ (10,050 kJ/m ³); gas at 1 atm and 60 °F (15 °C)
	48,900 Btu/ft ³ (1,825,000 kJ/m ³); gas at 3,000 psig (200 barg) and 60 °F (15 °C)
	121,000 Btu/ft ³ (4,500,000 kJ/m ³); gas at 10,000 psig (690 barg) and 60 °F (15 °C)
	227,850 Btu/ft ³ (8,491,000 kJ/m ³); liquid
Methane	875 Btu/ft ³ (32,560 kJ/m ³); gas at 1 atm and 60 °F (15 °C)
	184,100 Btu/ft ³ (6,860,300 kJ/m ³); gas at 3,000 psig (200 barg) and 60 °F (15 °C)
	561,500 Btu/ft ³ (20,920,400 kJ/m ³); liquid
Propane	2,325 Btu/ft ³ (86,670 kJ/m ³); gas at 1 atm and 60 °F (15 °C)
	630,400 Btu/ft ³ (23,488,800 kJ/m ³); liquid
Gasoline	836,000 Btu/ft ³ (31,150,000 kJ/m ³); liquid
Diesel	843,700 Btu/ft ³ (31,435,800 kJ/m ³) minimum; liquid
Methanol	424,100 Btu/ft ³ (15,800,100 kJ/m ³); liquid

2) Expansion Ratio: The difference in volume between liquid and gaseous hydrogen can easily be appreciated by considering its expansion ratio. Expansion ratio is the ratio of the volume at which a gas or liquid is stored compared to the volume of the gas or liquid at atmospheric pressure and temperature. When hydrogen is stored as a liquid, it

vaporizes upon expansion to atmospheric conditions with a corresponding increase in volume. Hydrogen's expansion ratio of 1:848 means that hydrogen in its gaseous state at atmospheric conditions occupies 848 times more volume than it does in its liquid state. When hydrogen is stored as a high pressure gas at 3600 psig(250 bar) and atmospheric temperature, its expansion ratio to atmospheric pressure is 1:240.

3.2 Chemical Property

1) Flammability: Three things are needed for a fire or an explosion to occur: fuel, oxygen and a source of ignition. Hydrogen, as a flammable fuel, mixes with oxygen whenever air is allowed to enter a hydrogen vessel, or when hydrogen leaks from any vessel into the air. Ignition sources take the form of sparks, flames or high heat.

2) Flash Point: All fuels burn only in a gaseous or vapor state. Fuels like hydrogen and methane are already gases at atmospheric conditions, whereas other fuels like gasoline or diesel that are liquids must convert to a vapor before they will burn. The characteristic that describes how easily these fuels can be converted to a vapor is the flashpoint. The flashpoint is defined as the temperature at which the fuel produces enough vapors to form an ignitable mixture with air at its surface. If the temperature of the fuel is below its flashpoint, it cannot produce enough vapors to burn since its evaporation rate is too slow. Whenever a fuel is at or above its flashpoint, vapors are present. The flashpoint is not the temperature at which the fuel bursts into flames; that is the auto ignition temperature.

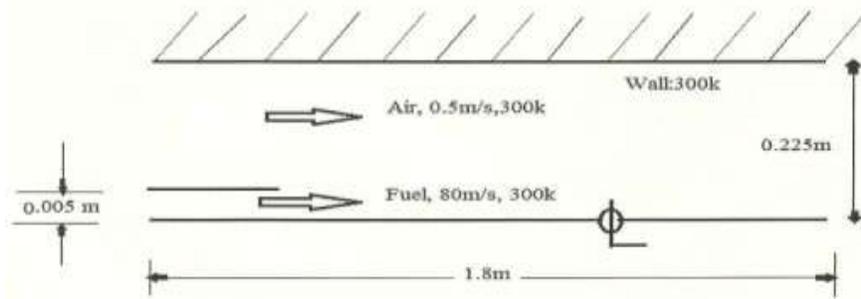
3) Auto ignition Temperature: The auto ignition temperature is the minimum temperature required to initiate self-sustained combustion in a combustible fuel mixture in the absence of a source of ignition. In other words, the fuel is heated until it bursts into flame. Each fuel has a unique ignition temperature. For hydrogen, the auto ignition temperature is relatively high at 1085 oF. This makes it difficult to ignite a hydrogen/air mixture on the basis of heat alone without some additional ignition source.

4) Octane Number: The octane number describes the anti-knock properties of a fuel when used in an internal combustion engine. Knock is a secondary detonation that occurs after fuel ignition due to heat buildup in some other part of the combustion chamber. When the local temperature exceeds the ignition temperature, knock occurs. The performance of the hydrocarbon octane is used as a standard to measure resistance to knock, and is assigned a relative octane rating of 100. Fuels with an octane number over 100 have more resistance to auto-ignition than octane itself. Hydrogen has a very high research octane number and is therefore resistant to knock even when combusted under very lean conditions. The octane numbers of comparative fuels are indicated in table. The octane number has no specific relevance for use with fuel cells.

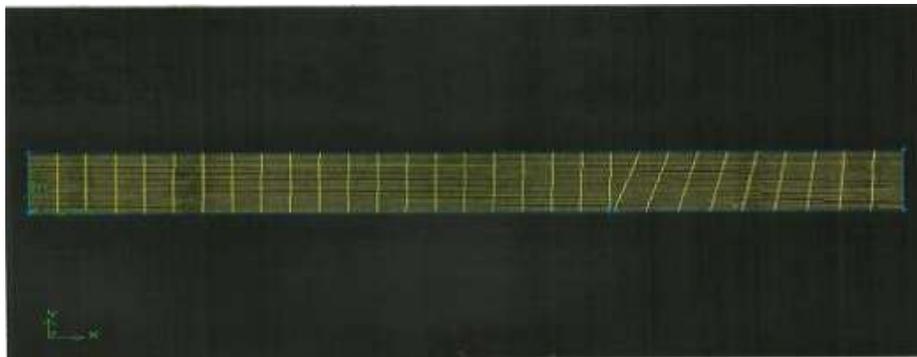
Table 2 : Octane number of comparative fuels

Fuel	Octane Number
Hydrogen	130+ (lean burn)
Methane	125
Propane	105
Octane	100
Gasoline	87
Diesel	30

- Geometry** : The model is created using GAMBIT pre-processor software. The working domain is generated with the help of the geometry. A combustor is created such that inlet and outlet faces are perpendicular to the flow. So the flow entering normal to the inlet face will automatically behave as the free stream air. The geometry of the combustor is created using the vertices. The vertices are connected using the straight line creating the surface of the wall such that it forms to edges one will act as nozzle as a center wall. The geometry of the combustor in 2D is shown below in the fig.

**Fig 3 Geometry of Combustor**

A combustor of length 1.8m and height 0.225m is created as 2D model. The high speed fuel jet initially expands with little interference from the outer wall and mixes with the low speed air, the Reynolds number based on the fuel jet diameter is approximately 28,000.

**Fig 4 Domain**

The meshing on the domain is done with structured mesh at both the faces. Clustering of mesh is done near the wall in order to capture the boundary layer clearly. Meshing of domain is created using Quadrilateral mesh. The domain consists of 930 nodes and 869 elements.

Analysis : The mesh is generated in GAMBIT and is solved using FLUENT. FLUENT is a commercial CFD code that solves the RANS model accurately. It uses a second order upwind discretization based on the simple pressure velocity coupling and the formulation can accommodate compressible flows. It solves equations describing the airflow of the model case by conservation of momentum, mass and energy.

Boundary Condition

Air-Fuel mixture is allowed to pass through the combustor 2D model, it is made possible through species transport and gaseous combustion. Air is passed inside the combustor at the velocity of 0.5m/s and fuel is passed at the rate of 80m/s, whose wall is maintained at the temperature of 300K initially and then increased to 2000K later. Extra fuel can be sprayed through the opening provided at certain distance from the combustor end. From the species transport, aviation fuel mixture can be added to the analysis. Properties and the mixing rate of the reactions are provided.

FLUENT offers various "under-relaxation factor" which reduces the change in variable iterations. The convergence of a solution is measured by the residuals or differences between the previous iteration and the current iteration. For all simulations the residuals were set to appropriate values. FLUENT continued iterating until the solution is converged and all residuals fell below the appropriate values.

IV RESULTS AND DISCUSSIONS

4.1 Comparison Chart

1) **Density:** It is defined as the amount of mass contained per unit volume.

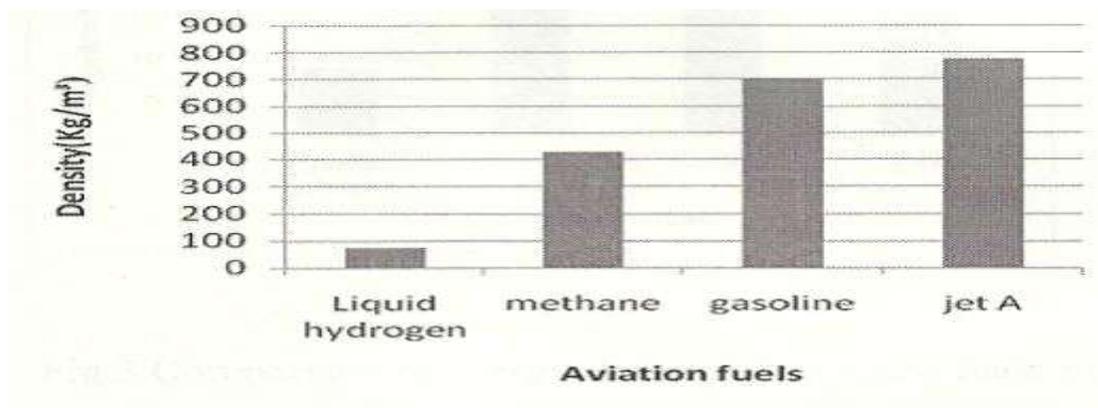


Fig 5 Comparison of density of aviation fuels in Kg/m³

- Auto Ignition Temperature: It is the minimum temperature required to initiate self-sustained combustion in a combustible fuel mixture in the absence of a source ignition.

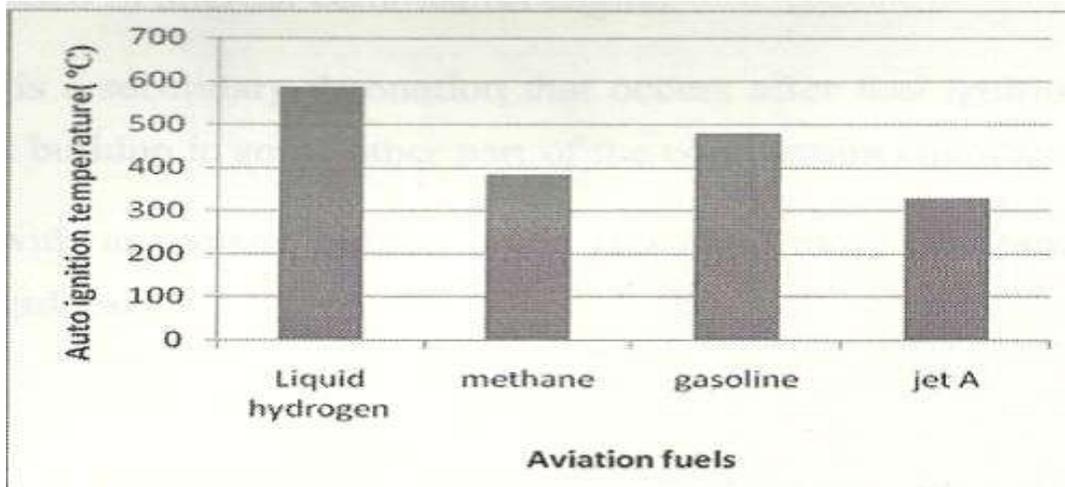


Fig 6 Comparison of auto ignition temperature of aviation fuels in 0C

- Flash Point: The temperature at which the fuel produces enough vapors to form an ignitable mixture with air as its surface.

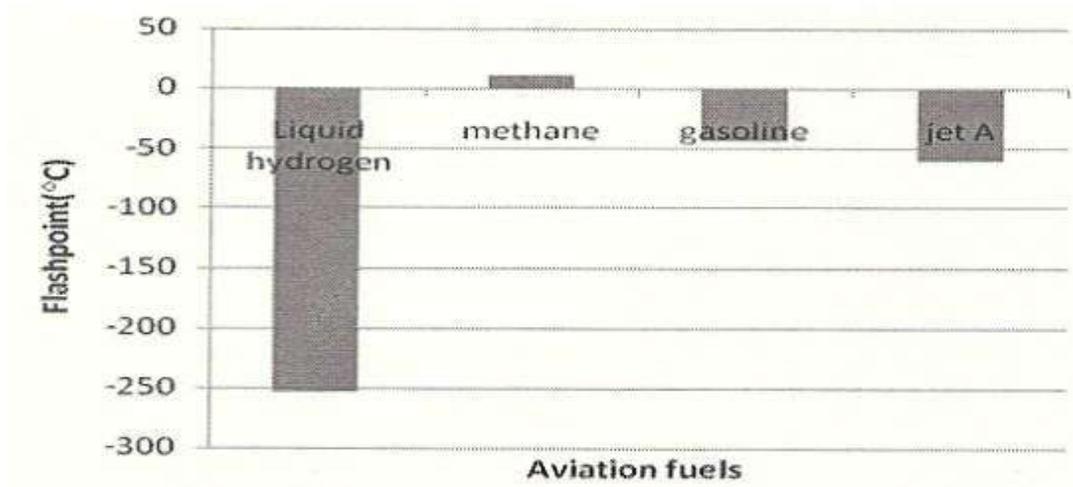


Fig 7 Comparison of flash point of aviation fuels in 0C

- Octane Number: It describes the anti-knock properties of a fuel when used in internal combustion engine.

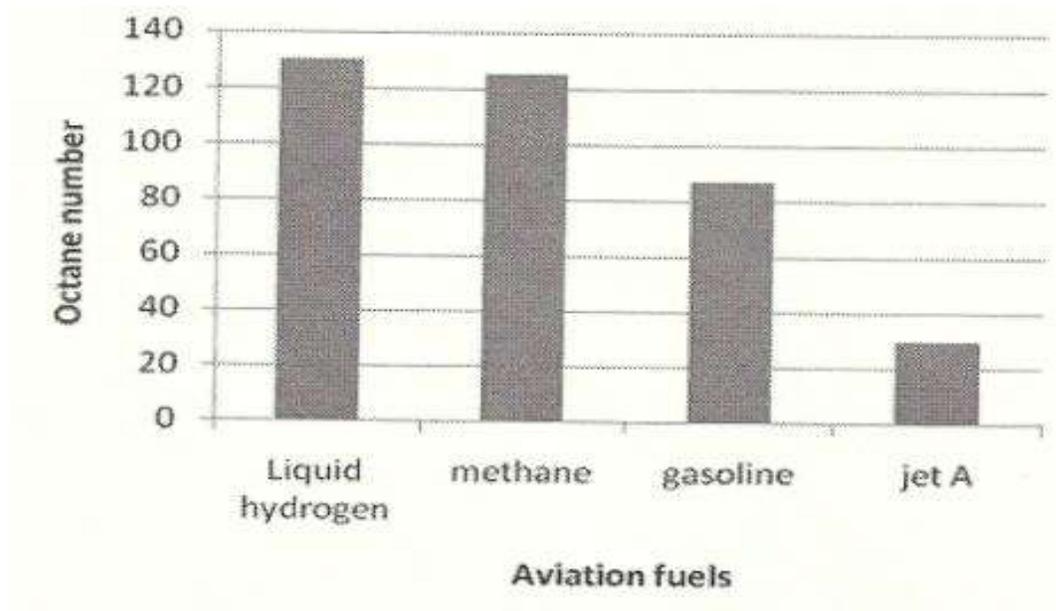


Fig 8 Comparison of Octane number of aviation fuels

Freezing Point: The temperature below which a liquid turns into a solid.

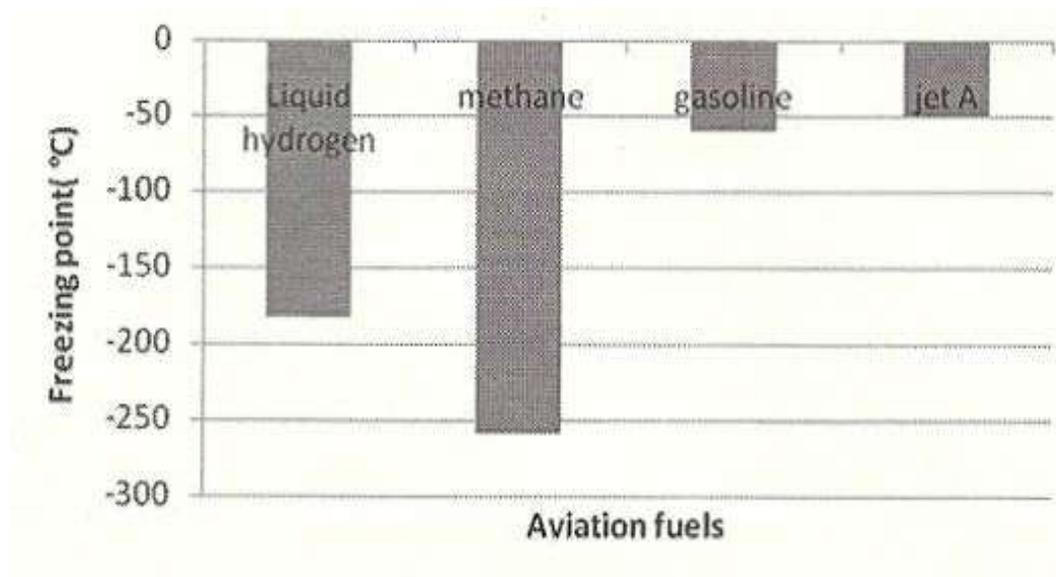


Fig 9 Comparison of Freezing Point of aviation fuels

CO₂ Emission: Aviation fuel with more carbon atoms emits more CO₂ as pollutant.

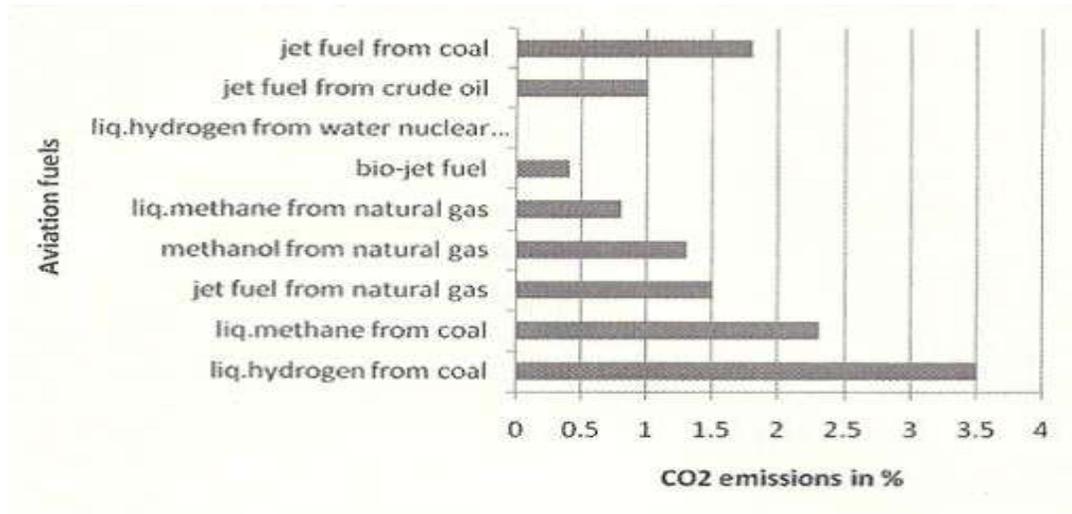


Fig 10: Comparative chart of CO2 emission by various aviation fuels

4.2 Analyzed Hydrogen Data's

1) Static Temperature

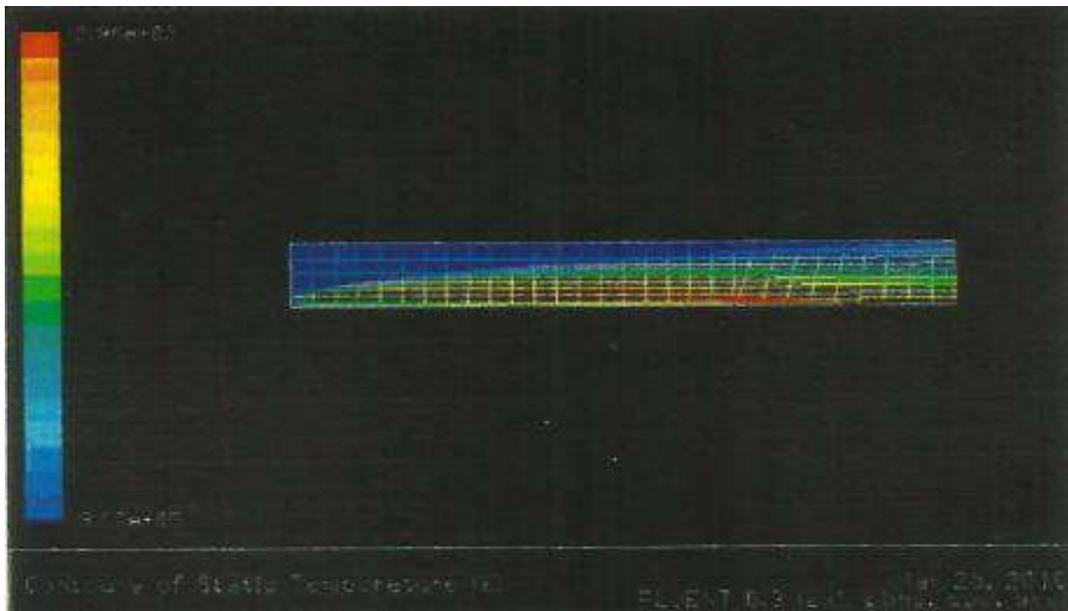


Fig 11 Contour of Static Temperature of Hydrogen-Air

Mass Fraction of pollutant NOX

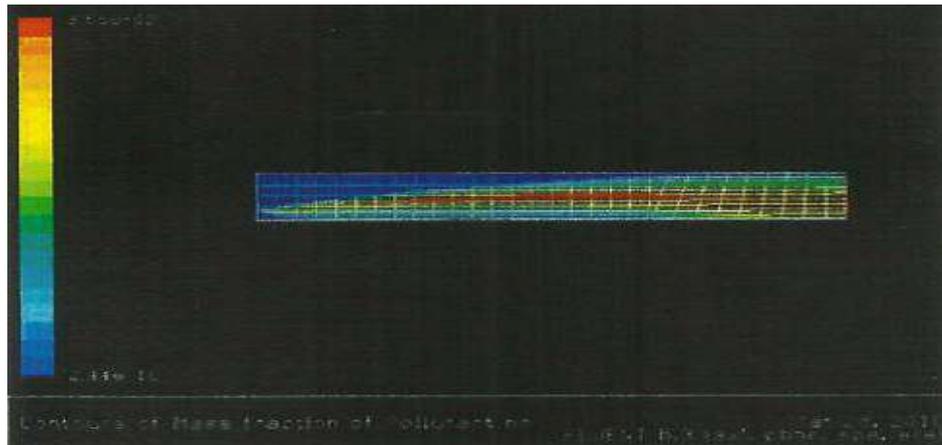


Fig 12 Contour of pollutant NOX of Hydrogen-Air

NOX Emission

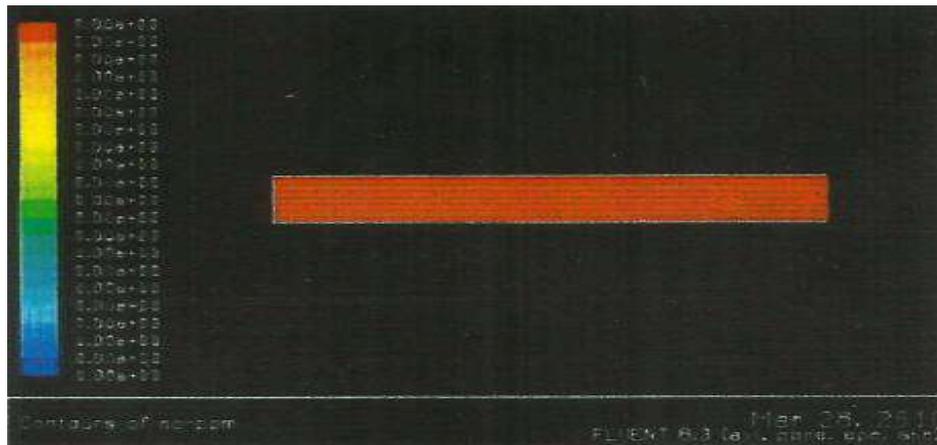


Fig 13 Contour of pollutant NOX of Hydrogen-Air

Velocity Vs Static temperature

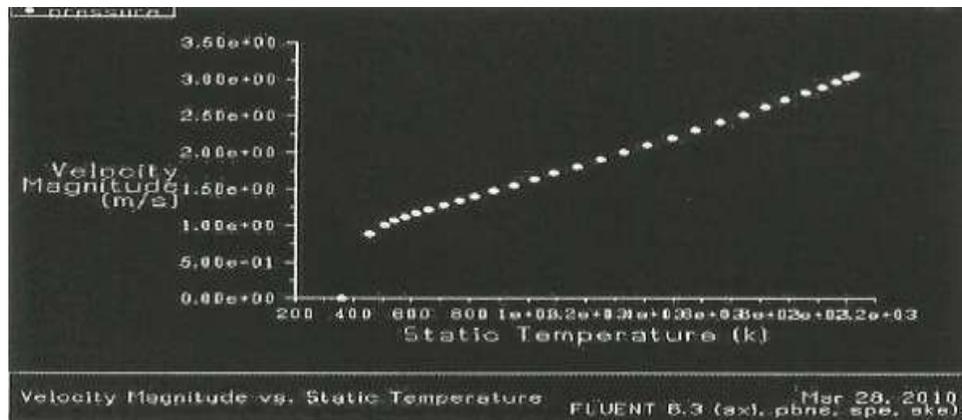


Fig 14 Graph of Velocity Vs Static Temperature

V CONCLUSIONS

From the computational analysis the performance of Hydrogen-Air is far better than other fuels, while considering the side of pollutants. From the results, it is very clear that hydrogen is the only fuel that emits zero NOX. The result predicted using the FLUENT code satisfies the theoretical computations of hydrogen properties. Hence, it can be concluded from the combustion study that,

1. Emission of harmful NOX is zero.
2. Emission of CO₂ is also zero as it does not have carbon atoms unlike other aviation fuels.
3. Specific heat is less such that less amount of heat per unit mass is enough to raise the temperature.
4. Also from the comparison chart, hydrogen has the appreciable property values.

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- **Subanesh Shyam R** - Aeronautical Engineering , Karpagam University, Pollachi Main Road, Coimbatore.

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GROWTH STORY OF A HOSPITAL; PROBLEMS AND PITFALLS (A STUDY OF RAMZAN HOSPITAL SRINAGAR, JAMMU & KASHMIR)

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ABSTRACT

You can't stop the waves, but you can learn to surf (Jon-Kabat-Zin). The quote best describes the fate of businesses when befallen with unsolicited and unexpected market changes. The winning edge for businesses in such a scenario is to do what they can, with what they have and where they are. Healthcare industry is facing an acute competition worldwide. There has been a paradigm shift in the "modus operandi" of the industry to offset fierce competition. Over the time, the health institutions have been forced to adjust their pace with this fast moving competition wagon or suffer adverse consequences of being a plodder. Thus, in order to sustain in the market and cherish its long term goals, the hospitals in general have to manage diverse kinds of significant changes. New challenges and demands spring, as the hospitals try to grow and survive. Such has been the case with Ramzan hospital Srinagar. Despite having constrained resources at hand, the hospital refused to be intimidated by the formidable growth bottlenecks. The management of the hospital rightly navigated the challenges and resourcefully continued to progress despite potential odds. The case study explores the growth history of Ramzan hospital and throws light over the successful management principles in augmenting the hospital growth process. At the core of all its growth process is the focus on patient satisfaction. The hospital's challenge filled voyage can serve as a great learning source for anyone looking to improve healthcare in the developing world.

Keywords: Competition, Healthcare in Kashmir, Hospital Growth, Patient Satisfaction, Quality Function Deployment, Ramzan Hospital

I BACKGROUND OF THE CASE

The changing market scenario, aggressive competition and consequent substantial diminishing share of profits are persuading the hospitals to come with various new and innovative ways of cost cutting measures while continuing to provide quality services [1] [2]. New sources of competition and new technologies suddenly appear out of nowhere. Most healthcare providers today are under intense economic pressure. Reorganisation, takeover, mergers, downsizing, joint ventures and other major changes are extremely common, as hospitals try to grow and survive. Amidst alike buzzing alarms, is the pertinent issue of patient satisfaction. The shift towards consumer focused

services has resulted in attaching more importance to intangible service outcomes like user satisfaction besides satisfying host of other tangible features of an efficient service delivery. Today's hospital industry has begun to function like a service industry with a more patient centered service outlook in its services. Thus, the hospital management has to be highly receptive of the changing scenarios. The various strategies devised for diverse business purposes has to have adequate room for flexibility. As far as survival in the market is considered, the hospital administrators have to successfully adopt the change and be ready to change again on a continuous basis. They have to come out of their comfort zones and break the status quo time and again.

The Ramzan hospital have grown from a small surgical unit. The hospital began with a noble cause of social entrepreneurship. The hospital grew to its present business model with strong embedded roots of societal concern. On a initial note, it faced the multitude of market obsessions which it leveraged optimally. Surviving in hostile circumstances, the hospital's relentless attempts have given the edge to its survival. Despite of possessing constrained resources, the hospital went on adapting itself to the changing market. At the core of its growth essence lies the strong focus to changing customer needs and preferences.

II ENTREPRENEURSHIP JOURNEY

It was the vision of Mr. Gh. Mohuddin Khanday, a vibrant administrator and a dynamic entrepreneur to set up an elite surgical unit at Gogi Bagh Srinagar, adjacent to the Government Lalla Ded Maternity hospital. Being a philanthropic personality, he was shaken by witnessing the healthcare sufferings of people in the region. It was the time when Kashmir Valley was passing through difficult circumstances since 1989 due to insistent disturbances and civil unrest. The healthcare delivery system was one of the worst hit services. The mass exodus of healthcare professionals from valley to outside had created an artificial scarcity of qualified human resources for health. Patients in the region were thrown to depths of disappointments while meeting their healthcare needs. The huge supply and demand gaps in the availability of human resource, poor healthcare infrastructure, non-availability of medicines & medical equipments led to service delivery chaos through overcrowded hospitals. This had undermined the treatments and made the patients vulnerable to various sorts of deprivations. Thus during that epoch, the patients were largely either unserved or underserved at the then existing healthcare setup. There were healthcare chaos due to mismanagement of existing healthcare facilities. The dearth of adequate qualified medical professionals coupled with poor healthcare facilities had adversely affected the healthcare service. Among the many healthcare services, the maternity and childcare service was the one which was greatly affected and had thus jeopardized the lives of both the mother and child.

2.1 The people taking the first steps are the ones counted among the fortunate

During the initial years of establishment, the hospital came up with a 20 bedded surgery unit. The hospital strived to face the manifold start up hiccups ranging from infrastructure hurdles to scarcity of venture capital and high-cost. The limited resources and scant knowhow's that they had that time were serious challenges which led to low levels of patient satisfaction. One of the pertinent issues was related to hiring experts and competent support staff, who could handle and resolve cases to the patient's satisfaction. Along with the limited resources including the financial & human capital, there was a wide-ranging skepticism about the commercial viability of the businesses in Jammu

and Kashmir. Due to rampant and ruinous effects of militancy and civil unrest upon businesses within Kashmir, success stories were few and far in between. However, against all the odds, the hospital management had single minded determination to see the venture succeed and thus refused to let these challenges intimidate them. They skillfully navigated many challenges and leveraged the scant opportunities. Initially, the hospital was partially successful in attracting a very specific surgical patient crowd from Srinagar and its adjoining localities.

III HOSPITAL TURNAROUND

The scenario had heightened the urgency of bringing novel interventions into practice. Inspired by the zeal and enthusiasm, the entrepreneur ventured out into healthcare service in 1991, despite of too turbulent functional setup of healthcare in Kashmir. Ramzan surgical unit was expanded to include a comprehensive Mother & Childcare service as well in 1993. In line with the objective of delivering best value to the patients, the hospital authorities equipped themselves with tools of market research in order to identify the potential opportunities for serving the patient needs effectively. Multiple marketing strategies for effective segment penetration were developed and implemented to entail all of the aspects of service tangibility and intangibility. The patient centered approach made the administration to put in practice various satisfaction and feedback measures on continuous basis. A random sample of 80 patient-feedback-questionnaire contained 42 cases that had revisited the hospital, 22 cases who had been referred through word of mouth, and 16 through other non conventional means [Researcher's primary survey]. Besides, the questionnaire are designed to gauge the patient's likeability of continuing to receive other related health services (healthcare needs the hospital is not rendering at the particular moment) from the same hospital. In the above random sample, 66 patients had manifested their intent to get their other healthcare needs fulfilled under the same roof). Greater emphasis is attached to the investigation of customer wishes and requirements by means of adapted QFD (Quality Function Deployment) methods. The pertinent and more of customized service attributes identified through the process are transferred to the appropriate hospital function for action. In this way, the hospital is successful in identifying and prioritizing the customer expectations diligently. Thus, comprehensive patient satisfaction measures are put in practice to facilitate the collection of data on patient experiences on an ongoing basis.

Table 1: Patient flow and service growth of the last five years

Year	Service	No of Beds	Average Patient Flow per Month	Marginal Patient Flow
2009	Surgery/Gynecology /Obstetrics/ Lab/Diagnostics	38	720	720
2010	M & C	41	878	158
2011	ENT	49	1106	228
2012	Ophthalmology	66	1199	93
2013	Medicine	112	1676	477

Source: Hospital Records

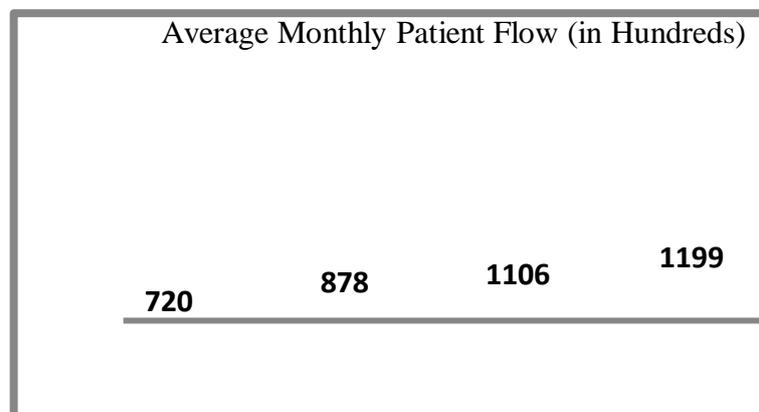
The subsequent results of overwhelming market response prompted the hospital to add more services into its portfolio indefinitely (M&C: 2010, ENT: 2011, Ophthalmology: 2012, Medicine: 2013). The diversification

decisions are ruled out and what should be added to the service line was left to the domino effects of patient satisfaction obtained through various satisfaction evaluation instruments. As is evidenced from the recent past data of patient flow, the hospital went on adding to service line depending upon the responsiveness of the volume and the nature of patient demands. Alternatively, an analysis of diversification data shows a corresponding increase in patient flow with the marginal patient flow highest for Medicine & this trend seems to be ever growing from the year 2009- 2013 (M&C-158, ENT- 228, and Ophthalmology- 93 & Medicine- 477).

The hospital management seems to play a proactive role in creating a felt need within the target population before they can actually plunge into the growth wagon. This is what supports the unhindered success of every service added so far.

IV SUPPORTING THE UNRIVALED MISSION

Moreover, the growth strategies of Ramzan hospital have been ensured through aspects like hospital's conducive work environment, employee reliability, competent and empathetic staff and other facets of employee engagement. Besides, the other features of maintaining rational prices and commitment to quality service delivery have gone on a long way in assuring a strong brand image and patient loyalty. This goes in accord with Michael E. Porter who in 1980 established that differentiation involves creating a product/service that is perceived as unique. The customers see the product or service as unrivalled and unequaled. The provider manages to reduce the price elasticity of demand and customers tend to be brand loyal. Thus, a substantial insulation from competition can be achieved.



Graph 1: Average Monthly Patient Flow



Figure 1 Minor OT: Hospital Interiors

V THE RAMZAN “WE CARE” SLOGAN: A FEATHER IN THE CAP

“While patients get cure, we use to think how better we can care! Perhaps it is what supports our slogan, ‘We Care’ and became the essence of our hospital’s rampant growth and furthering trend of positive effects on patient satisfaction can be regarded as a by-product of the same strategy” said Mr. Gh. Mohuddin Khanday, the Managing Director of Ramzan hospital Srinagar. The hospital now shares a significant market share with strong brand image and consumer loyalty. The patients of the hospital’s target areas used to travel from one facility to another for treatment, especially in the cases of chronic diseases that involve several medical disciplines because of inadequate lines of service provided by that time hospitals. By unearthing business models like advertising and low cost business models particularly those that co-ordinate various healthcare activities, the Ramzan hospital have rightly increased efficiency, improved care and saved consumers time. The management of the hospital have optimized bundle of separate channels of service and have brought substantial amounts of integration within and outside the core business. Consequently to a considerable extent, the hospital has brought the care under single roof only. Thus the wandering off burden of patients to get their multiple healthcare needs fulfilled from myriad providers was ameliorated to a great extent. The consequent results of bringing the treatment under one roof have served as a boon for its heightened levels of patient loyalty. In this case, the patients get one stop shopping.

VI THE RAMZAN HOSPITAL: PRESENT PROFILE

Ramzan hospital is now a *120* bedded private hospital located in Srinagar city. The hospital shares a significant market share with strong brand image and patient loyalty. Presently, the hospital receives patient crowd not only from Srinagar city and its adjoining areas but also from far flung areas of Kashmir valley (average monthly patient flow: 1676; Table 1). The hospital is now offering superspeciality services in surgeries and has achieved hallmark in surgery with minimally invasive procedures like laproscopy. The hospital is specialised in providing state of the art facility in followings lines of service: Table 2

Table 2: Ramzan Hospital's Primary Lines of Services

Sl. No.	Service
01	Surgery (Major/Minor)
02	Obstetrics and Gynaecology
03	Mother & Childcare
04	Radiology/Diagnostic
05	ENT
06	Ophthalmology
07	Medicine

Source: The Hospital's Present Profile

VII SWOT ANALYSIS

Significant time and efforts were devoted to develop an insight of the organisation and the situation. Extensive qualitative interviews with the hospital managers and the key persons revealed the following strategic results: Table 3. The matrix covers the points which are all comprehensive but are not exhaustive.

Adequate review of the matrix was conducted to allow for the development of contingent plans and aid the organisation in decision making for all sorts of situations in healthcare business.

Table 3: SWOT Analysis- Ramzan Hospital

STRENGTHS	WEAKNESS
<ul style="list-style-type: none"> i. Strong Brand Image ii. Favorable patient loyalty iii. Competent leadership iv. Superior hospital location v. Shared vision vi. Conducive work environment 	<ul style="list-style-type: none"> i. Lack of Hospital's Creative Advertisements ii. Inadequate Investment in R&D iii. Lack of Thorough T & D Programs iv. Lack of Comprehensive Electronic Data Management System v. Little or No Online Presence
<ul style="list-style-type: none"> vi. Strong Market Potential vii. Availability of New Technology viii. Lack of Dominant Competition ix. Untapped Market Segments 	<ul style="list-style-type: none"> i. Turbulent Operational Healthcare Setup of the Geographic Area ii. Seasonal Demand Variations iii. Changing Patient Preferences
OPPORTUNITIES	THREATS

VIII CONCLUSION

The dynamic business environment poses substantial challenges to the businesses at varied levels. There has to be an intelligent identification and assessment of the factors which impede the growth and survival of businesses.

Meanwhile, in the times of suffocated growth phases the businesses have to tap their potential resourcefully and optimally.

The hospital industry is witnessing acute competition nowadays. The increasingly changing healthcare needs have shrunk the profit margins of hospitals considerably. In such a volatile milieu, understanding the dynamics of patient satisfaction comes handy in fostering the healthcare business growth.

IX ACKNOWLEDGEMENTS

My profound gratitude stands to Dr. Zaffer Khanday, Ramzan Hospital, who granted permission for undertaking the study at this hospital. Majority of the healthcare institutions which were approached for the study were wary about sharing their information. Thus, obtaining approval for study was an arduous and time consuming task.

The researcher is thankful to Department of Management, Jamia Hamdard University for providing the continual guidance and inputs which served as too critical for the study.

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NETWORK LOAD MANAGER AN INTELLIGENT NETWORK LOAD BALANCING SYSTEM

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ABSTRACT

Enough to handle the traffic on the network it's time to look into building a web Farm that uses multiple machines on the network acting as a single server. A Web Farm is a not so fancy term for a collection of servers [that act as a single Web server. Administration of two or more servers and keeping them properly synched is actually a lot more work than administering a single server. The Load Balancing can also provide benefits in the overload scenario. For one, it's generally cheaper to throw mid-level machines at a load problem rather than buying lone top of the line high end machine.

Keyword: *Controller server, Primary server, Secondary server, Server farm*

I INTRODUCTION

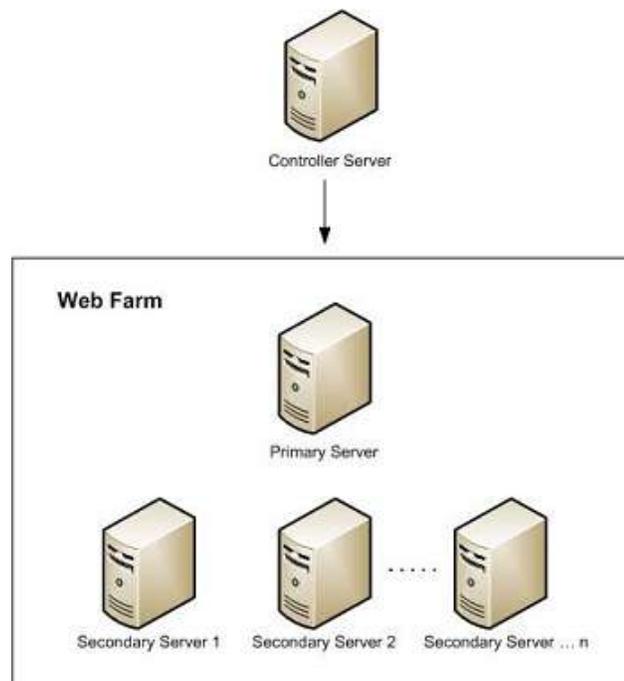
The research describes the process of developing a Network Load Balancing system from design to implementation. When a single Server machine is not enough to handle the traffic on the network it's time to look into building a web Farm that uses multiple machines on the network acting as a single server. A Web Farm is a not so fancy term for a collection of servers [that act as a single Web server. Administration of two or more servers and keeping them properly synched is actually a lot more work than administering a single server. The Load Balancing can also provide benefits in the overload scenario. For one, it's generally cheaper to throw mid-level machines at a load problem rather than buying one top of the line high end machine.

Load Balancing also provides something else that has nothing to do with scalability: The ability to have failover support if something goes wrong on one of the servers in the pool. Because a Web Farm is made up of essentially identically configured servers, a failure on a single server will not bring down the entire server contents. Other servers in pie pool can continue to process requests and pick up the slack. For many companies if this feature of load balancing is often important for peace of mind both in the knowledge that a single point of failure on the Server is avoided as well as providing an in place mechanism to grow the application should the need arise at a later point.

II WEB FARM

A Web Farm is used in highly available applications and which have a lot of users that cannot be served by a single server. They provide better performance and are easily scalable. It means we'll have multiple web servers behind a Network Load Balancer (NLB). Whenever a request comes, it first goes to the load balancer, which checks all the available web servers and finds the web server which has comparatively less requests to serve, and passes the request to that web server. Let's have a pictorial overview.

Most of the large applications are deployed in a Web Farm scenario. A single server might not be able to handle millions of requests in a day, and we provide a virtual IP to the Load Balancer, and the URL is mapped to the Load Balancer; the load balancer takes the decision to pass the request to a specific web server. In this scenario, the session mode InProc does not work. We need to use the OutProc mode, because if the first request is served by server1 and it stores session data, but later for another request the Load Balancer finds that server1 is busy handling other requests, it can pass the request to another server, which obviously will not have the session data and this can result in a bizarre output. In OutProc mode, session data is not stored in the AppDomain of the web server. We store the data in another server.



2.1 Seamless Provisioning and Deployment

The Web Farm is designed to enable you to create group of servers and set up provisioning for them with a one-step process that is automated and keeps the server farm up to date. You can customize the components that are provisioned and include additional platform components.

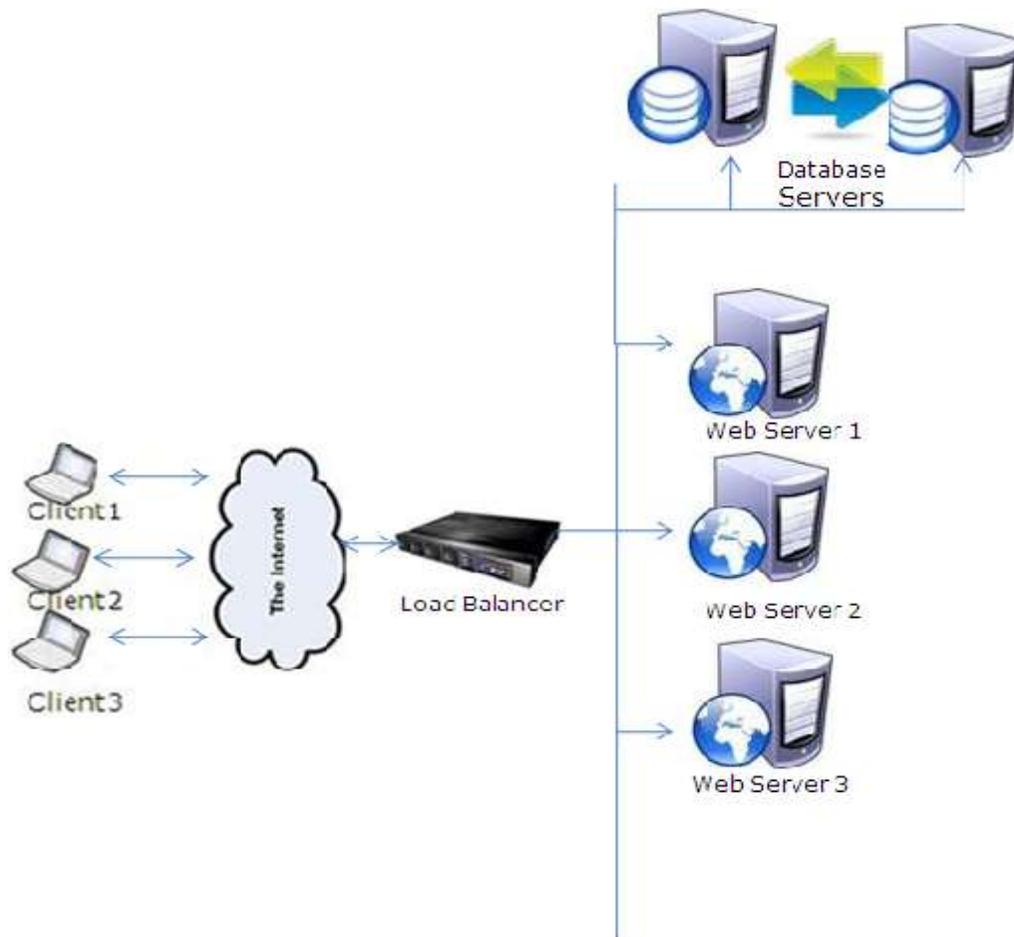
You can configure provisioning policy and add additional content to the farm. In addition, you can use WFF to view up-to-date status of provisioning and of the health of the servers in the farm.

2.2 Elastic Scaling and Load Balancing

The Web Farm integrates with Application Request Routing (ARR) for load balancing and elastic scale through the same one-step process. WFF works with third-party load-balancing products and enhances the ability to upgrade, swap, and add servers by simplifying the underlying logistics. It also provides a snapshot of server readiness so that you can easily view servers that are available for load balancing.

2.3 Simplified Server and Farm Management

The Web Farm provides one view and user interface to see the status of operations running throughout the server farm. You can also use the interface to run the most frequently used operations on the farm as a whole or on individual server in the farm. Additionally, you can interact programmatically with WFF functionality by using Web Farm Framework APIs and Windows Power Shell cmdlets.



III USING WEB FARM TECHNOLOGY TO PROVIDE HIGH AVAILABILITY FOR MESSAGE QUEUING

To increase the availability and scalability of Web server resources, a Web farm is often deployed as a collection of independent servers, to which all HTTP incoming requests are directed. Network Load Balancing clusters, DNS round robin, and network address translation (NAT) are typically used to deploy Web farm capability.

3.1 Message Queuing in Network Load Balancing clusters

Message Queuing services can be implemented in an Network Load Balancing cluster. Network Load Balancing clusters distribute client connections over multiple servers, providing scalability and high availability for client requests for services and applications, but they do not have failover capabilities. In its most common implementation, Network Load Balancing distributes incoming TCP/IP traffic between multiple Internet Information Services (IIS) servers, which comprise a Web farm. Network Load Balancing can combine up to 32 servers running Windows Server 2008 or later into a single load-balancing cluster.

- Servers can be added without shutting down the cluster. The heart of Network Load Balancing is the WLBS driver, which is loaded into each member server, or host, in the cluster. This driver includes the statistical mapping algorithm that the cluster hosts collectively use to determine which host handles each incoming request.
- Under this type of clustering, if a host fails or goes offline, Network Load Balancing automatically reconfigures the cluster to redirect subsequent client requests to hosts that are still viable members of the cluster. Any client connections that were open when the host failed or went offline are ended. On retry, the client connection is routed to a viable host. The downtime for client connections is less than 10 seconds.
- Network Load Balancing allows all computers in the cluster to be addressed by the same set of cluster Internet Protocol (IP) addresses, while also maintaining their existing, dedicated IP addresses. This feature transparently distributes client requests among the hosts in the cluster, using virtual Internet Protocol (IP) addresses. You must run IIS 7.0 or another TCP/IP service on each host, and the hosts must serve the same content so that any of them can handle any request. You can copy updated pages to local disks on the hosts, or you can use commercial file-replication software to perform updates.
- Network Load Balancing allows you the option of specifying that all connections from the same client IP address be handled by a particular server (unless, of course, that server fails). It also permits you to allocate all requests from a Class C address range to a single server. When you set up a Web farm using Network Load Balancing, each server is in constant communication with all the others. They exchange performance statistics and divide the responsibilities of handling incoming requests.
- Every incoming request is seen by every server in the farm, and Network Load Balancing has its own algorithm to determine which server will handle each request. When messages are sent over HTTP transport to a queue at a virtual URL address, a TCP session is established with one of the nodes in the cluster. Messages can be sent only to destinations specified by direct format names. In the case of express and recoverable messages,

the receiver is not required to maintain any internal state, and Message Queuing does not guarantee exactly-once delivery through a Web farm, although a best-effort attempt is made by means of a lightweight no persistent duplicate removal mechanism. When transactional messages are sent over HTTP transport, in-order delivery is guaranteed by including an SRMP stream header entry that includes information for message sequencing.

➤ When a session between a client and a node is disconnected and the client is routed to a different node for the next session, the messages whose delivery was not acknowledged are resent by the client and accepted by the new node with the possible creation of duplicates. Message queuing applications can be deployed on the nodes of an Network Load Balancing cluster to receive and process messages sent to the cluster.

3.2 DNS Round-Robin Distribution

Microsoft DNS server supports a process referred to as round-robin distribution, a common session-based load balancing technique that balances the number of clients connecting to an Internet site supported by multiple servers. Round-robin distribution is specified by RFC 1794. With DNS round-robin, a single logical DNS name (such as www.microsoft.com) maps to several IP addresses. When a request is made to resolve the DNS name, the DNS server sends back one of the addresses from the list. Each time a request is made for this DNS name, the DNS server rotates the addresses in round-robin fashion to distribute the set of users across a set of servers.

Thus, different users requesting the same DNS name are given different IP addresses to balance the load. This technique distributes incoming requests evenly among the available IP addresses but does not fully balance the load because it is not interactive. This is because the DNS server does not monitor the loading of each IP address nor does it check whether a particular server is currently running. Round-robin distribution can be a useful starting point for small groups of servers. If you are using round-robin distribution, closely monitor your servers so that you can quickly remove any failed machines from the distribution list.

3.3 Network Address Translation

Network address translation (NAT) is a protocol that allows a network with private addresses to access information about the Internet through an IP translation process. NAT can be used to configure a small network to share a single connection to the Internet.

IV CONCLUDING

The Windows Web Platform delivers all the components that service providers require to deploy a highly available, highly scalable, Shared Hosting environment. This article has provided an overview of the core architecture, Remote Administration configuration, and optional components that are needed by service providers to deploy and manage Shared Hosting offerings.

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4G WIRELESS TECHNOLOGIES

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ABSTRACT

4G wireless communication networks are characterized by the need to support heterogeneous terminals differing in size, display, battery, computational power, etc. For efficient use of the wireless spectrum all devices should be served by the same spectrum instead of allocating spectra dedicated to the different terminal classes. 4G mobile communications should not focus only on data-rate increase and the new air - interface, but should, instead converge the advanced wireless mobile communications and high-speed wireless access systems. 4G mobile will deliver the best business solutions to the wireless and mobile industries, such as CDMA/WLAN/GPRS/ and WCDMA/OFDM/WLAN.

4G is being developed to accommodate the quality of service (QoS) and rate requirements set by forthcoming applications like wireless broadband access, Multimedia Messaging Service (MMS). Video chats, mobile TV, HDTV content, Digital Video Broadcasting (DVB), global positioning system (GPS), minimal service like voice and data and other streaming services for "anytime-anywhere". This paper will provide you an overview of 4G wireless technologies.

I INTRODUCTION

4G or Fourth Generation is future technology for mobile and wireless communications. It will be the successor for the 3rd Generation (3G) network technology. Currently 3G networks are under deployment. Approximately 4G deployments are expected to be seen around 2010 to 2015. There is no formal definition for what 4G is: however, there are certain objectives include, that 4G will be fully IP based integrated system. 4G will be capable of providing between 100 Mbps and 1Gbps speeds both indoor and outdoor with premium quality and high security.

The evolution from 3G to 4G will be driven by services that offer better quality (e.g. Multimedia, video and sound) thanks to greater bandwidth, more sophistication in the association of a large quantity of information, and improved personalization. Convergences will other network (enterprise, fixed) services will come about through the high session data rate. Machine-to-machine transmission will involve two basic equipment types: sensors (which measure parameters) and tags (which are generally read/write equipment). The 4G system was originally envisioned by the Defense Advanced Research Projects Agency (DARPA). In simplest terms, 4G will be an integrated system of voice, data and image communications that will support a wide range of personal and business communications [1].

II GENERATIONS OF WIRELESS COMMUNICATION

The history and evolution of mobile service from the 1G (first generation) to 4G (fourth generation) are discussed in this section. As the second generation was a total replacement of the first generation networks and handsets, and the third generation was a total replacement of the second generation networks and handsets, so the fourth generation cannot be just an incremental evolution of 3G technologies. The following table presents a short history of mobile telephone technologies[2].

Technology	1G	2G	3G	4G
Design began	1970	1980	1990	2000
Implementation	1984	1991	2002	2010
Service	Analog voice, synchronous data at 9.6Kbps	Digital voice, short messages	Higher capacity, broadband data up to 2Mbps	Higher capacity, complete IP oriented data to hundreds of megabits.
Standards	AMPS, TACS etc.	TDMA, CDMA, GSM, GPRS.	WCDMA, CDMA 2000	Single Standard
Data Bandwidth	1.9 Kbps	14.4 Kbps	2 Mbps	200 Mbps
Multiplexing	FDMA	TDMA	CDMA	CDMA
Core Network	PSTN	PSTN	Packet Network	Internet

III ABBREVIATIONS

AMPS: advanced mobile phone service

TACS: total access communications system

TDMA: Time division multiple access

CDMA: code division multiple access

GSM: global system for mobile

GPRS: General packet radio system

WCDMA: wideband CDMA

FDMA: frequency division multiple access

PSTN: public switched telephone network

IV PRINCIPAL TECHNOLOGIES USED IN 4G

- **OFDM (Orthogonal Frequency Division Multiplexing):** OFDM increases bandwidth by splitting a data-bearing radio signal into smaller signal sets and modulating each onto different subcarriers. Transmitting them simultaneously at different frequencies. The subcarriers are spaced orthogonally and

thus large numbers can be packed closely together with minimal interference. To maintain orthogonally among the thorns, a cyclic prefix is added, the length of which is greater than the expected delay spread. With proper coding and interleaving across frequencies. Multipath becomes an OFDM system advantage of yielding frequency diversity. OFDM can be implemented efficiently by using fast Fourier transforms (FFTs) at the transmitter and receiver.

- **MIMO (Multiple Input-Multiple Output):** MIMO is a spatial diversity technique that increases coverage or data capacity by either transmitting the same data on different antennas. A high-performance 4G broadband wireless mobile service requires multiple antennas be used at both the base station and subscriber ends. Multiple antenna technologies enable high capacities suited for internet and multimedia services and also dramatically increase range and reliability. Multiple antennas at the transmitter and receiver provide diversity in a fading environment. By employing multiple antennas, multiple spatial channels are created, making it unlikely that all channels fade simultaneously. With MIMO, the channel response becomes a matrix. Because each narrow band carrier can be equalized independently, the complexity of space-time equalizer is avoided.
- **AMC (Adaptive Modulation and Coding):** The principle of the AMC is to change the modulation and coding format (transport format) in accordance with instantaneous variations in channel conditions. AMC extends the system's ability to adapt to good channel conditions. Channel conditions should be estimated based on feedback from the receiver.

AMC allows different data rates to be assigned to different users, depending on their channel conditions. Since channel conditions vary over time, the receiver collects a set of channel statistics, such as modulation and coding, signal bandwidth, signal power, training period and automatic gain control, which are used by both the transmitter and the receiver to optimize system parameters.

- **Open Broadband Wireless Core:** The open wireless platform requires Area- and power-efficient broadband signal processing for wideband wireless applications. The highest industry channel density (million operations per second [MOPS] pooling) in flexible new base transceiver station (BTS) signal processing architectures. Terminal solutions that achieve the highest computational efficiency for application with high flexibility
Powerful, layered software architecture using the virtual machine programming concept [6].

V APPLICATIONS OF 4G

To achieve the goals of true broadband service, the systems need to make the leap to a fourth generation (4G) network. This is where **Global Wireless Communication (GWC)** enters the fray and access it. GWC will provide high speed, high capacity, low cost-per-bit IP-based services: fiber optic, wireless connections system operating in the frequency ranges that surpass all other telecommunication companies on planet Earth

4G will consist of a hierarchy of quality/bandwidth modes, organized somewhat like this:

- Vise, low-to-medium resolution images, moderate data rates.

- High quality audio, images with good quality on small screens. This can be achieved with WiMax, cable, satellite and DSL in supporting roles.
- Wide coverage with HDTV quality images, hundreds of Mbps data rates. Broadcast HDTV, digital cable, satellite and next generation of WiMax/WiBro support this level of quality.
- Local distribution of HDTV quality images, hundreds of Mbps data rates[3].

Some of the other applications of 4G are as follows:

- **Virtual Presence:** This means that the 4G provides user services at all times, even if the user is off-site.
- **Virtual Navigation:** 4G provides users with virtual navigation through which a user can access a database of a street, building etc.
- **Tele-Medicine and Education:** 4G will support remote health monitoring of patients. For people who are interested in lifelong education. 4G provides a good opportunity.
- **Tele-geoprocessing applications:** This is a combination of GIS (Geographical Information System) and GPS (Global positioning System) in which a user can get the location by querying [5].

VI FEATURES OF 4G

- a. **Advanced Security:**One thing about most forms of broadband internet technology despite their great speed is their security weakness. A lot of them have one or two features that make them highly vulnerable and even though the 4G internet technology is perfect when it comes to security it has been designed in a way that makes it cover the weakness of other technologies.
- b. **Reliability:**The most about the 4G mobile internet technology is how reliable it is an also the fact that it is not affected by the weather. It can be really frustrating to be enjoying your broadband internet connection only to start experiencing problems due to harsh weather conditions. The 4G technology addresses all these and it won't in any way be affected by the weather.
- c. **Converged Services:**The idea of convergence means that the creation of the atmosphere that can eventually provide seamless and high-reliability and quality broadband mobile communication service and ubiquitous service through wired and wireless convergence networks without the space problem and terrestrial limitation, by means of ubiquitous connectivity. 4G mobile systems will mainly be characterized by a horizontal communication model, where such different access technologies as cellular, cordless, wireless LAN type systems, short-range wireless connectivity, and wired systems will be combined on a common platform to complement each other in the best possible way for different service requirements and radio environments.
- d. **Broadband Services:**Broadband is a basis for the purpose of enabling multimedia communications including video service, which requires transmission of a large amount of data; it naturally calls media convergence aspect, based on packet transport, advocating the integration of various media on different qualities. The increasing position of broadband services like **Asymmetric Digital Subscriber Line (ADSL)** and optical fiber access systems and office or home LANs is expected to lead to a demand for similar services in the mobile communication environment [4].

VII FIFTH GENERATION

5G is not officially defined term or technology, but people refer technologies that can deliver the speed beyond 4G as 5G. It's expected to be finalized somewhere in 2012 or 2013. New standards proposals or releases beyond 4G are networks rather than end user access. To understand the necessities and uses of 5G could be raised once the 4G rollout is completed and experienced. Thus the typical 5G concept would be raised in somewhere around 2013-2015. Expected speed may be multiple of Gigabit Ethernet. This technology would be mainly used in backhauling telecom.

VIII 4G AND 5G NETWORKS

4G and 5G are both mobile wireless access technologies offers Ethernet speed on mobile devices to experience triply play services. Currently 4G is being deployed in several countries in Europe and North America. LTE and WI MAX are two different technologies to achieve 4G defined speeds. Whereas 5G is a concept only and not officially defined.

Difference Between 5G and 4G

- 4G offers theoretically closer to Gigabit Ethernet whereas users expect multiple Gigabit speed from 5G.
- 4G is being used in Backhauling Networks as well as user access networks, whereas users expect 5G to be back hauling backbone networks

IX CONCLUSION

This study provided an overview of 4G evolution and technologies. 4G is more than a cellular technology. It combines the cellular and WLANs to create the ultimate network. 4G networks are fully compatible with each other and offer truly global and locally roaming. As the wireless carrier explores the most efficient ways to deploy 4G services, they will face numerous challenges. However, with the range of solutions that will be available at their disposal, they will also have to opportunity to shorten their return on investment, improve operating efficiency, and increase revenues. 4G seems to be a very promising generation of wireless communication that will change the people's life in the wireless world. 4G is expected to be launched in 2010 and the world is looking forward for the most intelligent technology that would connect the entire globe.

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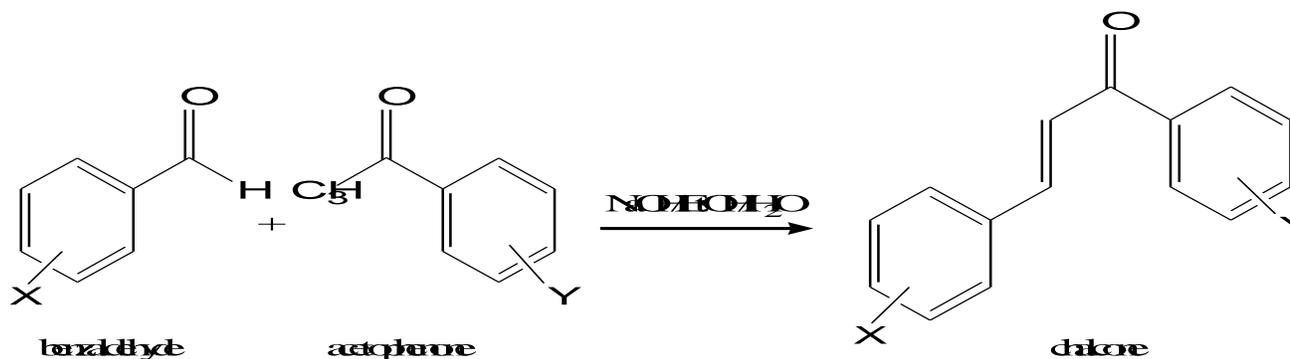
SYNTHESIS AND ANTIBACTERIAL ACTIVITY OF SOME SUBSTITUTED CHALCONE DERIVATIVES

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ABSTRACT

Chalcone derivatives were synthesized by the Claisen-Schmidt condensation of aromatic aldehydes with methyl ketones. Chalcone is unique template that is associated with several biological activities. 2-hydroxy-2,5-dichloro acetophenone (1) were synthesized by Fries migration and condensed with aromatic aldehyde to produce the new chalcone derivatives (2a-e). The new 1-(2-hydroxy-3,5-dichlorophenyl)-aryl-prop-2-ene-1-ones (2a-e) (chalcones) were characterized using FT-IR and NMR. The synthesized compounds were also screened against some bacterial species i.e., *S. aureus*, *K. pneumoniae*, *S. typhi*, *P. vulgaris*, *S. flexneri*, *E. coli* & *P. aeruginosa*, to evaluate their activity as promising antibacterial agents.



Keywords: Chalcone, Acetophenone, Aromatic aldehyde, Bacterial species

1 INTRODUCTION

Chalcones or 1,3-diphenyl-2-propen-1-one derivatives are a class of open chain flavonoids in which two aromatic rings are linked by a three carbon α,β - unsaturated carbonyl skeleton. Chalcones and their derivatives have shown a wide variety of therapeutic activities such as anti-oncogenic [1], anti-inflammatory [2a,2b], anti-ulcerative [3], analgesic [4], anti-viral [5], anti-fungal [6], anti-malarial [7], anti-bacterial activities [8a,8b], anti-cancer activity[9], anti-invasive [10] and anti-tumour [11]. During the last decade, the antimicrobial resistant represent the major problem facing the world, so that several new antibiotics and antifungal agents are accepted each year to help treatment the infectious diseases. In order to

discovering new antimicrobial agents, this research illustrated the synthesis novel chalcone derivatives and screening their activities against some gram positive and gram negative bacterial species.

II METHOD AND EXPERIMENTAL

The melting points are determined in open capillary tube & are uncorrected, purity of compounds was checked by TLC on silica gel-G plates .IR spectra was recorded on R Kin Elmer spectrophotometer. ^1H NMR spectra were recorded in CDCl_3 on Bracker AC 300 F .Spectrophotometer at 300MHz using TMS as internal reference. Antimicrobial activity of the compounds was assayed by cup plate agar diffusion method [12]

The titled compounds were tested against pathogenic bacteria for their antibacterial activity by paper disk method[13].The organism tested were staphylococcus aureus., klebsiella pneumoniae , salmonella typhi, proteus vulgaris , shigella flexuaria , Escherichia coli & pseudomonas aeruginosa . The solution of these compounds was prepared in DMSO as a solvent at a concentration of $50\mu\text{g/ml}$. The culture medium used was nutrient agar. After 24 hours of inhibition at 37°C , the zones of inhibition were measured in millimeter.

2.1 Preparation of 1-(2-hydroxy-3,5-dichlorophenyl)-3-aryl-prop-2-ene-1-ones (2a-e) :

2-Hydroxy-3,5-dichloro acetophenone (1) (0.01 M) was dissolved in ethanol (15 ml). Then aromatic aldehyde (0.01 M) was added to it. The mixture was heated to boiling. Aqueous NaOH solution (40%, 8 ml) was added dropwise with constant stirring to the reaction mixture, orange cake was formed. The reaction mixture was kept overnight. Then it was decomposed by adding water containing a little conc. HCl. The crude product was crystallised from ethanol-acetic acid mixture to get 1-(2-hydroxy-3,5-dichlorophenyl)-3-aryl-prop-2-ene-1-ones (2a-e).

Table –1

Physical characterization data of 2-hydroxy-3-5-dichloro chalcones (2a-2e)

comp	R ₁	R ₂	Yields %	M.P. ⁰ C	Molecular
2a	H	OCH ₃	85	169	C ₁₆ H ₁₂ O ₃ Cl ₂
2b	H	H	85	140	C ₁₅ H ₁₀ O ₂ Cl ₂
2c	Cl	H	80	158	C ₁₅ H ₉ O ₂ Cl ₃
2d	NO ₂	H	90	220	C ₁₅ H ₉ O ₄ Cl ₂ N
2e	H	OH	75	168	C ₁₅ H ₁₀ O ₃ Cl ₂

2.2 Spectral Interpretation of 2a

IR (max cm⁻¹)- 3068.2 (Ar-H); 1599 (c=c); 702, 737,780 , (C-H); 824 (C-Cl); 1045 (C-O-C); 1637.3 (C=O)

HNMR: OH (CDCl₃, ppm); 3.87(S, 3H), 6.9-7(m 6), 3.53 (S₂H)

Thus, the following Chalcones were prepared by this method.

1. (2a) 1-(2-hydroxy-3,5-dichlorophenyl)-3-phenyl-prop-2-ene-1-one
2. (2b) 1-(2-hydroxy-3,5-dichlorophenyl)-3-(4-methoxyphenyl)-prop-2-ene-1-one
3. (2c) 1-(2-hydroxy-3,5-dichlorophenyl)-3-(3-chlorophenyl)-prop-2-ene-1-one
4. (2d) 1-(2-hydroxy-3,5-dichlorophenyl)-3-(3-nitrophenyl)-prop-2-ene-1-one
5. (2e) 1-(2-hydroxy-3,5-dichlorophenyl)-3-(4-hydroxyphenyl)-prop-2-ene-1-one

2.3 Properties and Constitution of the Compound (2a-e) :

- The compound (2a-e) gave green colouration with neutral alcoholic FeCl₃ solution indicating the presence of phenolic -OH group.
- The compound (2a-e) shows unsaturation test with bromine water and KMnO₄ solution.

Antimicrobial activities

TABLE - 2 :

Antimicrobial activity of 1-(2-hydroxy-3,5-dichlorophenyl)-3-aryl-prop-2-ene-1-ones (2a-e)

Microorganisms	2a	2b	2c	2d	2e
<i>S. aureus</i>	--	--	--	--	--
<i>K. pneumoniae</i>	14	14	11	15	18
<i>S. typhi</i>	--	12	12	13	11
<i>P. vulgaris</i>	15	17	16	15	16
<i>S. flexuuri</i>	--	--	--	--	12
<i>E. coli</i>	12	12	12	--	18
<i>P. aeruginosa</i>	16	--	--	14	12

- N.B.** -- : Resistance (Inactive)
 11-15 : Weakly active
 15-20 : Moderately active
 20-30 : Highly active

Results and Discussion :

From the Table-2, it is observed that *S. aureus* is inactive against all these compounds whereas *S. flexueri* is weakly active against 2e. *P. aeruginosa* are weakly active against 2d and 2e compounds. *P. vulgaris* is the organism which is moderately active against all compounds of this series and *K. pneumoniae* is moderately active against 2e and weakly active against 2a, 2b, 2c and 2d.

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