CLASSIFICATION OFAPPLES USING NEURAL NETWORKS

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ABSTRACT

The aim of the paper is to present appraisal on several procedures in detection and isolating of rotten fruits .It will help to provide a better class product at the consumer end. Some of these methods used are Neural Networks, Fuzzy Logics, Neuro-Fuzzy and Support Vector Machines. In this paper, we have also explored different physiognomies which tell us about apples superiority and how we can select the superlative ones to accomplish a practical efficiency in taxonomy .We have also associated different techniques prevailing in this field.

Keywords*: *Classification of Fruits, Computer Vision, Feature Extraction of Objects, Neural Networks.

I. INTRODUCTION

We all like to eat fresh and best quality fruits, but with time they start to rot or begin to brown when left in open. Same challenges are experienced by the factory owners when they store, process and pack them. Artificial Intelligence can be used to ease the problems faced by them and can also improve the finances in the fruit industry.

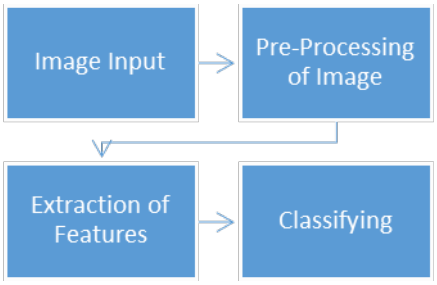

Figure 1-Block Diagram of Image Processing

Soft Computer Vision Systems provides substantial information about the nature and attributes of the fruits which reduces costs, guarantees the maintenance of quality standards and provides useful information in real time. It acquires and analyze an image of a real scene by using computers and process it. The techniques include image acquisition, image pre-processing and image interpretation, leading to classification of fruits. The overall appearance of fruit object is a combination of its chromatic attributes (color) and its geometric attributes (shape, size, texture), together with the presence of defects thatcan diminish the external quality. Thus automated fruitgradation plays an importantrole toincrease the value offoodstuffs.

Zou Xiao-bo et al .proposed a paper for detection of apples defects using three color cameras system. They proposed using three camera systems for taking multiple child photographs of an apple and then sent for processing. Image preprocessing includes background segmentation, image de-noise, child image segmentation and sequential image processing. In image,the region of interest (ROI) are defined and then bieng analysed for the defects.The ROIs are generally darker than their surrounding non-defective surfaces, and in image grey-level landscapes they usually appear as significant concavities using the concept of topographic representation .[1]

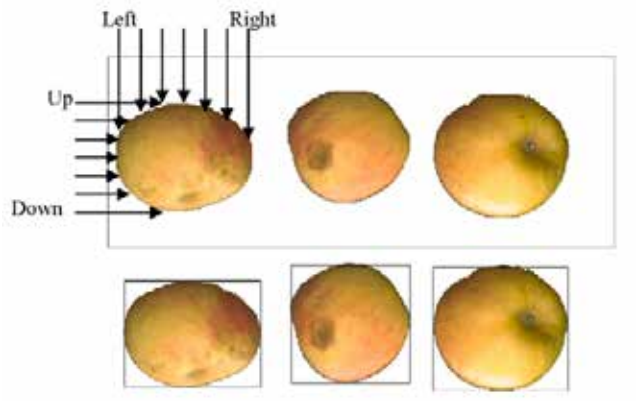

Figure 2- Single child images of apples [2]

Dubey et al. proposed a new defect segmentation method of fruits based on color features with K-means clustering unsupervised algorithm. Color images of fruits were used for defect segmentation, carried out into two stages. At first, the pixels were clustered based on their color and spatial features, where the clustering process was accomplished. Then the clustered blocks were merged to a specific number of regions. This two step process was useful in increasing the computational efficiency by avoiding feature extraction for every pixel in the fruit image. They had taken apple as a case study and evaluated the proposed approach using defected apples. The investigational results explained the usefulness ofproposed approach to improve the defect segmentation quality in aspects of exactness and computational time.[2]

II. DIFFERNET TECHNIQUIES

There are different techniques that can be used for classification and clustering of the apples based on different physiognomies. Some of these are Neural Networks, Fuzzy Logics, Neuro-Fuzzy and Support Vector Machines. The table shows the the *ac*curacy of different classifiers that can be used for apples.[3]

Table 1 – Accuracy of Different techniques used for classification of apples [3]

Classifier Technique Used	Highest Accuracy Achieved
Multi-LayerPerceptron-Neural Networks	89.9
Fuzzy Logics	89
Neuro-Fuzzy	Not defined
Support Vector Machines	90

2.1 Neural Networks

Neural Networks are encouraged from the brain system. Likewise, our brain learn from everyday life and use it in future, Neural Networks also works on the same code. There are two stages in Neural Networks i.e. Training and Testing. It iscomposedof a large number of highly interconnected processing elements working in unison to solve specific problems. NN, like brain, learn by example. We train the system on no. inputs (example) and then use them in real time to test it.

Artificial Neural Networks; like other machine learning methods - systems that learn from data have been used to solve a wide variety of tasks that are hard to solve using ordinary rule based techniques, including computer vision and speech recognition.

D. Unay et al. proposed a method using Artificial Neural Networks based segmentation to grade apples using machine vision. Images of apples are taken by high resolution monochromatic camera with four interference band-pass filters centered at 450 nm, 500 nm, 750 nm and 800 nm with respective bandwidths of 80 nm, 40 nm, 80 nm and 50 nm respectively. Segmentation of defects is proposed at pixel level, therefore for each pixel of the fruit its intensity values from four filters are used as local features. Afterwards, average, median and standard deviation of the segmented area calculated.in total, there are 13 inputs and 2 outputs. [6]

III. CLASSIFYING PARAMETERS

The accuracy and precision of any classifier depends on the parameters and physiognomies used as the inputs to classify the objects. Here, our main focus is on fruits .there are many parameters with which we can classify them but the most prominent are the color, shape , size and weight. The maturity and variety of fruit, say apple can easily be determined from the color of the peel. Pre-maturely harvested apples tend to be small, poorly colored while over ripped ones are softer as they have more water content, are heavier and also darker in color.

Li Yanxiao et al. purposed color grading of apples based on feature parameters.tp classify the apples, they used 17 parameters as inputs to organizational feature parameters in Genetic Algorithm (GA). These consists of 3 average color gradients (R, G , B), the variances (V_R,V_G,V_B) and the color coordinates (r ,g ,b) were calculated from the three-primary colors. Then, these RGB images were converted to HSI (hue-saturation-intensity) model where 8 more parameters were extracted from it. These were based on different Hue values of the images. Compared with BP-ANN and SVM, the OFPs method was more accurate than BP-ANN, but a little lower than SVM for identification results [4].

Ali et al. developed a neural network to classify seven major varieties of date fruit: Berhi, Khlass, NubotSaif, Saqei, Sefri, Serri, and Sukkari. They used physical features like weight, volume and sizeof the dates as the parameters for classification for different neural networks.[6]

Xu Liming et al. developed automated strawberry grading system based on K-means clustering system. They extracted three basic physical characteristics of strawberry i.e. shape, color and size .The results show that the strawberry size detection error is not more than 5%, the color grading accuracy was 88.8%, and the shape classification accuracy was above 90%. The average time to grade one strawberry was below 3 seconds.[5]

To classify the apples, 4 parameters i.e. red, green, blue and gray value per pixel are used. First, the network is trained to input data , after it is tested using real practical data to calculate the efficiency of the network .

IV. METHODOLOGY

Phase 1- Data Collection and Extraction

This project comprises of three phases.

A total of 40 apples of red golden variety were examined comprising both good (20) and bad (20) quality apples. The photographs of the apples were captured using iPhone 4 camera of 5 MP under conditions of optimum light. By manual segmentation, background of the image is removed to focus on region of interest i.e. flesh of the apple. After pre-processing the image ,

Figure 3- Original Images (RGB) of Apples

Figure 4- Filter Images of Apples. Left to Right. Red, Green, Blue and Gray

The process of information extraction is explained below.

1) Add your images in matlab.
2) Type “imtool” in command window.
3) File -> Extract from workspace.
4) Mask the background of the image.
5) Then export back to workspace.
6) Use following commands

: (1)a = size(image name)

// give you the size of the image i.e. (pixels in x –axis) * (pixels in y-axis)

: (2) b = rgb2gray(image name)

// change colored image into grayscale

: (3) m= sum(sum(image name))

// gives the sum of the pixels in x-axis and y-axis of color image.

: (4) n= sum(sum(b))

// gives the sum of the pixels in x=axis and y-axis of gray image.

· Now,we will find the avergae color (red/green/blue) or graylevel per pixel.

· We have sum of all the pixels values, divide it by total number of pixels.

· This gives an average color value per pixel with which good and bad apples can be distiguished.

Phase 2- Neural Network Training

To train a Neural Network, a several number of adaptive learning algorithms for feed forward neural networks are available. Many of these algorithms are based on descent algorithm well known in optimization theory. They usually poorconvergence

rate. An example is thestandard backpropagation

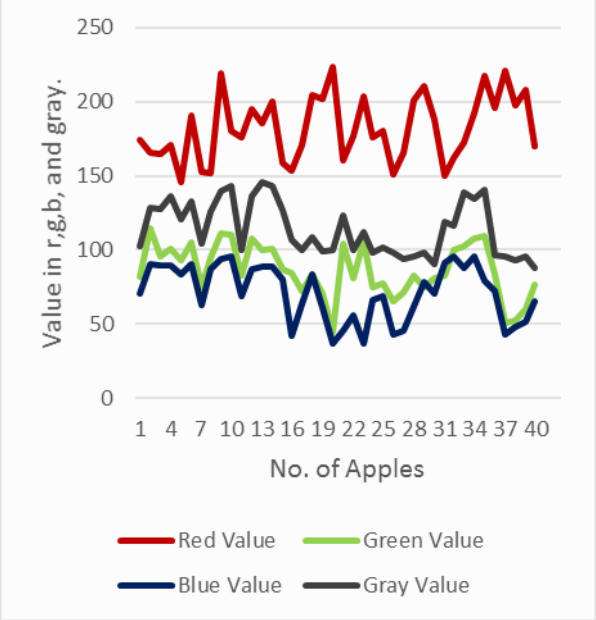

Figure 5- Line Graphs showing R,G,B and Gray Value of the Apples used for development of this network

which behaves badly on large scale systems. By using a step size mechanism, scaled conjugate gradient (SCG) avoids time consuming line search per learning iteration, which makes the SCG algorithms faster than many other second order algorithms. So, the training of neural networks was carried out using scaled conjugate gradient (SCG)backpropagation. [7]

Out of total 40 apples, 30 were used to train the neural network using SCG back propagation.

Now, the important parameters for training the neural networks is to choose the adequate number of hidden neurons. It is difficult to determine a good network topology from number of inputs and number of outputs. Increasing number of hidden layers can increase the accuracy but can lead to complexity of the system [8]. The inputs parameters in this are 4 values, keeping default value of 10 is fine.

The training was completed successfully with a cross entropy of 2.165 e-0 which is a lower value and so, better. The training ran for 41 epochs until the minimum gradient value was reached. The confusion matrix is shown below.

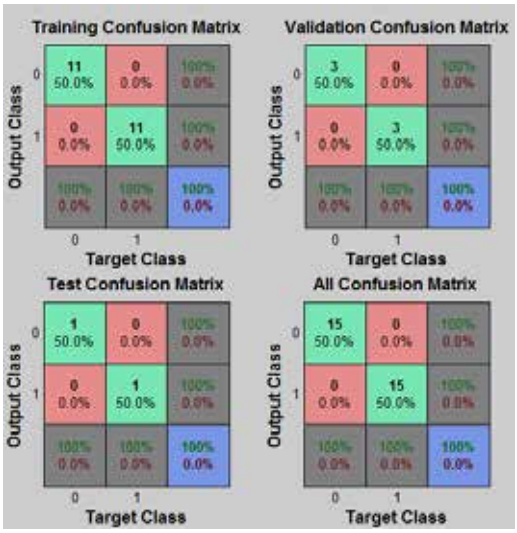

Figure 6- Confusion graphs showing the result of training of the Neural Network

Phase 3-Neural Network Training

The validity of a designed network can only be verified if it is tested using some practical substantiated data. To test the network, a set of color values (Red, Green, Blue and Gray) of apples were used. The outputs of these values were known with which the testing process was successfully completed.

RED	green	BLUE	GRAY	1=GOOD /0=BAD
150.07	82.49	91.34	118.97	1
162.14	100.08	95.67	116.46	1
172.78	102.65	87.45	138.87	1
192.69	107.86	95.84	134.57	1
217.84	109.71	79.45	140.77	1
195.88	83.77	72.4	96.5	0
220.75	50.87	42.55	95.67	0
197.37	52.61	48.33	92.72	0
207.99	60.05	51.54	95.488	0
169.89	76.77	65.1	88.15	0

Figure 7- Color values used for testing of the network

The testing process was completed with cross entropy of 1.214e-2 and %E of 10.00e-0. The network is tested successfully with the efficiency of 90%[Figure 8].

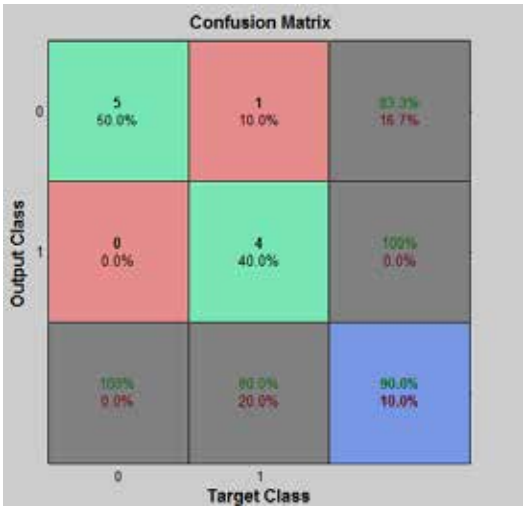

Figure 8- Efficiency of networks after testing

V.RESULTS AND DISCUSSIONS

Figure 8 shows the efficiency of the network formed is 90% which is higher than the stated in Table 1. The results can be further improved by considering some other inputs physiognomies like water content, density, softness etcetera. Studying apples under UV light can also be used to further expand this research. A lot other techniques are available in this field but each one has its own pros and cons.

In the end, we can conclude that autonomous grading of the fruits using Soft Computer Techniques will not only improve the fruits quality at the consumer end but will also reduce the cost of the industry . Though, these systems cannot match the precision of the human eye and hands, but the speed and the cost at which they work, can easily overcome that. There are lot many techniques that can be improved and many new can be developed in the field which will improve the efficiency of the systems and can equal human accuracy.

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THERMOGRAM IMAGE FOR IMAGE ENHANCEMENT

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ABSTRACT

Today there is no area where images are not used, taking an example of Medical images, to study a variety of medical imaging techniques to diagnose and treat human diseases. In these years the digitalizing process of medical images starts from gathering, scanning, display to reconstruction, diagnosis, transmission, storage, etc is closely confined up to the development of computer science. Thermogram means a photographic record made by thermography. In this paper a Analysis is made about the Thermogram Image and the enhancement using the Thermography instrument

Keywords: Gray Image, Images, Infrared Technology, Pixels, Temperature, Thermogram,

I INTRODUCTION TO THERMOGRAPHY

A regional temperature map of the surface of a part of the body made by a thermograph or A graphic record of temperature variations or The visual record obtained by THERMOGRAPHY; called also thermograph

A technique for sensing and recording on film hot and cold area of the body by means of an infrared detector that reacts to blood flow diseases states that manifest increased or decreased blood flow present thermographic patterns that can distinguish from those of normal areas.

All objects when heated emit electromagnetic energy. The amount of energy is related to the temperature. The higher the temperature, the more electromagnetic energy it emits.

The electromagnetic spectrum contains various forms of radiated energy including gamma rays, X-rays, Ultraviolet, infrared and radio. Infrared energy covers the spectrum of 0.7 to 100 μm.

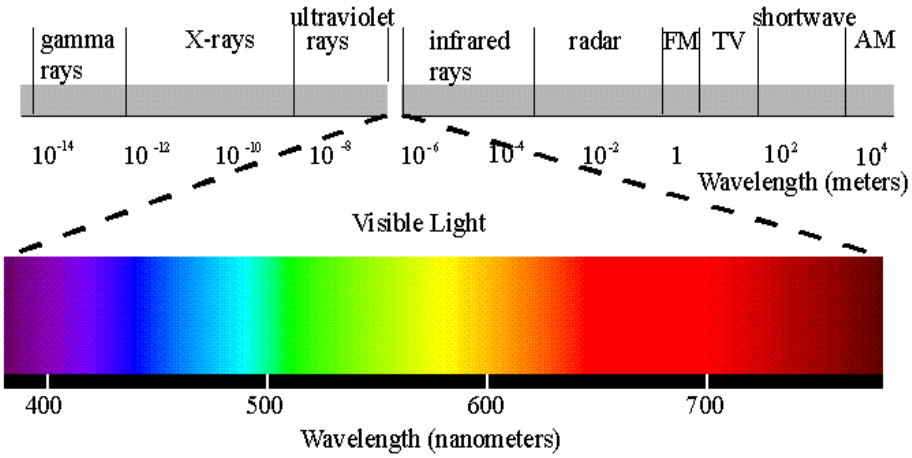

Figure 1.1 Electromagnetic spectrum

1.1 Infrared

All matter (examples planets, gases) produces some amount of electromagnetic radiation across a range of wavelengths or energies

All materials, which are above 0 degrees Kelvin (-273 degrees C), emit infrared energy.

Thermal, or infrared energy, is light that is not visible because its wavelength is too long to be recognized by the human eye;

- Ø NEAR INFRARED
- Ø MID INFRARED
- Ø THERMAL INFRARED

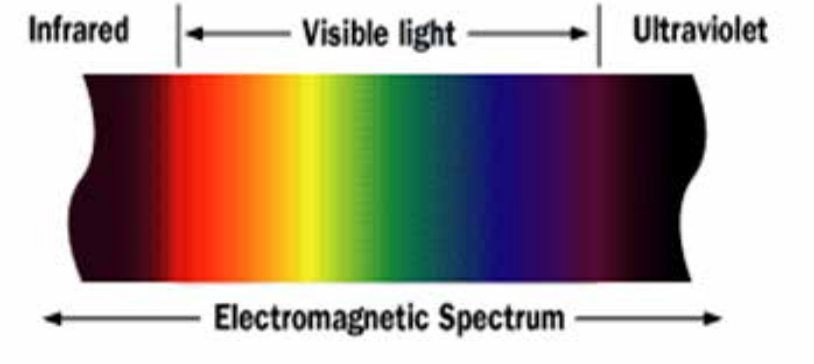

Figure 1.2 Classification of Spectrum

"Infrared" denotes to the portion of the electromagnetic range where natural life-forms emit the most light, at wavelengths somewhat longer than what we perceive as the color.

Why Don't We See It.

Put simply, Human eyes do not have the basics necessary features for detecting infrared. Although there are practical evolutionary details for this, infrared is a reality that exists behind the scenes.

1.2 Normal Infrared

Human beings are not able to see infrared, where as we can still *sense* it through what is frequently called heat. Physical touch is the straightest way of observing it. We feel it on a hot day under the sun, or when we walk on the campfire.

The electromagnetic band is a range of all electromagnetic waves arranged according to wavelength and frequency. A wave has several characteristics the diagram 1.5 shows the highest point in the wave is called the *crest* and the lowest point in the wave is referred to as the *trough.* The distance between one wavecrest to another wavecrest is called a *wavelength. Frequency* is the number of wavecrests passing a given point per second. As the wave frequency increases, the wavelength decreases. The shorter the wavelength the more energy contained; the longer the wavelength, the less energy. For example: a steel slab exiting the furnace at the hot strip will have short wavelengths. we can sense the heat and realise the red glow of the slab. The wavelengths have become smaller crest to crest and the energy being emitted has increased, entering the visible band on the electromagnetic spectrum. By contrast, (infrared energy) when the coil comes off of the coilers it

has been cooled. There is a loss of energy. The wavelength have increased crest to crest and decreased in frequency.

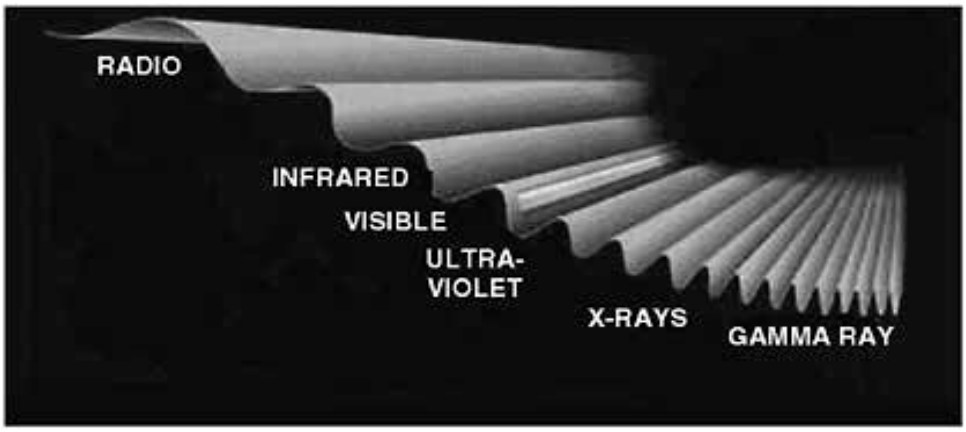

Figure 1.3 Wavelengths.

1.3 Basic Infrared Theory

Infrared is light that works outside the dynamic range of the human eye. The heat is measured & viewed by the developer of the infrared images. Later this information is transformed into digital data & processed into video images that are called Thermograms. Individual pixel of a thermogram images has a temperature value and the image's contrast is derived from the differences in surface temperature. An infrared examination is a harmless technique for detecting thermal differences that indicate problems with equipment. Infrared surveys are conducted with the plant equipment in operation, so production need not be interrupted. The comprehensive information can then be used to prepare repair time/cost estimates; evaluate the scope of the problem; plan to have repair materials available, and perform repairs effectively.

II HEAT TRANSFER CONCEPTS

Heat is a form of thermal energy. The first law of thermodynamics is that heat given up by one object must equal that taken up by another. The second law is that the transfer of heat takes place from the hotter system to the colder system. If the object is cold, it absorbs rather than emits energy. All objects emit thermal energy or infrared energy through three different types or modes. The three modes are conduction, convection, and radiation. It is important to understand the difference of these three forms.

2.1 Conduction

Conduction is the transfer of energy through or between solid objects. A metal bar heated at one end will, in time, become hot at the other end. When a motor bearing is defective, the heat generated by the bearing is transferred to the motor casing. This is a form of conduction.

2.2 Convection

Convection is the transfer of energy through or between fluids or gases. If you took the same motor mentioned above and placed a fan blowing directly on the hot bearing, the surface temperature would be different. This is convection cooling. It occurs on the surface of an object. An operator must be careful to identify the true cause

and effect. In this case, the difference between good and bad source heating and the surface cooling due to convection.

2.3 Radiation

Radiation is the transfer heat by wavelengths of electromagnetic energy. The most common cause of radiation is solar energy. Only radiated energy is detected by an infrared imager. If our motor were sitting outside in the slab storage yard with slabs stacked around it, the electromagnetic energy from the sun and from the slabs would increase the temperature.

The infrared energy emitted from the measured object is converted into an electrical signal by the imaging sensor (microbolometer) in the camera and displayed on a monitor as a colour or monochrome thermal image.

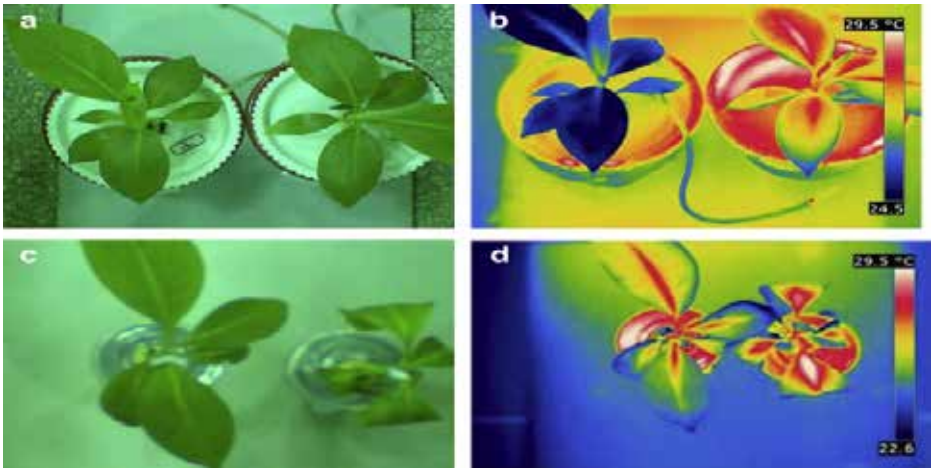

Figure 1.4 Color thermal image

Figure 1.5 Thermal Imaging Camera

The spectrum and amount of thermal radiation depend strongly on an object's surface temperature. This makes it possible for a thermal imaging camera to display an object's temperature.

III INFRARED THERMOGRAPHY SECURITY

Equipment included in an infrared thermography inspection is almost always energized. For this reason, a lot of attention must be given to safety. The following are basic rules for safety while performing an infrared inspection:

Plant safety rules must be followed at all time.

Notify area personnel before entering the area for scanning.

Qualified electrician from the area should be assigned to open and close all panels.

Where safe and possible, all equipment to be scanned will be on line and under normal load with a clear line of sight to the item.

Equipment whose covers are interlocked without an interlock defect mechanism should be shut down when allowable. If safe, their control covers opened and equipment restarted.

Examples: The very first thermal image in 1948 took 40 minutes to scan

Figure 1.6 First Thermal image in 1948

Thermal Image of the Immediate Effects of Cell Phone Radiation

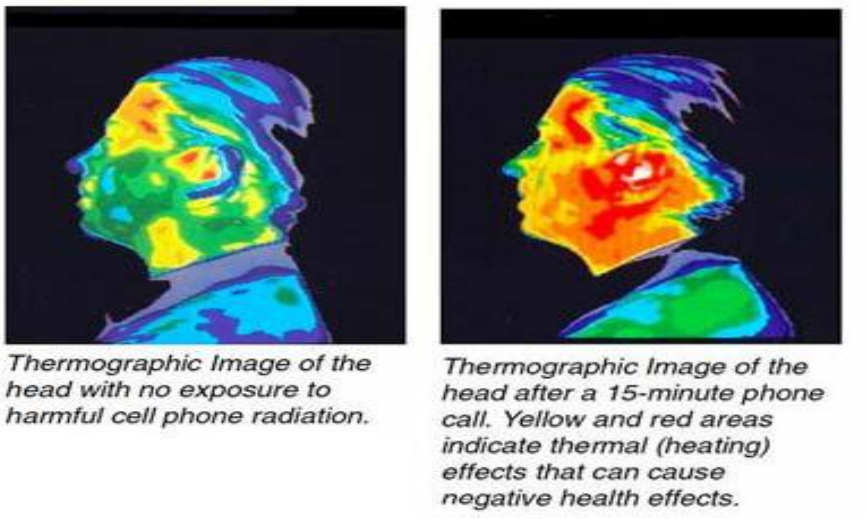

Figure 1.7 Thermographic image for Cell phone radiation

Medical Therapeutic Massage

Treatment Progress

Figure 1.8 Backbone treatment

Various Conditions

“red glove” in hands related to pancreatic issues,

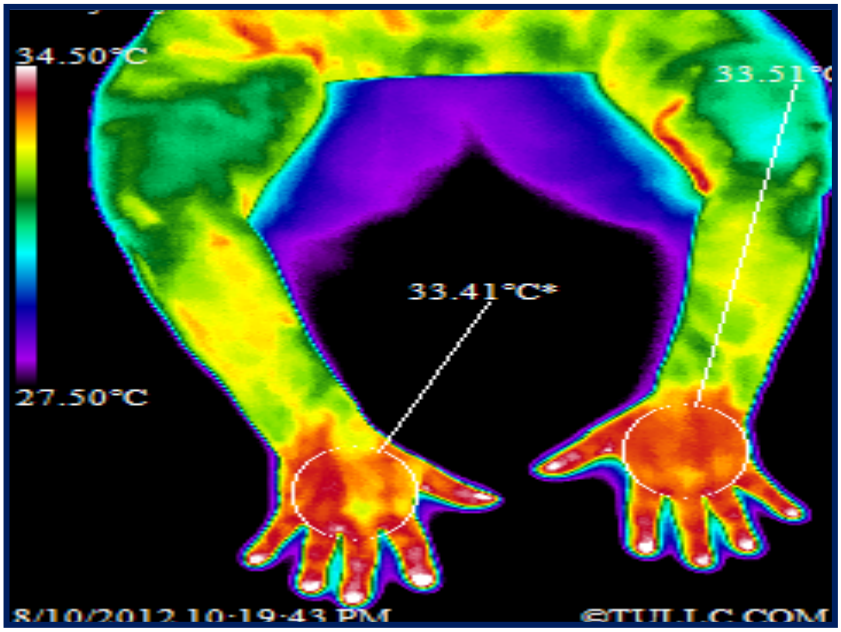

Figure 1.9 Hands related to Pancreatic

digital neuropathy in toes,

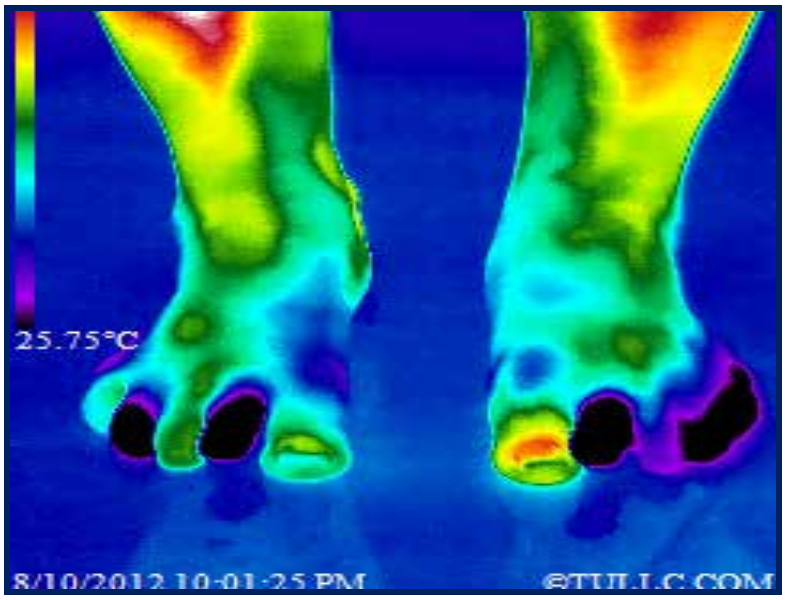

Figure 2.0 neuropathy in toes

kidney inflammation and back pain

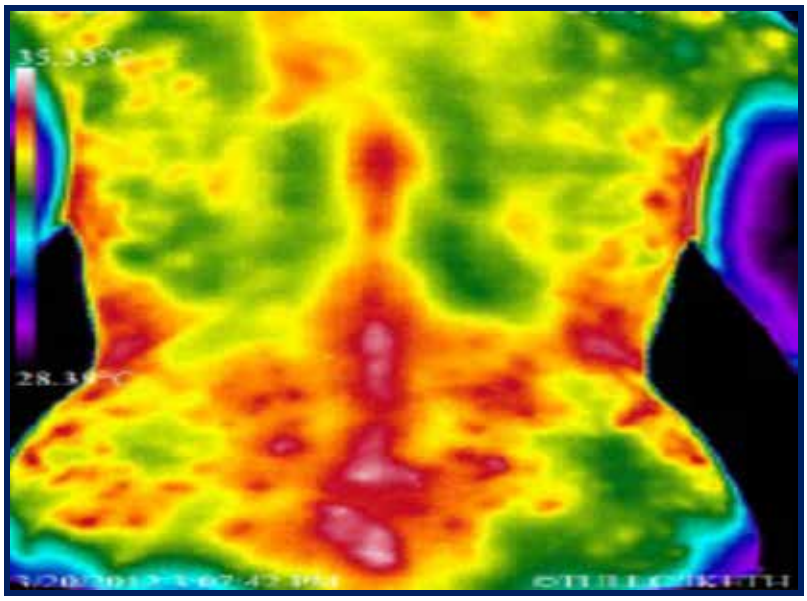

Figure 2.1 Kidney inflammation and back pain

IV CONCLUSION

By this survey we can conclude that thermogram Imaging is a completely non-invasive, non-contact, medical imaging procedure for detecting and monitoring various diseases and physical injuries. It helps the doctor to diagnose the problem early stage of the diseases

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A REVIEW OF GRAVITY WAVES IN MESOSPHERIC REGION

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ABSTRACT

In this paper role of gravity waves, wave packets and relation between observed periods and unobserved wave numbers have been studied. The effect of gravity wave breaking on eddy diffusion has been discussed. Parameterization of turbulence and stress as well as identify the magnitude of known mechanism of generating gravity waves are attempted to study.

***Keywords**: Wave Packet, Group Velocity, Flow Acceleration,, Eddy Diffusivity, Wave Number.*

I. INTRODUCTION

The gravity waves play a major role in mesospheric dynamics. Many Researchers (Balgiano, Consensus et.al) are review that the wind irregularities were due to turbulence [1,3]. The irregularities were due to internal gravity waves argued by Hines [13, 25]. The most perfunctory review of the parameterization will be given including a description of some improvement found in Holton and of some recent thoughts on turbulence due to sub-breaking waves [19-20]. In this paper role of gravity waves, wave packets and relation between observed periods and unobserved wave numbers are studied. The horizontal as well as vertical propagation of gravity wave packet in order to develop some intuition about the origin of Mesospheric gravity waves are also considered [4-8].

II. PARAMETERIZATION OF TURBULENCE AND STRESS

Lindzen introduced the simplest model capable of describing the effect of breaking gravity waves [9-12, 19]. He considered zonally travelling gravity waves which were standing waves in the meridional direction, i.e., waves in the following form

$$e^{ik(x-ct)-\delta x^2}[\text{Cos}(ly + \varphi) + \text{Sin}(ly + \varphi)] \,, 0 \leq \delta \leq 1 \qquad (1)$$

Where

x = eastward distance

y = northward distance

t = time

k = eastward wavenumber

c = eastward phase speed

l= northward wavenumber

φ = arbitrary phase constant

In slowly varying medium, using the WKB approximation,

$$\delta T = A\,\Gamma^{1/2} T^{-1/2} \lambda^{1/2} e^{i\int \lambda dz} e^{z/2H} e^{ik(x-ct)-\delta x^2} [\mathrm{Cos}(ly + \varphi) + \mathrm{Sin}(ly + \varphi)] \quad (2)$$

A = Amplitude factor

Γ = Static Stability = $\frac{dT}{dz} + \frac{g}{c_p}$

T = Basic temperature

δT = Perturbation temperature

$$\lambda = |N/(\bar{u} - c)|\left(1 + \frac{l^2}{k^2}\right)^{1/2} \quad (3)$$

$\bar{u}$ = Mean zonal flow

$$N^2 = \frac{g}{T}\left(\frac{dT}{dz} + \frac{g}{c_p}\right)$$

From eq (2)

$$\frac{d\delta T}{dz} = \frac{i}{2H} A\,\Gamma^{1/2} T^{-1/2} \lambda^{3/2} e^{i\int \lambda dz} e^{z/2H} e^{ik(x-ct)-\delta x^2} [\mathrm{Cos}(ly + \varphi) + \mathrm{Sin}(ly + \varphi)] \quad (4)$$

Breaking occurs when,

$$\left|\frac{d\delta T}{dz}\right| = \Gamma$$

From eq (4)

$$\frac{A}{2H}\,\Gamma^{1/2} T^{-1/2} \lambda^{3/2} e^{z/2H} = \Gamma \quad (5)$$

If the breaking height , z_{break} is observed then from eq (5) determines A.

CASE-I

$z > z_{break}$

It is assumed that sufficient turbulence is generated to prevent $\frac{d\delta T}{dz}$ from growing further. According to Lindzen, in the absence of damping, $\frac{d\delta T}{dz}$ would grow exponentially with a local exponent given by

$$\frac{1}{2H} - \frac{3}{2}\frac{1}{(\bar{u}-c)}\frac{d\bar{u}}{dz} \quad (6)$$

Damping rise to imaginary part of c, which produces an imaginary contribution to [14-17]. The damping so that λ_i is exactly equal to the growth exponent given by eq (6), so that growth is exactly cancelled. This degree of damping, sufficiently small to permit Lindzen to relate c_i to eddy diffusivity, given by

$$kc_i = \lambda^2 D_{eddy} \quad (7)$$

and requirement that growth be cancelled then leads to

$$D_{eddy} = k\frac{|u-c|^4}{N^3\left(1+\frac{l^2}{k^2}\right)^{3/2}}\left|\frac{1}{2H} - \frac{3}{2}\frac{1}{(\bar{u}-c)}\frac{d\bar{u}}{dz}\right| \quad (8)$$

CASE-II

$z = z_{break}$, we have

$$\overline{\acute{w}\acute{u}} = \frac{k}{2}\frac{N^2}{\lambda^3} \quad (9)$$

Where

$\acute{w}$ = perturbation vertical velocity

$\acute{u}$ = Perturbation zonal velocity

For plane wave of the form eq (1) in the absence of damping, the Eliassen-palm theorem requires

$$\frac{d}{dz}((\rho_0\overline{\acute{w}\acute{u}}) = 0 \quad (10)$$

Implying no acceleration of the mean flow.In the presence of damping due to wave breaking eq (10) is replaced by

$$\rho_0\acute{w}\acute{u} = \rho_0(z_{break})\frac{k}{2}\frac{N^2}{\lambda^3}\Big| z_{break} = e^{-2}\int_{z_{break}}^{z}\lambda i dz \quad (11)$$

From eq (6) the flow acceleration F_x is given by

$$F_x = -\frac{1}{\rho_0}\frac{d}{dz}((\rho_0\overline{\acute{w}\acute{u}}) = \overline{\acute{w}\acute{u}}(\frac{1}{H} - \frac{3\frac{d\bar{u}}{dz}}{(\bar{u}-c)}) \quad (12)$$

Taking the account of filtering properties of troposphere and stratospheric winds concluded that for winter c=0 while for summer c=20 m/s. k was chosen to be the smallest value consistent with

$$k(\bar{u} - c) \geq f^1 \quad (13)$$

Where

F = 2Ω sinφ

φ = lattitude

Ω = $2\pi/day$

Eq (13) being necessary for vertical propagation in the presence of rotation.

III. CALCULATION OF GRAVITY WAVE

All proposed mechanism for gravity wave generation fall into some given broad categories [2, 24]:

3.1 Mountain Waves

Mountain waves are forced by flow over topography. The forcing appears in the lower boundary condition where

$$\acute{w}(0) = U_0\frac{\partial}{\partial x}h(x) \text{ at } z = 0 \quad (14)$$

Where

h = surface elevation

U_0 = Surface mean wind

We assume surface elevation of the form

h(x) = h $e^{(ikx-\delta x^2)}$[Cos(ly + φ) + Sin(ly + φ)]

Eq (14) becomes

$\acute{w}(0) = (ik-2\delta x)\, hU_0\, e^{(ikx-\delta x^2)}[\text{Cos}(ly + \varphi) + \text{Sin}(ly + \varphi)]$ (15)

From lindzen, we have

$\acute{w}(z) = A\, \lambda^{-1/2}\, e^{i\int_0^z \lambda dz} e^{z/2H}\, e^{(ikx-\delta x^2)}[\text{Cos}(ly + \varphi) + \text{Sin}(ly + \varphi)]$ (16)

Where, for c = 0

$\lambda^2 = \frac{N^2}{U_0^2}(1 + \frac{l^2}{k^2})$

From eq (15), we have

$A = ikU_0 h\lambda_0^{1/2}$

We also have from lindzen (1981)

$\acute{u} = \frac{\lambda}{k(1+\frac{l^2}{k^2})}\acute{w}$ (18)

From eq (16) and eq (18) we get by averaging over x,

$\overline{\acute{w}\acute{u}} = \frac{kU_0 h^2 N_0 e^{z/H}}{2(1+\frac{l^2}{k^2})^{1/2}}$ (19)

From eq (9), we have

$\overline{\acute{w}\acute{u}}\big|_{z_{break}} = \frac{k}{2}\frac{U^2(z_{break})}{N(z_{break})(1+\frac{l^2}{k^2})^{3/2}}$ (20)

From eqs (19) and (20), we have

$e^{z_{break}/H} = \frac{U^2(z_{break})}{N(z_{break})U_0 h^2 N_0(1+\frac{l^2}{k^2})}$ (21)

For simplicity we will take

$N = N_0 = 2\frac{\pi}{300s}$

We will also take

U_0 =10m/s, which probably excessive

3.2 Shear Collapse

This is probably the most efficient mechanism for generating gravity waves with phase speeds greater than zero [18]. Thus, invoking phase speeds greater than average troposphere wind speeds; we must consider what could possibly be trying to maintain an unstable shear layer at that speed.

IV. WAVE NUMBER AND OBSERVED PERIOD

To extend the periods,τ, are observed,they are related to phase speed by the simple relation

$\tau = \frac{2\pi}{kc}$ (22)

A clue to the privacy of periods or phase speed is given by eq (3) where we see tendency of all wave with the same phase speed to have the same vertical wavelength independent of k and hence period[21-23]. This is in line with currently available data.

V. WAVE PACKETS AND GROUP VELOCITY

Let us for a moment consider a gravity wave packet travelling in the x-z plane. Locally we have

$$\sigma = N\frac{k}{m} \tag{23}$$

Where

$\sigma =$ Frequency observed in moving frame following mean flow = k(c-u)

k= wave number in x direction

m= wave number in z direction

N= Brunt-Vaisala frequency

The group velocity in x- direction is given by

$$C_{gx} = \text{U} + \frac{\partial\sigma}{\partial k} = \text{U}+ \frac{N}{m} = \text{U}+ \frac{\sigma}{k} = \text{U}+ (\text{c-U}) = \text{c} \tag{24}$$

In the Z- direction given by

$$C_{gz} = \frac{\partial\sigma}{\partial m} = -\text{N}\frac{k}{m^2} = -\frac{\sigma}{m} = -\text{k}\frac{(c-U)}{m} = -(c-U)^2\frac{k}{N}$$

From eqs (23) and (24), we have

$$\frac{C_{gx}}{C_{gz}} = -\frac{m}{k}\frac{c}{(c-U)} \tag{25}$$

VI.CONCLUSIONS

In this paper we have conclude that the parameterization of Lindzen wherein the effect of gravity wave breaking on the generation of eddy diffusion and on the deposition of wave momentum flux can be seen in the simplest. The origin of gravity wave observed in the mesosphere is likely to be far removed horizontally. We also investigated that gravity wave propagate through significant planetary scale stationary waves. It is very important variable in determining D_{eddy} and F_x due to breaking waves.

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PERFORMANCE ANALYSIS OF ZERO CROSS-CORRELATION CODE IN SAC-OCDMA WITH DCF AND EDFA

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ABSTRACT

Spectral Amplitude Coding-Optical Code Division Multiple Access (SAC-OCDMA) is a future communication technique because of its high speed, efficiency, security and unlimited bandwidth capability. There are many codes used to make it more scalable, flexible, reduce Multiple Access Interface (MAI).But the minimum cross-correlation property is the code's best property. So Zero Cross Correlation (ZCC) code used in SAC-OCDMA with zero cross correlation property enhance the system performance. In this paper the performance of ZCC code in SAC-OCDMA system without EDFA, with EDFA, with DCF and both EDFA and DCF is analysed for 5 numbers of users at data rate of 10 Gbps. The simulation result analysed in optisystem 7.0.

Index Terms- Dispersion Compensating Fiber, (Dcf), Erbium Doped Fiber Amplifier (Edfa), Multiple Access Interface (Mai), Spectral Amplitude Coding- Optical Code Division Multiple Access (Sac-Ocdma), Zero Cross Correlation (Zcc)

I. INTRODUCTION

The increasing large number of users demand in present and future telecommunication need new technology that can handle video, voice and data at high bandwidth and high data rate[1].The use of FDMA(Frequency Division Multiple Access) and TDMA (Time Division Multiple Access) multiple access techniques are not acceptable where traffic is busty. Thus CDMA (Code Division multiple Access) is most successful technique which can handle large number of users efficiently. The combination of optical fiber and CDMA further improves the network performance by reducing disadvantages of CDMA [2].Hence OCDMA (Optical Code Division Multiple Access) is a current and future communication multiple access technique due to increased data rate, flexibility, scalability, large users data handling capability, security and bandwidth [3].In OCDMA each user has a unique code for sending the data. But MAI (Multiple Access Interface) degrade OCDMA network performance [4]. Hence use of SAC coding technique in OCDMA i.e. SAC-OCDMA (Spectral Amplitude Coding- Optical Code Division Multiple Access) increases network performance by reducing MAI [5]. The ZCC (Zero Cross Correlation) code choice in SAC-OCDMA is very efficient coding technique due to following advantages as [6]

1. Zero cross- correlation
2. Simple to design
3. High and secure data transmission
4. Simple code construction
5. High flexibility in adding large number of users

SAC-OCDMA technique can be used for long range communication with EDFA (Erbium Doped Fiber Amplifier) . EDFA is located on optical fiber link which acts as a booster to increase system capacity [7]. Other factor like dispersion also reduces the system performance. Hence for this DCF (Dispersion Compensating Fiber) is used. Thus using EDFA and DCF fulfil the goal of communication system means long distances with secure data at high speed [8].

In this paper the performance of ZCC code in SAC-OCDMA without EDFA, with EDFA, with DCF and both EDFA and DCF is analysed for long distance communication. The system is simulated by optisystem 7.0 for 5 numbers of users at bit rate of 10 Gbps.

II. SYSTEM PERFORMANCE ANALYSIS

2.1 ZCC Code Introduction

The ZCC coding technique is most beneficial code as compared to other codes in SAC-OCDMA because it follows zero- cross-correlation property as [9]

$$\sum_{i=1}^{K} Am(i)An(i) = \begin{cases} w & m = n \ \text{autocorrelation} \\ 0 & m \neq n \ \text{crosscorrelation} \end{cases} \quad (1)$$

where **A**m and **A**n are two ZCC codes sequence with weight w.

ZCC code is a matrix of 0 and 1. It is designed in matrix of P×Q [10].

The general form of ZCC code is

$$Z(w=i) = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$$

Where

w = weight of the matrix.

i = integer {1, 2, 3…∞}

P – Number of users = w+1.

Q – Minimum code length = w (w+1).

A – Replication of matrix w-1.

B – Matrix (w×2w), diagonal matrix of ones with alternate of zeros matrix (w×1) in between.

C – (1×w (w-1) matrix of zero.

D – (1× [0 1]) matrix replication for w times [10]

For example ZCC code for

weight w=1

$$Z(w=1) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

weight, w=2

$$Z(w=2) = \begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 \end{bmatrix}$$

2.2 Simulation Setup Analysis

The simple block diagram of ZCC code in SAC-OCDMA for 5 numbers of users with code weight 4 is shown in Fig 1. In this block diagram the transmitter section consists of laser as an input source. The power splitter split

the light of laser in 20 wavelengths in range 1550 nm to 1565.2 nm. The chip spacing is 0.8 nm. The encoder part consists of PRSB (Pseudo Random Bit Sequence), NRZ (Non Return to Zero), Mach-Zehnder Modulator and unique data format for each user. Then each user's power is combined in power combiner. This power fed into the optical fiber having length is 70km.

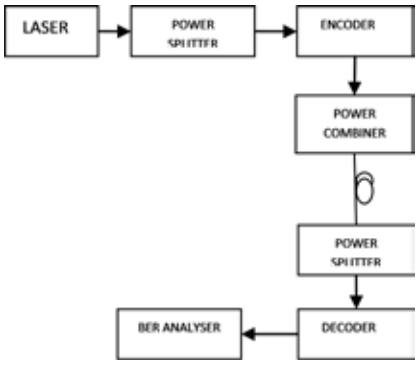

Fig. 1 Basic Block Diagram Of ZCC Code SAC-OCDMA System [9], [10]

At receiver side power splitter is used for splitting the power to decoders. The decoder part consists of PIN photo detector, low pass filter and BER analyser.BER analyzer shows eye diagram ,Q factor and minimum BER for different number of transmitting users[9],[10]. In Fig 2 transmitter and receiver section is same as above in Fig 1 but in optical fiber cable EDFA is used. In Fig 3 EDFA is replaced by DCF having length 5 km and in Fig 4 both DCF and EDFA used with same fiber optical cable.

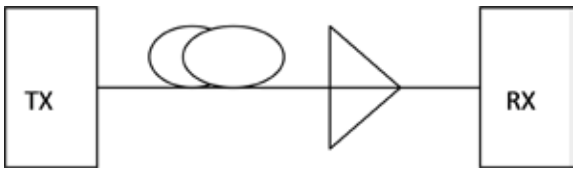

Fig. 2 Block diagram of ZCC code in SAC-OCDMA with EDFA

Fig.3 Block diagram of ZCC code in SAC-OCDMA with DCF

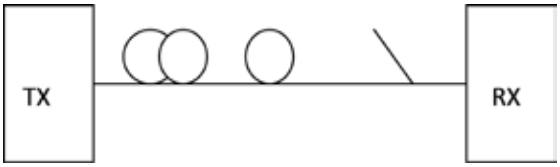

Fig. 4 Block Diagram of ZCC Code In SAC-OCDMA With Both DCF And EDFA [11]

TABLE I [10], [12]

Parameters Used

S.No.	Parameters	Values
1	Low Pass Bessel Filter cut off frequency	0.75 * Bit rate
2	Reference wavelength	1550 nm
3	Data bit rate	10 Gbps
4	DCF length	5 km

5	EDFA power	10 dBm
6	Input power	10 dBm
7	Attenuation	0.2 dB/km
8	Dispersion	16.75 ps/nm-km
9	Dark current	10 nA
10	Responsivity	1 A/W
11	EDFA Noise Figure	4 dB

III. RESULTS AND OBSERVATIONS

The performance of ZCC code in SAC-OCDMA is analysed in optisystem 7.0 for 5 numbers of users at data bit rate of 10 Gbps.

TABLE II

BER Performance Analysis

User No.	Simple	With EDFA	With DCF	Both DCF and EDFA
1	3.6×10^{-16}	1.8×10^{-23}	5.1×10^{-38}	1.5×10^{-46}
2	2.1×10^{-16}	2.2×10^{-24}	4.7×10^{-35}	1.6×10^{-41}
3	1.2×10^{-7}	2.3×10^{-19}	3.1×10^{-19}	4.1×10^{-14}
4	2.5×10^{-16}	2×10^{-19}	3×10^{-28}	1.4×10^{-32}
5	3.4×10^{-12}	1.3×10^{-16}	4.3×10^{-17}	9.7×10^{-19}

TABLE III

Quality Factor Range Analysis

Users	Simple	With EDFA	With DCF	Both DCF and EDFA
1-5	5-8	8-10	8-12	7-14

In TABLE II, for simple system BER (Bit Error Rate) ranges from 10^{-7} to 10^{-16} and Q factor ranges from 5 to 8 for 5 numbers of users. By using the EDFA the performance of simple system increased with BER ranges from 10^{-16} to 10^{-24} and Q factor ranges from 8 to 10. The BER performance can be further increased with DCF ranges from 10^{-19} to 10^{-38} and Q factor ranges from 8 to 12. But the best result can be obtained by using both DCF and EDFA in simple ZCC code SAC-OCDMA system by reducing dispersion and boosting the incoming users' transmission. In this system BER ranges from 10^{-14} to 10^{-46} and Q factor range from 7 to 14. Fig. 5 shows the eye diagram of ZCC code SAC-OCDMA system. It has small eye opening which shows the noise. But in Fig 6,

ZCC code in SAC-OCDMA system is used with both DCF and EDFA.As compared to Fig 5, it has large eye opening .Hence shows the immunity to noise and best system performance as compared to other systems.

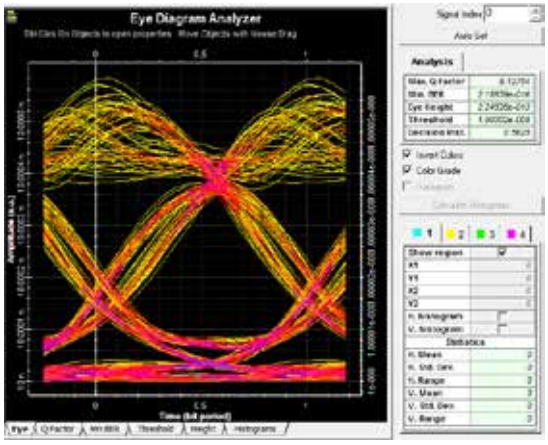

Fig. 5 Performance of simple ZCC code in SAC-OCDMA system

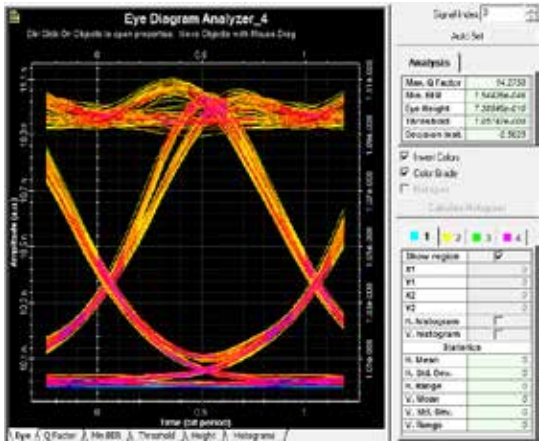

Fig. 6 Performance of ZCC code in SAC -OCDMA system with both DCF and EDFA

IV. CONCLUSION

In this paper the performance of ZCC code in SAC-OCDMA with DCF and EDFA has been analysed. As ZCC code follows code's best property i.e. zero cross-correlation in SAC-OCDMA, thus reducing MAI noise problem and increase the system performance efficiently. The use of EDFA and DCF in further increase the system performance. But the best performance can be obtained by using both DCF and EDFA in system at data rate of 10 Gbps and at distance of 70 km. Thus it can be conclude that both DCF and EDFA in ZCC code system is more superior to others systems .Thus this system can be easily used for long range communication with high data rate and high quality.

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GREEN ENTREPRENEURSHIP IN BUSINESS SCHOOLS: DETERMINING THE GREEN CULTURE IN EDUCATION

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ABSTRACT

This study examines how green efforts like energy conservation, environmentally responsible behavior, teaching through modeling, inculcating green culture, green aesthetics etc. contributes to both sustainable education(Green Education) and the adoption of sustainable behavior(Green Culture) within educational and organizational practice. The challenge is current Business school curriculums don't have courses on Ecopreneurship or Green Entrepreneurship; neither do they have any structured mechanism for implementing the Green Culture.

Green Entrepreneurship is the move by entrepreneurs to a sustainable business framework that is environmentally friendly by not only making profit but also driven by concerns toward saving our world and making it a better place to live in for us and our future generations to come. Both protection of environment and achievement of entrepreneurial goals are very vital to the concept of Green Entrepreneurship.

A Business School is a University level institution that confers degrees in Business Administration or Management. It teaches topics such as Accounting, Finance, Human Resource Management, Marketing and Information Technology use in Business etc. Business Schools shape the future Entrepreneurs in a professional manner.

Green Culture in education has a broad dimension which includes sustainability education, Green eco-friendly practices, responsible behavior etc. through which it is inculcated in youth and they are sensitized on Green Business opportunities and solutions and to opt for Green Entrepreneurship as a fruitful and responsible career beneficial to both society and self.

Our Study is **descriptive** in nature and is based on **secondary sources of Information** mostly where we will examine the **level of Green Initiative in Higher Educational Institutions.** The **Key points** to be discussed are:

- The educational curriculum and the level of involvement of Green Practices.
- Green Business Plan Generation and Projects undertaken.
- Organizational/Institutional policy and initiative on going Green or eco-friendly.
- Promotion of Green Initiatives on Institutional level- Green Projects, Training and skill Development, Green Mapping, Green Mentorship etc.

Green Entrepreneurship in Business Schools is an emerging practice which is gaining more prominence from all avenues with each passing day. Our Future generation must realize that this is the need of time and one must not solely question the Administration on solution to such matters but as being a responsible part of society each

of us must fulfill or serve our environmental obligations and responsibilities so as to create a smarter and more sustainable planet.

"In the long term, the economy and the environment are the same thing. If it is unenvironmental it is uneconomical. That is the rule of Nature.**" – Mollie Beattie**

Keywords: Green, Entrepreneurship, Green Entrepreneurship, Ecopreneurship, Sustainable, Business School, Green Culture, Education.

Aim of the study

- To examine the contribution of business schools in green entrepreneurship movement.
- Determining the role of business schools in promoting green culture in education.

I. INTRODUCTION

Sustainability today is main global agenda and a vital factor in determining the success and failure of business. Sustainable development practices had created new markets, products and demand (such as in the famous case of Microsoft and Apple) and drive new business models that is heavy on innovation and light on cost structure. Sustainability is now the backbone of any business and the early movers towards sustainable business practice will definitely enjoy unparalleled advantages against competitors. Business that ignores sustainability agenda will definitely loose out in terms of profitability and market share. Multinational business today is facing even more delicate issues in the areas of environment and social aspect so sustainability is vital aspect for growth. Here in this research paper we are discussing about green culture adoption by Business schools. A business school acts as a catalyst between students and sustainable education, by inculcating green culture and sustainable education through modeling, curriculum, and other educative materials, techniques and methods. Business school develops sustainable education in future managers which can help those managers in their jobs and personal venture. This is a proactive approach which is known as *green entrepreneurship*. We will further discuss about green techniques adopted by business schools to promote energy conservation, use of renewable source of energy etc. A systematic approach adopted by business schools towards green entrepreneurship includes:

- Nurturing a (green) business culture and raising awareness among students about opportunities arising from environmentally friendly business models.
- Creating an enabling environment which promotes and encourages green investment and entrepreneurship.
- Supporting new and emerging entrepreneurs through the provision of business development services and other financial and technical support teams.
- The youth can be well targeted, since entry requirement are low and willingness for innovation is high.

1.1 Green Culture: A Holistic Approach

"Green Culture" is a concept which integrates the principles of green creative industries, green business, green science and green thinking as a holistic approach to problem solving and development through multidisciplinary cooperation of sectors such as urbanism and architecture, science and innovation, business and entrepreneurship,

art and design and so on. Green culture promotion and education is the sustainable way of thinking and living. Green Culture in education has a broad dimension which includes sustainability education, Green eco-friendly practices, responsible behavior etc. through which it is inculcated in youth and they are sensitized on Green Business opportunities and solutions and to opt for Green Entrepreneurship as a fruitful and responsible career beneficial to both society and self. Embracing sustainable behaviors in the daily activities of a school requires the support of organizational culture. Organizational culture includes the shared values, norms and practices in an organization (Hill & Jones, 2008). Adopting green culture by business schools has promoted the energy conservation concept like saving electricity through solar light, developing garden in college campus, no use of plastic and making environment pollution free. Recently, several institutions have developed new strategies to reduce energy consumption, build and maintain 'green buildings', and engage student in education based on environmental sustainability. A paradigm shift in education where 'sustainable education' engages students in a holistic practice of transformative learning focused on myriad forms of sustainability, including environmental (Sterling, 2001).

1.2 Business School: Encouraging Future Innovations

A Business School is a University level institution that confers degrees in Business Administration or Management. It teaches topics such as Accounting, Finance, Human Resource Management, Marketing and Information Technology use in Business etc. Business Schools shape the future Entrepreneurs in a professional manner. Business schools are the most appropriate nursery of shaping and developing management graduates for entrepreneurship who posses integrity and ethical standards, a deep sense of social responsibility, a commitment to the upliftment of their communities, understands protection and sustainability of the environment, and the improvement of quality life. Today business school teaches sustainable education as well as green culture so as to promote the green entrepreneurship. Both protection of environment and achievement of entrepreneurial goals are very vital to the concept of Green Entrepreneurship. Business is required to respond to the threats of climate change and identifies opportunities arising from the sustainable development of businesses, economies and markets. According to some recent studies business schools worldwide are beginning to move towards accepting the border responsibilities of management in society, and preparing leaders of tomorrow for future market realities and challenges, by equipping them with the sustainability perspective required for socially responsible business.

(***Source: PPT, M.M Bagali, AHRD***)

Fig.1 Importance of Management Education to Green Movement

1.3 Green Entrepreneurship: Taking the two perspectives

Green entrepreneurship can be defined from two perspectives related to the output (products and services) as well as the process (or production) of an economic activity. Entrepreneurs can enter into an overtly 'green' business sector. Providing green and environmentally friendly products and services (waste management). Alternately green entrepreneurs can provide their products or services through an environmentally friendly process or with the help of clean technologies (e.g. Eco-tourism). Usually green entrepreneurs consider both aspects in their business models, creating additional decent employment through the use of more environmental impact as a result of people or companies using the final product and services. (International Labor Organization)

Green entrepreneurship is an uncommon mix of entrepreneurial spirit, passion and humility combined with a sense of personal obligation to environmental and social progress. Green entrepreneur did not start their business to generate fortune instead; they are highly concerned with environmental integrity and social impact of business. (Allen & Malin, 2006) Green Entrepreneurship has been defined as 'Introducing new business that belongs to develop environmental friendly products or services or to use renewable resources or for the benefit of the society. There has been a growing interest in the development of a 'green' or 'low carbon' economy as a means of reconciling economic development and the environment. For this green entrepreneurship should be promoted by business school so as to inculcate the green initiative in each and every student. Green entrepreneurship is themed on nurturing a culture of entrepreneurship which is eco-friendly. Green Entrepreneurship is the move by entrepreneurs to a sustainable business framework that is environmentally friendly by not only making profit but also driven by concerns toward saving our world and making it a better place to live in for us and our future generations to come. Both protection of environment and achievement of entrepreneurial goals are very vital to the concept of Green Entrepreneurship. Green entrepreneurs are embracing environmental values as a core component of their identity and seeing them as a competitive advantage of their company in the market place (Allen & Malin, 2008). Research studies also argue that the difference between ecologically-oriented start-ups and conventional start-ups lies in the environmental considerations of the green entrepreneurs themselves (Schick et al., 2002). By promoting green entrepreneurship one can enhance environmental voice in long term planning especially regarding sustainability and social justice in local economies (Allen & Malin, 2006)

II. ROLE OF BUSINESS SCHOOLS IN PROMOTING GREEN ENTREPRENEURSHIP: ESTABLISHING GREEN CULTURE

Business schools are nowadays practicing green culture through awareness drive among students and also by promoting renewable source of energy. Recent trend shows that various business schools have adopted *Green theme* classes in which curriculum taught is about sustainability education. Sustainability education involves several key principles, including the important role of modeling. According to research on teaching sustainability education, there are four identified sources of modeling that significantly shape student's perceptions and behavior-individual role models, facilities and operations, governance, and school culture(Higgs& McMillan,2006) Green Entrepreneurship in Business Schools is an emerging practice which is

gaining more prominence from all avenues with each passing day. Our Future generation must realize that this is the need of time and one must not solely question the Administration on solution to such matters but as being a responsible part of society each of us must fulfill or serve our environmental obligations and responsibilities so as to create a smarter and more sustainable planet. This study demonstrates that conservation efforts, when modeled successfully in a business school, can simultaneously and synergistically meet the goals of conservation and sustainability education. In turn it will create a more sustainable and preserved environment.

2.1 Green culture in Business Schools: A Commitment to society

Business Schools are adopting green culture through student activities and campus operations. Some of the examples are given below:

- **Green Theme Classes:** Green theme classes give the innovative idea about how to save various sources of energy, use of eco-friendly product and services. By teaching it is inculcated in the students and hence it is promoted to whole society.
- **Green Curriculum:** curriculum taught to the students focused about sustainable education for mankind. A thorough coursework is modeled based on Green Themes. E.g. Environmental appreciation Courses, IGNOU, Environment Education in School System(EESS) based Higher education syllabus etc
- **Campus operation:** This program focuses on implementing energy conservation and waste reduction, establishing best practices by use of LED light bulbs, planting trees, bio-degradable toilets, smoking free zone, use of bicycle instead of motorcars, and encouraging individual behavior change.
- **Student Sustainability Associates:** It is a peer to peer educational program that employs selected MBA students who promote sustainable living among the student bodies or associations. The program focuses on energy and water conservation and recycling as well as waste reduction. Through activities, campaigns and information sharing, the student's sustainability associates encourage the student body to generally take greater responsibility for their own role in driving university-related environmental impacts. Representatives also suggest infrastructure and policy improvements and removes barriers to student's initiative to conservation.
- **Green Week:** Business schools hosts a series of events to raise environmental awareness in a particular week. Green week events include: field trips, films, panels and business review and the environmental tours to factories; and displays and activities on recycling and composting in dining facilities and other conservation measures.
- **Green Team:** The green team includes staff working to implement and communicate best individual practices to reduce waste, water use, and energy use. The green team sponsors an annual energy competition and/or poll in which employees compete to reduce energy use in their building for one month
- **Green Skills:** Green skills includes promoting and demonstrating sustainability in action through creation of employment opportunities and the provision of training, research and on-ground projects.
- **Green Jobs:** Green jobs are central to sustainable development and respond to the global challenges of environmental protection, economic development and social inclusion. These efforts create decent employment opportunities, enhance resource efficiency and build low-carbon footprint sustainable societies. Example of green jobs is given below.

I. Improve energy and raw materials efficiency

II. Limit greenhouse gas emission

III. Minimize waste and pollution

IV. Protect and restore eco-systems(natural)

V. Support adaption to the effects of climate change.

2.2 Green Business plan generation and projects undertaken

Business schools are now involved in various green business plans in collaboration with Government and NGOs. A notable trend has shown that most of the business schools use solar energy, LED lights in their campus. Number of projects are running, Government have also provided positive donations to business schools for innovative green projects. This culture is now inbuilt in every business school and they are doing a fine job both economically and socially.

2.3 Organizational institutional policy and initiative on going green or eco friendly

Business schools approach is now going green or they are promoting eco-friendly products and services. Many business schools passed a *mandatory notice* to make environment clean by reducing waste, making pollution free zones or some initiative like rain water harvesting, bio degradable toilet, use of computer database instead of paper, energy conservation etc. These initiatives are now growing very fast and it has become a growing culture among youth. Government of India is also taking initiative as they have launched program like Swachh Bharat Mission. It promotes the cleanliness drive in schools, colleges and now gaining popularity among youth population. Also Swachh Bharat mission started a viral strategy by which one can upload his/her photos on website and can become popular.

2.4 Promotion of green initiative on institutional level green projects, training and skill development, Green Mapping, Green Mentorship etc

Business Schools are undertaking various ***Green projects*** in collaboration with Government and other social organizations which are based on promoting Green entrepreneurship. Individuals are financed, trained and provided with various other incentives to start-up green ventures as well various group policies based on Green strategies are also there. College Alumni are helped on several matters relating to such. Several prospective projects such as Green Township and homes, Green Factory building, Green Construction etc. are undertaken in collaboration with Business schools. Moreover ***Workshops and Seminars*** are also organized based on green themes so as to motivate and aware the future managers/entrepreneurs towards a fruitful sustainable and eco-friendly future.

Some of the important green methods or concepts utilized by Business schools in promoting Green Entrepreneurship initiative are:

- **Green Mapping**: Green mapping is a unique method of cartography which involves creating local maps based on universal symbol sets and plotting the location of community's environmentally conscious points such as recycling centers, heritage sites, toxic factories, socially conscious businesses etc.
- **Green Mentorship**: Green mentorship program nurtures a group of trainees to undertake various issues relating to Green Entrepreneurship and solve them in a sustainable manner in a given time frame. Overseeing and controlling of activities by professionals and trainers is done. Advocating the sustainability concept is the soul of these programs.
- **Other Programs**: This includes Training and green development, Green curriculum generation, Green syllabus, Practical on-site trainings, Green Websites like ces.iisc.ernet.in (an initiative of IIM-A, IIM-B and GOI) etc.

The Role of Business Schools is thus established as a vital source to sustainable and Green future. It encompasses the components of ***education*** and ***awareness*** as well as an ***institutional support*** to Green Entrepreneurship and green culture.

III. CONCLUSION

"Given the strategic importance of environmental management from a national perspective, it is necessary for the business schools in India to take a more proactive role in creating managers and business leaders who have a good understanding of how to incorporate environmental issues into corporate decision making" - **ces.iisc.ernet.in**

"Without an understanding of how to conserve natural resources and the compelling need to do so, few people would be motivated to participate actively in programs on environmental conservation, Environment education and awareness thus assume critical importance. The 'Environmental Education, Awareness and Training' is an important scheme of the Ministry of environment and Forests for enhancing the understanding of people at all levels about the relationship between human beings and the environment and to develop capabilities/skills to improve and protect the environment" - **india.gov.in/archive**

Thus, by thoroughly examining the study we can say that Environmental management through environmental education plays an important role in developing Green culture and promoting Green Entrepreneurs and this is where the Business Schools plays a vital role as they are the factories where future entrepreneurs are produced. By instilling the Green aspirations in the future generations the Business schools provide for a sustainable green development. We can now validate that:

'Green Entrepreneurship in Business Schools: Determining the Green Culture in Education'

Suggestions:

- Business Schools are the place where future ***change agents are nurtured-the Entrepreneurs***. By instilling the ***green values*** it plays an important role in safeguarding our environment and us and therefore they need to be ***supported at institutional levels*** by Administration and other financial and non-financial agencies to undertake green education culture to new heights and create awareness and sustainable development.
- The ***Green curriculum*** also needs to be ***standardized*** and ***a separate subject*** must be included on ***environmental management*** and made mandatory to be followed so that every manager created have some concern for the eco-system in which they live.
- ***Green Projects and initiatives*** should be undertaken on mass scale so as to develop eco-ventures more progressively. Moreover ***other green methods*** like Green mapping and green mentorship, Green jobs, Green teamwork etc. should be promoted in every Business School so that a Green mindset can be formed by the future entrepreneurs.
- ***Business Schools, Administration and Society must work in collaboration*** to promote the Green movement and pave path for sustainable developments.

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STUDY ON COMBINED ECONOMIC-EMISSION DISPATCH OF THERMAL-HYDRO POWER GENERATION SYSTEMS

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ABSTRACT

Electric power has been become a primary requirement for present day life and to various economic sectors. To balance the increasing demand for Electric power, the number of generating units, transmission lines and distribution systems is rising steadily. Because of these increasing electric power systems have been become the most complex industrial systems of the modern age and a main source of gaseous emissions and pollutants. Electric power systems must be operated in such a way that the load demand is met reliably, cost-effectively and in an environmentally responsible manner. Two such objectives which are conflicting with each other that are, minimizing the fuel cost and the gaseous emissions need to solve simultaneously. So for multi-objective optimization techniques are employed to obtain trade-off relationships between these conflicting objective functions. This paper presents a study on Combined Economic-Emission Dispatch of Thermal-Hydro Power Generation Systems and various techniques that can be used for these problems with their merits and demerits.

Keywords: Combined Economic-Emission Dispatch, Valve-Point Effects, Short Term Hydrothermal Scheduling, Techniques with Their Merits and Demerits.

I. INTRODUCTION

Economic operation and planning of electrical power systems have always been a primary concern in the electrical power industry. Optimal economic operation of power generation systems is achieved through the efficient use of the available fuel which comes mostly from irreplaceable natural resources. An imperative truth that raises the importance of the optimal economic operations is that the electrical energy cannot be stored in large amounts. In addition, significant reduction in the amount of fuel used and hence in the operating costs can be achieved by a small percent of savings in power generation systems [1]. Operating costs of different generating units are dissimilar due to various reasons such as their characteristics and efficiencies and the distances between their locations and load centres. Consequently, an optimal power generation schedule that determines the generation level of each of the units is essential to meet the load demand at the minimum cost [2]. Furthermore, the operating cost of a specific generating unit is not linearly dependent on the power it produces. In fact, this relationship is a nonlinear and even non-smooth function. Obtaining the optimal economic generation schedule can only be realized by considering various operational constraints and limitations. The load demand, for instance, must be satisfied all the time while including the system losses that are function of

the power generation. Other practical issues such as the valve-point effects and reserve margins considered by the generation patterns need to be taken into consideration.

II. THERMAL GENERATION PLANT: OPERATING COST MODELING

The total cost of operating thermal plants includes cost of labour and maintenance in addition to the costs of fuel and other supplies. In general, the economic dispatch process considers the cost of the fuel burnt in the fossil units. This does not mean that the other costs are neglected but they are commonly assumed to be a fixed percentage of the incoming fuel costs [3]. As a result of a mechanical process, energy is produced and transformed into mechanical form through steam or combustion turbines. The electric generator is driven by the turbine and hence, energy is finally transformed into electrical form. The power output of this system is connected to the electric power load. In addition, it supplies the auxiliary power system requirements of the plant itself. Fig.1 is a schematic illustration of a typical turbine-generator unit.

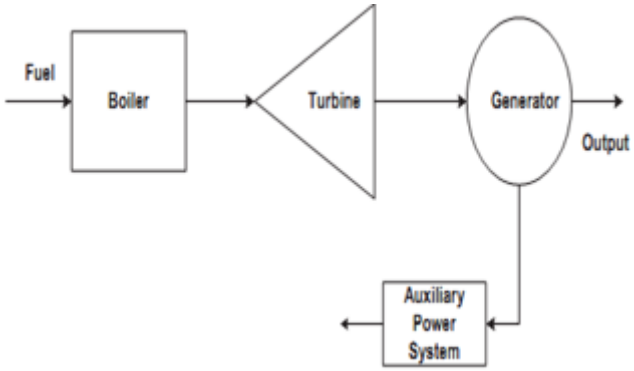

Fig.1: Typical turbine-generator models

The input to the thermal plant is generally measured in MBtu/h and the output power is in MW. The input-output relation of a thermal unit, which is known as “heat-rate” curve, is shown in Fig.2.

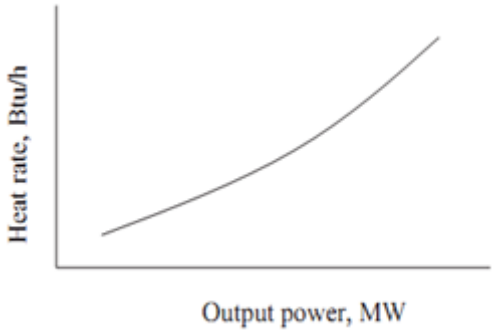

Fig.2: Heat-rate curve

The heat-rate curve is converted to the fuel cost curve representing the relationship of the operating cost of a fossil-fired thermal unit and its output power as shown in Fig.3. This cost is usually approximated as a quadratic function of the real power generation in equation (1).

$$F_i(P_{gi}) = a_i P_{gi}^2 + b_i P_{gi} + c_i \quad (1)$$

The lower limit of the output power P_{gi}^{min} is the minimum economical loading limit below which the operation is infeasible technically and/or economically. On the other hand, P_{gi}^{max} represents the upper limit and the maximum output power.

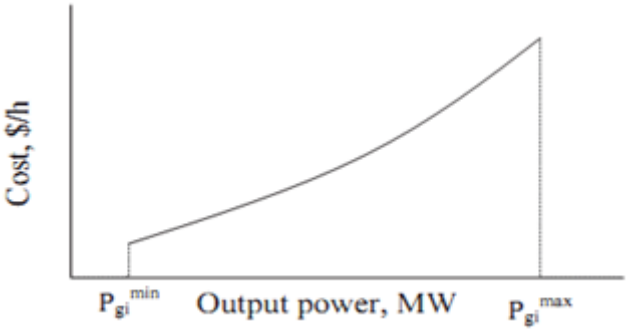

Fig.3: Incremental fuel-cost Curve

The derivative of the fuel cost curve with respect to the active power results in an important characteristic which is a measure of the cost of the next increment of power. This relationship, which is shown in Fig.3, is known as the "incremental fuel-cost" curve.

$$\frac{dF_i(P_{gi})}{dP_{gi}} = 2a_i P_{gi} + b_i \qquad (2)$$

III. ECONOMIC DISPATCH PROBLEM

The economic dispatch problem is designed to determine the optimal loading of all committed generating units to minimize the cost function subject to the system constraints [2]. These running generating units are assumed to be known in advance. It is also assumed that the information about the daily load demand is also available. Accordingly, assuming that the number of committed units is Ng and the total load demand isP_D, then the ED problem can be formulated with the following objective function:

$$F_T = \sum_{i=1}^{N_g} F_i(P_{gi}) \qquad (3)$$

Minimize

This is subjected to operational equality and inequality constraints as follows:

Load balance equation

$$\sum_{i=1}^{N_g} P_{gi} - P_D = 0$$

Generation unit capacity limits

$$P_{gi}^{min} \le P_{gi} \le P_{gi}^{max}$$

IV. OPTIMAL ECONOMIC DISPATCH: TRANSMISSION LOSSES CONSIDERED

In power systems where electrical energy is transmitted using long transmission lines, network losses cannot be neglected as they significantly affect the generation dispatch. In practical systems, it is estimated that the system power losses can be as much as 5% to 10% of the total power generation .The generating units in this system are

connected to an equivalent load bus through a transmission network [2]. In the ED problem, the transmission losses are included in the load balance Equation (4). Accordingly, the objective function expressed in Equation (3) is to be minimized while satisfying the following active power balance equation:

$$\sum_{i=1}^{N_g} P_{gi} - P_D - P_L = 0 \tag{4}$$

Where P_L are the active power losses as a function of only the real power generation. The real power transmission losses in power systems are principally computed using the exact power flow equations. However, it is a common practice to express the losses as a quadratic function only in terms of real power generation. This function is referred to as the loss formula and its simplest form is known as George's formula [3].The parameters are called the loss coefficients or B-coefficients. In order to obtain a more accurate loss formula, a linear term and a constant is added to the expression of (5) to form what is referred to as Kron's loss formula [3]:

$$P_L = \sum_{i=1}^{N_g}\sum_{j=1}^{N_g} P_{gi} B_{ij} P_{gj} + \sum_{i=1}^{N_g} B_{i0} P_{gi} + B_{00} \tag{5}$$

$$P_L = \begin{bmatrix} P_{g1} & P_{g2} & \cdots & P_{gNg} \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1Ng} \\ B_{21} & B_{22} & \cdots & B_{2Ng} \\ \vdots & \vdots & \ddots & \vdots \\ B_{Ng1} & B_{Ng2} & \cdots & B_{gNg} \end{bmatrix} \begin{bmatrix} P_{g1} \\ P_{g2} \\ \vdots \\ P_{gNg} \end{bmatrix}$$

$$+ \begin{bmatrix} P_{g1} & P_{g2} & \cdots & P_{gNg} \end{bmatrix} \begin{bmatrix} B_{01} \\ B_{02} \\ \vdots \\ B_{0Ng} \end{bmatrix} + B_{00}$$

The B-coefficients mainly depend on the operating condition of the system. They are usually assumed to be constant parameters, unless the system operating state of a new generation scheduling is significantly different from the base case.

V. OPTIMAL ECONOMIC DISPATCH: VALVE-POINT EFFECTS CONSIDERED

The ED problem is approximated by a smooth differentiable quadratic or piecewise quadratic objective function, which is the same approach used by classical optimization methods. However, due to the valve-point effects, the real input-output characteristics contain higher order nonlinearity and discontinuity which results in a non-convex, non-smooth fuel cost function. These discontinuities in the fuel cost curves are caused by sharp increases in throttle losses as a result of the effects of wire drawing at valve points. As a consequence of steadily lifting the valve, the losses decrease until the valve is fully opens [3].

The valve-point effects are represented using two different approaches**.** In the first, the effects are formulated as inequality constraints that represent them as prohibited operating zones [24]. The second approach, which is considered, includes a rectified sinusoidal term in the original objective function to model these effects. Accordingly, the input-output characteristic function of Equation (6) is modified to obtain an accurate cost function model. The valve-point effects are included in the fuel cost function as follows**.**

$$F_i(P_{gi}) = \sum_{i=1}^{N_g} a_i p_{gi}^2 + b_i P_{gi} + c_i + \left| e_i \sin\left(f_i (P_{gi}^{\min} - P_{gi}) \right) \right| \tag{6}$$

The coefficients e_i and f_i are constant fuel cost coefficients for unit i with valve-point effects. The total cost function to be minimized can be expressed as follows:

$$F_T = \sum_{i=1}^{N_g} a_i P_{gi}^2 + b_i P_{gi} + c_i + \left| e_i \sin\left(f_i (P_{gi}^{min} - P_{gi}) \right) \right| \quad (7)$$

VI. SHORT-TERM HYDRO-THERMAL GENERATION SCHEDULING

The objective of hydro-thermal scheduling is to determine the generation level for each committed hydro and thermal unit in such a way that the total operating cost is minimized while satisfying various operational constraints [2]. In large-scale hydro-thermal generation systems, it is indispensable to operate thermal and hydro plants integrated in the same grid in order to achieve the optimal economic operation. Although the capital cost of hydro-electric plants is high, their operating cost does not depend on the output power. In contrast, the capital cost of the thermal plants is lower but their operating cost varies with the output power. In addition, while the starting and speed of response of thermal units are slow, hydro-electric plants can respond and start quickly and can handle fluctuating loads with high reliability. For these complementary characteristics of thermal and hydro-electric plants, the integrated operation of these plants is both economic and convenient practice. In contrast to thermal power production, there is no fuel cost associated with hydro-electric generation. However, fixed charges are accounted for regardless of the amount of the hydro power produced. Therefore, it is essential to use up the entire amount of water available over a planning period of time. In addition to generating electric power, hydro-electric plants must meet certain obligations as the reservoirs are multipurpose in most cases. A maximum forebay elevation, for instance, must not be exceeded due to the flooding considerations. In addition, to meet irrigational and navigational commitments, a minimum reservoir discharge and spillage must be observed [3].

A wide range of optimization techniques has been applied to solve the STHTS problem. These techniques are principally based on the criterion of local search through the feasible region of solution [3]. Applied optimization methods can be mathematical programming algorithms such as linear and nonlinear programming, dynamic programming and interior point methods**.** Among the other methods are the artificial intelligence techniques including neural networks, fuzzy systems and the evolutionary methods such as genetic algorithms and simulated annealing.

The methods considered in this survey can be classified as follows:

- Lagrangian relaxation and Benders decomposition-based methods
- Interior point methods
- Mixed Integer programming
- Dynamic programming
- Evolutionary computing methods
- Artificial intelligence methods
- Optimal control methods

These optimization methods can be generally classified into two main groups: deterministic methods and heuristic methods. Deterministic methods include Lagrangian relaxation and Benders decomposition methods, mixed integer programming, dynamic programming and interior point methods. Genetic algorithms, particle swarm optimization and other evolutionary methods are heuristic. Most of the methods that have been used to

solve the STHTS problem are deterministic in nature. However, modern heuristic methods are getting more attention in solving large-scale optimization problems.

To search for the optimal solution, classical deterministic methods, also known as derivative-based optimization methods, apply techniques such as the gradient and Hessian operators. They use single path search methods while heuristic methods use population-based search techniques to search the solution hyperspace. This difference, in fact, is an advantage for the heuristic methods as it helps searching in spaces with non-smooth characteristics. It also improves convergence for heuristic methods and makes it less dependent on the initial solution points. Being derivative-free, modern methods are applicable to any optimization problem regardless of the linearity or nonlinearity of its objective function and constraints. In contrast, different deterministic methods are required for different optimization problems. Another main difference between the two classes is that heuristic methods use stochastic techniques and include randomness in moving from one solution to the next while determinist methods follow deterministic transition rules. This, of course, gives an advantage to heuristic methods in avoiding local minima.

GA was presented in [4] and applied to determine the optimal short-term scheduling of hydro-thermal systems. In this paper, a case study system of chain cascaded hydro units and a number of thermal units was used to evaluate the algorithm where the unit commitment problem was assumed solved while the economic dispatch sub-problem was considered. Many practical constraints were included in the formulation, however, the size of the problem of the case study was small and there was no evidence that the algorithm could be successfully applied to larger size problems. The performance of the algorithm was considered good although no comparison with other approaches was carried out in order to evaluate whether the algorithm was competitive or not. A concurrent solution of the unit commitment and the economic dispatch sub-problems in addition to the STHTS problem using GA was presented in [5].

In [6], SA was implemented to solve the thermal sub-problem while the hydro sub-problem was solved using a peak shaving method in order to find the optimal short-term scheduling for hydro-thermal power systems. The proposed method was tested using a modified version of a realistic power system and was considered robust with good performance and reasonable conversion time although it was not compared to other optimization approaches.

Umayal et al. in [7], presented a PSO application to find the short-term optimal generation schedule as a multi-objective optimization problem. In addition to the minimization of operation costs, the formulation of the objective function had to consider minimizing gaseous emission in order to satisfy environmental constraints. Several practical constraints including emission control and the usual hydro and thermal constraints were considered but some of them such as ramp rates were not accounted for. In order to evaluate the proposed algorithm, two testing systems were employed and good performance results were reported.

An EP algorithm in [8] was applied and compared to a genetic algorithm approach and when tested showed better performance in terms of cost while no details were shown regarding computational time and memory size.

A modified differential evolution-based approach was compared to an EP algorithm in [9] when applied to solve the short-term hydro-thermal scheduling problem. Effects of valve-point loading and emission function inclusion were investigated while various thermal and hydro constraints were considered.

In [10, 11] a Lagrangian relaxation-based algorithm and a dynamic programming technique were integrated into an expert system to solve the STHTS problem. Steam and gas turbines were considered as well as many

constraints such as the nonlinearity of thermal generation cost, transmission losses and the water discharge rates. The algorithm was reported to reach a feasible solution in an acceptable time although additional iterations were required in some test cases to find the optimal Lagrangian multipliers for the nearest feasible solution.

In [12, 13], a multi-pass dynamic programming was integrated with an evolutionary programming (EP) algorithm in order to obtain an improved solution. Two case studies were presented to implement the approach considering, in addition to thermal and hydro units, pumped storage units which either worked in pumping mode or generation mode with no idle times.

In [14] paper presents a bibliographical survey of the work published on the application of different optimization methods used to solve the short-term hydrothermal coordination problem. Various optimization techniques that tackled the problem are overviewed and classified with their advantages and limitations having been critically discussed. The paper provides a general literature survey and a list of published references on the topic aiming to offer the essential guidelines regarding this active research area.

VII. COMBINED ECONOMIC-EMISSION DISPATCH (CEED)

Wong et al. proposed an SA-based algorithm to solve the multi-objective generation dispatch optimization problem [15]. In addition to fuel and environmental costs, security requirements of the all-thermal system were taken into consideration in the problem formulation. To represent the environmental objective, constant weighting factors were augmented in the pollutant emission objective function. The effectiveness of the method was demonstrated using a single test system assuming the security of supply to be primary concern and neglecting the transmission power losses.

In [16,] two proposed algorithms were basically a combination of GA and SA techniques. Using relative weighting factors, the total emission of various pollutants were combined into a single objective before obtaining the trade-off curves between total fuel cost and emission. A 10-unit all-thermal generation system with its emission included three pollutants; NOx, SO_2 and CO_2, was utilized to demonstrate the performance of the two hybrid algorithms. In addition, the impact of fuel type switching and hence heat-rate characteristics of generators were also considered in the simulation results.

In [17] both deterministic and stochastic models are first formulated, and then an improved particle swarm optimization (PSO) method is developed to deal with the economic load dispatch while simultaneously considering the environmental impact. Comparative studies are carried out to examine the effectiveness of the proposed approach. First, a comparison is made between the proposed PSO approach and other approaches including weighted aggregation and evolutionary optimization. Then, based on the proposed PSO, the impacts of different problem formulations including stochastic and deterministic models on power dispatch results are investigated and analyzed.

In [18]**,** a decision making technique was proposed to determine the multi-objective function optimization. The economic dispatch and environmental marginal cost are optimized using Powell's method while the Goal programming was utilized for the trade-off between the conflicting objectives. No more than one generation system with 5 thermal generating units was employed to test the method and demonstrate its performance.

A multi-objective function was treated in [19] to find the optimal scheduling for all-thermal power generation systems. The multi-objective function did not only consider cost and emission minimization but also security and reliability aspects. An expert fuzzy set system was proposed to find the optimal solution for a dynamic generation dispatch problem. The multi-objective problem was transformed into a single objective to obtain

Pareto optimal solutions using fuzzy logic. The technique was tested using a moderately sized system and the performance was assessed using various membership functions.

An improved bacterial foraging algorithm is presented [20] in this paper and applied to solve the short-term hydro-thermal scheduling problem considering the environmental aspects. The proposed algorithm is a modified bacterial foraging technique which applies a dynamic deceasing function for updating the solution vector and improving the convergence characteristics of the algorithm. The objective function of the optimization problem considered minimizing the NOx emission in addition to the fuel cost. Simulation results have shown the effectiveness the algorithm in finding the optimum or near optimum solutions and capturing the cost-emission trade-off relationship.

Security issues were considered as a third objective in the multi-objective economic emission dispatch problem presented in [21]. The GA applied in this work was hybridized with an SA technique to perform the selection operation of the algorithm. The proposed hybrid algorithm was tested using two standard systems and a Pareto optimal set of solutions was provided in form of trade-off curves in addition to some statistical data on the convergence property. However, no information was revealed regarding the computation time although it was mentioned that reducing search time was one of the advantages of the algorithm.

The hydro-thermal scheduling problem was treated in [22] to minimize both cost and emission. A simplified direct method was proposed to minimize these two non-commensurable objectives considering various water availability constraints. A single example of a hydro-thermal generation system which included 4 thermal and 2 hydro units was employed to test the proposed method without considering the transmission losses. Although no information regarding the execution time was mentioned in the paper, the proposed algorithm was claimed to be fast and potentially applicable for real time operations. The multi-objective economic-emission load dispatch formulated in [23] considered line flow constraints by expressing them in terms of active power generation using distribution factors. Although transmission losses were considered in the power balance equation, some other practical constraints were not included.

VIII. CONCLUSION

In the conventional economic dispatch problem, the cost function for each generator has been approximately represented by a single quadratic function. But, the characteristics of generating units are highly nonlinear inherently, because of the constraints power system and emission. More recently, improved heuristic techniques like Genetic algorithm, Evolutionary Programming (EP), Tabu Search (TS) and neural networks are being used to find global or near global optimal solution of simple ED.

Most of the ED approaches available in the literature cannot be directly used to optimize such non-linear cost function. By contrast, the merits of PSO algorithm convinced and encouraged various researchers to utilize this algorithm for solving the stabilization issue of power system control. Moreover, the cost function for each generator has been approximately represented by a single quadratic function in the conventional approaches. From the literature, it is clearly observed that PSO provides better performance than other conventional techniques. Other modern optimization techniques like Ant Colony Optimization (ACO), Artificial Bee Algorithm can be used for the significant performance of the power system.

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A REVIEW: MAIN ASPECTS OF POWER CONSUMTION IN WIRELESS NETWORKS

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ABSTRACT

The power consumption of wireless access networks is becoming an important issue in the green cellular-technology. The concept of green 4G LTE system depends on enhanced design strategy of efficient LTE energy system in order to reduce greenhouse emission as well as operators energy bill. In this paper we deals with study and analysis of the investigating power consumption in wireless network and investigating the possible way to reduce the power consumption at Base Station. We also characterized the techniques of the power consumption in wireless network and to explain the latest work on this way. This paper is also showing that the effects of the techniques on power consumptions which are used by many authors.

Keywords: Base station, Fuel cell, Pico hydro, Sleep modes, Solar and Wind power.

I. INTRODUCTION

As we all know that the energy consumption in ICT industry has become a very serious issue from either economical or environmental perspective. Recent research shows that nowadays the Information and Communication Technologies (ICT) sector is responsible for 2-4% of the worldwide carbon emissions which will even double in the next 10 to 15 years, if no precautions are made. A significant amount of these emissions, about one sixth, is caused by the telecommunication networks. Furthermore, the Wireless World Research Forum (WWRF) expects that by 2017 7 billion users are served by 7 trillion wireless devices.

In the struggle for reducing the environmental impact of information and communication sector emphasis Telecommunication and wireless network, power consumption of the network has become more attention topics. Many research paper and previous studies shows that mobile communication network are responsible of small sharing of total globally energy consumption, reducing this power consumption has become an essential key from perspective of environment impacts and operator cost views. Approximately 90 percent energy consume due to the core network, and radio access network (Mobile Station and Base Station) in wireless network and whereas the BTS is the main energy consumption component which consume maximum energy of that. Within base station, a huge amount of energy is wasted in the power amplifier and through the antenna feeder cable. The wireless network can be viewed into three major subsection-core networks that is working as switching system, interface to fixed network and billings system.2nd base station (BTS) which is established the radio frequency interface between the network and mobile station. Other, mobile station, which is used by the subscriber making a phone and data call. The core network and Radio Access network – (base station, MS) is energy greedy. It is estimated that over 90% of the energy Consumption in wireless network due to those two

elements. Today, there are quite a number of technologies that helps to reduce base station power consumption, such as the software solution which save power through turning off selected carriers on low traffic periods, the green energy solution which offers solar wind and other renewable energy for base station's power supply according to local natural conditions, and the energy-saving air conditioning technology which combined with the local climate and environment characteristics, reduce the energy consumption of air conditioning equipment etc [2][3][4].

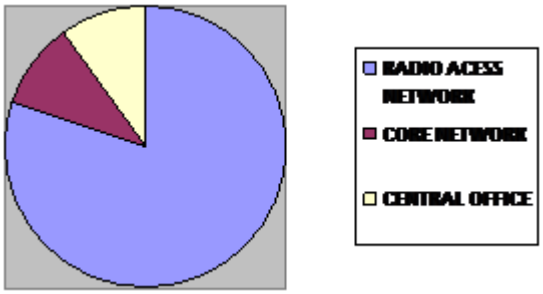

Fig:-1.1 Consumption of Energy In Wireless Networks

II. RELATED WORKS ON THE ENERGY SAVINGS

There are several works which have done to measure the energy consumption and CO2 emission in the different part of telecommunication network. It estimated that more than 90% power consumption in the wireless network by the operator parts. The operator parts consist of the two components –one mobile switching centre including BSC & radio interferences and billing system and others mobile base stations (BTS).The base station consume maximum power of it. Some method in order to reduce the energy consumption as improving transmitter efficiency, system level features to use air cooling, to use alternative energy source (wind, solar etc.) and during the low traffic load (night period) [2] [3].CO2 .The author proposed three step in [2] in order to reduce the power consumption and CO2 emission in wireless network –to minimize BTS energy consumption, to minimize the numbers of BTS, using renewable energy source [2].

This paper [10] also showed that energy consumption in wireless network during the various traffic loads. They also proposed that to reduce the numbers of some active devices during low traffic such as night time and weekend day, then it is more possible to save energy [10].

The 2% of the input dc voltage is using at the transmitter as RF power because due to inefficiencies of the RF power amplifier and rest of power is to use for the radio equipment and signal operation and also a large amount radiated as heat. The [5] paper, we propose a cooperative sleep-mode strategy for heterogeneous mobile networks where several small cells supply the overlapping coverage, and provide a mathematical model for analyzing the performance of the strategy.

III. POWER CONSUMPTION DUE TO THE BASE STATION EQUIPMENT

Base station is the main power consumption element in the cellular network. It consume more than 90 percent power overall network. The power consumption of BTS depends on the type of base station like macro base station, micro base station, Pico base station and depends upon base station sectoring. It can be one; two and three sector cell pattern .Normally power consumption of macro base station is higher than micro and Pico base station.

Base station consists of few elements such as DC power supply, Cooling System, Radio unit and base band unit. The following figure the Base Station Block diagram.

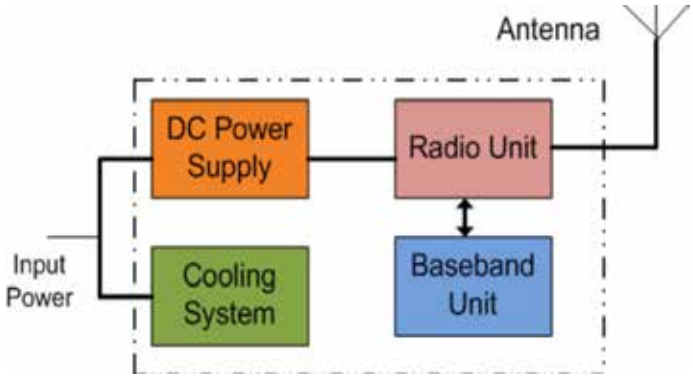

Fig 1.2: Base Station Block Diagram

3.1 DC Power Supply

The basic function of power supply is to produce a power for whole equipment of Base station transceivers. It takes AC supply as an input and produce DC voltage as power. To set DC power supply in order to provide the suitable DC supply to Radio equipment and Base band unit in the Base station cabinet. The size and capacity of the DC rectifier is depending on the several of the Base station cabinet size like small system, medium system and large system. Approximately 11 percent of powers are consumed due to DC power supply at the Base station cabinet [8]. Example specification of the DC power supply of base station cabinet is given in the following electrical Specification of DC power supply.

For small system:

INPUT	OUPUT
Voltage range 220V ac (150V~300V)	Voltage :-48Vdc
Current 18 A	Current:40 A
Frequency:50Hz(47~63Hz)	Maximumpower:2260 W
Efficiency 87%	

Table 1: Specification for DC power supply for small system

For medium system:

INPUT	OUTPUT
Voltage range:150V~280V	Maximum output power 4250 W
Current 33A (Max.)	Voltage:-48Vdc
Frequency 50 Hz (47~63Hz)	Current 75 A

Table 2: specification for DC power supply for medium system

This DC power system can be used for GSM, CDMA base transceiver, module station, rural station, small capacity switching office in local network

The large DC power system is used when the system cabinet is to need greater than 4000W power [10]. It has a large capacity. This power system can be used for mobile switching centre, Base station controllers, GSM base station, CDMA base **station Cabinet, terminal station, transmission** equipment and data communication equipment. It Also has AC input capacity such like 415Vac (AC Voltage), 50A.**S**

3.2 Cooling System

Nowadays wireless sector is demanding how to decrease the energy within separate temperature zone in an electronics enclosure extended life span and want to confirm that every component in an electronic shelter or

cabinet should be worked in its high performance. Power consumption of base station is much larger than any other public institute (buildings) because of a large amount of heat is generated from telecom components and environmental requirement for their suitable operation. Approximate 25 percent energy consumed which is due to air condition ring or cooling system out of the whole energy consumption of baste station[19] A large amount of BTS are installed over the world within telecommunication network. Cooling system or air-conditions system adds more energy consumption over the wireless network. That is why energy savings gets more attentions.

Radio base station used in mobile telecommunication systems is responsible for producing an amount heat and which needs to be removed. A typical Base station cabinet can produce as much heat as approximately 1600-2500W [21]. Approximately 80% of the amount of this heat radiation produces in the radio transmitter equipment [21]. Normally base station cooling system are designed in order to full fill the requirements event by indoor climates, which observed to the temperature.

3.2.1 Air condition

For base station or base station cabinet, it is an important problem solving which the internal heat generated and radiated. Outdoor temperature or weather condition of base station and small size of shelters can provide to indoor weather temperature increase. Actually Air condition are designed to maintain internal temperature of cabinet as close as 25° C to +30°C and in order to protect the electric components from damage in increase of temperature[1006].

Usually base station are to cooled down to 25°C under various type of Air conditioners for reliable cooling and Consider to be designed which is requirement less than .5°C temperature changing per minute. Telecom standard (ETSI European Telecom Standard) has one limitation that inside the cabinet of mobile base station not greater than 0.5°C temperature changing per minute. Its quit hard cooling air forced from outside into inside of cabinet by using fan. Therefore, air-condition is essential for cooling the base station cabinet.

3.2.2. Ventilation cooling Technology

Ventilation cooling technology has been developed in order to formulate the full use of outdoor cooling fresh air. Internal heat generated inside the cabinet, which is directly taken away by using outdoor fresh cooling. In that case energy consumption of, air-condition is to make up relatively low. That is mean the running time of air-condition can be less.

3.3 Baseband Signalling Unit

*N*ormally, base band unit consists of base band transmitter and receiver (BB-TX and BBRX) and cooling fan. The digital data can be processed in the base band unit. The base band units produce the data, which are feeding into Radio unit. These equipment also responsible for consuming more energy.

3.4 Power Consumption Due To Radio Unit

RF unit consists of power amplifiers transceivers and cooling fan. This component converts the digital signal into radio frequency signal. This component is directly connected to the Antenna via coax feeder cable. Radio unit consume more than 60 percent of the energy of the base station cabinet.

3.5 Power Consumption Due To Propagation Path Losses

Path loss propagation relates communication attenuation between transmitting end and the receiving end Propagation losses are caused by the natural expansion of RF signal front free space that takes the shape of an increasing sphere, absorption losses. Normally when RF signal passes through the different kind of media, it

cause reflection, diffraction, scatting and absorption due to the obstacles .As a result received signal strength can be either increased or decreased.

IV. IMPROVING THE ENERGY EFFICIENCY OF BTS

This chapter reviews the following methods to improve the power consumption in mobile network. The few models can be followed up in order to improve the energy efficiency of Base station.

4.1 Improve the Efficiency and Linearity of RF Power Amplifier

Nowadays-wireless Communication Company has interested for high efficient linear power amplifier to adjust the current wireless technology. UMTS network and past communication network propose high data rate transmission and transmitting the power, which bears high peak to average ratio signal. The BTS power amplifier drives at the low power level than the maximum and a resulting of degrading more the efficiency. The total energy consumption of third generation BTS more differs than the second generation BTS whereas current BTS use more radio frequency carriers and they have more signals processing units. As a result, the RF power amplifier consumes a large portion of the power. So it has become more important to reduce the power consumption of the RF power amplifier for achieving the high capacity base station. In order to obtain best achievement in reduction of power consumption of amplifier, to increase the energy efficiency and linearity of the power amplifier must be increased. Energy efficiency of the amplifiers can be defined as the ratio of the output power and the total power consumption. So we can say like Amplifier efficiency can be a term of measured so that how much of the input signal is usefully applied to the output. There are a few techniques, which can be used to increase the linearity of PA like feedforwad, predistortion, Cartesian Feedback. The feed forward amplifier is a well-known linear amplifier and that is used in current WCDMA BTS. This amplifier has good stability and linearity. However, it has relatively low energy efficiency. On the other hand, if the power amplifier would be designed with digital pre-distortion and crest factor reduction techniques, then the power efficiency of the RF amplifier will be approximate double than the current using feed forward amplifier.

While increasing the improvement in power, efficiency of the amplifier, which has more significant reduction of the total power consumption of base station equipment, and make it as high capacity base station and low CO2 emission.

The main requirements for future RF power amplifiers is given into the following

• High linearity, which can satisfy higher order modulation schemes?

• To have greater average output power levels.

• To have broader operating bandwidth

• To reduce the operational expenditure by decreasing the energy consumption at BTS.

• To decrease the environmental impact by reducing the wireless network energy consumption. The table 3 shows that the specifications of various types of amplifiers.

Table: 3 Various Specifications of Amplifiers

Amplifier class	Efficiency	Linearity	Bandwidth
Class-A	Low	Very good	Very good
Class-AB,B	Moderate	Good	Good
Class –C,E	Good	Low	Low
Class-F	Very good	Very low	Very low

4.2 To Reduce the Power Consumption Removing the Feeder Cable Losses

In this model we are considering three sectors Omni, dual carrier, and 20W per carrier that is analyzed in ‘’power system Efficiency in wireless communication’’ [7]. In this situation, it gets the total power 10.3 KWh as input source power. This power is used to produce the 120 W RF transmitting power. That means only 1.16% percent to use as transmitting the RF signal out of a large amount of input signal. Therefore, The RBS efficiency is 1.16 percent. The rests of power is to used for base band.

signal processing, radio equipment unit and DC power supply and cooling system which is showing on the block diagram .To produce 120W RF transmitting signal at antenna side, Its need to supply additional 120 W through the feeder cable at the base of tower .Because of this amount will be faded into the feeder cable. On the others parts ,radio equipment unit consumed 4160W for RF power amplification, for signal processing unit 2190W ,for DC power supply 1170W with 85% power supply efficiency and for cooling system 2560W.

The following table shows power consumption due to feeder coax cable loss and without feeder loss

Table: 4 Power consumption with feeder losses and without feeder coax losses

Power consumption with feeder cable loss		**Power consumption without feeder cable loss**	
Power in	240 W/23.80dBW	Power in	240 W/23.80dBW
Power out	120 W/20.79dBW	Power out	240 W /23.80dBW
ERP	37.80 dam/6.025W	ERP	40.80dBm/12.022W
Coax cable loss	3 dB/50 meter	Coax cable loss	0 dB/50 meter

4.3 Baseband Site Optimization

The cooling system is responsible around 25% of energy consumption through the base station site [10]. Radio equipment and baseband unit generate a large amount of heat. So cooling system is also essential equipment in order to protect the inner components of the cabinet from damage. A base station has a long cooling period through the whole year. We can eliminate the cooling system by using the natural cooling system where indoor and outdoor temperature will equity into the BTS cabinet. For this purpose, ventilation technology can be used and where two fan can be used one for taking away inner heat to the outdoor and other taking in the fresh cooling air from outdoor. Only air condition system can use for summer season from May to September. At the winter season, it can be fully eliminated by using the natural fresh’s air. As a Result we can obtain a better achievement for reduction of energy consumption and on CO2 footprint emission. Ericson in their life cycle perspective proposed that the concrete base station tower has lower environment effect as compare with used steel tower tube [Ericsson LCA]. In the city area, the base station can be putted at the top of the buildings without using any steel tower. It is also more energy efficient and cost efficient. It has also less CO2 emission.

4.4. Alternative Energy Solutions

In our continuous effort to improve the energy efficiency of base station. All operator and Vendor Company who are looking forward to reduce the energy consumption for base station. Alternative energy source can be used for the following purpose whereas there is no electricity grid off or remote base station site or for low and medium capacity sites. Few techniques can be considered as alternative energy source.

4.4.1 Solar power

Many telecommunication operators already developed a solar power base station, which is operating in remote area where the lack of electricity supplies. For low and medium capacity sites or repeater sites, it can be used to provide virtually free energy [33].solar is generated using the photovoltaic properties of semiconductor converting the light energy source into electricity [11]. It can be installed in area with long and very good sunlight and where 6-8 hours sunlight is available during the daytime.

4.4.2 Wind power

As solar power, wind power can be provided virtual free energy [12]. The main advantage of the wind power is that can be used to operate the macro base station normally. Wind is produced by the nature. So sometimes, it can have drawn back when no winding or low winding is. During this period, other source like diesel generator can be used to provide the power at base station. It can be installed in Coastal or hilly areas and it need to operate wind speed of four mile per hour or 30 mile per hours, at least eight mph across a 4 hour period [11].

4.4 3 Fuel cell

Fuel cells are used as viable energy solutions for telecommunication network. They can operate at the place of diesel generator. Partly replace batteries and at the remote area where need a long energy back up [12]. It is a strong alternative energy source. Fuel cell can be deployed to convert the fuel such as hydrogen in to electric power except any combustion. There are a few kind of fuel cell, which can be used in telecommunication network like proton exchange membrane fuel cell. It can always operate at low temperature and it has up to 40-50 percent efficiency [11].

4.4.4 Pico Hydro

Pico hydro system can deploy at the lighting and basic electricity requirement in remote areas. Where high rainfalls, steep flowing stream and river, which can provide energy source for base station. This system drives a turbine operate a generator and which convert the mechanical energy into electrical energy [12]

According to all alternative energy solution solar and wind power is very useful. This alternative electricity source only can use where minimum 6-8 hours good sunlight during the daytime. Wind power can be used where wind speed 4 to 30 mile per hour. Therefore more energy saving is possible in this sites area using alternative energy source. Other hand it has low environmental impact like CO2 emission. The table 5 [18] shows that we have saved the energy if we use this power sources. The table below gives some indication of the power required and the possible solutions for other telecoms solutions. These examples need to be seen as indicators of possible configurations and the local conditions may require larger or smaller solutions.

The traffic load of the network varies during the day and night period. At the night time, it has more less traffic compare as daytime. The number of active calls rate is less than busy hour. When the traffic is low, specifically night time it can be putted some TRX or few sector of BTS on standby mode or shut down mode from base station controller with unchanging all service and capacity. More energy consumption reduction is possible per BTS. There are huge BTS installed in the network, so a large amount of power consumption can be decreased**.**

Sleep mode operation is an effective way to save energy while maintaining acceptable quality periods are those in which the BS transmits packets while during “inactive” accordingly [4]. The power consumption of a periods the BS stays either idles or its transmitting devices are turned off. The sleep mode of service (QoS). To save energy, a BS can be turned off when the traffic load is light, but the quality of service will deteriorate BS during “active” and “inactive” periods. “Active” techniques are a better way to reduce the energy consumption on the

cell site. Many papers show the algorithms that how to sleep mode are activated in BTS and also this technique is also used in various circumstances. Cell zooming is also a same concept of sleep mode. In this concept the cell area is increasing or decreasing according to requirements of condition. With sleep node techniques we save 40% to 50% energy and also some methods are saved up to 65% to 70% energy which is shown in some papers. In paper [19], the sleep mode techniques are used in all three types of BTS cell namely Microcell, Macro cell, and Femtocell.

Table 5: Power Required and Possible Solutions [18]

Application	Site power required	Examples solar and wind solutions
GSM Base Station 2/2/2	600-1800W	4KW Solar Array and 6KW turbine depending upon conditions
GSM Base Station 4/4/4	900 – 2300W	6KW Solar Array and 6KW turbine depending upon conditions
UMTS Node B Macro/Fibre 2/2/2	750 – 1000W	3KW Solar Array and 2.5KW turbine depending upon conditions
UMTS Node B Macro/Fibre — 4/4/4	1300 – 1700W	4KW Solar Array and 2.5KW turbine depending upon conditions
Large WiMax Base Station	1.3kW (4 Sector)	4KW Solar Array and 2.5 or 6KW turbine depending upon conditions
Metro Wi-Fi	<30W, includes a backhaul solution	100W Solar Array and small turbine depending upon conditions
P2P link (two heads)	110W for two units	1KW Solar Array and 600W or 2.5KW turbine depending upon conditions

Fig 1.3 Alternative Energy Solution [18]

V. CONCLUSIONS

A large amount of traffic in cellular communication network continues in growth. As a results demanding of energy still increasing for telecom equipment and other hand increasing the energy price which has both great impact on telecom operator. This problem can be solved with improving the energy efficiency telecom network. . In this paper we can see that the Base Station (BTS) is the main equipment, which is the responsible for approximately 70 percent of energy consumption in cellular network. We can propose main five power saving strategies model, where a large volume of telecommunication equipment will maintain energy efficiency achievement, which will decrease power consumption and present a competitive advantage in the mobile network. Increasing linearity and efficiency of BTS RF power amplifier, removal feeder cable, Alternative cooling system, Alternative energy source for electricity and decrease the power during low traffic load.

The tables 6 show that how would we save the energy by taking this precautions and strategies. This strategies save approx 85% energy.

Table 6: Energy saving Strategies

Energy saving Strategy Approximate	Saving in percentages
Natural Cooling System	25 %
Removal feeder loss	33.98 %
High eff. and linear PA used	30 %
Alternative energy source used	10 %
During Low traffic load	46 %
Total Energy Savings	85%

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X-RAY DIFFRACTION ANALYSIS AND MICROSTRUCTURAL EXAMINATION OF AL-SIC COMPOSITE FABRICATED BY STIR CASTING TECHNIQUE

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ABSTRACT

The composites as engineering materials arevery importantbecause more than 200 are compositesout of about 1600 engineering materials available today. In the present study, the effect of silicon carbide on stir cast aluminium metal matrix composite is developed by varying SiC 10%, 20%, 30%, 40% and 50% by weight at stirring speed of 300 rpm. In the present scenario, crystallite size, lattice strain, lattice constant and interplaner distance, by x-ray diffraction(XRD) patternof aluminium metal matrix composites reinforced with silicon carbide particles produced by stir casting method at 680^{0}C and 900^{0}C pouring temperatures, are found and discussed.Compositions of aluminium alloy and aluminium-silicon carbide composites are found by energy dispersive spectroscopy (EDS) and scanning electron microscopy (SEM). It is found that as the crystallite size increases, lattice strain decreases and vice-versa.The crystallite size was varying to be about 12nm to42nm corresponding to this, lattice strain as 0.0055 to 0.0025 respectively.Micrographs results show the presence of silicon carbide in aluminium alloy.

Key words: Aluminum alloy, Composites, Microstructure, Stir Casting, XRD

I. INTRODUCTION

The advantage of particular properties of any material to meet specific demands is the most important motivation for the development of composites. A composite is a material that consists of constituents produced via a physical combination of pre-existing ingredient materials to obtain a new material with unique properties when compared to the monolithic material properties. The composites are classified on the basis of: (1) their matrix such as polymer, ceramic and metal, (2) their reinforcement, such as oxides, carbides, and nitrides, (3) their reinforcement shape such as continuous fibers, short fibers, whiskers, particulates and orientation, and (4) their processing routes such as liquid processing, solid processing and semi-solid processing. Metal matrix composites (MMCs) are composed of a metallic matrix (Al,Mg,Fe,Cu, etc) and a dispersed ceramic (oxides, carbides, nitride, etc) or metallic phase (Pb,Mo,Wetc). Ceramic reinforcement may be silicon carbide, boron, alumina, silicon nitride, boron carbide, boron nitride etc. whereas metallic reinforcement may be tungsten, beryllium etc. MMCsmainly aluminium metal matrix composites (AMCs) are used for space shuttle,

commercial airliners, electronic substrates, bicycles, *underwater*, automobiles, golf clubs and a variety of other applications [1]. Aluminum is usually reinforced by Al_2O_3, SiC, C, SiO_2, B, BN, B_4C, AlN, etc.

1.2 Selection of Aluminium Alloy

Aluminium alloys are represented by 1XXX, 2XXX upto 8XXX. The first digit gives basic information about the principal alloying elements.The designation system also says something about the hardening of the alloys belonging to a family [2]. The 1xxx series designatespure or unalloyed aluminium materials which are distinguished according to their degree of purity. The 8xxx series designations are for miscellaneous types of alloys such as Fe containing alloys. The 2xxx, 6xxx and 7xxx series are heat-treatable alloys. The 1xxx, 3xxx and 5xxx series are non-heat-treatable alloys. Among them, A356.0 has excellent properties and applications such as aircraft pump parts, automotive transmission cases, aircraft fittings and control parts, water-cooled cylinder blocks, aircraft structures and engine controls, nuclear energy installations, and other applications where high-strength permanent mold or investment castings are required [1].

1.3 Stir Casting Method for Fabrication of AMCs

Stir Casting is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix by means of mechanical stirring. The liquid composite material is then cast by casting methods. Its advantages are simplicity, flexibility and applicability to a large scale production. Fillers are substances added to reduce the cost and/or improve its thermal, physical and mechanical properties. Commonly used fillers are $CaCO_3$, Al_2O_3, ceramics, SiC, etc. Silicon carbide also known as carborundum. It is produced with a nominal 0.0055 in. (140mμ) [3], [4]filament diameter and are characteristically found to have high strength, modulus and density. Melting temperature of SiC is 2730^oC.

1.3 Literature Review

1.[5] found the technical difficulties associated with low cost stir casting technique used in the production of Al-SiC MMCs to attain a uniform distribution of reinforcement, good wettability between substances, and a low porosity material. It was observed that, the composites produced by liquid metallurgy techniques show excellent bonding between the ceramic and the metal when reactive elements, such as Mg, Ca, Ti, or Zr are added to induce wettability. The addition of Mg to molten aluminium to promote the wetting of alumina is particularly successful, and it has also been used widely to promote wetting of different ceramic particles, such as SiC, mica.

2. [4]investigated that, a two-step mixing method improves the wettability of the SiC particles and ensure a good particle distribution. Before mixing, SiC particles are to be preheated at 1100 °C for 1 to 3 hours to make their surfaces oxidized and SiC particles were observed to act as substrates for heterogeneous nucleation of Si crystals in A356, Al6061-10%SiC.

3. [6] reported that the effect of stir casting by preparing Al6061-SiC-Al_2O_3 Hybrid composites and found that the vortex method is one of the better known approaches used to create a good distribution of the reinforcement material in the matrix. Good quality composites can be produced by this method by proper selection of the

process parameters such as pouring temperature, stirring speed, preheating temperature of reinforcement etc. The coating of an alumina to the blades of the stirrer is essential to prevent the migration of ferrous ions from the stirrer into the molten metal.

4.[7] depicted the various factors to improve wettability between reinforcement and matrix interface, good wettability of B_4C in aluminium higher than that of SiC can be found. This is attributed to the formation of a layer of liquid B_2O_3 on the B_4C particles. Due to its low melting point, B_2O_3 exists above 450^{o}C as a liquid on the surface of B_4C and enhances wettability through a liquid–liquid reaction.

Extensive literature survey show that the works have been done on Al-SiC composite. However, no any researcher worked on the mixing condition of the SiC in aluminium by stir casting technique. In the present study, the effect of temperatures and filler material on the metallurgical properties and homogeneity of Al-SiC metal matrix composite fabricated through stir casting method, taking different mixing conditions of the filler material with the matrix, is explored.

II.EPERIMENTAL DESIGN AND PROCEDURE

The experiments were designed on the basis of the literature survey. In the preset study, the three conditions of mixing of the filler material were taken. The two pouring temperatures 680^{o}C and 900^{o}C were taken for the comparison purposes in between just above melting temperature of aluminium (660^{o}C) and the superheating condition (900^{o}C) of aluminium with the filler material.Three mixing conditions are

(a) Case-1:- Addition of filler material (SiC) before melting aluminium matrix (Al)
(b) Case-2:- Addition of filler material (SiC) during melting aluminium matrix (Al)
(c) Case-3:- Addition of filler material (SiC) after melting aluminium matrix (Al)

Table 1Composition of SiC and Aluminium Alloy

Composition of SiC (size = 220 mesh = 63 μm)					
Constituent	C	SiO_2	Si	Fe_2O_3	SiC
Weight (%)	1.1	1.4	2.2	0.3	Balance
Composition of Aluminium Alloy					
Element	Si	Zn	Fe	Cu	Others	Al
Weight (%)	≤1.5	0.1-.14	≤0.4	≤0.28	1-1.5	Balance

2.1 Experimental Set-Up

In this study, theside-blow converter furnace was used to meltaluminium ingots. Stir casting set upwas developed from a previous compocaster unit [8], [9].A digital thermocouple was used to measure the temperature of the molten metal directly in the mild steel crucible. Mild steel material was chosen for the stirrer rod and impeller/blade. The diameter of the crucible was 105mm and the melt height is 65mm. A two flat bladed

90^{o}angled stirrer was chosen. The stirrer impeller/blade diameter is 80mm, blade height is 35mm, thickness 3mm and width is 15mm with slope of 22.5^{o} from each side of the blade and the rod was connected with the DC motor of 1 Hp having maximum speed of 1400 rpm with analog speed regulator as shown in the Fig.1.A two-way switch was connected to the motor in ordered to get the clockwise and anti-clockwise rotation of the blade and controlled manually. This whole mechanism is kept just 50mm above the crucible during stirring. The die for permanent mouldwas designed according to the specimen required [10], [11] to test the hardness, wear resistance, and compressive strength which is according to ASTM standard. For this purpose a mild steel material was chosen for making die. Die was cuboid in shape and in two pieces size 7 inch x 7 inch x 1.5inch and 7 inch x 7 inch x 0.75 inch. The four moldsof Φ13mm and 25.4mm height at pitch circle diameter (PCD) 76mm were made in the die. The spruewas at the center of the PCD of the same dimensions. This sprue is connected to the four molds via four runners(groove 3mm) as shown in the Fig.1. These molds and spruewere made by simply drilling followed by a taper (2^{o}) reamer.Taper in the molds and sprue were given for easy removal of the ingots/pieces. Burrs were removed by grinding followed by polishing by sand paper. Shrinkage allowances were given 0.3mm for aluminiummetal matrix [12].In order to hold the two pieces of the die, two silver steel rods (M10 x 50) are inserted at the two corners of the die and remaining two corners joined by two bolts (M8 x 40).

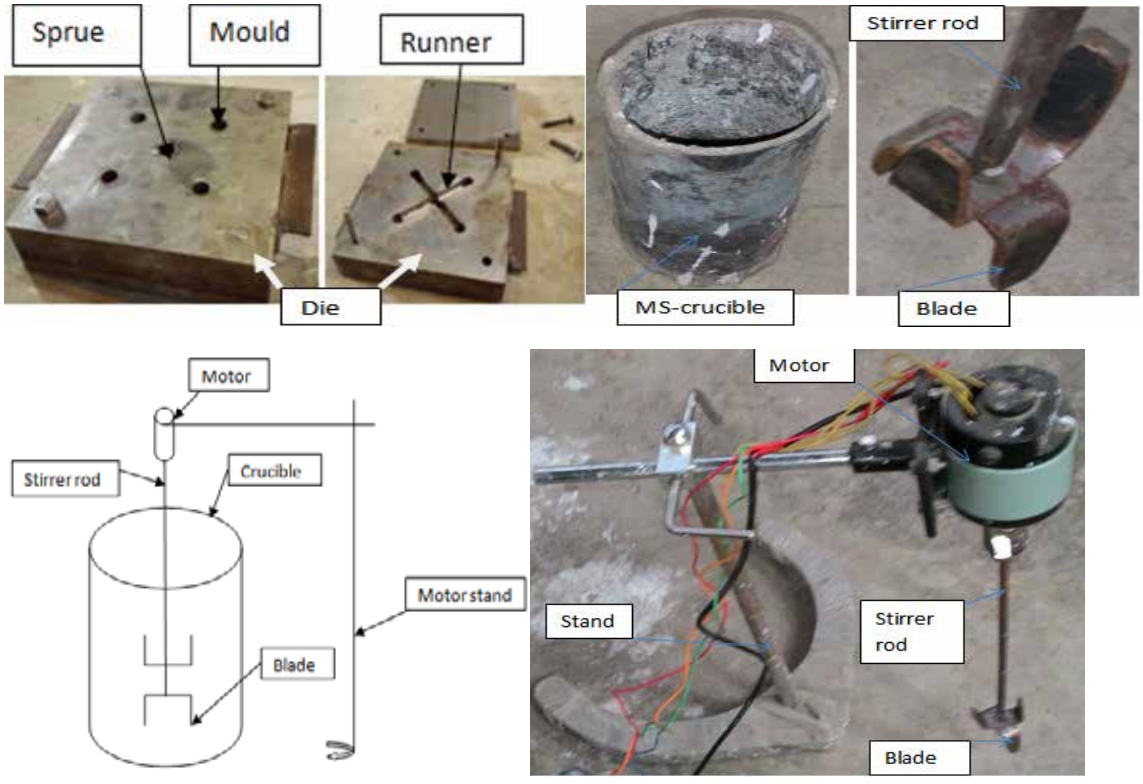


Figure 1: Stir Casting Set Up

2.2 Sample Preparation

(1) Collection and preparation of the raw materials (Al +SiC particles).

(2) Take bout 300g aluminium in the crucible and then melt it into a furnace.

(3) The melt was then skimmed to remove the oxides and impurities, and then pour into the die in case of aluminium alloy at pouring temperature about 680±20^{o}C.

(4) In case of making composite, after being liquid, mix the filler material (10%,20%,30%, 40%, and 50% SiC by wt.) and temperature was raised about 730°C within 5 minutes.

(5) During cooling, stirring was started at speed [8]of 300±10rpm for60 seconds and then poured in the die at the pouring temperature of 680°C in all three cases.

(6) In case of pouring temperature at about 900±20°C, the temperature was raised at about 950°C before stirring. It should be remembered that during stirring at speed of 300rpm for 60 seconds, the temperature was dropped by about 50°C.

(7) The die after pouring was quenched in the air.

(8) After casting, the samples weremade as shown in Fig.2, by hand hacksaw and file, for hardness, compressive and wear tests specimens for the purpose of determining the mechanical properties.

(9) In case of micrography, the specimen were prepared by dry and wet polishing by polishing machine and sand paper of 400, 600, 1000, 1200 grit size followed by zero finish sand paper.

10% 20% 30% 40% 50%

Figure 2:Samples of Composite Containing wt. % SiCin Aluminium Matrix

2.3 Study of X-Ray Diffraction

The X-ray diffraction measurements were carried out with the help of aD8 advance Goniometer model 2036E201, (Bruker) using Cu Kα radiation (Kα= 1.54056 Å) at an accelerating voltage of 40 kV and a current of 20 mA. In this test the sample was in stationary condition, only the arms of the X- ray tube was rotating in the opposite direction from 30^0 to 70^0 of 2θ during the test. The samples were scanned with a scan rate of 2^o/ min.

2.3.1 Indexing the pattern of cubic structure via analytical method

Bragg's Law

$n\lambda = 2\, d \sin\theta$ (1)

$\lambda = 2\, d_{hkl} \sin\theta_{hkl}$ (2)

Fix λ=1.54Å .....for Cu kα

$d_{hkl} = 1.54Å / (2 \sin\theta_{hkl})$

$\Rightarrow d_{hkl} = 0.77Å / \sin\theta_{hkl}$ (3)

For a cubic, $a = b = c = a_0$

$\Rightarrow d_{hkl} = \frac{a_0}{\sqrt{h^2+k^2+l^2}}$ (4)

or, $a_0 = d_{hkl} / (h^2 + k^2 + l^2)^{1/2}$ (5)

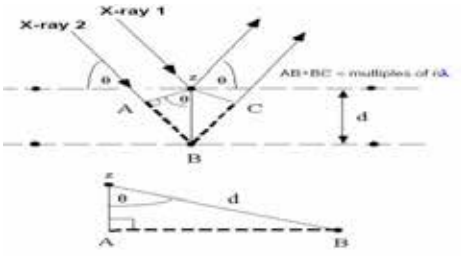


Figure 3: X-Ray principle

Wherea, b, c, a_0 = Lattice constants, h,k,l = Miller Indices, d_{hkl} = Interplaner distance/spacing, λ = wave length = 1.54Å, n = order of reflection=1, 2, 3, ……..… a positive integer, θ = Braggs angle = angle of incident

Scherer's Equation

The average crystallite size was determined from the full width at half maximum (FWHM) of the X – ray diffraction peak by using Scherer's equation [13].

$D_p = (k \lambda) / (B \cos\theta)$(6)

Where D_p = average crystallite size, λ = X – Ray wavelength, B = FWHM of the diffraction peak, θ = diffraction angle and K = Scherer's constant of the order of about unity (0.94) for usual crystals.

The stress in the material results in lattice distortions of crystals; consequently, the diffraction peaks of the crystals are broadened. The relationship between the half width of the broadened diffraction peaks (B) and the distortion of lattice or lattice strain(Δd/d) was described by [13]. The lattice distortion (Δd/d) can be obtained from the following equation:

$(\Delta d/d) = B / (4 \tan\theta)$ (7)

Where θ, is half of the diffraction angle and d, is diameter of the particle.

2.3.2 Indexing of Aluminium Diffraction Pattern

For different Cubic Lattices values of the Miller Indices $(h^2 + k^2 + l^2)$ are as follows

Table 2Values of Miller Indices for different Cubic Lattices[14], [15]

Different Cubic Lattice	Value of $(h^2 + k^2 + l^2)$
Primitive	1,2,3,4,5,6,7,8,9,10,……
BCC	4, 6, 8, 10, 12, 14, 16, 18, ...
FCC	3, 4, 8, 11, 12, 16, 19, 20……..

Aluminium is under the category of FCC, hence $(h^2 + k^2 + l^2)$values will be 3, 4, 8, 11, 12….etcetera.

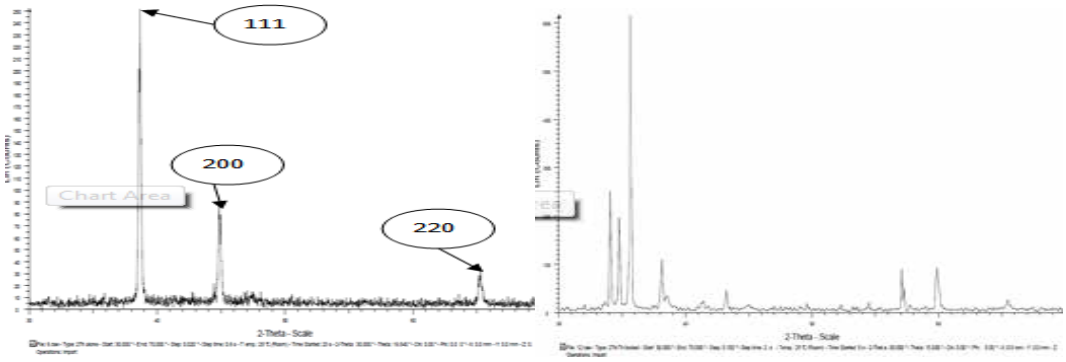
III. RESULTS

3.1 X-Ray Diffraction Pattern

Table 3Finding values of Interplaner Distance and Lattice Constant

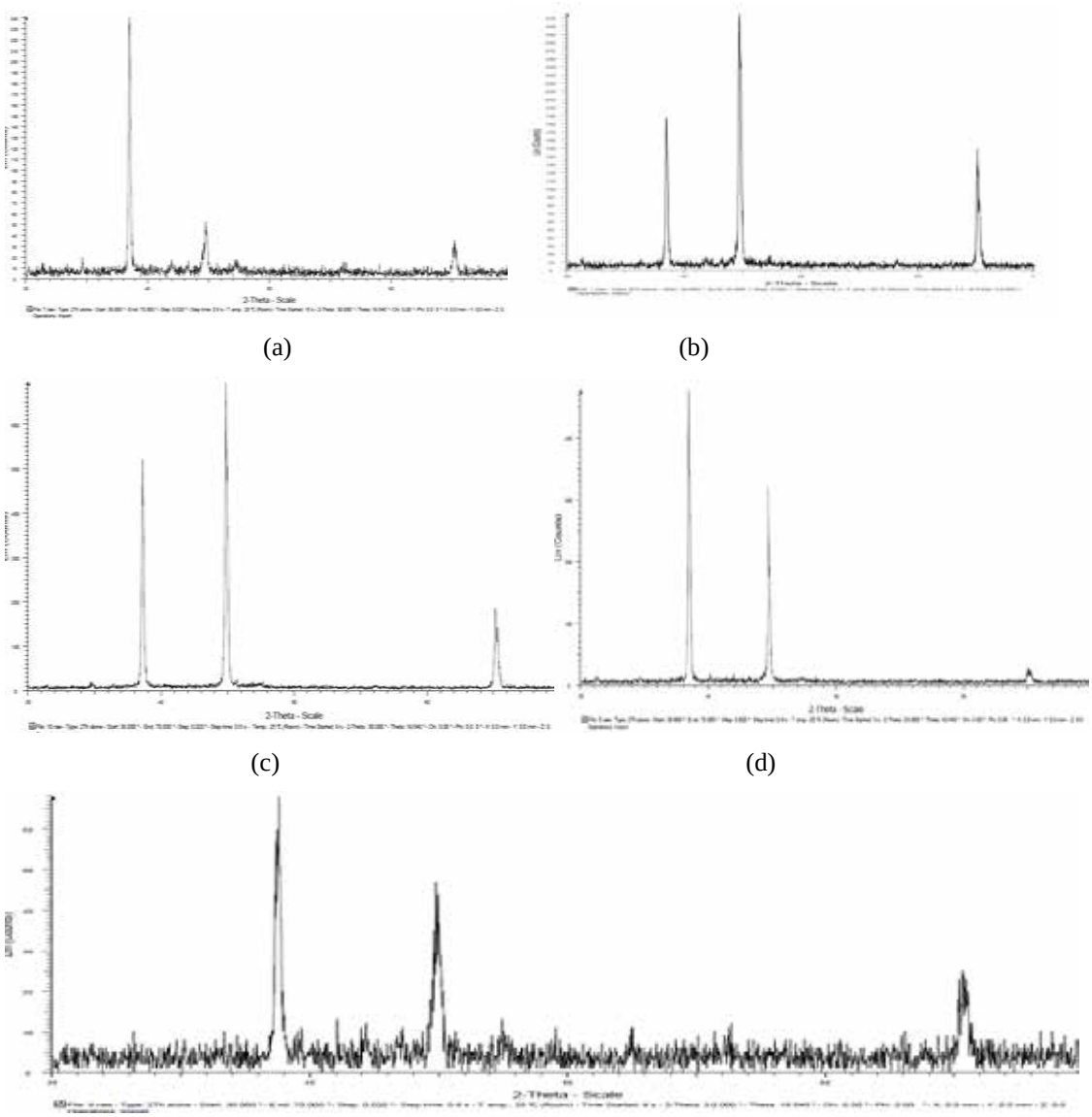
Peak	2θ	$\sin\theta_{hkl}$	$(h^2 + k^2 + l^2)$	(hkl)*	$d_{hkl}(\AA)$	$a_0(\AA)$
1	38.52	0.3299	3	(111)	2.3340	4.0426
2	44.76	0.3808	4	(200)	2.0220	4.0440
3	65.14	0.5384	8	(220)	1.4302	4.0452

*Consider Lowest Index Plane



(a) (b)

Figure 4: X-ray diffraction pattern of (a) Aluminium and (b) SiC



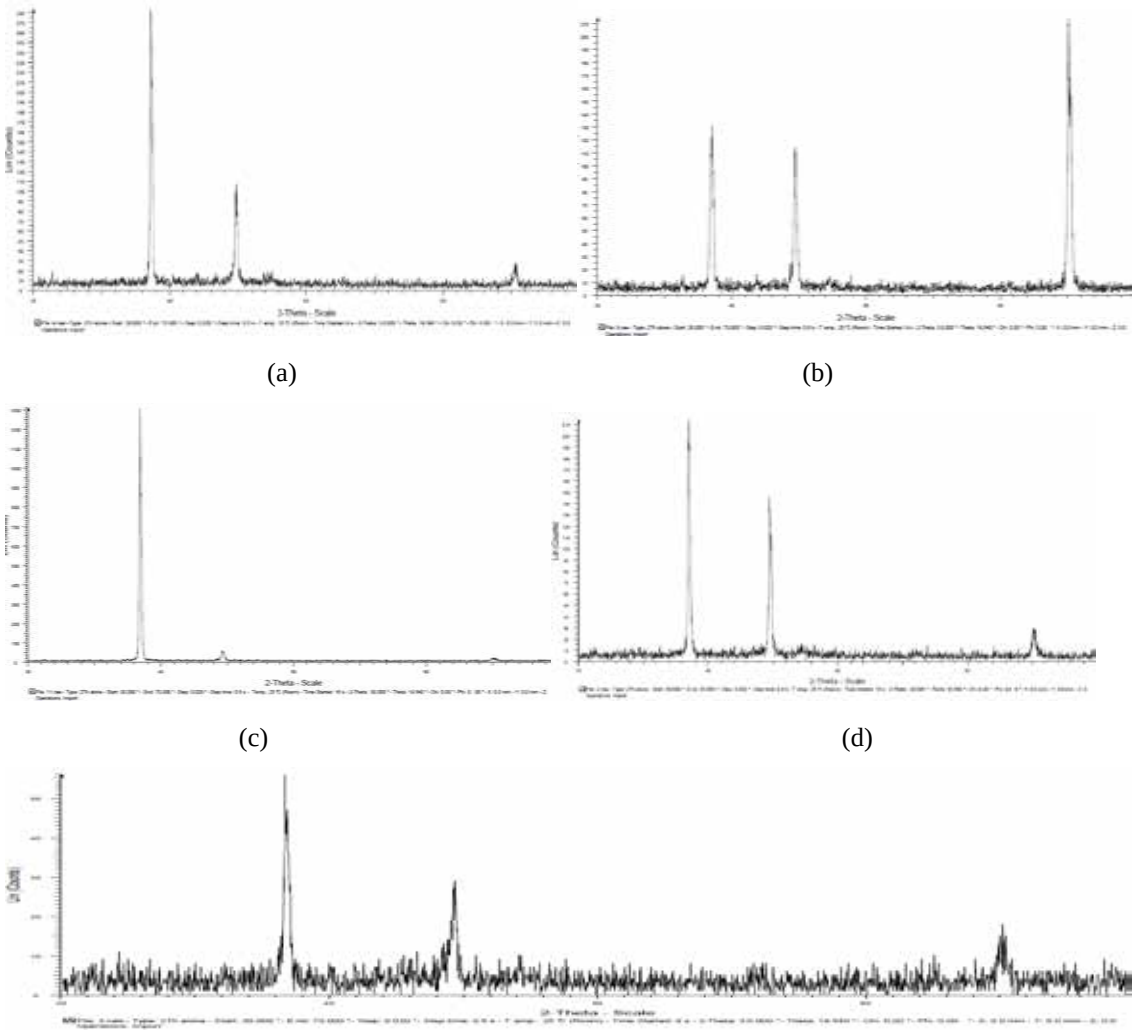
(a) (b)

(c) (d)

(e)

Figure 5: X-Ray Diffraction Pattern of Composites at 680 deg C Pouring Temperature (a) Al+10% SiC,

(b) Al+20% SiC, (c) Al+30% SiC, (d) Al+40% SiC and (e) Al+50% SiC



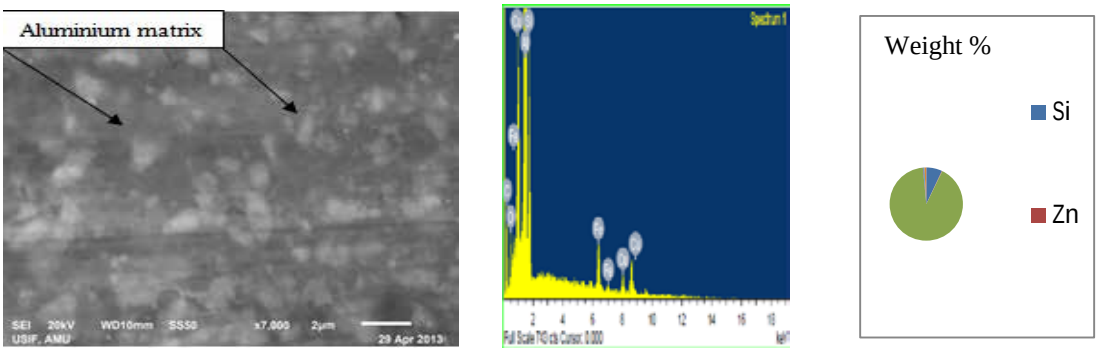
(a) (b)

(c) (d)

(e)

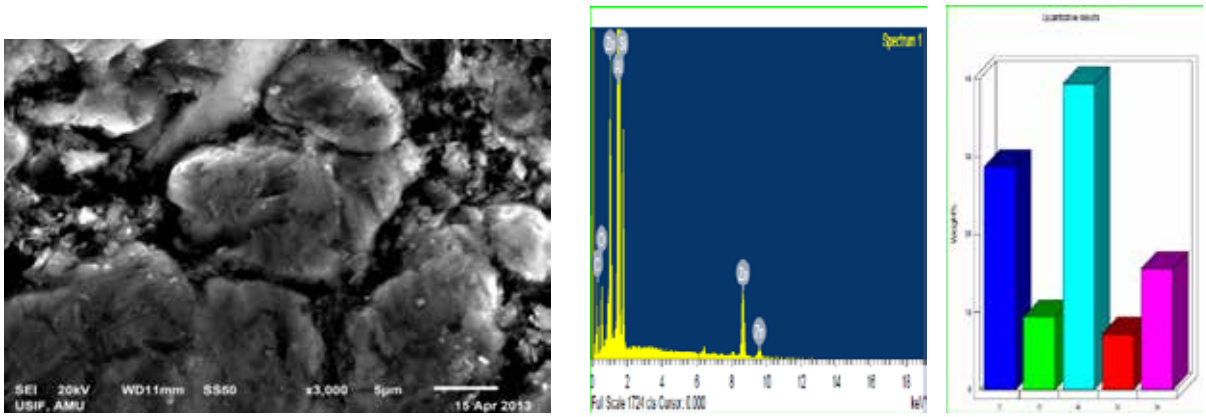
Figure 6: X-Ray Diffraction Pattern of Composites at 900 deg C Pouring Temperature (a) Al+10% SiC, (b) Al+20% SiC, (c) Al+30% SiC, (d) Al+40% SiC and (e) Al+50% SiC

3.2 Micrographyby SEMand EDS



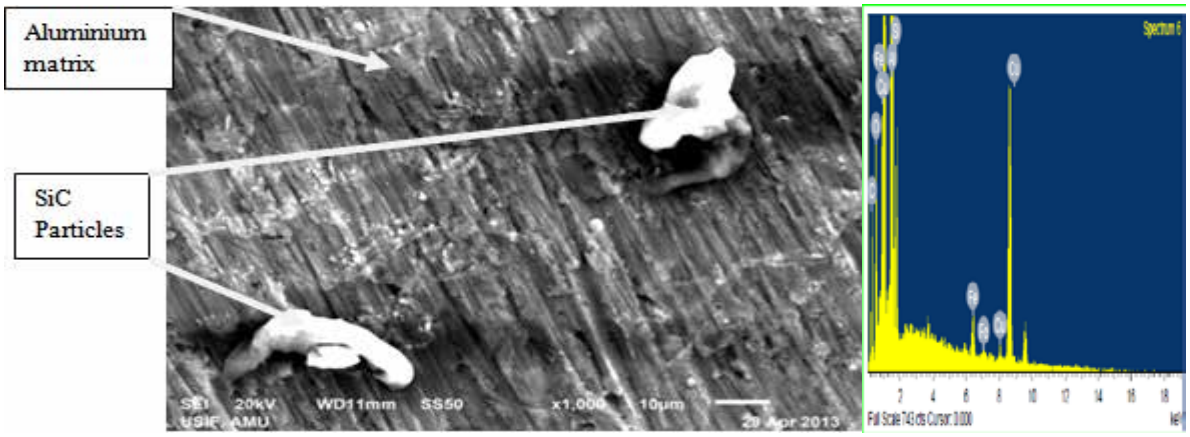
(a) (b) (c)

Figure 7: (a) SEM Micrograph, (b) EDS and (c) Composition of AluminiumAlloy, Pouring Temperature 680 deg C



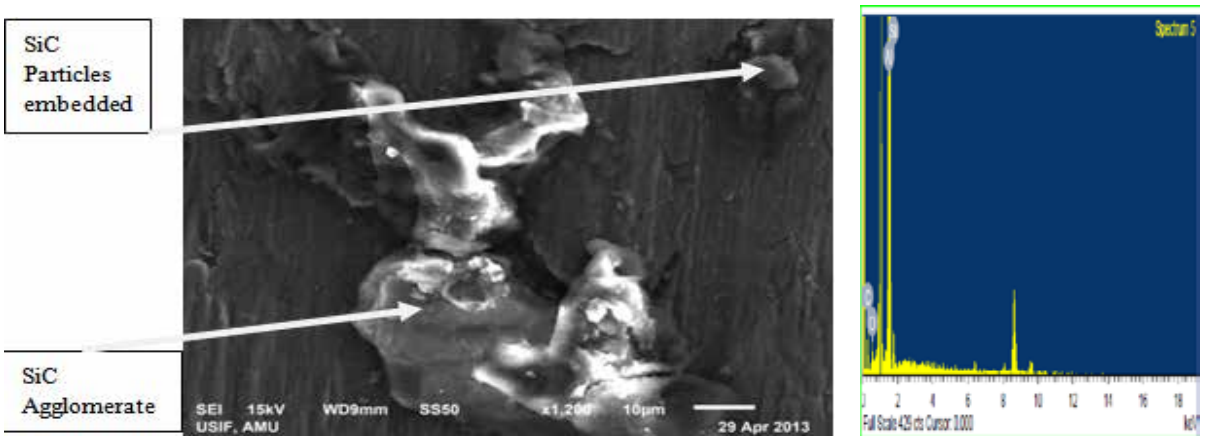
(a) (b) (c)

Figure 8: (a) SEM Micrograph, (b) EDS and (c) Composition of Composite (Al+30%SiC), Addition of SiC before Melting Matrix, Pouring Temperature 680 deg C



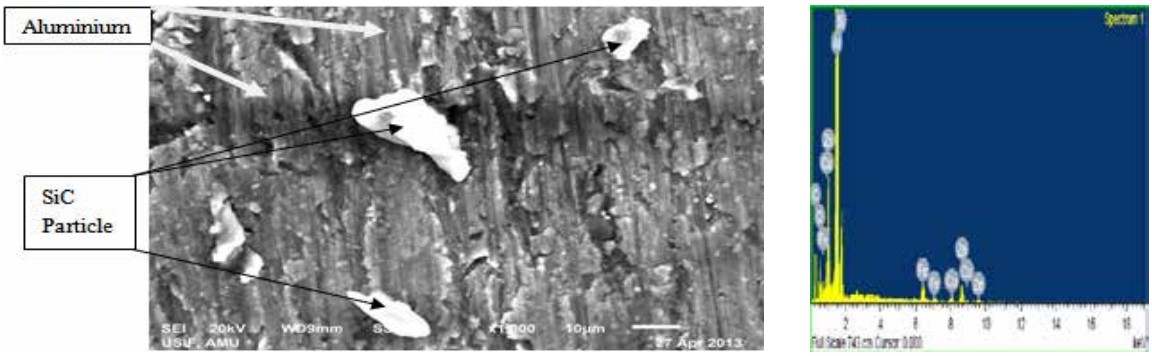
(a) (b)

Figure 9: (a) SEM Micrograph and (b) EDS of Composite (Al+30% SiC), Addition of SiC before Melting Matrix at Pouring Temperature 900 deg C



(a) (b)

Figure 10: (a) SEM Micrograph and (b) EDS of Composite (Al+30% SiC), Addition of SiC during Melting Matrix at Pouring Temperature 680 deg C



(a) **(b)**

Figure 1: (a) SEM Micrograph and (b) EDS of Composite (Al+30 % SiC), Addition of SiC after Melting Matrix at 680 deg C

IV. DISCUSSION

4.1 Microstructural Examination

Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) were used in order to examine the morphological changes of certain phases in the microstructure of silicon carbide particles in aluminium matrix.The SEM and EDS micrographs of aluminium and Al-SiC composites with SiC contents 30% have been shown in the Fig.7, 8, 9, 10, and 11.

In this study, the irregular shapes of most of the particles in the composite were found. The particles of the filler material are found randomly oriented and at most of the places at 30%SiC, they are embodied and closely packed into the matrix which improved the mechanical properties[10], [11]. Scanning electron images of Al-SiC composites revealed that the typical microstructure of the Al-SiC composites shows low porosity levels[11] and better distribution of the SiC. Another probable explanation could be the important segregation and agglomeration of SiC at the interfaces of Al-SiC composites. The importance of the matrix strength on the mechanical properties of the composites is confirmed by the influence of the presence of the SiC. The agglomeration tendency was also observed in the composite. The SEM and EDS analysis of composites show the presence of the dispersed phase, i.e. silicon carbide is homogeneously distributed in the matrix phase of aluminum and on the surface of the composites. There are some white particles which predicted the presence of aluminum oxides (Al_2O_3), formed during polishing with atmospheric oxygen and pores in the grain boundaries are clearly visible during the investigation [16].From the electron micrographs of the composites, it is alsofound that at about 30 wt.%SiC and pouring temperature 680^0C, addition of SiC during melting matrix, particles are more uniformly embedded in the aluminium matrix than 10, 20,40 and 50 percent which is one of the reasons because of which at these percents the mechanical properties were lower than 30% and there was less segregation of SiC particles at 30 percent.

4.2 X-Ray Diffraction Analysis of Composite

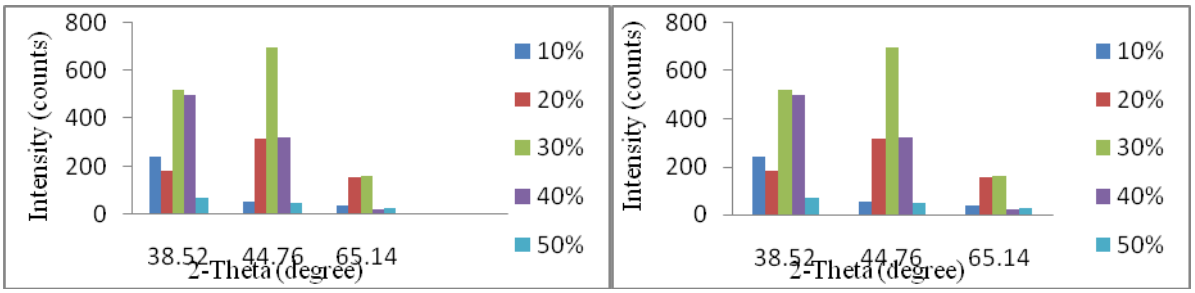
Samples, for X-ray diffraction analysis, were prepared as per the standard practice[13]. Fig. 4, 5, 6 show an X-ray diffraction (XRD) pattern taken for aluminium, SiC powder and composites to verify its quality and standard SiC XRD pattern.The aluminium 30%SiC composites prepared by stir casting at 680^0C and 900^0C pouring

temperature were subjected to X- ray diffraction analysis for the constituents present and the results obtained are shown in the Fig.5, 6. X-ray Cu-kα radiation was passed through these composite samples and X-ray patterns were obtained. The X-ray diffraction pattern in Fig. 4 shows that three highest intensity peaks, namely, (111), (200) and (220), are distinctly visible for aluminium while many peaks are visible for SiC powder. This is believed to be due to low purity of aluminium and the better purity of SiC, as well as due to the preferred orientation in the aluminium and SiC powder samples along the (111), (200) and (220) planes [16].Different constituents, such as aluminium and SiC were identified after matching experimental peaks obtained with those of the standard peaks. X-ray diffraction results revealed the presence of SiC.

4.2.1 Determination of Crystallite Size, Lattice Strain, Interplaner Distance, Lattice Constant and Peak Height

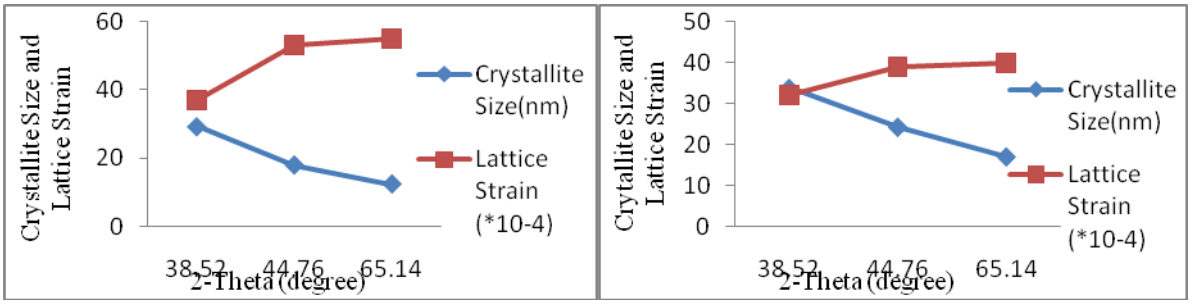
The analysis was carried out to find out crystallite size, lattice strain(amount of induced strains or strain distortion) and peak height of the Al-SiC composites. The variation of peaks height of different composites, at 680^0C and 900^0C pouring temperaturesare shown in the Fig.12. It is seen that peak height increases and then decreases with 2-theta scale. It is found that intensity is highest at 44.76 degree (deg) on 2-theta scale for 30%SiC. Higher the intensity larger numbers of atoms at that position are depicted. Therefore, Al+30%SiC composites are predicted better uniform distribution of reinforcement and hence mechanical properties are improved [10], [11].

The crystallite size is determined by using Scherrer's equation (6) of the all composites fabricated by stir casting technique at pouring temperatures 680^0C and 900^0C. The graphs of the variation of the crystallite size and lattice strain with respect to 2-theta scale are shown in the Fig.13, 14,15,16,17. It is depicted that as the crystallite size decreases, lattice strain increases for both pouring temperatures. This is due to the fact that as the crystallite size decreases, the particle diameter'd' is constant and Δd (equation 7) decreases, and hence lattice distortion increases. This also shows better embedment of SiC in the aluminium matrix.The Interplaner distance (d_{hkl}) and Lattice constant (a_0) are found by using Brag's law (equations 3 and 5) for aluminium as shown in the Table 3. It is depicted that Interplaner distance decreases and Lattice constant increases with respect to 2-theta scale. Fig.18, 19, 20 show the effect of weight (wt.) %SiC in aluminium matrix on the crystallite size and lattice strain. It is revealed that crystallite size increases firstup to 30%SiC and then decreases while lattice strain decreases up to 30 %SiCand then increases for 680^0C pouring temperature and its reverse explanations is true for 900^0C pouring temperature. Therefore, better improvement of mechanical properties were found [10], [11] at 30%SiCfor 680^0C pouring temperature. The maximum and minimum crystallite size were found to be about 42nm and 12nm respectively, and corresponding to this, lattice strain as 0.0025 and 0.0055 respectively.



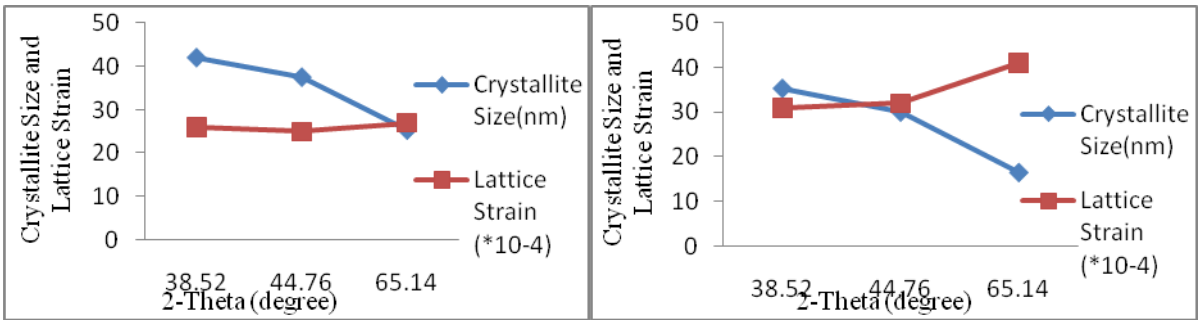
(a) (b)

Figure 12: Effect of SiC on Intensity at Different Peaks at (a) 680 and (b) 900 deg C



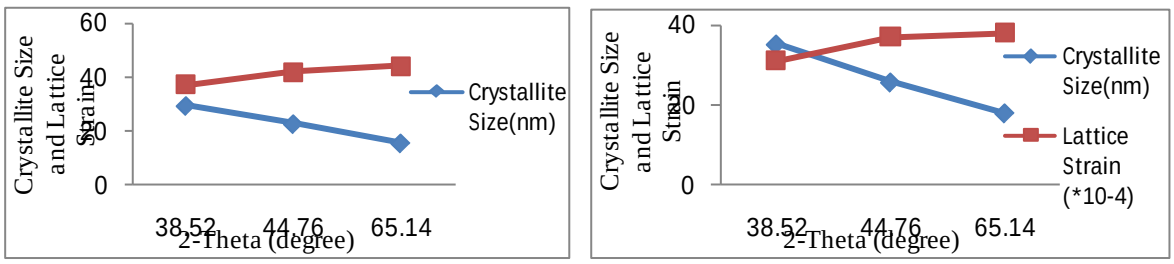
(a) (b)

Figure 13:Variation of Crystallite Size and Lattice Strain of Composites (a) Al+10% SiC and (b) Al+20% SiC at Different Peaks, Poring Temperature 680 deg C



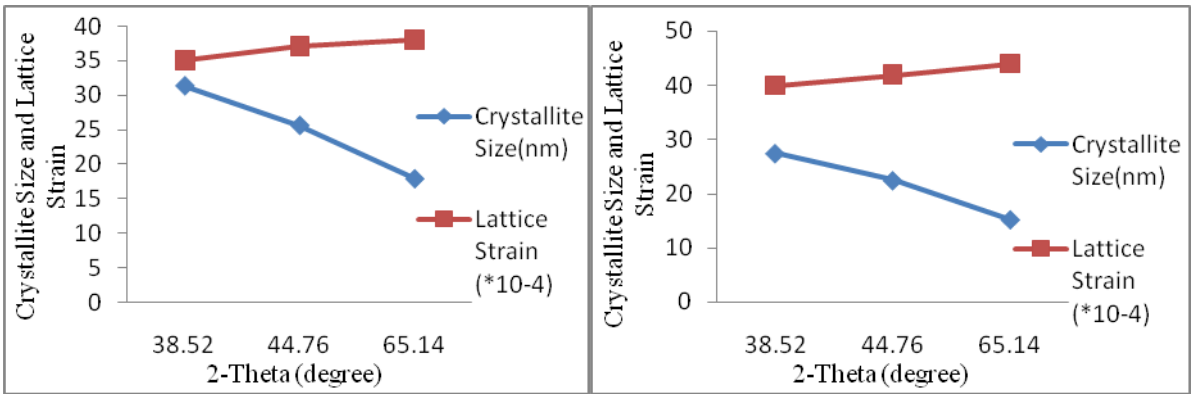
(a) (b)

Figure 14: Variation of Crystallite Size and Lattice Strain of Composite (a) Al+30% SiC and (b) Al+40% SiC at Different Peaks, Pouring Temperature 680 deg C



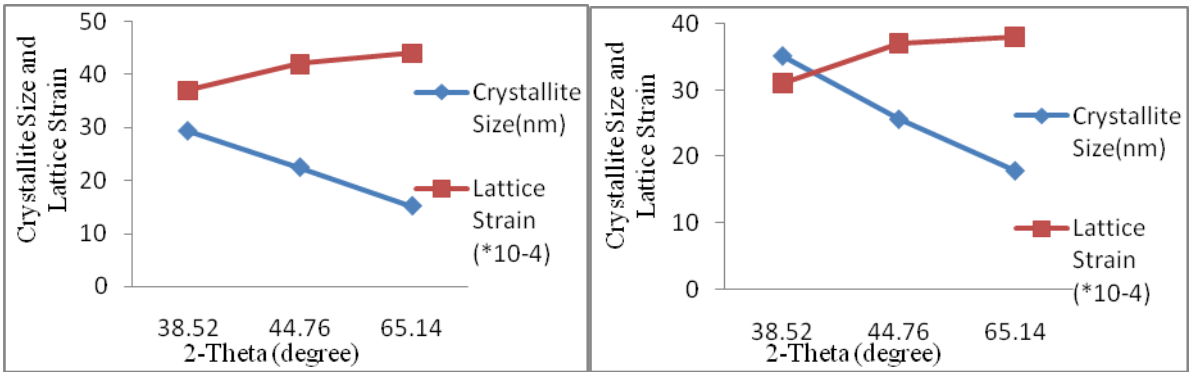
(a) (b)

Figure 15: Variation of Crystallite Size and Lattice Strain of Composite (a) Al+50% SiC, Pouring Temperature 680 deg C, (b) Al+10% SiC, Pouring Temperature 900 deg C at Different peaks



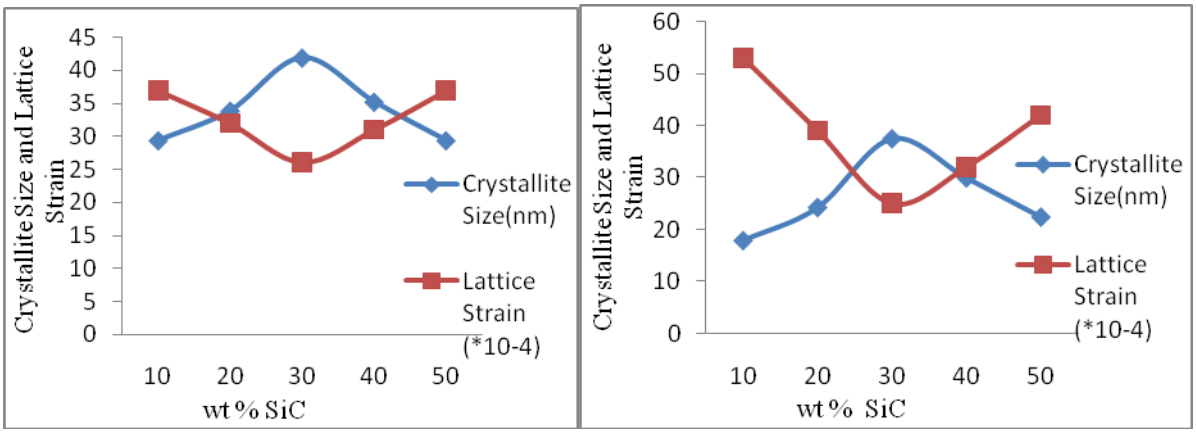
(a) (b)

Figure16: Variation of Crystallite Size and Lattice Strain ofComposite (a) Al+20% SiC, (b) Al+30% SiC at Different Peaks, Pouring Temperature 900 deg C



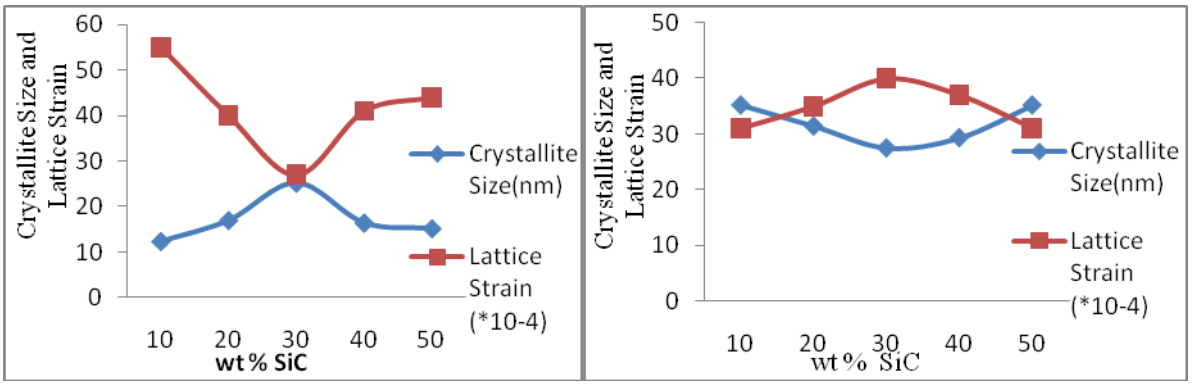
(a) (b)

Figure 17: Variation of Crystallite Size and Lattice Strain of Composite (a) Al+40% SiC, (b) Al+50% SiC at Different Peaks, Pouring Temperature 900 deg C



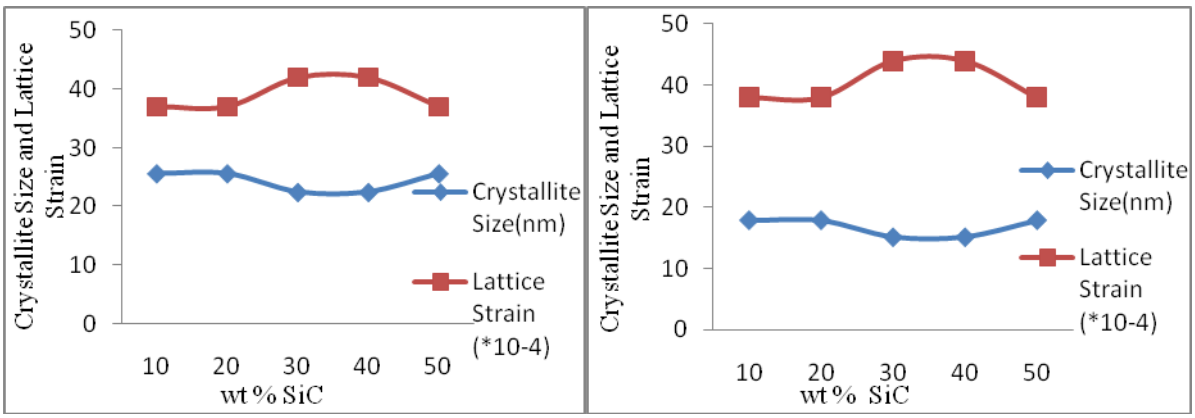
(a) (b)

Figure 18: Effect of SiC on Crystallite Size and Lattice Strain at 680 deg C Pouring Temperature (a) at 2-theta = 38.52deg and(b) at 2-theta = 44.76deg



(a) (b)

Figure 19: Effect of SiC on Crystallite Size and Lattice strain (a) at 680 deg C, 2-theta = 65.14deg and (b) at 900 deg C, 2-theta = 38.52deg



(a) **(b)**

Figure 20: Effect of SiC on Crystallite Size and Lattice Strain at 900 deg C Pouring Temperature (a) at 2-thet = 44.76deg and (b) 2-theta = 65.14deg

V. CONCLUSIONS

1. The aluminium silicon carbide composites weresuccessfully fabricated by stir casting technique at 680^0C and 900^0C pouring temperature at stirring speed of 300rpm.
2. The different peak heights were found at different 2-theta scale for different compositions.
3. It was depicted that crystal size increases first and then decreases at 680^0C pouring temperature.
4. The maximum crystallite size was found at 30 wt. %SiC.
5. The crystal size decreases first and then increases for pouring temperature 900^0C.
6. The lattice strain was found reverse variation of the crystal size.
7. Energy dispersive spectroscopy showed the presence of different constituents in aluminium alloy and composites and better results were found in addition of SiC during melting Al, at 680^0C.
8. The presence, segregation and agglomeration of SiC particles were seen by SEM and XRD.
9. The maximum and minimum crystallite size were found to be about 42nm and 12nm respectively, and corresponding to this, lattice strain as 0.0025 and 0.0055 respectively.

VI. ACKNOWLEDGEMENTS

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A STUDY ON LENGTH AND WEIGHT RELATIONSHIP WITH RELATIVE CONDITION FACTOR OF LABEO DYOCEILUS FROM W. RAMGANGA RIVER, CENTRAL HIMALAYA, INDIA

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ABSTRACT

Present study deals with length-weight relationship and condition factor of Labeo dyocheilus investigated from Western Ramganga River, Uttarakhand, India for two years 2009 to 2011. Log transformed regressions were used to test the allometric growth. Each fish was measured and weighed by electronic instrument. Samples were collected by using nets at depths ranging from 1 to 3 meters. The Length Weight Correlation Coefficient of Spot-II (r=0.959) is found to be higher when compared to that of Spot-I (r=0.941), this correlation was not less than 0.910, shows that the results of length weight relationship were highly significant in all months during the period of observation. In the present study the parabolic equation "b" values ranged from 1.012 to 1.889 for Spot-I and 1.133 to 2.105 for Spot-II whereas relative condition factor (K_n) for the Spot-I and Spot-II ranged from 0.959 to1.021 and 0.968 to 1.023 respectively.

Keywords: Length-Weight Relationship, Allometric Growth, Condition Factor, Labeo Dyocheilus, W. Ramganga River.

I INTRODUCTION

Studies on length-weight relationship are of considerable importance in fishery because it shows relevance to fish population dynamics and pattern of growth on fish stocks. Length and weight measurements in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production. Knowledge of length weight relationship is of paramount importance in fishery biology as it serves several practical purposes. This expression had been extensively used in the study of fish population dynamics for estimating the unknown weights from known lengths in yield assessments [1], in setting up yield equation for estimating population strength [2, 3], in estimating the number of fish landed and in comparing the populations over space and time [4]. It also yields information on growth, gonadal development and general condition of fish [5] and therefore,

useful for comparison of body forms of different groups of fishes. The length-weight relationship has a biological basis also as it depicts the pattern of growth of fishes.

The study of weight-length has its applied value in fish biology. These studies are also widely used for conversion of the growth-in length equation to growth-in-weight for use in stock assessment models and estimation of biomass from length observations [6, 7, 8]. In addition, the data on length and weight can also be used to compare fish life history between regions in species and populations [6, 9, 10]. Length-weight relationship is of great importance in fishery assessments [9]. Length and weight measurements can give information on the stock composition, life span, mortality, growth and production [11, 12, 13, 14].

The estimation of population size of a fish stock for the purpose of its rational exploitation often requires knowledge of individual body length weight relationship in the population [15]. Length weight relationship have several applications, namely on fish biology, physiology, ecology and fisheries assessment. Length weight relationship gives us life history and morphological comparisons between different fish species or between different fish populations from different habitats [9, 16, 17]. Length-weight relationships are very useful for fisheries research because they; allow the conversion of growth-in-length equations to growth-in-weight for use in stock assessment models; allow the estimation of biomass from length observations; allow an estimate of the condition of the fish; and are useful for between region comparisons of life histories of certain species [9, 14, 18]. They are an important component of Fish Base [18].

Length-weight relationship has been commonly used to describe the mathematical model between length and weight so as to derive one from the other. Since length can be easily and accurately measured, the data on length are available in various studies. It is highly valuable in cases where weight can be determined from length already known and vice versa. Along with above length weight relationship is used to compute the departure 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” [7]. This parameter helps to assess the experimental improvements in environment for an existing fish and for the purpose of new stocking. The importance of the study in fishes is to assess the growth of fish in different environments.

The length weight relationship provides an opportunity to calculate an index commonly used by fisheries biologists to compare the relative condition factor or well being of a fish. 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. The relative condition factor is also affected by several other factors like environment, feeding, breeding etc. [5]. The relative condition factor is an essential part of the culture biology. The higher values of condition factor shows well being of the fish and lower values indicate the fish are in poor condition. The condition of a fish is affected by the seasonal changes of food and feeding habits, gonadal cycle and health affected by disease etc. Condition indices have been used by fish culturists as indicators of the general ‘well-being or fitness’ of the population under consideration.

In fishes, Condition factor (k) reflects through its variations and provides information on the physiological state of the fish in relation to its welfare. From nutritional point of view, there is accumulation of fat in the abdominal parts

of the body and the gonads [5] and from reproductive point of view, the highest (k) values are reached in some species such as *Amblypharygodon mola, Botia lohachata* & *Rhinomugil corsula* [19, 20, 21, 22, 23]. Condition factor (k) also gives information about two comparative populations of different feeding zones, density, climate, and other conditions, in determining the period of gonadal maturation and the degree of feeding activity of a species to verify whether it is making good use of its feeding source [24, 25, 26].

As no or very few information were available so far on the length-weight relationship and condition factor of *Labeo dyocheilus* and therefore, the present study was under taken to establish the pattern of growth and general condition of this fish species from the natural waters for direct use in fishery assessment. It is for the first time that this species is being studied from this region.

II MATERIALS AND METHODS

For the present study the total length and total weight of fish were recorded in fresh condition. Moreover, the other parameters were measured within a fortnight of collection. Two spots were selected for the study which was geographically much isolated from each other, named Chaukhutia and Masi. Then statically analysis was also made for pooled data. The Length-weight relationship (LWR) was derived from equation: $W=aL^b$ [5, 27]. The logarithm transformation of the equation was expressed as: Log W= Log a + b Log L [5, 28]. This equation is sometimes known as the length- weight key [29]. Where 'a' and 'b' are constants estimated by regression analysis, 'W' is weight of fish and 'L' is length of fish. If fish retains the same shape, it grows isometrically and the length exponent "b" has the value b = 3.0 [7], a value significantly larger or smaller than b = 3.0 shows allometric growth [25]. A value less than b = 3.0 shows that the fish becomes lighter for its length and if greater than b = 3.0, indicates that the fish becomes heavier for its length as it grows. The linearity of regression was tested by the analysis of variance. The length-weight relationship provides an opportunity to calculate an index commonly used by fisheries biologists to compare the "condition factor" or "well being" of a fish [30]. This index is condition factor, "K" ($K= 100 X W/L^3$). Where 'K' is relative condition factor, 'W' is weight of fish and 'L' is length of fish. Fish with a high value of K are heavy for its length, while fish with a low "K" value are lighter [30].

III RESULTS AND DISCUSSION

The length and weight of *Labeo dyocheilus* was observed for month wise, two year during 2009 to 2011 that has been presented in given table. The Length Weight Correlation Coefficient "r"of Spot-II (r=0.959) is found to be higher when compared to that of Spot-I (r=0.941). In the present study the monthly value of r was found to be 0.910 to 0.991 in Spot-I and 0.938 to 0.994 in Spot-II. In Spot-I the lowest r value i.e. 0.910 were obtained in September and highest r value is 0.999 obtained in January. In Spot-II the lowest r value i.e. 0.938 were obtained in June and highest r value is 0.994 obtained in July. In the present study the value of correlation coefficient (r) was not less than 0.910 shows that the results of length weight relationship were highly significant in all months during the period of observation. In the present study the parabolic equation "b" values ranged from 1.012 to 1.889 for Spot-I and 1.133

to 2.105 for Spot-II was observed that show in the Table. For the both side the lowest value observed in the month of January whereas highest value in the month of August, showing the close impact of environment into parabolic equation "b". The results of the monthly mean relative condition factor (K_n) for the Spot-I and Spot-II ranged from 0.959 to1.021 and 0.968 to 1.023 respectively. The minimum K_n value (0.959) for the Spot-I was observed in August, first maximum K_n value (1.021) was observed in January month, in respect of the Spot-II the minimum K_n value (0.968) were observed in the month of August, K_n max (1.023) values were obtained in January.

Length and weight of a particular species of fish are closely related to each other [5]. Therefore, mathematical representation of length-weight relationship from a study of number of specimens of different sizes can be derived. Since length is a linear measure and weight is a measure of volume, it takes a cube form. Hence, a cube law generally expresses length-weight relationship. The length-weight relationship of a stock from a particular area of a fish is a very useful tool for the study of population dynamics. In addition, it also gives an idea about the general condition of the population.

Hayes [31] performed simulations of length–weight regressions and found that for sample sizes commonly used in fisheries research, estimates of the mean-weight-at-length were biased low, whereas estimates of the intercept were biased high. The specific gravity or outline of the fish were subject to change, the cube law does not necessarily hold good always [32]. We also follow this statement for our favor in this particular. The research in *Channa punctatus* concluded that of both sites were growing with negative allometry, recorded values are "b" as 2.9 for site 1 and 2.29 for site 2 [33]. Values of "b" recorded between 2.5 to 3.44 for the fishes studied in different marine body [34]. Length weight relationship in *T. putitora*, from Beas River, observed low regression coefficient (2.5) in the male fishes [35].

According to Pervin and Mortuza [36], these values usually ranged from 2.5 to 4.0 for many fish species. When $b = 3$, the fish grows isometrically resulting in ideal shape of fish such as observed for *L. lineatus* and *O. microcephalus* in both areas. When the value of *b* is less than 3.0, the fish experiences a negative allometric growth [36, 37].

Many factors could contribute to the differences of growth of fish such as differences of habitat, fish activities, food habits and seasonal growth rates [38, 39]. Other factors such as temperature, trophic level and food availability in the community were also important. The correction coefficient (r) for length weight relationship for both years is high which indicates that the length increases with increase in weight of the fish. This is in agreement with previous studies on different fish species from various water bodies [40, 41, 42, 43]. No significant difference in the length-weight relationship of hill stream loach *Botia dayi* Hora in different seasons, but observed good growth during spring-summer month which pressed the value of "n" to go high [44]. Work in the fish *Barilius bendelisis* show that the length and weight relationship very close between 0.921 to 0.909 [45]. The length-weight relationship of *B. bendelisis* is found significantly closed but the value of "b" fluctuated from a minimum of 1.72 to 3.74 in summer in female and again it reaches its peak in autumn. This research finding was in our support as the higher values may be due to maturation of gonads, differences in food availability in lotic and lentic environments and other environmental conditions.

The study of length weight relationship has been made [5] on *Perca fluviatilis* who reviewed the cubic parabola in to a general parabola as $W = a L^b$, where b is an exponent to which is an initial growth depends. The value of "b" may vary from 2.5 to 4.0 if fish retains the same shape [46]. The growth rate, however, is quite low due to longer life span (7.5 years age). *Tor putitora* has a long life span (17+ years) and had very low K value ie. 0.055 per year, *Cirrhinus mrigala* (L=850 mm and K= 0.43 per year), *Catla catla* (L = 700 mm & K = 0.73 per year), *Labeo rohita* (L4= 510 mm & K= 0.80 per year) and *Labeo calbasu* (L = 525 mm & K= 0.76 per year) [47].

In fish, the factor of condition (K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare. Two parameters of growth such as asymptotic length (L¥) and growth coefficient (K) are inversely proportional to each other [2]. Nutritional point of view, there is the accumulation of fat and gonadal development [5], reproductive point of view; the highest K values are reached in some species [19]. Condition factor also gives information when comparing two populations living in certain feeding, density, climate and other conditions; when determining the period of gonadal maturation and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source [48]. Furthermore, studies confirmed that lowest K values during the more developed gonadal stages might mean resource transfer to the gonads during the reproductive period [49], values of the condition factor vary according to seasons and are influenced by environmental conditions [50].

The Central Himalaya is a region of an exceedingly diversified climate and natural aqua-resources [51]. The Uttarakhand region is blessed with splendor, varied natural water resources such as of snow fed rivers and upland lakes which serve as potential fishery resources of cold water fish species [52]. Environmental annual and seasonal changes are responsible for variation in growth of biological factors of river [53], ecological condition of fish, niche in the ecosystem and preferred food items determine growth of fish [54], gonadal structure, functions and growth in fishes are controlled by environmental factors [55], seasonality shows in gonadal biochemicals changes that associates with variation in growth, even among the individuals of the same species [56, 57, 58]. Above cited literature or research work especially on Labeo dyocheilus at Western Ramganga River, were also similar and in support of our work and research findings.

IV TABLE AND FIGURES

Table1. Month wise values of analyzed two years summarized data, statistical modeling based on Length-Weight relationship, Regression analysis, coefficient of Correlation on length weight relationship and Relative condition factor (K_n)

S.No.	Month	(Parabolic Equation) $W = a L^n$ Spot-I & Spot-II	(Correlation Coefficient "r") Spot-I & Spot-II	(K_n Average) Spot-I & Spot-II	(K_n S.D.) Spot-I & Spot-II
1.	Jan	$W = -5.742 L^{1.756}$	**0.991**	0.986 - 1.128	**1.021 ± 0.035**

		W = -6.346 **L** **1.995**	0.976	0.887 - 1.132	**1.023 ± 0.059**
2.	Feb	W = -9.114 **L** 1.564 W = -8.731 **L** 1.476	0.920 0.988	0.966 - 1.125 0.897 - 1.089	0.999 ± 0.030 1.002 ± 0.074
3.	Mar	W = -4.031 **L** 1.321 W = -8.025 **L** 1.558	0.947 0.970	0.918 - 1.117 0.921- 1.141	1.0± 0.084 1.006 ± 0.069
4.	Apr	W = -5.644 **L** 1.430 W = -7.602 **L** 1.697	0.964 0.964	0.967 - 1.059 0.890 - 1.105	1.002 ± 0.052 1.009 ± 0.078
5.	May	W = -5.940 **L** 1.582 W = -5.822 **L** 1.812	0.981 0.966	0.944 - 1.071 0.880 - 1.106	1.006 ± 0.058 1.010 ± 0.074
6.	Jun	W = -7.844 **L** 1.681 W = -7.633 **L** 1.978	0.968 **0.938**	0.969 - 1.132 0.926 - 1.187	1.008 ± 0.041 1.012 ± 0.070
7.	Jul	W = -8.412 **L** **1.889** W = -9.256 **L** **2.105**	0.912 **0.994**	0.981 -1.046 0.940 - 1.052	1.010 ± 0.027 1.014 ± 0.041
8.	Aug	W = -6.123 **L** 1.345 W = -7.251 **L** 1.487	0.924 0.955	0.929 - 0.997 0.875 - 1.030	**0.959 ± 0.031** **0.968 ± 0.087**
9.	Sep	W = -5.461 **L** **1.012** W = -6.121 **L** **1.133**	**0.910** 0.967	0.956 - 1.032 0.925 - 1.021	0.989 ± 0.028 0.994 ± 0.079
10.	Oct	W = -4.697 **L** 1.023 W = -6.873 **L** 1.309	0.945 0.935	0.961 - 1.142 0.869 - 1.112	0.999 ± 0.025 0.979 ± 0.084
11.	Nov	W = -4.143 **L** 1.032 W = -4.542 **L** 1.165	0.955 0.948	0.905 - 1.164 0.927 - 1.011	1.008 ± 0.070 0.989 ± 0.019
12.	Dec	W = -6.104 **L** 1.140 W = -4.989 **L** 1.255	0.930 0.967	0.995 - 1.121 0.883 - 1.128	1.011 ± 0.011 0.997 ± 0.055

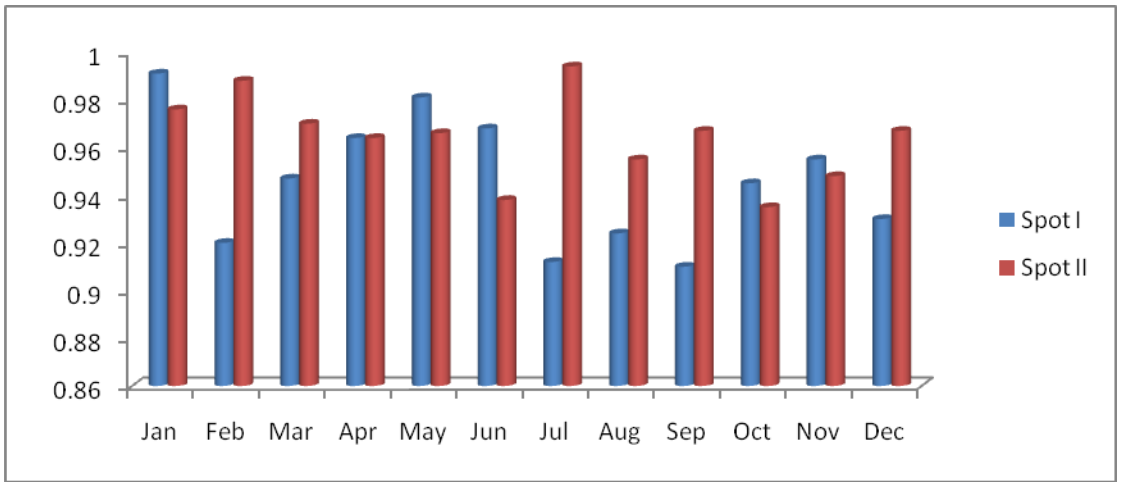

Figure 1. Length Weight Correlation Coefficient were high near one, in all months during study

V CONCLUSIONS

In summary, we can say that the growth in weight is almost proportional to the cube of its length. Condition factor (K_n) has positive influence with increasing length or weight. Regression parameters were found to be highly significant. Findings of the present study can used in the study of fish population dynamics, comparison of body forms of different fish groups, pattern of growth of fishes, to compare fish life history between regions and morphological comparisons between different fish species or between different fish populations from different habitats.

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