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Volume - I

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Website : www.kamlanehrucollege.ac.in
Email : KNJST15@gmail.com

Our Inspiration

Late Govindraoji Wanjari

Ex. MLA & Founder President,
Amar Sewa Mandal

PUBLISHED WITH SUPPORT OF AMAR SEWA MANDALS

Kamla Nehru Mahavidyalaya

Blessings, From :
Dr. Smt. Suhasini Wanjari
President, Amar Sewa Mandal.

It gives me immense pleasure to know that Kamla Nehru Mahvidyalaya is publishing the research journal **'KAMLA NEHRU JOURNAL OF SCIENCE AND TECHNOLOGY (KNJST)'** a peer reviewed national journal.

I feel proud and satisfied when I look back and find that our college has come so far. A small sapling has developed into a full grown tree . The publication of the research journal is one more feather in its cap.

Ours is multi faculty educational institute having a splendid history of 32 years where , we focus on innovative activities and promote research and academic growth. The publication of this journal will provide an opportunity to the researchers to get innovative ideas for making worthy contributions . It would stimulate young mind involved in science and research activities and motivate them to exchange ideas and concepts to maintain a scientific and technological temper through publication of their research papers.

I greet everyone behind this venture and extend my best wishes for publication.

Message From :
Adv. Abhijiit G. Wanjarri
Secretary, Amar Sewa Mandal
Member of Management Council
RTM Nagpur University, Nagpur.

I feel very proud and extremely happy to know that Kamla Nehru Mahavidyalaya is going to publish National level research journal **'KAMLA NEHRU JOURNAL OF SCIENCE AND TECHNOLOGY (KNJST)'.**

It is a healthy and fruitful academic activity which provides a platform to all those who are engaged in higher education and research . This journal also provides a common platform to express and exchange new research innovative ideas and technologies amongst the researchers .

I am sure that KNJST journal will disseminate the information for the benefit of students and scholars as well as teachers of disciplines of science, engineering and technology.

I wish the KNJST journal a grand success.

Special Thanks

to

Dr. Smt. S. G .Wanjari mam

President, ASM

Adv. A.G .Wanjarri Sir

Secretary , ASM

for the release of Journal

Kamla Nehru Journal of Science and Technology

knjst15@gmail.com

VOLUME - I

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PREFACE

Dear Colleagues,

With great pleasure, we announce the creation of a new journal,

Kamla Nehru Journal of Science and Technology- KNJST which is the result of an agreement between faculties of Life Sciences, Chemistry, Mathematics, Engineering, Pharmacy, Physics and Cosmetic Technology of the Kamla Nehru Mahavidyalaya, affiliated to, RTM Nagpur University, Nagpur.

The aim of this action is to bridge the gap between these domains of knowledge, and to offer the common possibility of publishing current results of research work and efforts in innovations.

It is anannual journal, fully in English, with the research papers available on website. National distribution is intended.

The Scientific Board will be responsible for the proper quality of accepted contributions. The members of this Board have been invited from all over the country.

As the appointed Main Editor of this new journal, I have the pleasure of inviting the authors from the areas covered by the title, and I would like to ensure a high editorial level in the printed research papers.

We are pleased to acknowledge the help and support of Hon'ble Dr. Smt. Suhasini Wanjari, President, Amar Sewa Mandal, Nagpur and Adv. Abhijit G. Wanjarri, Secretary, Amar Sewa Mandal, Nagpur. Their dynamic leadership and constant support have provided us great strength in publication of this journal. I am thankful to the Principal Dr. A.K. Shende and Vice – Principal, Dr. P.B. Dahikar, Kamla Nehru Mahavidyalaya, Nagpur, for their constant inspiration and guidance in publication of this Journal.

I thank all our faculty members, non – teaching staff, students of Kamla Nehru Mahavidyalaya whose untiring help has mainly been responsible for success of this journal .

All possible efforts have been made to make this journal as complete as possible, and we welcome any suggestion regarding improvement of the Journal.

CONTENTS

STUDIES ON EXTRACTION OF LYCOPENE BY SOLID SOLVENT EXTRACTION

Mr. R.B. Tupe*[1], Mr. S.M. Patil[2], Dr. B.K. Sakhale[3]

*1Institute of Chemical Technology, Mumbai-400019, India.

2Laxminarayan Institute of Technology, Nagpur-440033, India.

3University Department of Chemical Technology, Aurangabad-431001, India.

swapnil.udct@gmail.com

ABSTRACT

Lycopene is a naturally occurring chemical that gives fruits and vegetables a red colour. It is one of a natural pigments called carotenoids. Lycopene is found in watermelon, pink guava, apricot, and tomatoes. Tomatoes are rich in lycopene,it used as antioxidant, anti-cancer,anti-aging, sun protective and infertility. The maximum yield of lycopene from BSS 150 particle size tomato powder by solid solvent extraction (SSE) and examine on spectrophotometer and obtained 18.33 mg lycopene from 1 gm of tomato powder.

Keywords: *Lycopene, Solid Solvent Extraction, Spectrophotometer.*

INTRODUCTION

Lycopene from the neo-latin *lycoperiscum*, the tomato species, is a red carotene and carotenoid pigment and phytochemicals found in tomatoes and other red fruits and vegetables, such as red carrots, watermelon, and papaya, although not in strawberries, red bell peppers, or cherries, although lycopene is chemically a carotene it has no vitamin A activity. Foods that are not red may also contain lycopene, such as brown beans or parsley. In plants alge, and other photosynthic organisms, lycopene is an important intermediate in the biosynthesis of many carotenoids. Including beta carotene, which is responsible for yellow, orange, or red pigmentation, photosynthesis and photoprotection, like all carotenoids, lycopene is a polyunsaturated hydrocarbons. Structurally, lycopene is a tetraterpene and assembled from eight isoprene unit.

Lycopene is not an essential nutrient for humans, but it is commonly found in the diet mainly from dishes prepared from tomatoes. When absorbed from the intestine, lycopene is transported in the blood by various lipoproteins and accumulates primarily in the blood, a dipose tissue, skin, liver, and adrenal glands, but it can be found in most tissue.

APPLICATIONS

People take lycopene for preventing heart disease, hardening of the arteries and cancer of the prostate, breast, lung, bladder, ovaries, colon, and pancreas. Lycopene is also used for treating human papilloma virus infection, which is a major cause of uterine cancer.

Asthma. Research on the effects of lycopene in people with asthma is inconsistent. People with a history of exercise-induced asthma, taking a specific lycopene product seems to improve lung function after exercise.

Hardening of the arteries (atherosclerosis). There is some evidence showing that higher lycopene blood levels is associated with a reduced risk of hardening of the arteries. There is also early evidence that higher lycopene blood levels can reduce the risk of heart disease associated with hardening of the arteries.

Enlarged prostate (benign prostatic hypertrophy). Early research shows that taking lycopene can slow the progression of prostate enlargement and can improve symptoms in people with this condition.

Breast cancer. Research about how lycopene affects breast cancer risk is inconsistent. Some evidence suggests that having higher lycopene blood levels is associated with a lower risk of breast cancer.

Prostate cancer. Research on the effects of lycopene for preventing or treating prostate cancer is inconsistent. Some research suggests that increasing lycopene consumption in the diet, or higher lycopene blood levels, is linked with a lower risk of developing prostate cancer.

Pancreatic cancer. Some early research shows that a diet high in lycopene, primarily from tomatoes, seems to lower the risk of developing pancreatic cancer.

Male fertility problems. Early research shows that taking lycopene by mouth daily for 3 months improves sperm quality.

Lung cancer. Research about how lycopene affects the risk of lung cancer is inconsistent. Some research shows that lower lycopene intake in the diet is linked to an increased risk of lung cancer.

MATERIALS & METHODS

Materials

Fresh, sound, fully ripe deep red color quality tomatoes of local cultivator were procured from the market.

Reagents

All chemicals used for the extraction purpose were of the analytical. Standard lycopene was procured from Sigma chemical with 99 % purity.

Sample preparation

Tomatoes brought from local market were carefully washed, cleaned so that outer surface should be free from soil and dust particles.

Sieve separation

The tomato powder obtained was subjected to sieve analysis. First it put on top sieve and then it was shaken for 20 min manually, in order to get the fine powder of different particle size.

Extraction of Lycopene

The powder of tomato was subjected to lycopene extraction by using Solid Solvent Extraction in order to study, method of extraction for maximum yield of lycopene.

Solid Solvent Extraction

The lycopene was extracted by using Solid Solvent Extraction techniques was described below. Approx. 0.05 gm of tomato powder of selected particle size was added to 10 ml of analytical grade acetone in 250 ml glass beaker. The solution was agitated gently to 1 min, followed filtration using by a 5.5 cm whatman paper filter of 125 mm. The filter paper was transferred to the original 250 ml beaker along with 10 ml acetone. The solution was agitated and filtered as before. This step was repeated for a total of 4 filtrations of the powder. A total of 40 ml acetone was used, but evaporation caused the final solution to be less than 40 ml. Volume of solution was noted before injection into the spectrophotometer. All steps were performed in subdued light.

Analysis by Spectrophotometer

All solutions were prepared under subdued light and kept at freezing temperature (-18^{0}C). A double beam spectrophotometer of JASCO makeV-630 was used for the analysis of sample. Standard sample concentrations were made first and by taking the spectra analysis max that obtained at 472 nm. Other peaks were obtained at 444 nm and 503 nm which are cis-isomer and di-cis isomer respectively. The absorbance of all SSE samples was taken at 472 nm. Which shows that as particle size decreases the optical density increases. As well as the absorbances of extracted sample by SFE were also taken at 472 nm, which also show same relationship.

RESULTS AND DISCUSSION

Sieve analysis of tomato powder

The dried tomato powders were subjected to sieve analysis for getting the fine powder of different particle size. The powder obtained having different particle sizes were classified in to four sizes as per the BSS.

Table 1: Sieve analysis of tomato powder

BSS	Percent powder (%)
60	11.16
85	26.32
100	19.84
150	1.46

Extraction of lycopene by SSE

The tomato powders of different particle sizes were subjected to lycopene extraction by using SSE technique. Then the extracts obtained were analyzed by using UV spectrophotometer and the absorbance was measured at 472 nm. The data obtained with respect to the yield of lycopene content according to different particle size were studied and the results are presented in following table 2.

The data presented in table shows that as particle size decreases the extracted lycopene concentration increases, which indicates that as tomato powder become finer there was more extraction of lycopene. The reason for moreextraction of lycopene is that as powder become finer, the matrices of cell are freely available for dissolution of organic solvents and it easier and quantifiably available in extracted sample.

Table 2: Effect of particle size on extraction of lycopene by solid solvent extraction method

BSS	Absorbance at 472 nm	Lycopene concentration (mg)/gm
60	0.7325	6.97
85	1.1286	10.74
100	1.2273	11.68
150	1.9250	18.33

In fig. 2 showed the spectra analysis for particle size of 150 BSS, but it did not match with graph of standard lycopene graph it might be due to very fine powder, which facilitated for extraction of various components along with other cis and di-cis isomers, which was undesirable.

CONCLUSION

This study confirms that different yield was obtained from different particle size of tomato powder and maximum yield was obtained from 150 BSS particle size 18.33 mg per 1 gm sample, below 150 particle size was not suitable because of various isomers were coming with all trans-isomer. Also observed that particle size decreases the extracted lycopene concentration increases, which indicates that as tomato powder become finer there was more extraction of lycopene. The reason for more extraction of lycopene is that as powder become finer, the matrices of cell are freely available for dissolution of organic solvents.

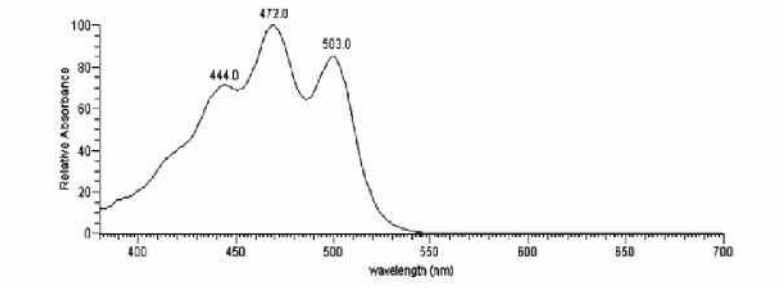

Fig. 1: Standard lycopene curve

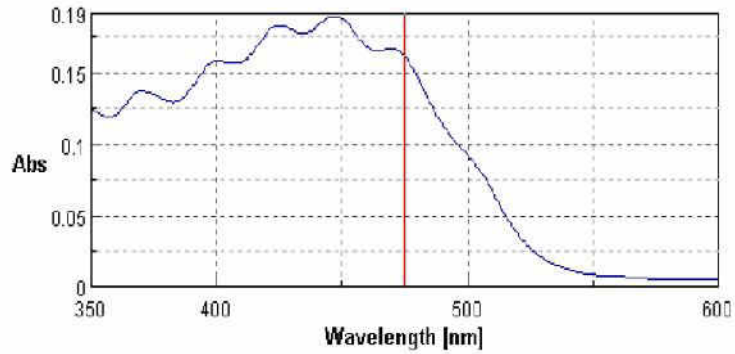

Fig. 2: Spectra analysis for particle size (150 BSS) Peak executed – 472 nm Absorbance – 0.18927

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THERMOELASTIC PROBLEM IN A RECTANGULAR PLATE WITH HEAT GENERATION

Madhavi V. Khandait

Department of Mathematics, Kamala Nehru Mahavidyalaya, Nagpur, Maharashtra, India

Email: madhavikhandait@rediffmail.com

ABSTRACT

The present paper deals with the determination of the quasi-static thermal stresses in a finite thin rectangular plate defined as $0 \le x \le a,\ 0 \le y \le b$ *subjected to the heat generation within the solid at a rate of* $g(x, y, t)$. *The constant temperatures are prescribed at the boundaries* $x = a$ *and* $y = b$ *while the initial edges* $x - 0$ *and* $y = 0$ *are thermally insulated. The governing non-homogeneous heat conduction equation in a thin rectangular plate is solved with the help of integral transform technique. The results are obtained in the series forms in terms of trigonometric functions.*

Keywords: *Transient, Thermoelastic problem, Thermal Stresses.*

INTRODUCTION

The initial boundary value problems of heat conduction of rectangular plate are of considerable technological importance. Several authors have considered the problem in rectangular plate with various types of initial boundary conditions. Tanigawa Y., Ishihara M., Morishita H. & Kawamura R. [5] studied analysis of two dimensional thermoelastoplastic bending deformation of a plate subject to partially distributed heat supply. Tanigawa Y. and Komatsubara Y. [7] discussed thermal stress analysis of a rectangular plate & it's thermal stress intensity factor for compressive stress field. Ishihara M., Tanigawa Y., Kawamura R. & Noda N. [2] studied theoretical analysis of residual stresses removed by heat supply. Further Vihak V. M., Yuzvyk M. Y. & Yasinkij A. V. [6] investigated the solution of the plane thermoelastic problem for a rectangular domain. Adams R. J. & Bert C. W. [1] determined thermoelastic vibration of a laminated rectangular plate subjected to a thermal shock. Gogulwar & Deshmukh [8] studied thermal stresses in a rectangular plate due to partially distributed heat supply. Morimoto et al [5] did thermal buckling analysis of an inhomogeneous rectangular plate due to uniform heat supply. El-Maghraby [1,2] solved two-dimensional problem of a thick plate with heat sources in generalized thermoelasticity. Recently Kulkarni & Deshmukh [9] deals with the realistic problem of the quasi-static thermal stresses in a rectangular plate subjected to constant heat supply on the extreme edges $(x = a, y = b)$ whereas the initial edges $(x = 0, y = 0)$ are thermally insulated.

In this paper the work of Kulkarni & Deshmukh [9] is modified & discusses the thermo elasticity subject to the heat generation within the plate at the rate of $g(x, y, t)$.

To our knowledge no one has done such type of work so far. This is thus a new and novel contribution in the field. Such types of problems are useful in the determination of the state of strain in a rectangular plate constituting foundations of containers for hot gases or liquids, in the foundations for furnaces.

ANALYSIS

Heat Conduction

Consider a finite rectangle $0 \le x \le a,\ 0 \le y \le b$ which is initially at constant temperature T_k. For time $t > 0$ there is a heat generation within a plate at a rate $g(x, y, t)$. The plate is subjected to a constant heat supply at the edges at $x = a$ and $y = b$ whereas the edges at $x = 0$ and $y = 0$ are thermally insulated. The boundary value problem of heat conduction is given as

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{g(x, y, t)}{\lambda} = \frac{1}{k}\frac{\partial T}{\partial t} \qquad \ldots.(2.1)$$

with initial condition

$$T(x, y, t) = T_k \text{ at } t = 0,\ o \le x \le a,\ 0 \le y \le b \qquad \ldots.(2.2)$$

and boundary conditions

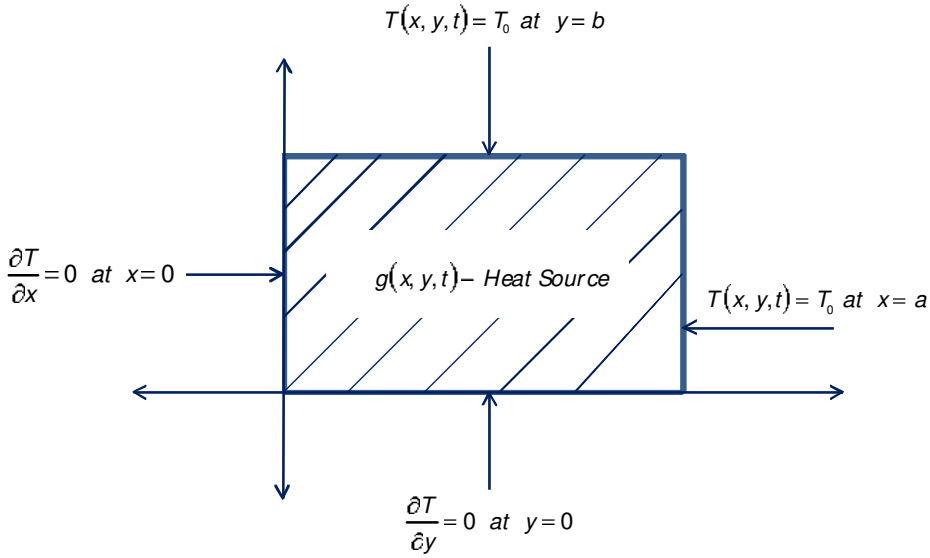
$$T(x, y, t) = T_0 \text{ at } x = a,\ 0 \le y \le b, \qquad \ldots.(2.3)$$

$$T(x, y, t) = T_0 \text{ at } y = b,\ 0 \le x \le a, \qquad \ldots.(2.4)$$

$$\frac{\partial T}{\partial x} = 0 \text{ at } x = 0,\ 0 \le y \le b \qquad \ldots.(2.5)$$

and $$\frac{\partial T}{\partial y} = 0 \text{ at } y = 0,\ 0 \le x \le a \qquad \ldots.(2.6)$$

where k & λ are the thermal diffusivity & thermal conductivity of the material of the plate respectively.



Thermal Stresses

Here, the plate is assumed sufficiently thin & considered free from traction. Therefore, it is assumed that the plane perpendicular to the neutral plane $(z=0)$ before deformation remains perpendicular to it after deformation & that the axial stress σ_{zz} is negligible compared with other stress components.

Since the plate is in a plane-stress state without bending, Airy's stress function method is applicable to the analytical development of the thermoelastic field. The fundamental equation as in (8) given by the relation

$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)^2 U=-\alpha E\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)T \qquad \ldots.(2.7)$$

Where α, E & U are linear coefficient of the thermal expansion, Young's modulus of elasticity of the material of the plate & Airy's stress function respectively.

The displacement components u_x & u_y in the X & Y directions are represented in the integral form and the stress components in terms of U are given by

$$u_x=\int\left[\frac{1}{E}\left\{\frac{\partial^2 U}{\partial y^2}-\nu\frac{\partial^2 U}{\partial x^2}\right\}+\alpha T\right]dx, \qquad \ldots.(2.8)$$

$$u_y=\int\left[\frac{1}{E}\left\{\frac{\partial^2 U}{\partial x^2}-\nu\frac{\partial^2 U}{\partial y^2}\right\}+\alpha T\right]dy, \qquad \ldots.(2.9)$$

$$\sigma_{xx}=\frac{\partial^2 U}{\partial y^2}, \qquad \ldots.(2.10)$$

$$\sigma_{yy}=\frac{\partial^2 U}{\partial x^2} \qquad \ldots.(2.11)$$

and $$\sigma_{xy}=-\frac{\partial^2 U}{\partial x\partial y} \qquad \ldots.(2.12)$$

where ν is the Poisson's ratio of the material of the plate.

The equations (2.1) to (2.12) constitute the mathematical formulation of the problem.

SOLUTION OF THE PROBLEM

To find the temperature function $T(x,y,t)$, we develop the integral transform and its inversion formula as

$$\overline{T}(\alpha_n,\beta_m,t)=\int_{x=0}^{a}\int_{y=0}^{b}K(\alpha_n,x)\;K(\beta_m,y)\;T(x,y,t)\,dx\,dy \qquad \ldots.(3.1)$$

$$T(x,\,y,\,t)=\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}K(\alpha_n,x)\;K(\beta_m,y)\,\overline{T}(\alpha_n,\beta_m,t) \qquad \ldots.(3.2)$$

where the kernels

$$K(\alpha_n, x) = \sqrt{\frac{2}{a}}\cos(\alpha_n x) \qquad \ldots.(3.3)$$

$$K(\beta_m, y) = \sqrt{\frac{2}{b}}\cos(\beta_m y) \qquad \ldots.(3.4)$$

α_n is n^{th} root of transcendental equation $\cos(\alpha_n a) = 0$

$$\text{i.e. } \alpha_n = \left(\frac{2n+1}{2a}\right)\pi \text{ and} \qquad \ldots.(3.5)$$

β_m is m^{th} root of transcendental equation $\cos(\beta_m b) = 0$

$$\text{i.e. } \beta_m = \left(\frac{2m+1}{2b}\right)\pi. \qquad \ldots.(3.6)$$

On applying integral transform defined in (3.1) & its inversion defined in (3.2) to the equations (2.1) to (2.6) respectively, one obtains the expression for the temperature distribution as

$$T = \left\{ T_0 - \frac{4}{ab}\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\cos(\alpha_n x)\cos(\beta_m y)\, e^{-k(\alpha_n^2+\beta_m^2)t}\left[\frac{(-1)^{n+m}}{\alpha_n\beta_m}T_0\right.\right.$$
$$+ \frac{K}{\lambda}\int_{t=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\, g(x, y, t)\, e^{k(\alpha_n^2+\beta_m^2)t'}\, dx\, dy\, dt'$$
$$\left.\left. + T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\right]\right\}, \qquad \ldots.(3.7)$$

Using equations (2.7) & (3.7), one obtains the Airy's stress function as

$$U = \frac{4\alpha E}{ab}\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\frac{\cos(\alpha_n x)\cos(\beta_m y)}{(\alpha_n^2+\beta_m^2)}e^{-k(\alpha_n^2+\beta_m^2)t}\left[\frac{(-1)^{n+m}}{\alpha_n\beta_m}T_0\right.$$
$$+ \frac{K}{\lambda}\int_{t=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\, g(x, y, t)\, e^{k(\alpha_n^2+\beta_m^2)t'}\, dx\, dy\, dt'$$
$$\left. + T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\right], \qquad \ldots.(3.8)$$

Now using equations (3.7) & (3.8) in equations (2.8) to (2.12), one obtains the expressions for displacement & stresses respectively as

$$u_x = \left\{\frac{4\alpha}{ab}\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\left(\frac{(\nu-1)\alpha_n^2 - 2\beta_m^2}{\alpha_n^2+\beta_m^2}\right)\left(\frac{\sin(\alpha_n x)}{\alpha_n}\right)(\cos(\beta_m y))\, e^{-k(\alpha_n^2+\beta_m^2)t}\left[\frac{(-1)^{n+m}T_0}{\alpha_n\beta_m}\right.\right.$$
$$\left.\left. + \frac{k}{\lambda}\int_{t'=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\, g(x, y, t')\, e^{k(\alpha_n^2+\beta_m^2)t'}\, dx\, dy\, dt'\right.\right.$$

$$+ T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\Bigg] + \alpha T_0 x\Bigg\}, \qquad \ldots.(3.9)$$

$$u_y = \Bigg\{\frac{4\alpha}{ab}\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\left(\frac{(\nu-1)\beta_m^2 - 2\alpha_n^2}{\alpha_n^2+\beta_m^2}\right)(\cos(\alpha_n x))\left(\frac{\sin(\beta_m y)}{\beta_m}\right)e^{-k(\alpha_n^2+\beta_m^2)t}\Bigg[\frac{(-1)^{n+m}T_0}{\alpha_n\beta_m}$$

$$+\frac{k}{\lambda}\int_{t'=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\,g(x,y,t')\,e^{k(\alpha_n^2+\beta_m^2)t'}\,dx\,dy\,dt'$$

$$+ T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\Bigg] + \alpha T_0 y\Bigg\}, \qquad \ldots.(3.10)$$

$$\sigma_{xx} = \left(\frac{-4\alpha E}{ab}\right)\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\frac{\beta_m^2\cos(\alpha_n x)\cos(\beta_m y)}{(\alpha_n^2+\beta_m^2)}\,e^{-k(\alpha_n^2+\beta_m^2)t}\Bigg[\frac{(-1)^{n+m}T_0}{\alpha_n\beta_m}$$

$$+\frac{k}{\lambda}\int_{t'=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\,g(x,y,t')\,e^{k(\alpha_n^2+\beta_m^2)t'}\,dx\,dy\,dt'$$

$$+ T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\Bigg], \qquad \ldots.(3.11)$$

$$\sigma_{yy} = \left(\frac{-4\alpha E}{ab}\right)\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\frac{\alpha_m^2\cos(\alpha_n x)\cos(\beta_m y)}{(\alpha_n^2+\beta_m^2)}\,e^{-k(\alpha_n^2+\beta_m^2)t}\Bigg[\frac{(-1)^{n+m}T_0}{\alpha_n\beta_m}$$

$$+\frac{k}{\lambda}\int_{t'=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\,g(x,y,t')\,e^{k(\alpha_n^2+\beta_m^2)t'}\,dx\,dy\,dt'$$

$$+ T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\Bigg] \qquad \ldots.(3.12)$$

and $$\sigma_{xy} = \left(\frac{-4\alpha E}{ab}\right)\sum_{n=0}^{\infty}\sum_{m=0}^{\infty}\frac{\alpha_n\beta_m}{(\alpha_n^2+\beta_m^2)}\sin(\alpha_n x)\sin(\beta_m y)\,e^{-k(\alpha_n^2+\beta_m^2)t}\Bigg[\frac{(-1)^{n+m}T_0}{\alpha_n\beta_m}$$

$$+\frac{k}{\lambda}\int_{t'=0}^{t}\int_{x=0}^{a}\int_{y=0}^{b}\cos(\alpha_n x)\cos(\beta_m y)\,g(x,y,t')\,e^{k(\alpha_n^2+\beta_m^2)t'}\,dx\,dy\,dt'$$

$$+ T_k\left(\frac{\sin(\alpha_n a)}{\alpha_n}\right)\left(\frac{\sin(\beta_m b)}{\beta_m}\right)\Bigg]. \qquad \ldots.(3.13)$$

SPECIAL CASES

Case (i): Set $T(x,y,t) = T_k = 0$ & $g(x,y,t) = g_{L_i}\delta(x-x_1)\delta(y-y_1)\delta(t-\tau)$. By applying the integral transform defined in equation (3.1) to the above equation and putting in equations (3.7) to (3.12) one obtains the expressions for temperature distribution, Airy's stress function, displacement components in the X & Y directions & the stress components as

$$T = \left\{ T_0 - \frac{4}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \cos(\alpha_n x) \cos(\beta_m y) \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] \right\}, \quad \ldots.(4.1)$$

$$U = \left\{ \frac{4\alpha E}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\cos(\alpha_n x) \cos(\beta_m y)}{(\alpha_n^2 + \beta_m^2)} \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] \right\}, \quad \ldots.(4.2)$$

$$u_x = \left\{ \frac{4\alpha}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \left(\frac{(\nu-1)\alpha_n^2 - 2\beta_m^2}{\alpha_n^2 + \beta_m^2} \right) \left(\frac{\sin(\alpha_n x)}{\alpha_n} \right) \cos(\beta_m y) \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] + \alpha T_0 x \right\}, \quad \ldots.(4.3)$$

$$u_y = \left\{ \frac{4\alpha}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \left(\frac{(\nu-1)\beta_n^2 - 2\alpha_m^2}{\alpha_n^2 + \beta_m^2} \right) \cos(\alpha_m x) \left(\frac{\sin(\beta_m y)}{\beta_m} \right) \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] + \alpha T_0 y \right\}, \quad \ldots.(4.4)$$

$$\sigma_{xx} = \left\{ \frac{-4\alpha E}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\beta_m^2 \cos(\alpha_n x) \cos(\beta_m y)}{(\alpha_n^2 + \beta_m^2)} \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] \right\}, \quad \ldots.(4.5)$$

$$\sigma_{yy} = \left\{ \frac{-4\alpha E}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\alpha_m^2 \cos(\alpha_n x) \cos(\beta_m y)}{(\alpha_n^2 + \beta_m^2)} \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] \right\} \quad \ldots.(4.6)$$

and $$\sigma_{xy} = \left\{ \frac{-4\alpha E}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\alpha_n \beta_m}{(\alpha_n^2 + \beta_m^2)} \sin(\alpha_n x) \sin(\beta_m y) \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} e^{-k(\alpha_n^2+\beta_m^2)t} T_0 \right.\right.$$

$$\left.\left. + S_{L_i} e^{-k(\alpha_n^2+\beta_m^2)(t-\tau)} \cos(\alpha_n x_1) \cos(\beta_m y_1) \right] \right\} \quad \ldots.(4.7)$$

where $S_{L_i} = \dfrac{k\, g_{L_i}}{\lambda}$ represent the instantaneous line heat source strength.

Case (ii): Setting initial temperature $T_k = 0$ & $g(x, y, t) = 0$ in equations (3.7) to (3.12), one obtains the expressions for the temperature distribution, Airy's strerss function, displacement & the thermal stresses as

$$T = \left\{ T_0 - \frac{4}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \cos(\alpha_n x) \cos(\beta_m y)\, e^{-k(\alpha_n^2+\beta_m^2)t} \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} T_0 \right] \right\}, \quad \ldots.(4.8)$$

$$U = \left\{ \frac{4\alpha E}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\cos(\alpha_n x) \cos(\beta_m y)}{(\alpha_n^2 + \beta_m^2)} e^{-k(\alpha_n^2+\beta_m^2)t} \left[\frac{(-1)^{n+m}}{\alpha_n \beta_m} T_0 \right] \right\}, \quad \ldots.(4.9)$$

$$u_x = \left\{ \frac{4\alpha}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \left(\frac{(\nu-1)\alpha_n^2 - 2\beta_m^2}{\alpha_n^2 + \beta_m^2} \right) \left(\frac{\sin(\alpha_n x)}{\alpha_n} \right) (\cos(\beta_m y))\, e^{-k(\alpha_n^2+\beta_m^2)t} \left[\frac{(-1)^{n+m} T_0}{\alpha_n \beta_m} \right] \right\}, \quad \ldots.(4.10)$$

$$u_y = \left\{ \frac{4\alpha}{ab} \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \left(\frac{(\nu-1)\beta_m^2 - 2\alpha_n^2}{\alpha_n^2 + \beta_m^2} \right) (\cos(\alpha_n x)) \left(\frac{\sin(\beta_m y)}{\beta_m} \right) e^{-k(\alpha_n^2+\beta_m^2)t} \left[\frac{(-1)^{n+m} T_0}{\alpha_n \beta_m} \right] \right\}, \quad \ldots.(4.11)$$

$$\sigma_{xx} = \left\{ \left(\frac{-4\alpha E}{ab} \right) \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\beta_m}{\alpha_n} \frac{\cos(\alpha_n x) \cos(\beta_m y)}{(\alpha_n^2 + \beta_m^2)}\, e^{-k(\alpha_n^2+\beta_m^2)t} \left[(-1)^{n+m} T_0 \right] \right\}, \quad \ldots.(4.12)$$

$$\sigma_{yy} = \left\{ \left(\frac{-4\alpha E}{ab} \right) \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\alpha_n}{\beta_m} \frac{\cos(\alpha_n x) \cos(\beta_m y)}{(\alpha_n^2 + \beta_m^2)}\, e^{-k(\alpha_n^2+\beta_m^2)t} \left[(-1)^{n+m} T_0 \right] \right\} \quad \ldots.(4.13)$$

and $$\sigma_{xy} = \left\{ \left(\frac{-4\alpha E}{ab} \right) \sum_{n=0}^{\infty} \sum_{m=0}^{\infty} \frac{\sin(\alpha_n x) \sin(\beta_m y)}{(\alpha_n^2 + \beta_m^2)}\, e^{-k(\alpha_n^2+\beta_m^2)t} \left[(-1)^{n+m} T_0 \right] \right\}. \quad \ldots..(4.14)$$

CONCLUSION

In this paper the work of Kulkarni & Deshmukh [9] is extended due to heat generation for non-homogeneous boundary value problem in a thin rectangular plate & obtained the thermoelastic expressions. The thermal stresses are obtained subjected to the constant temperatures on the surfaces $(x = a, y = b)$ with the help of integral transform technique. Also discuss the special cases.

In the special case (i), the thermoelastic expressions are obtained due to an instantaneous line heat source of strength S_{L_i} situated at a point (x_1, y_1) & releasing heat spontaneously at time $t = \tau$, inside a finite rectangle $0 \le x \le a,\ 0 \le y \le b$, which is initially at zero temperature & for $t > 0$ the outer boundaries of which are kept at constant temperature $(x = a \,\&\, y = b)$ & other boundaries are kept insulated.

In the special case (ii), the initial temperature is zero & there is no heat source then the expressions (4.8) to (4.14) are obtained for a homogeneous rectangular plate, which represents the **limiting case of the homogeneous thermoelastic problem in a thin rectangular plate.**

Any particular case of special interest can be derived by assigning suitable values to the parameters & functions in the equations (4.1) to (4.14).

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THERMO GRAVIMETRIC AND OPTICAL STUDIES OF ZNO-PANI NANOCOMPOSITE MATERIAL

A.K. Barve[1], S.M. Gadegone[1], M.R. Lanjewar[2] and R.B. Lanjewar[2*].

[1.] Kamla Nehru Mahavidyalaya, Sakkardara, Nagpur 440009.

[2.] Shivaji Science College, Congress Nagar, Nagpur-440012

[2*.]Dharampeth M.P. Deo Memorial Science College, Nagpur 440033.

E-mail:rb_lanjewar@rediffmail.com

ABSTRACT

Synthesis of nanocomposite material was carried out in the presence of appropriate molar proportions of zinc acetate salts as precursors. The composites which are conducting polymers have been widely used because of their lower density as well their good environmental stability as in the case of polyaniline (PANI) composite material. The composites, thus synthesized have been characterized by Fourier transfer infrared (FTIR) spectrophotometer, UV-Visible spectrophotometer thermogravimetric analysis (TGA), and X-ray diffraction. The morphology of these composites was studied by Transmission electron microscopy. FTIR and UV-Visible spectroscopy confirmed the existence of Zinc oxide in the nanocomposite. The particle size distribution from XRD and TEM lies in the range of 20-25 nm.

INTRODUCTION

Thecomposite of metal oxide to the polymer network (PN) integrate the synthetic composite technology. The combination of these polymers with crystalline material constitutes the Interpenetrating polymer network (IPN) composites. IPN considered to be novel application in material development[1]. Polymer nanocomposite has advantages such as high surface area to volume ratio. The conducting polymers includes in the synthetic polymers which combines the mechanical and chemical properties of polymers with the electronic properties of metals and semiconductors[2]. The conducting polymers have been attracted intense interests in research and applications due to their interesting chemical, electrical and optical properties, Polyaniline (PANI) is one of the most important conducting polymers because of its high conductivity, easy and economical fabrication process, very good redox properties, high stability and wide range of applications[3,4]. Polyaniline can be widely used as a matrix for dispersing various types of inorganic fillers. The combination of metal oxide nanoparticles can improve the properties of PANI in the field of electricity, magnetism, etc. when the metal ion is added during the polymerization of polyaniline, the metal ions may interact with the nitrogen atom of polymer chain and can form conducting as well magnetic polymer[5].

Shukla et al[6] synthesized ZnO/PANI by wet chemical method and results revealed that electrical resistance of a ZnO/PANI film of ~200 nm thickness was monitored against humidity to use as

humidity sensitive element and the electrical conductance lies in the range of 10^{-2} Scm^{-1} and thermal stability up to 280^{0}C. B. Sharma et al[7] developed a thin film for PANI and ZnO/PANI by solution casting and spin coating method and the FTIR spectra showed ν(Zn-O) to be shifted towards higher wave number and dielectric constant was found to be decrease due to interface between ZnO nps and PANI.

EXPERIMENTAL TECHNIQUES

Materials

Aniline was purchased from Finar, INDIA. Other reagents as potassium peroxodisulphate, triethanolamine and sulphuric acid were of AR grade from Merck. Also Zinc acetate and sodium carbonate GR grade purchased from Merck, INDIA. All these chemicals were used as received without any further purification.

Preparation Methods

The ZnO-PANI nanocomposite material is prepared by polymerization of aniline with potassium peroxydisulphate as an oxidant in an ice condition. The metal precursor of different concentration of zinc acetate (0.1M to 0.6M) and triethanolamine solution was added. The precipitation is obtained by adding sodium carbonate to the above solution and stir for 6 hours in order to get homogenous mixture of nanocomposite polymer. The product was filtered, washed with double distilled water several times and dried in oven at 60^{o}C for 15 hours.

Characterization techniques

The crystal structure were examined by a Brucker D8 advance X-ray Diffractometer at UGC-DAE Consortium, Indore with Cu K radiation (λ = 1.54 Å) to check the phase system and purity of the sample. The infrared spectrum of the solid nanoparticle and its composite was recorded by Shimazdu FT-IR Spectrometer at Kamla Nehru College, Nagpur. For absorbance spectra of nanocomposite material and study of photocatalytic activity, Shimazdu 1800 double-beam UV–visible spectrophotometer was used in the range of 200-800nm. The TEM used in this work is at UGC-DAE Consortium, Indore. The TGA analysis was carried out using Perkin Elmer Diamond STA 6000, STIC Kochi.

RESULT AND DISCUSSION

XRD

The most common peaks found for ZnO-PANI [002], [101], [102], [103] at 12.88º, 19.04º, 32.97º and 59.27º. The existence of [002] peak at 32º reveals the crystalline structure of ZnO in the polymer network indicates highly ordered crystal structure with interlayer spacing of 0.336 in PANI nanocomposites. The average size of the ZnO-PANI particles from the peak width using Scherrer's equation was calculated to be in the range of 20-25 nm for all the six series of ZnO composite material which is in agreement with the TEM results. Addition of ZnO nanomaterial to ZnO-PANI nanocomposites also gives rise to a sharp peak at 32.97º and 59.38º which clearly indicates the presence and crystallinity of the ZnO nanomaterial in resultant nanocomposite materials. The various crystallite sizes for six concentration of ZnO composites was 23.45 nm for

0.1M, 19.62 nm for 0.2M, 24.11 nm for 0.3 M, 24.26 nm for 0.4 M, 21.58 for 0.5M and 20.74 nm for 0.6M. The above data matched with the JCPDF no. 21-1486.

TEM

Fig. 2 shows the micrograph of Pani/ZnO nanocomposite which is homogeneous and uniformly distributed. The size of nanoparticles was found to be 20-30nm in the nanocomposites indicates that the surface of nanoparticle has interaction with PANI, which is also supported by XRD analysis. Thus, it can conclude that ZnO spherical nanoparticles are completely embedded in the polyaniline network chain.

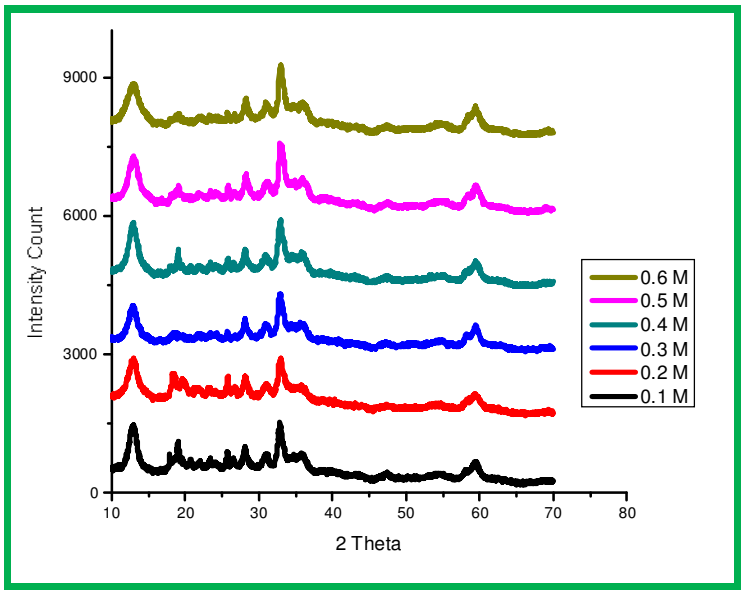

Fig. 1 XRD pattern for ZnO-PANI molecule

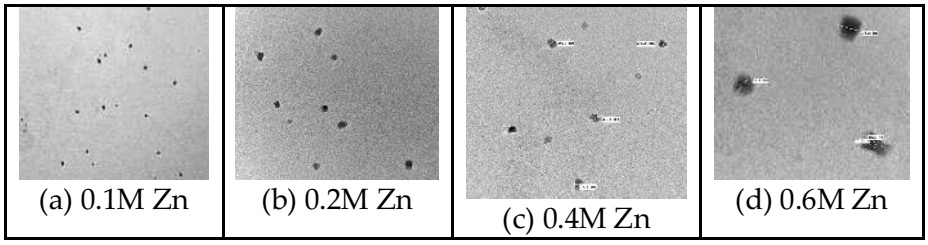

Fig. 2 TEM images for ZnO-PANI nanocomposite material

Thermogravimetric analysis

For Zinc oxide/PANI nanocomposite material, the thermogram shows two weight losses as seen in Fig. 3. The first decomposition start at 260ºC which corresponds to the breakdown of the molecule and second breakdown start at 530ºC corresponding the complete decomposition of the PANI chain. The weight loss calculated to be 2.832mg (found 2.814mg) incurring the 81.52% of weight loss. After that there were no weight changes till 520°C, this shows that the temperature is stable to that temperature and strength of composite also increased due to PANI Chain with ZnO material. The composite then decompose at 550°c. In ZnO/PANI nanocomposites, decomposition occur at reduced temperature because of a strong interaction at the interface of ZnO and PANI.

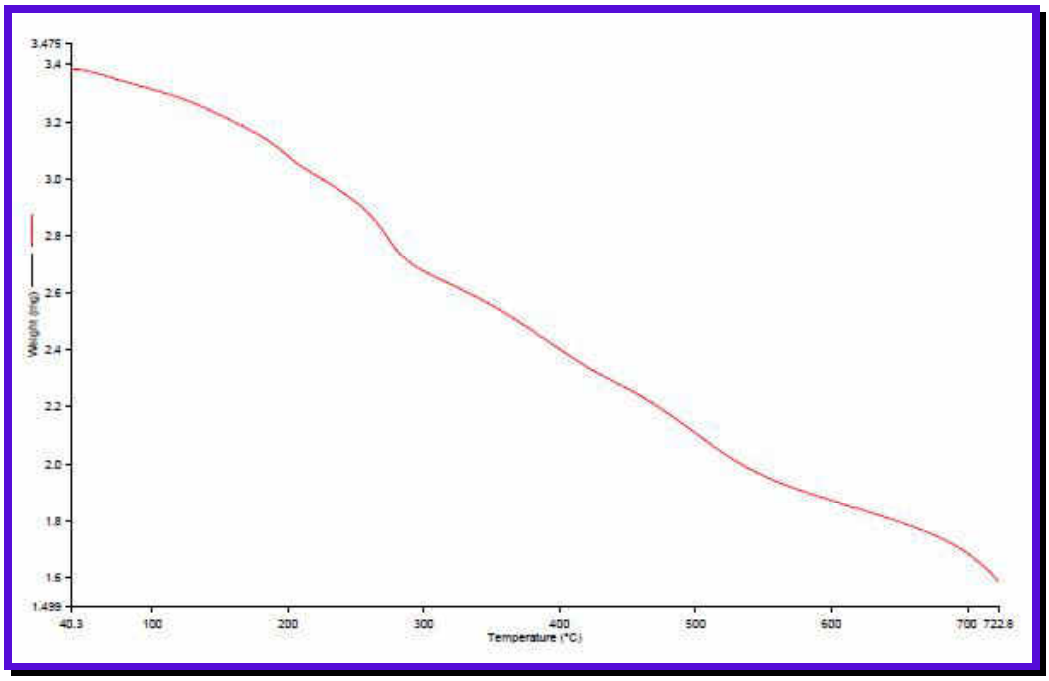

Fig.3 TGA of 0.1M ZnO-PANI

Table 1: TGA data for different concentration of Zn metal precursor

Oxide Composites	Molar Concentration	Temperature at which max. degradation takes place (°C)	Onset of degradation (°C)	End set of degradation (°C)
ZnO/PANI	0.1	272.50	260.0	320
	0.2	273.60	260	310
	0.3	273.95	260	320
	0.4	274.81	260	320
	0.5	275.41	260	320
	0.6	276.0	260.5	320.7

Coats–Redfern method was used to study the kinetics of thermal degradation of PANI/MO composites. This method is an integral method and thermal degradation functions for the Coats–Redfern method. The mechanisms of solid-state thermal degradation reaction and corresponding thermal degradation functions g(α).

$$g(a) = kt$$

For diffusion mechanism: $D = a + (1+a)\ln(1-a)$

For first order of reaction (Mampel equation): $F = -\ln(1-a)$

For geometrical models: $R_n = [1-(1-a)^{\frac{1}{n}}]$

Where Rn Phase-boundary reaction; n=1, 2 and 3(one, two and three dimensional) respectively

Thermogravimetric function g(α) and activation energy(E) is obtained from the equation:

$$\ln\left[\frac{g(a)}{T^2}\right] = \ln\left\{\left(\frac{AR}{\Phi_E}\right)\left(\frac{1-2RT}{E}\right)\right\} - \frac{E}{RT}$$

where α is the decomposed fraction at any temperature and is given as:

$$a = \frac{C_i - C}{C_i - C_f}$$

where C is the weight at the chosen temperature

C_i is the weight at initial temperature and C_f is the weight at final temperature

α, is the heating rate and E is the activation energy for decomposition.

Activation energy (E) can be calculated from the slope of the curve and pre-exponential factor (A) using the intercept value of the plot of ln [$g(\alpha)/T^2$] against the reciprocal of absolute temperature (1/T).

FTIR

Fig. 5 shows the FTIR spectra of the ZnO-PANI nanocomposites materials synthesized from 0.1M to 0.6M of Zinc acetate salt solution. The spectra shows intense peak at 3261 cm^{-1}, 2895 cm^{-1}, 1583cm^{-1}, 1413cm^{-1}, 1300cm^{-1}, 1043cm^{-1}, 833cm^{-1}, 740cm^{-1}, 698cm^{-1} and 468cm^{-1}. However, peaks are also seen at 2092cm^{-1}, 1948cm^{-1}, 1209cm^{-1}, 1209cm^{-1}. The peak at 3261cm^{-1} and 3055cm^{-1} can be assigned to the N-H stretching vibration bond between the amine and imine sites of the composite material. The next peak 2895cm^{-1} corresponds to the O-H stretching bond which is present at the PANI Chain. The bands at 1583cm^{-1} and 1418cm^{-1} can be assigned to C=C stretching of Quinoid and benzenoid ring vibration respectively. The bands at 1209cm^{-1} is due to the emeraldine base structure[8, 9] i.e. delocalization of πe-s in polyaniline structure and 1300cm refers to the C-N stretching mode for benzenoid unit. The bands at 835cm^{-1} corresponds to the out of plane bending vibration of C-H bond of p-substituted benzene rings. However, the band observed at 745cm^{-1} may be shown for Zn-O-Zn material[10] while 470cm^{-1} confirms the presence of ZnO material[11]. In the ZnO/PANI spectra, most of the peaks observed on the high wavenumber as compared to the pure polyaniline chain. This is because of the interaction of ZnO material with the Polyaniline chain. Some peaks are affected by ZnO during polymerization and there occurs restricted modes of vibration in PANI Chain. Initially the monomer first absorbed on the surface of oxide material and then polymerization proceeds in the presence of ZnO after addition of oxidant. This leads to the connection of polymer and hence stretching frequencies differ from pure polyaniline material.

UV-Visible Spectroscopy

In order to investigate optical properties of nanocomposite materials, UV–Vis spectroscopy was carried out on products. The UV–Vis spectrum of PANI–ZnO nanocomposites are shown in Fig. 3.39. PANI has two characterization absorption bands at around 330 nm and 620 nm that attributed to $\pi \rightarrow \pi^*$ transition of the benzenoid ring and $n \rightarrow \pi^*$ transition of benzenoid to quinoid, respectively[12]. It has been found that the shapes of UV spectra of nanocomposites are similar to those of PANI and some shifting in the bands is noticed. In the case of PANI–ZnO 0.1

M to 0.6 M nanocomposites, the peak around 615-628 nm is ascribed to the selective interaction between ZnO and Quinoid ring of polyaniline (ES). Furthermore, by increase of Zinc acetate salt concentration, intensity of the peak around 650 nm increased due to interaction between ZnO and PANI molecules. Additionally, the peak of PANI around 360nm is based on the $\pi \rightarrow \pi^*$ transition of the benzenoid ring where the peaks of PANI–ZnO nanocomposites 0.1M, 0.2M, 0.3M, 0.4M, 0.5M and 0.6M were around 360, 364, 372, 374, 375 and 380 nm, respectively, which shows red shifts. The shifting in the polymer chain is due to the interactions between PANI chains and ZnO nanoparticles which cause transfer of charges from PANI to ZnO via hydrogen bonding. Since ZnOis nonmetallic in nature and aniline is a weak base, hence aniline donates a lone pair of elctrons and forms complex like structure. The peak at 374 nm which is the characteristic band of pure ZnO nanorods[13]. This result is in a good agreement with X-ray diffraction patterns of these nanocomposites.

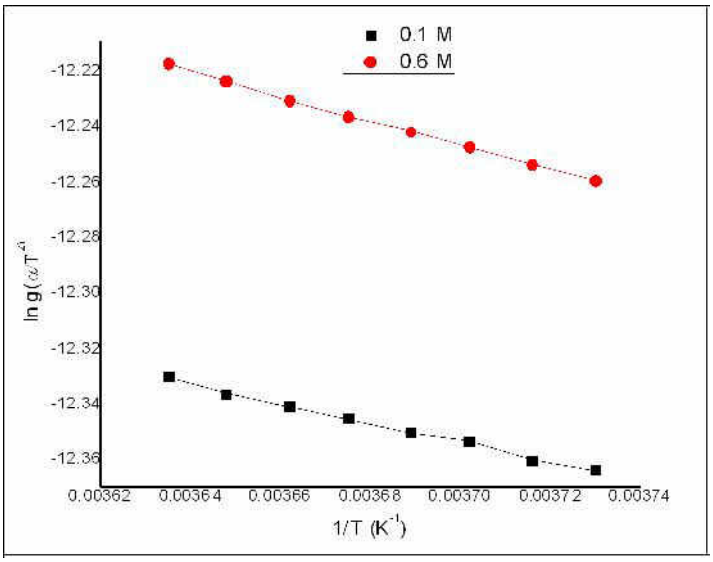

Fig. 4 Representative plot of Coats–Redfern equation for ZnO/PANI nanocomposites material

CONCLUSION

ZnO-PANI nanocomposite material has been synthesized by oxidative polymerization method using very easy, cheap and convenient process. The X-ray diffraction studies indicate the formation of the Wurtzite system of the ZnO nanomaterial in the polymer matrix of PANI. The UV-Visible and FTIR data shows the existence of ZnO nanoparticle in the PANI chain. The morphological characterizations by TEM revealed that the synthesized nanocomposite possess almost spherical shape with typical diameters of 20-30 nm.

ACKNOWLEDGEMENT

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SYNTHESIS OF NANOSIZED CHROMIUM SUBSTITUTED COPPER SPINEL FERRITE.

A. S. Kakde[1], M. J. Gothe[2], A. D. Despande[3], K. G. Rewatkar[1], P. S. Sawadh[4].

[1]Department of Physics, Dr. Ambedkar College, Nagpur.

[2]Department of Physics, N. E. J. C., Wardha.

[3]Department of Physics, P.C.E., Nagpur.

[4]Department of Physics, Bapurao Deshmukh College of Engg. Sevagram, Wardha.

ABSTRACT

Chromium substituted cupper spinel ferrite nanoparticles with nominal composition $CuCr_xFe_{2-x}O_4$ (for x = 0.0 & 0.5) have been synthesized by the sol-gel auto combustion technique. The XRD and TEM were employed to evaluate the structure properties of $CuCr_xFe_{2-x}O_4$ nanomaterials. The XRD analysis confirms the single phase formation. The various parameters such as lattice constants ('a' and 'c'), cell volume and crystallite size have also been calculated from the XRD data. From Debye Scherrer formula, the crystallite size is found in the range of 30–57 nm, which was supported by TEM studies. The DC electrical conductivity was measured as a function of temperature from 303 K to 650 K and found to behave like semiconductor. The electrical behavior of synthesized nano-spinel ferrites may be explained by polarons and hopping mechanism.

***Keywords**: Nanoparticle, sol-gel combustion technique, XRD, TEM, dc electrical conductivity etc.*

INTRODUCTION

Nanocrystalline ferrites are currently the subject of interest of its wide application in industrial as well as research areas. They are attractive because of their importance in ferrofluids, magnetic drug delivery, hyperthermia for cancer treatment etc [1]. An interesting example is that of $CuFe_2O_4$ which has got some peculiar properties like structural, electrical etc with the various substitutions allows tunable change in its properties. $CuFe_2O_4$ has an inverse spinel structure with Co^{+2} ions in octahedral sites and Fe3+ ions equally distributed between octahedral and tetrahedral sites [2]. The presence of nonmagnetic ions in spinel was found to alter their electrical properties and studies revealed useful information on the nature of exchange interaction, cation exchange, etc. Reddy et al [3] have been studied the electrical conductivity zinc–substituted cobalt ferrites as a function of composition and temperature. The electrical conductivity was found to increase with increasing temperature with a change of the slope at transition. It has been well understood that the electrical conductivity of the spinel is due to the movement of charge carrier between different valence cations on octahedral sites.

EXPERIMENTAL

Materials and Powder Preparation

The synthesis of $CuCr_xFe_{2-x}O_4$ was performed by a sol-gel auto combustion method. The raw materials used to form the precursors are copper nitrate, chromium nitrate, ferric nitrate & urea. The appropriate amounts of reactant were weighed out in a stoichiometric proportion. All the reactant dissolves in deionized water. This solution of homogenous mixture was put onto the magnetic hot plate at the temperature of 80^0C. After sometime, the solution transformed in to gel. The gel form of the solution ignited and fired in a specially designed microwave oven on 600 watt for 7 min. The gel was burnt out completely forming ash. The resulting ash was grinded with a pestle mortar to obtain the ultra fine ferrite powder. The synthesized sample was calcined at 800 ^{o}C for about 8 hours in the electric furnace to obtain monophase cubic ferrite.

Characterization Techniques

X-ray diffraction (XRD) analysis of the powdered samples was carried out by Bruker X-ray diffractometer equipped with a CuKa radiation source (λ=1.54Å).

To obtained detailed information on the morphology and verify the particle size of calcium substituted hexaferrites, a set of micrographs were taken by TEM-CM200at the operating voltage of 20-200KV with the resolution of 2.4 Å.

The samples were pressed in form of discs and rubbed with silver paste as contact material. Electric measurements as a function of temperature in the range 300- 673 K at constant frequency of 100 Hz were carried out using the Precision Impedance Analyzer 6500B.

RESULTS AND DISCUSSION

XRD patterns showed that the $CuCr_xFe_{2-x}O_4$ samples consisted of single phase spinel, which was confirmed to be the same cubic structure as shown in figure 1. The lattice parameters depend on the Cr/Fe cation ratio, because the ionic radii of Cr^{+3} (0.640 Å) has smaller ionic radii as compared to Fe^{+3} (0.690 Å). The average particle size of the samples calculated by Debye Scherrer formula was to be found in the nanometer range. The X-ray density as a function of Co concentration is tabulated in table No. 1.

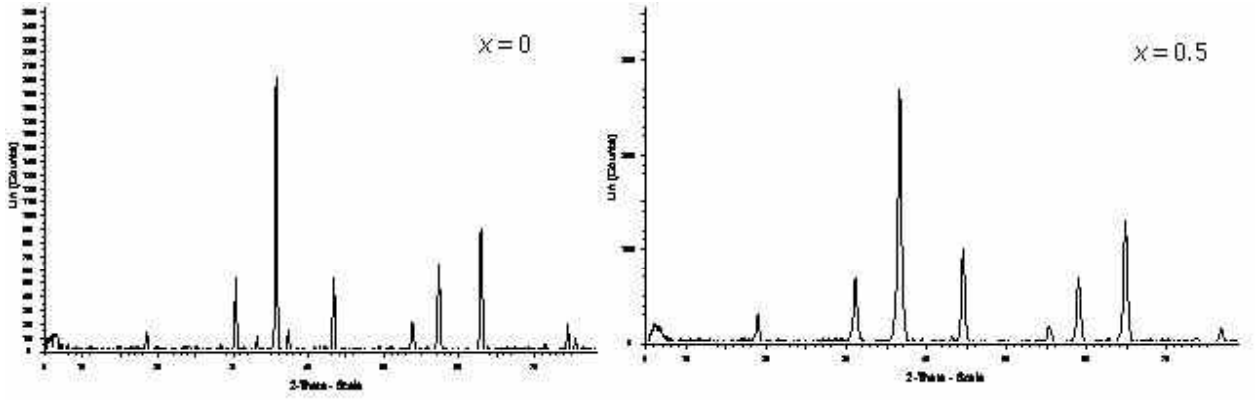

Fig. 1: X-ray powder diffraction patterns of the $CuCr_xFe_{2-x}O_4$ system

Table No. 1: Lattice parameter, cell volume, density, Porosity and Particle size of Cu-spinel ferrite annealed at 800^0C

Sr.No	Conc. (x)	a (Å)	V (Å3)	ϱx (gm/cm3)	ϱm (gm/cm3)	P(%)	Particle Size by Scherrer formula (nm)
01	x = 0.0	8.1286	537.09	5.916	3.254	44.99	30
02	x = 0.5	8.3379	579.65	5.437	3.102	42.94	57

Fig. 2 shows the TEM images of the samples calcinated at 800 °C, from the micrographs we observe that the oxides particles are finely dispersed and spherical in shape within narrow size range. The micrographs shows spherical particles with the particle size distribution of below 100 nm. It seems that the size of the particles is below 100 nm which resembles with the measurement of the crystallite size of sample by D Scherrer formula as between 30- 57 nm [4].

The plots of conductivity with temperature for, is shown in fig 3. From these plots it can be seen that the conductivity increase slowly. This conduction can be attributed to localized charge carriers. According to localized model the electronics are strongly localized on cations. Theoretical work by several over the years has provided some understanding of conduction in oxides and transition metal compounds. For these materials, the interaction between electrons and optical phonons is strong and conduction is explained on the basis of polarons. The treatment of conduction by polarons is discussed by several workers [5, 6, 7]. Polarons belonging to two categories large and small polarons. In the large polaron model, the conductivity is by band mechanism at all temperatures and the conductivity decreases with frequency. The small polaron conduct in band like manner up to a certain temperature, and the conductivity increases with frequency. At higher temperature, the conduction is by thermally activated hopping mechanism. The localization may be attributed to electron-phonon interaction or strong magnetic interaction between carriers and magnetic sub – lattice [8]. An additional localization Fe^{2+} ions may arise from inhomogeneous distribution of ions over octahedral and tetrahedral sites in spinel lattice' The experimental results in present case also shows a trend expected for small polaron conduction.

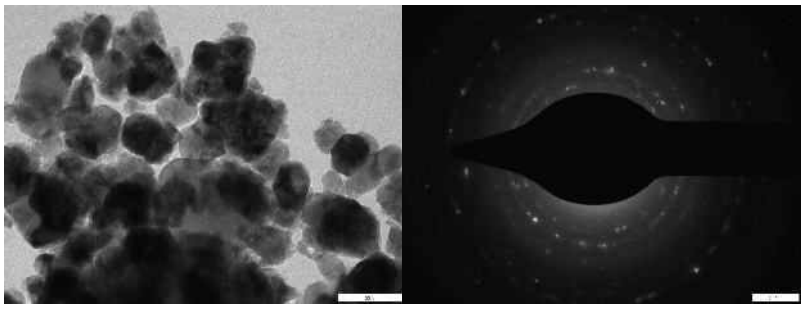

Fig. 2: TEM images pattern of the $CuCr_xFe_{2-x}O_4$ system

Table No. 2: Saturation Magnetization, Coercivity and Retentivity of Cu-spinel ferrite annealed at 800^0C.

Sr.No	Conc. (x)	Saturation Magnetization(emu/g)	Coercivity (G)	Rententivity (emu)
01	x = 0.0	0.049	38.219	0.000549
02	x = 0.5	1.8680	102.05	0.17447

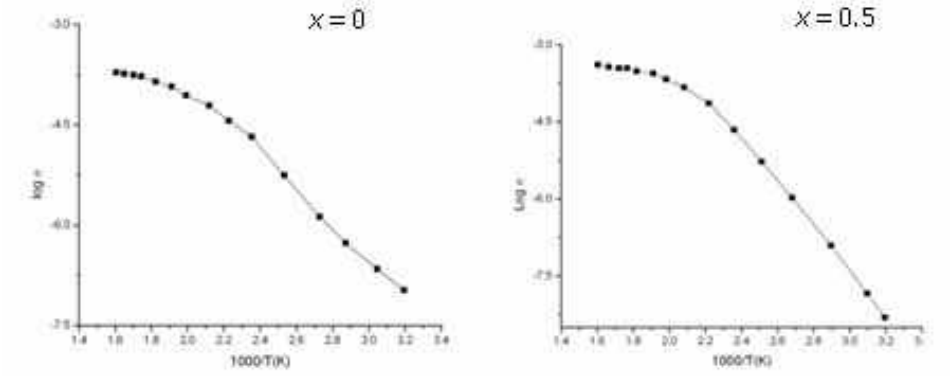

Fig. 3: Plot of log σ vs temperature of the $CuCr_xFe_{2-x}O_4$ system

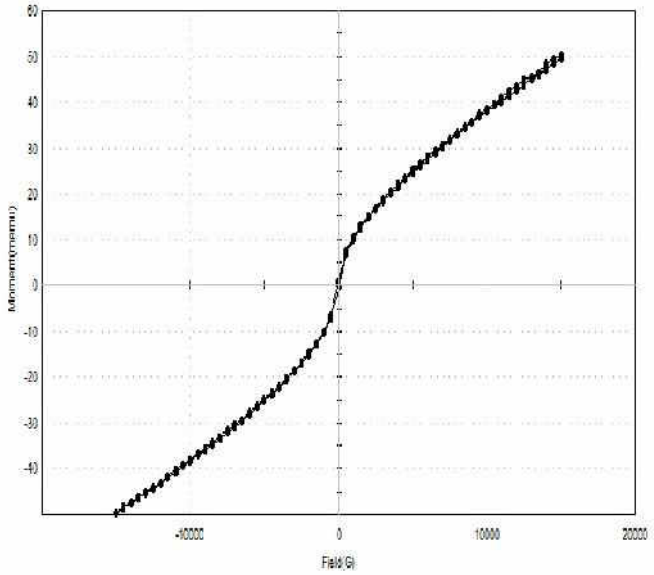

Figure 4: of the CuFe2-xO4 system. (x = 0.0)

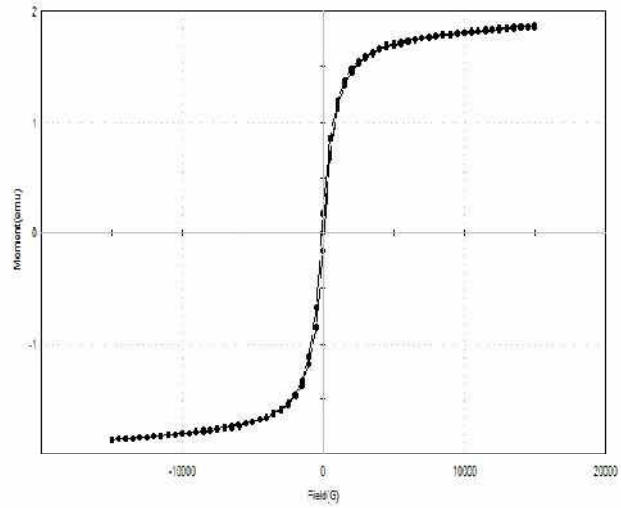

Figure 5: of the CuCrxFe2-xO4 system. (x = 0.5)

Hysteresis loops for the synthesized samples annealed at 800^0C are shown in the figures 4 and 5 respectively. It is observed that the saturation magnetization (M_s) increases with increase in

particle size [9]. From the table no. 2, it can be seen that the saturation magnetization increases from 0.049 emu/g to 1.8680 emu/g on increasing Cr concentration from x = 0.0 to x = 0.5. The variation of the coercivity with concentration (x) and average grain size has also been studied. It is observed that as the concentration and grain size increases, the value of coercivity (H_c) reaches the maximum value. The variation of H_c with grain size can be explained on the basis of domain structure and anisotropy of the crystal [10, 11].

CONCLUSION

From the XRD spectra, the structure of $CuCr_xFe_{2-x}O_4$ is a single phase normal spinel. TEM analysis revealed that the particles are nearly spherical. The particle size determined from TEM was found to be in close agreement with the XRD studies. From the electrical conductivity measurement it was found conduction mechanism is due to the small polaron hopping mechanism on the octahedral cation. From the magnetic properties it is clear that, the values of saturation magnetization and coercivity increases with the concentration of Cr^{+3}.

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IR, DTA STUDIES OF SODIUM SUBSTITUTED HIGH T_C OXIDE SUPERCONDUCTORS

D. S. Choudhary

Dhote Bandhu Science College, Gondia (M.S.)

E mail: dschoudhary@dbscience.org

ABSTRACT

A series of bulk superconducting $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ oxides ($0<x<0.4$) are prepared at an ordinary pressure of oxygen by solid state reaction method. The influences of substitution of Na with different concentration of Y on IR and DTA properties have been studied. It is observed that as the Na content for Y is increased, the intensity of the absorption bands is decreased and the temperature corresponding to exothermic reaction decreases while the temperature corresponding to endothermic reaction increases with increase in the Na content.

Key words- *Superconducting, IR, absorption bands, endothermic reaction.*

INTRODUCTION

Raman and infrared spectra of ceramic $YBa_2Cu_3O_{7-\delta}$ and related oxides have been examined by several workers [2].There has however been considerable disagreement in the observation. Many workers report Ramanbands close to 340. 440, 580 and 630cm^{-1}, of which the last is somewhat of a mystery peak with variable intensity from sample to sample. The 630 cm^{-1} band has not been reported by some workers, the band is also not found in $YBa_2Cu_2O_5$. The 630 cm^{-1} Raman band has been assigned to the Raman inactive Cu-O chain stretching mode and also to "defect clusters", but this band could also arise from the O-O stretching mode and also arise from the O-O stretching mode of peroxide - like species or due to an impurity such as $Y_2Cu_2O_5$. The 580 cm^{-1} band shows an increase in intensity with increasingδ, with the 500 cm^{-1} band shows an increase in intensity with increasingδ, while the 500 cm^{-1} band shows evidence of softening. There is some uncertainty regarding the assignment of the 430 and 580 cm^{-1} Raman bands which have been attributed to Cu-O stretching in the sheets. The infrared spectrum of ceramic $YBa_2Cu_3O_7$ shows only a few bands instead of the expected by investigators earlier. In Y $Ba_2Cu_3O_{7-\delta}$ an infrared band close to 190 cm^{-1} (associated with Y) and another at 140 cm^{-1} (associated with Ba or with a Cu-O chain band) are seen clearly just as in the Raman studies. Far infrared studies have been reported to show a superconducting gap starting at 210 cm^{-1}, but there seems to be some uncertainty about this result [3, 7].

The thermal analysis of the oxides becomes widespread attention due to their fascinating behavior below room temperature. The thermal collapse of crystals is usually accompanied by liberation of heat. The magnitude of this exothermic reaction and the temperature at which it occurs can after be determined by DTA. The DTA exothermic temperature is for the peak

corresponding to the collapse of the crystalline structure. Consequently, the position of this exothermic peak has after been used as an indication of thermal stability. Although thermal analysis gives valuable information on the changes after heating, it has not, successfully provided a general, reproducible and standard method for measuring thermal stability. Many factors influence the temperature at which the exotherm is observed, e.g. heating rate, the particular instrument used, atmosphere and sample holder. In the present study the IR spectral and thermal behavior of the $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ for x=0.00, 0.1, 0.2, 0.3 &0.4 (orthorhombic cuprate oxides) have been partially analyzed.

EXPERIMENTAL TECHNIQUE

The samples for infrared studies are made according to the technique used by Mazen *et al* 1992. Nearly 2 mg of oxygenated superconducting powder is mixed with KBr in the ratio 1:100 to ensure uniform dispersion. The mixed powder is then pressed in a cylindrical die of 1.2 cm diameter to obtain a clean disc by applying a pressure of about 10-tones.psi for 5 minutes. The procedure is repeated for all prepared oxides. The IR spectrum of these compounds has been recorded at room temperature in the mid frequency range (400 cm^{-1} to 4600 cm^{-1}) using infrared spectrophotometer model FTIR-8001 with resolution 4.0 cm^{-1}.

With this background, the infrared absorption spectra of various prepared compositions i.e.$Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ for x=0.00, 0.1, 0.2, 0.3 & 0.4 (orthorhombic cuprate oxide) are been recorded at room temperature which as shown in fig. 1.

The DTA studies were carried out on Mettler Toledo DTA model 851 available at RSIC, Nagpur. The temperature corresponding to exothermic and endothermic reaction for the different compositions are observed as below.

1) For $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ with x = 0.0 :

   Exothermic peak occur at 608.95ºC and 829.78ºC while endothermic peak occurs at 713.52ºC.

2) For $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ with x = 0.1 :

   Exothermic peak occurs at 87.73ºC and endothermic peak occur at 648.96ºC and 887.78ºC.

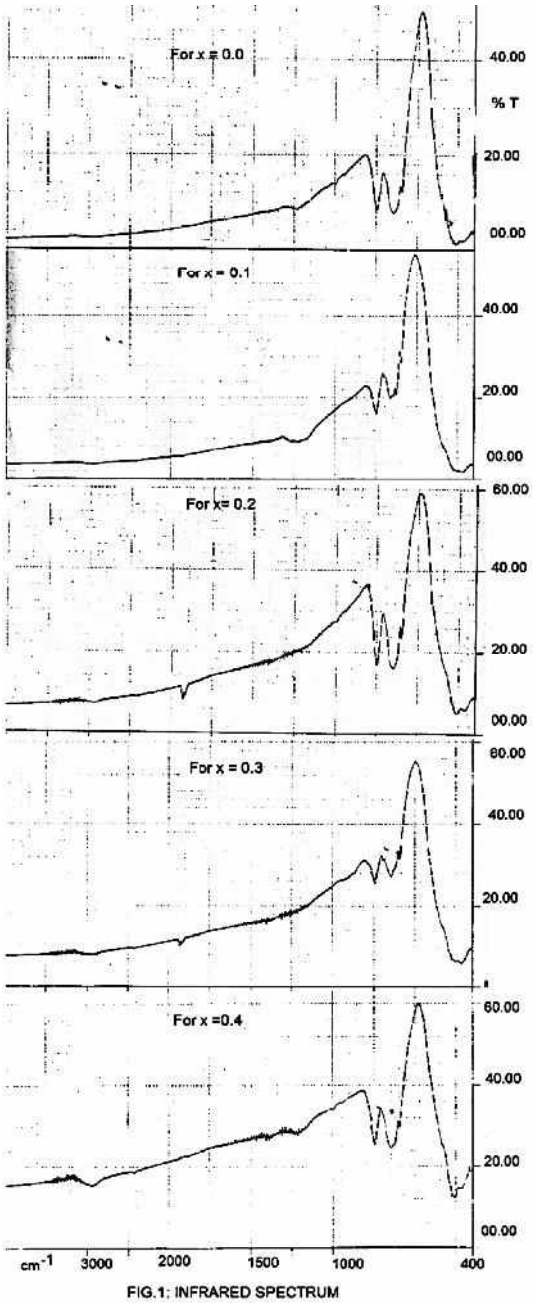

FIG.1: INFRARED SPECTRUM

3) For $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ with x = 0.2 :

   Exothermic peak occurs at 83.70ºC while endothermic peak occurs at 686.51ºC.

4) For $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ with x = 0.3 :

   Exothermic peak occurs at 81.97ºC and endothermic peak occurs at 665.77ºC.

5) For $Y_{1-x}Na_xCa_2Cu_3O_{7-\delta}$ with x = 0.4 :

   Exothermic peaks occur at 80.53ºC, 705.60ºC and 757.47ºC.

RESULT AND DISCUSSION

The IR spectra for $Y1_{-x}Na_xCa_2Cu_3O_{7-\delta}$ with x = 0.0, 0.1, 0.2, 0.3, and 0.4 samples are shown in fig. 1. We can clearly see that, as the Na content for Y is increased, the intensity of the absorption bands is decreased. In all IR spectra, some addition small absorption peaks and zigzag curved spectra is due to the hygroscopic behavior of the sample where the water content of the sample evaporates. The IR spectra are found resemblance with the IR of series of $LnBaCuCoO_5$ (L_n–rare earth ions) oxides related to $YB_aC_uC_oO_5$ phase [4]. It clears that the studied system indicating structural similarity amongst the oxides. It can clearly see that, as the Na content for Y is increased, the intensity of the absorption bands is decreased. In all IR spectra, some addition small absorption peaks and zigzag curved spectra is due to the hygroscopic behavior of the sample where the water content of the sample evaporates. The IR spectra are found resemblance with the IR of series of $LnBaCuCoO_5$ (L_n–rare earth ions) oxides related to $YB_aC_uC_oO_5$ phase [4]. It clears that the studied system indicating structural similarity amongst the oxides.

DTA curve gives an exothermic peak and an endothermic peak. Both the shape and size of the peak may furnish good information about the nature of test sample. Generally, sharp endothermic peak give ideas of changes in crystallinity or fusion presses whereas broad endothermic signify dehydration reactions, whereas chemical reactions give rise to exothermic peak.Faster heating rates resulted in the higher CO_2 concentration and yielded powders of carbonate / oxide and other impurity phases. Endothermic or exothermic reaction or melting events associated with the impurity phases were identified by differential thermal analysis [5]. All the samples calcined once at identical condition at normal pressure, shows the events of endothermal and exothermal reactions at different temperature as described in previous chapter. The observed slope of the curve for DTA measurements is caused by slight structure transformation which does not imply the complete reconstruction of the lattice from orthorhombic to tetragonal phase upon heating [6, 7]. Therefore, it can be concluded that the exothermic peak or the temperature at which heat is liberated goes on decreasing with increase in Na content at Y site.

CONCLUSION

As the absorption is absolute and dependent of composition, the change in wavelength is due to surrounding of the ions. The thermal stability of compound may vary with composition. But all compounds are found thermally stable up to 930°C. It is observed that the temperature

corresponding to exothermic reaction decreases while the temperature corresponding to endothermic reaction increases with increase in the Na content.

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SYNTHESIS AND MAGNETIC CHARACTERIZATION OF GALIUM-COBALT SUBSTITUTED CA-HEXAFERRITES

C. L. Khobaragade[1]*, M. N. Giriyab[2], S. V. Soni[3]

[1]Dept. of Applied Physics, Govindrao Wanjari College of Engg. & Tech., Nagpur.

[2] Dept. of Applied Physics, Smt. R. P. College of Engineering, Nagpur, India.

[3]Dept. of Applied Physics, Yashvantrao Chavan College of Engg., Nagpur.

*E-Mail: chanduparulk@gmail.com, Mobile: +919823343628

ABSTRACT

In the present investigation the samples with chemical composition $CaFe_{11}Ga_xCo_{1-x}O_{19}$ with (x = 0.01 to 0.05) were synthesized using perfect stoichiometric proportions of reacting oxides by standard ceramic technique. It shows hexagonal magnetoplumbite (M) structure having unit cell dimensions 'a' and 'c' which varies in the range between 5-6 Å and 21-23 Å with space group $P6_3/mmc$ (No.194). The saturation magnetization (M_s) decreases linearly from 27.39 to 26.72emu/g with increasing doping content from 0.01 to 0.05. The coercivity and retentivity increases successively with increase in Ga-Co concentration by changing magnetic field at 80 kOe. Crystallographic studies were explained on the cation distribution consistent with Gorter spin model of parallel alignment.

***Keywords**: Hexaferrite, Saturation magnetization, Coercivity, Retentivity, Curie temperature.*

INTRODUCTION

There have been numerous investigations on the hexagonal ferrites. The interest in this wide family is continuously growing due to their technological significance as permanent magnets, microwave device materials and perpendicular magnetic recording heads. These applications need different magnetic and electrical specifications and in this view, several attempts have been made to modify the properties of hexagonal ferrites using different materials processing routes including external doping [1, 2]. In CaM ferrites, three kinds of lattice sites 2a(S), $4f_2$(R) and 12K (R/S), trigonal bipyramidal 2b(R) and tetrahedral $4f_1$(S) sites are fully occupied by Fe^{+3} ions. The Fe^{+3} ions when replaced partially by other trivalent metal ions or combination of tetra and divalent ions, the magnetic properties of the calcium ferrite will be altered [3, 4]. The magnetic behavior of the compound has been explained on the basis of the interactions between these ions occupying the five sites. Due to several possible site distributions, various comparative magnetic interactions can arise in the lattice and in turn all these decide the magnetic behavior of the crystal.

EXPERIMENTAL TECHNIQUE

The synthesis of polycrystalline $CaFe_{11}Ga_xCo_{1-x}O_{19}$ with (x = 0.01 to 0.05) samples were done by high temperature solid state diffusion reactions of stoichiometric mixtures of AR grade CaO,

Fe_2O_3, CoO, GaO_4 oxides. The synthesis was divided into two steps: (i) after calcinations at 800°C for 2 h in air, the mixture was grinded and dried, compressed into pellets, and (ii) finally subjected to a thermal treatment at 1040°C for 106 h with intermediate grinding and were quenched in air.

The XRD patterns were taken to identify the phases formed and to confirm the chemical reaction by using Phillips X-ray diffractometer using CuKα-radiation with Ni as a filter. The X-ray diffraction pattern (Fig.1) shows a single crystalline phase without traces of impurities. The patterns were indexed to hexagonal magnetoplumbite structure [5] belongs to the space group $P6_3/mmc$ (No.194). It means that the sample belong to Primitive hexagonal three fold symmetric and mirror image structures.

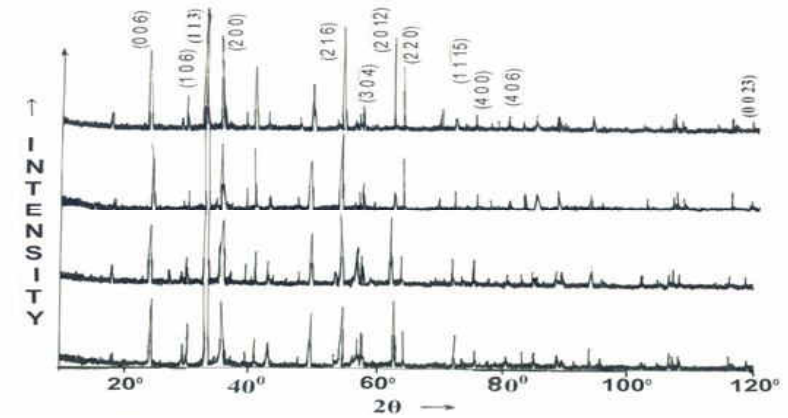


Fig.1: XRD analysis of $CaFe_{11}Ga_xCo_{1-x}O_{19}$ (x = 0.01 to 0.04) compounds.

The magnetic properties of polycrystalline sample have been measured by using a vibrating sample magnetometer in the applied field upto 80 KOe at room temperature. In order to prevent rotation of the powder grain, pressed samples were used. The transition temperature (T_c) has been measured using a Gouy's balance.

RESULTS AND DISCUSSION

The lattice parameters 'a' and 'c' of $CaFe_{11}Ga_xCo_{1-x}O_{19}$ with (x = 0.01 to 0.05) are listed in **Table-1**, which is calculated from the X-ray data. The lattice parameters a and c varies between 5-6 Å and 21-23 Å respectively. All the reflections can be indexed applying a hexagonal crystal system, which confirms that the phase belongs to the magnetoplumbite crystal structure [6]. By isomorphism of the M compounds the space group is presumed to be $^{\circ}_{4}{}^{6}$ h or $P6_3/mmc$ [7]. The results shows that the values of lattice parameters 'a' and 'c' analogous to the standard JCPDS data for magnetoplumbite hexagonal crystal structure.

Sugg and Vincent [8] reported the saturation magnetization M_s = 86 emu/g in the single crystals of the composition $BaFe_{10.25}Ir_{0.85}Co_{0.85}Bi_{0.05}O_{19}$, was calculated by assuming magnetic moment of Fe^{+3} to be 5μ_B and Co^{+2} to be 3.7μ_B. The saturation magnetization of polycrystalline sample for x = 0.01 to 0.05 for $CaFe_{11}Ga_xCo_{1-x}O_{19}$ compounds are 27.39 to 26.72 emu/g respectively; is smaller than M_s = 86 emu/g value measured on the single crystals. The lower value observed on polycrystalline samples is probably due to stacking defects of R-S blocks along c-axis. As the reported compounds that are in powder form could have small domain invisible by X-ray,

where rich calcium blocks (T or ®-alumina like conduction blocks) have been substituted for R-blocks, which promotes weaker magnetization.

It is seen from the Table-1 that the substitution of Ga^{+4}-Co^{+2} in $CaFe_{11}Ga_xCo_{1-x}O_{19}$ results in a sharp decline trend in the saturation magnetization. This probably could be due to stacking defects in spinel blocks as is seen in Zn-substituted aluminium ferrites [9].

The formation of $CaFe_{11}Ga_xCo_{1-x}O_{19}$ have been completed after 1040°C in 106 h heat treatment. It is interesting to notice that in method [10-13], there are no intermediate phases observed during the calcinations of the oxides. The greatest advantage of this method is that the calcinations time required to form the ferrites have been reduced to 1/25th of conventional high-temperature method. According to XRD examination during sintering at different stages, $CaCo_3$ seen to decompose at 785°C on account of the fact that the bonding of CaO-Co_2 weakened by the electron withdrawing oxygen's of FeO surrounding the Ca-ions and the reactive CaO species react instantaneously with Fe_2O_3, GaO_4, CoO to form crystalline CaM ferrite directly without the formation of intermediate phases.

The saturation magnetization measured at 80 kOe as a function of 'x' at room temperature. The magnetic moment of $CaFe_{12}O_{19}$ results from 12 Fe^{+3} ions, distributed on five lattice sites. The crystal structure of magnetoplumbite (M-type) compounds ($P6_3/mmc$) can be described as the superposition of two structural blocks, namely the R-block with composition $(CaFe_6O_{11})^{-2}$ and the S-block with composition $(Fe_6O_8)^{+2}$. The metallic cations are distributed within five different crystallographic sites with octahedral and tetrahedral environment. In Table-2, we have summarized the crystallographic characteristics of the five different sub-lattices together with the spin alignments corresponding to the collinear magnetic structure [14].

Successive decrease in the values of saturation magnetization due to the substitution of Ga-Co in the spinel blocks of the M-structure occupying the octahedral sites (12k). Coercivity (Hc) and retentivity (Br) carried out from the VSM (Fig.2a, 2b, 2c, 2d, 2e & 2f) for various compounds, illuminated in Table-1. The coercivity and retentivity increases continuously with the increase of Ga-Co concentration for increasing magnetic field at room temperature (300K).

The strong increase in coercivity and retentivity demonstrate that some inter sub-lattice exchange interactions are dominant. It can be seen that the spin co-linearity appears mostly in the spin up sub-lattice; especially the 12K sub-lattice has degree of frustration being in this way strongly affected by increase of 12K-$4f_{IV}$ interaction. A mean field analysis of the exchange interaction in BaM hexaferrites has been carried out [15]. The results shows that the Fe (12K) sublattice making a link among R and S structural block is subjected to very strong competitive exchange interactions. So, when the Fe^{+3} ions in the 12K sub-lattice are substituted by ferromagnetic (Co^{+2}) ions, strongness of the superexchange interaction between magnetic ions results in a fairly inclined ferrimagnetisms.

In case of M-structure predominant superexchange interaction is due to 1-oxygen-2 ions in which appertaining angle ® is large (approximately 140°), whereas the other interactions, the 2-oxygen-3 interactions which attempt to align the magnetic moments of these ions antiparallel, is smaller because the appertaining angle is unfavorable (appximately 80°). The orientations of the magnetic moments of the ferric ions in the crystals are generally aligned along the c-axis in

antiparallel with each other. This alignment occurs due to the superexchange interaction through oxygen ions which is responsible for spin alignment [16-17]. The coercivity and retentivity values may differ slightly because they also depend on the grain size [18].

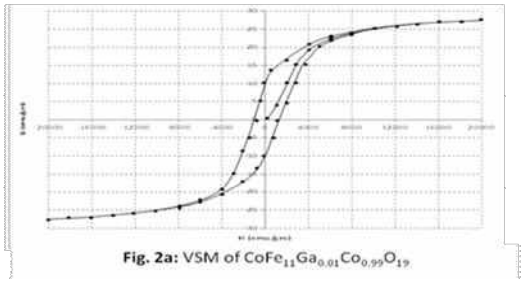


Fig. 2a: VSM of $CoFe_{11}Ga_{0.01}Co_{0.99}O_{19}$

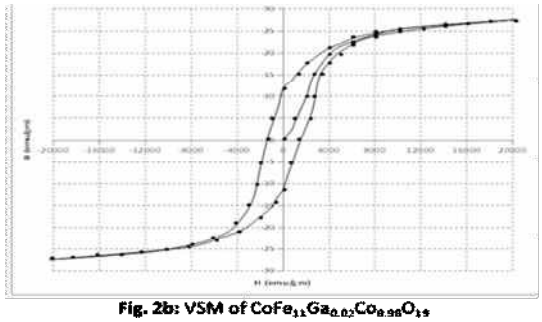
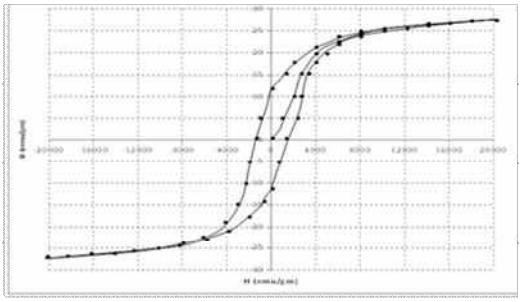


Fig. 2b: VSM of $CoFe_{11}Ga_{0.02}Co_{0.98}O_{19}$



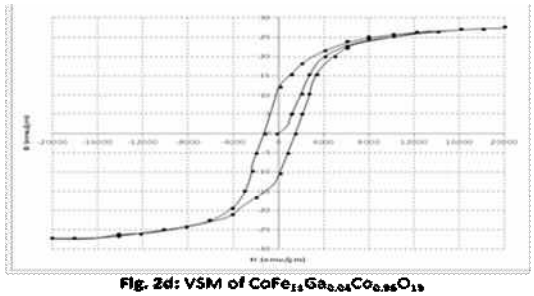
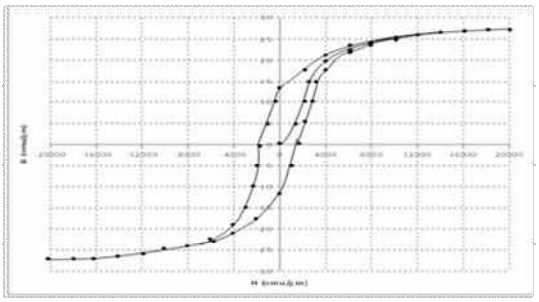


Fig. 2d: VSM of $CoFe_{11}Ga_{0.04}Co_{0.96}O_{19}$



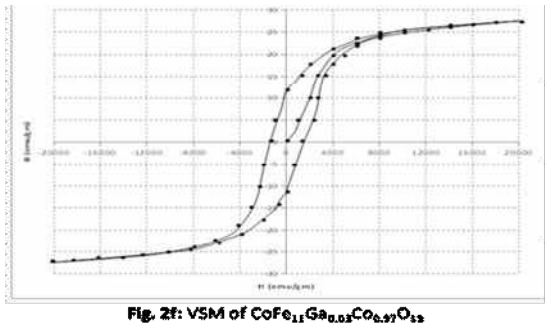


Fig. 2f: VSM of $CoFe_{11}Ga_{0.03}Co_{0.97}O_{19}$

Table-1 Lattice parameter ('a','c'), saturation magnetization (M_s), coercivity (Hc), retentivity (Br) and Curie temperature (Tc) of $CaFe_{11}Ga_xCo_{1-x}O_{19}$ (x = 0.01 to 0.05) compounds.

Compounds	a(Å)	C (Å)	Ms(emu/g)	Hc(Oe)	Br(emu/g)	Tc(K)
$CaFe_{11}Ga_{0.01}Co_{0.99}O_{19}$	5.7830	21.9609	27.39	1035	10.00	520
$CaFe_{11}Ga_{0.02}Co_{0.98}O_{19}$	5.8035	22.0248	27.32	1123	10.70	510
$CaFe_{11}Ga_{0.03}Co_{0.97}O_{19}$	5.7860	21.9595	27.28	1320	11.50	508
$CaFe_{11}Ga_{0.04}Co_{0.96}O_{19}$	5.7935	21.9803	26.93	1215	11.90	499
$CaFe_{11}Ga_{0.05}Co_{0.95}O_{19}$	5.8033	22.0069	26.72	1665	12.60	481

CONCLUSIONS

XRD analysis shows a single crystalline phase without traces of impurities. The patterns were indexed to hexagonal magnetoplumbite structure. Successive decrease in the values of saturation magnetization due to the substitution of Ga-Co in the spinel blocks of the M-

structure occupying the octahedral sites (12k). The coercivity and retentivity increases continuously with the increase of Ga-Co concentration for increasing magnetic field at room temperature (300K). The strong increase in coercivity and retentivity demonstrate that some inter sub-lattice exchange interactions are dominant. Due to this the ferrimagnetic nature of these compounds increases with the increase of Ga-Co concentration in this series of compounds.

Table-2 Structural and magnetic characterization of magnetic sub-lattice in magnetoplumbite structure.

Sub-lattice	Co-ordination	Block	No. of ions/FU	Spin direction
2a	Octahedral	S	1	Up
2b	Pseudo-tetrahedral	R	1	Up
$4f_1$	Tetrahedral	S	2	Down
$4f_2$	Octahedral	R	2	Down
12K	Octahedral	S-R	6	Up

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ULTRASONIC VELOCITY AND DENSITY CHARACTERIZATION OF MILK ADULTERATED WITH SODIUM CARBONATE (Na_2CO_3)

Prakash D. Wankar

J. B. College of Science, Wardha

Email: prakashdwankar@yahoo.in

ABSTRACT

Milk contaminated with sodium carbonate resulted in an important health hazard that affected many babies in India. Ultrasonic characterization of adulterated milk may detect grows levels in sodium containing contamination. Sound speed and density measurements were made in pure milk as a function of sodium carbonate adulteration.

Keywords *Ultrasonic velocity, Ultrasonic compressibility, density, viscosity.*

INTRODUCTION

Milk has traditionally been an important part of Indian diet, particularly for children, pregnant women, patients and senior citizens. For all of these categories, adulterated milk can be lethal, if not fatal. Our innocent population is at a big risk; the rising graph of cancers and kidney failures could well be sourced to inedible milk.

Adulteration of foodstuffs is a menace, which saps the vitality of common man. One of the commonly adulterated food is milk and milk products. Recent media reports reveal that many brands of milk commercially available in Kerala contain chemical additives such as sodium carbonate (Na_2CO_3), sodium bicarbonate ($NaHCO_3$), formalin (HCHO) etc. These are added to milk as neutralizers to preserve it for longer time and to prevent curdling. The continuous use of such milk may cause health hazards to the society [1- 2]. Since the frequency and quantity of milk consumed by infants and children are much more compared to adults, the health risk is more to them.

Milk chemical composition is combination of different substances, some of them in the form of complex biopolymers. Milk consists of water, lipids, carbohydrates, proteins, salts, and a long list of miscellaneous constituents as lecithin, vitamins, enzymes, nucleotides and dissolved gases. It may contents 105 different kinds of molecules [3-4]. Milk represents the main dairy product, and it is consumed all around the world, playing a fundamental roll in international commerce; this gives milk a great economic importance.

EXPERIMENTAL

Computation of the acoustical parameters require measurement of ultrasonic velocity (u), viscosity (η) and density (ρ). Analar grade sodium carbonate with different concentration was used in pure milk and water. Ultrasonic velocity at a frequency of 5 Mz was measured by using digital automatic ultrasonic velocity recorder (VCT-70 A). Density was measured by density bottle and viscosity was measured by Ostwald's viscometer. The constant temperature water bath low temperature (LAB HOSP) purchased from Lab- Hosp Corporation Guregaon (E) MUMBAI. Water bath is fully automatic with temperature sensors. The temperature is controlled automatically by thermostat at any point from room temperature 5^0 above the ambient to 99.9^0C having the accuracy of $\pm 1^0$C.

Formulation:

1) Ultrasonic velocity (u) is determined by: $U = 2d / t$
2) Adiabatic Compressibility (βa): $\beta_a = 1/ U^2. \varrho$

   Where, U - Ultrasonic velocity, ϱ- Density of liquid
3) Acoustic Impendence (Z): $Z = U. \varrho$
4) Free Length (L_f): $L_f = K_j. \beta_a^{1/2}$

   Where, K_j –Temperature dependent constant (199.5×10^{-8}), β_a - Adiabatic compressibility
5) Surface tension (σ): $\sigma = 6.63 \times 10^{-4} \varrho. U^{1/2}$

Where, η-viscosity, d-distance between reflector & transducer, M-molecular weight, K_j-temperature dependent constant, T- temperature in Kelvin , L_f - free length.

RESULTS AND DISCUSSIONS

As the concentration of sodium carbonate (Na_2CO_3) increases from 2 wt % to 10 wt %, the values of ultrasonic velocity, acoustical impedance, and surface tension increases nonlinearly Fig.1, Fig.3 and Fig. 5 while the values of adiabatic compressibility and intermolecular free length decreases nonlinearly which are given in Fig 2 and Fig 4.

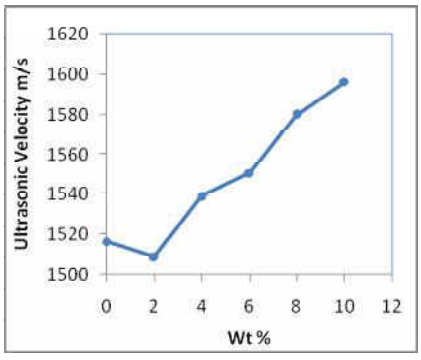

Fig. 1

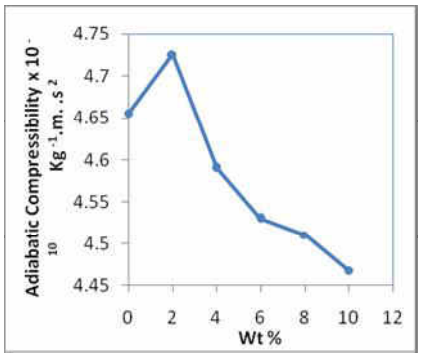

Fig. 2

The strong dipole-dipole interaction or hydrogen bond complex formation between the proteins molecules and other components present in the milk with Na_2CO_3 leads to the increase in ultrasonic velocity and decrease in adiabatic compressibility [5].

The higher value of acoustical impedance, surface tension shows that milk protein-Na_2CO_3 complex interaction dominates over the solvent-solvent interactions [6] while increasing values of surface tension shows the weak interaction which may be due to less interaction between hydrophobic fats and Na_2CO_3 present in milk-water mixture [7] .

The value of adiabatic compressibility and intermolecular free length decrease nonlinearly which is showing the presence of strong solute-solvent interactions in the mixture and due to this structural rearrangement is also affected [8]. The value of adiabatic compressibility and intermolecular free length increases up to addition of 4% of Na_2CO_3 and then decreases nonlinearly up to 10% addition of Na_2CO_3. This is due to weak interaction of milk protein-Na_2CO_3 complex and after addition of more and more Na_2CO_3, strong complex is formed and more is the interaction. Hence stronger is the interaction which gives rise to stronger association [9].

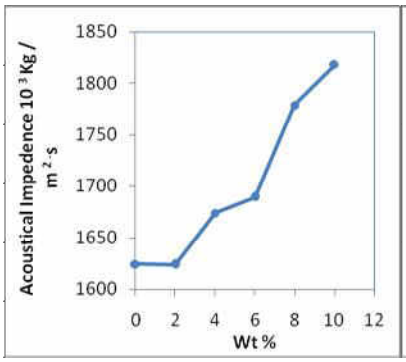

Fig. 3

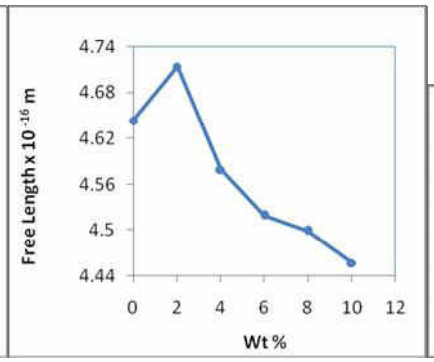

Fig. 4

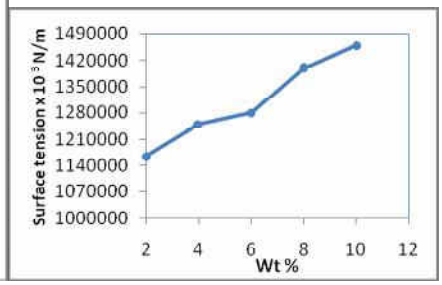

Fig. 5

CONCLUSION

As Na_2CO_3 is salt, it ionizes in milk and water mixture and forms milk protein-Na_2CO_3 complex. Hence values of ultrasonic velocity increases with respective to the pure milk which may be due to active interaction of ultrasound waves with the aqueous solution of milk protein-Na_2CO_3 complex **(Figure 6)** and also decrease in adiabatic compressibility indicates the enhancement of the bond strength **[10] .**

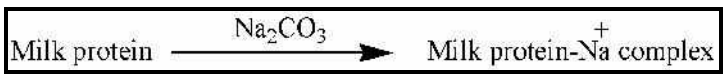

Fig. 6- Structure of milk protein-Na_2CO_3 complex

ACKNOWLEGEMENT

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DEVELOPMENT OF VIRTUAL EXPERIMENT ON SEQUENTIAL LOGIC CIRCUITS

Bhaskar Y. Kathane[1], Pradeep B. Dahikar[2]

[1]Bhawabhuti Mahaidyalaya, Amgaon (MS), Distt-Gondia, India, bykathane@rediffmail.com,

[2]Kamla Nehru Mahavidyalaya, Sakkardara Nagpur, India, pbdahikarns@rediffmail.com

ABSTRACT

The scope of this paper includes development and implementation of virtual lab for Sequential Logic circuits. Software for conducting the experimentations in Sequential Logic circuits has been developed which helps students to perform and practice the experiments. Sequential Logic Circuits such as counters, registers are implemented using VIS (Virtual Intelligent SoftLab) Model. We develop and implement the experiment of Counter and Registers as sequential logic circuits which is useful applications in modern electronics. In this paper we have designed the software that can observe the virtual results using virtual instruments. This will help students in understanding working of Sequential Logic circuits.

Keywords: *Virtual, SoftLab, Registers, Sequential Circuits, VIS Model.*

WHAT IS SOFTLAB

Electronics devices and the lack of resources make us unable to perform experiments, especially when they involve sophisticated instruments [1]. Web-based and video-based courses address the issue of teaching to some extent. Conducting joint experiments by two participating institution and also sharing costly resources has always been a challenge. With the present day internet and computer technologies the above limitations can no more hamper students and researchers in enhancing their skill and knowledge [2]. This model is capable of reducing the circuit by using Sequential Logic circuits. The Sequential Logic circuit is the simplification of Registers circuit and Counters circuit. This allows us to write a simplified Boolean equation and to draw a simplified logic circuit. This model provides the capability to complete the circuit using virtual instruments.

Laboratories play an important role in engineering education. The laboratory work provides an opportunity to witness classroom-learned theoretical concepts at work, operate instruments used in the experimental set-up, measure different quantities and thereafter analyze the experimental data and work collaboratively. However, physical distances and the lack of resources make us unable to perform experiments, especially when they involve sophisticated instruments. Also, trained teachers are always a scarce resource. Rapid development and ever increasing use of Information and Communication Technology (ICT) has revolutionized the education system by eliminating limitations in terms of physical distance, time and access, by providing equal opportunity to everyone, irrespective of place and time.

Virtual laboratories have been developed in different areas, to reproduce experiments that were made in physical laboratories. Virtual labs are useful for pre-practice and post-analysis of experiments developed in physical labs, and in some cases they can replace the physical lab itself. Although virtual labs may have many limitations, they have many advantages over physical labs. For example, some physical labs have scarcity of resources (in equipment and staff), limiting the researcher's performance. Virtual labs have relatively low costs, experiments can easily be repeated, and there are no inconveniences in failing experiments, because the virtual environment is controlled, and there are no risks for natural systems. It is desirable that virtual labs exploit the advantages of virtual reality, multimedia, and the Internet. Virtual labs have been developed for different areas, such as physics, electronics, Computer Science etc. Develop the Soft Lab for the following purposes.

- Lower the Measurement Costs with Virtual Instrumentation.
- Reducing system specification time cost.
- Lowering hardware and software prices.
- Minimizing set-up and configuration time costs.
- Decreasing application software development time costs.
- Lowering system validation & hardware calibration time costs.

During this exercised enabled us to gain virtual observations [3]. Virtual SoftLab can benefit thousands of students and professors to learn difficult experiments. The "Virtual laboratory" will bridge physical distance and availability of resources. Today it is possible to design good experiments among students for better learning.

Virtual Soft Lab that provides following benefits for Teachers

- Visual experiments for your lectures.
- Homework for students.
- Virtual laboratory exercises.
- Opportunities for independent exploration for your highly motivated students.
- Animated visualization for your struggling students.

Virtual Soft Lab that provides following benefits for Students

- Experiment with electronics component safely and independently
- Supplement classroom exercises to improve understanding with electronics devices.
- Visual classroom laboratories in your own home.

TOOLS & TECHNOLOGY

Visual Basic is a third generation event-driven programming language and integrated development environment from Microsoft for its COM programming model. VB is also considered as relatively easy to learn and use programming language, because of its graphical

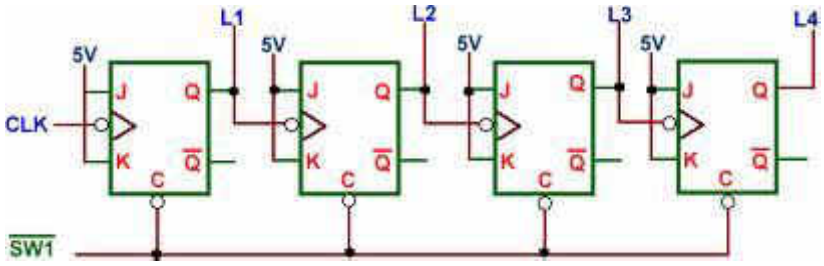
features. Visual Basic was derived from BASIC and enables use of graphics user interface, access to database and creation of ActiveX controls and objects. A programmer can put together the component provided with Visual Basic itself to develop an application. The language not only allows programmers to create simple GUI applications, but can also develop complex applications. Programming in VB is a combination of visually arranging Component or control on a form, specifying attributes and actions of those components. Visual Basic can create executables (EXE files), ActiveX control or DLL files, but is primarily used to develop Windows applications. The beauty of this model is that it does not require the Database to manage data [4].

VIS MODEL

We have constructed the programs in 'VB' such that all the blocks in the model can be fully visualized on the screen. This model can demonstrate the activities of Sequential Logic circuits visually. Inputs accepted throw software and virtual output will observe on screen. In an experiment we can provide different input values and observe output. Many digital computers and systems process 4-bit numbers. For instance, some digital chips will work with nibbles like 0000, 0001, 0010 and so on. For this reason, logic circuits are often designed to handle four input variables. Digital systems carry out a large number of arithmetic operations in short intervals of time. The results of these operations are usually shifted about in the system for further processing and eventually counted. Flip-flop circuit configurations designed for this purpose are called shift counters.

There are two basic types of counters called ripple or asynchronous counters and synchronous counters. A ripple or asynchronous counter consists of a chain of n flip-flops to provide a counting ratio of 2^n:1. For example, the binary counter shown in fig-1 counts trough sixteen discrete states and is essentially a divide-by-two counter, it is easy to construct circuits which counts through 2,3,8,16,32, etc., states by choosing an appropriate value for n

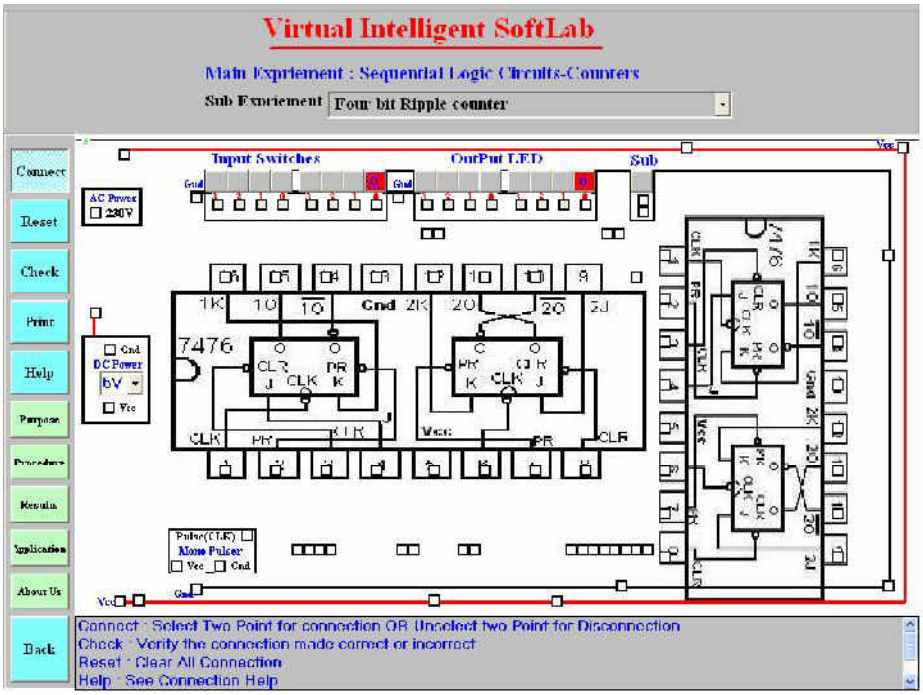
Since all the J, K terminals are permanently tied to the logic level 1, each FF toggles on every transition of the input signal leading to the waveforms. For an input containing 7 pulses, we have D=0 and C=B=A=1. This state corresponds to the binary number 0111 which is equal to the number of pulses in the decimal system [5].



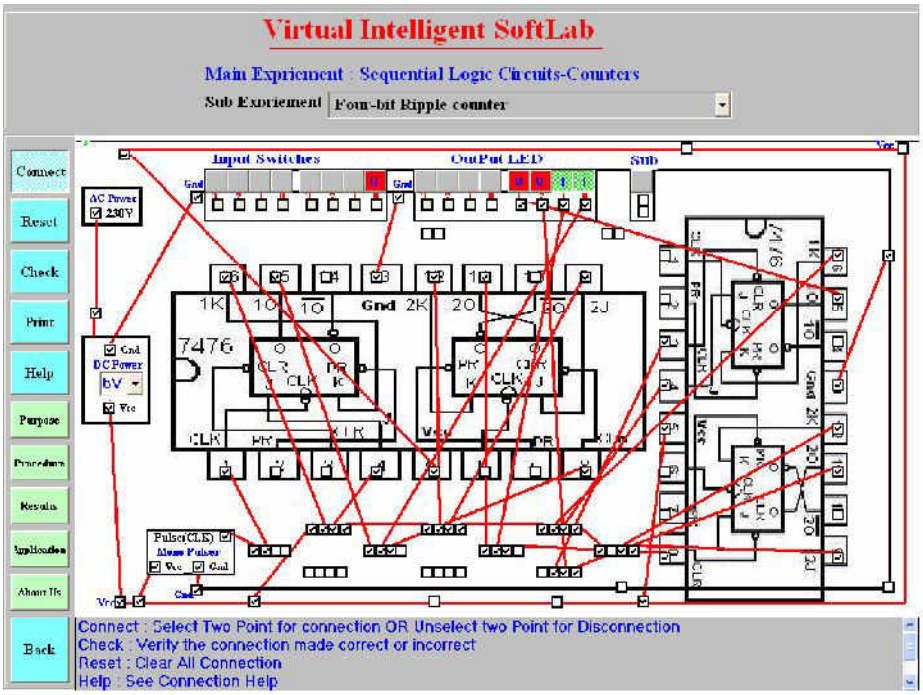
We have constructed the programs such that all the blocks in the model can be fully visualized on the screen. This model can demonstrate the activities of 4-bit ripple counter. Inputs accepted throw input pin such as clock, J, K pin and virtual output will observe on LED. In an experiment we can provide different input values with the combination of J and K pin and

observe output. This model provide circuit connection facility to user to made connection properly otherwise the result not generated.

The screen shot for studying 4-bit ripple counter Experiments is shown in fig-2.



Before Connection



After Virtual Connection

Fig-2: VIS Experiment on 4-bit Ripple Counter

Procedure

- Connect Vcc and Ground to respective Pins of IC.
- Connect Inputs to the Input Switches Provided in Virtual Bread board.
- Connect the outputs to the switches of Virtual O/P LED's.
- Apply various combinations of inputs according to the truth table and observed conditions of Virtual LED's.

A chain of n Flip-flops may be used to store an n-bit word. Such an arrangement is called the register. The register circuit in which the information is shifted from one FF to another with the help of a clock pulse is called the shift register. Fig 3 show a four bit shift register which holds information for four clock pulses giving it out on the fifth pulse. In the beginning all the Flip-flop have to be cleared such that Q=0 and Q'=1. Let us feed the information, i.e. logic level 1 at the J input of FF1. When the first clock pulse is ON, FF1 goes to the state Q=1, but the other Flip-flops remain in Q=0 as their J inputs are o. Then the next bit of information, say logic level 0, is fed to the J input of FF1. When the second clock pulse is ON, FF2 has J=1 leading to Q1=0 and Q2=1. The Q out puts of the other two Fs remains at 0. The first clock pulse shifted the information bit 1 to Q1 and the second pulse shifted information bit 1 to fQ2 and the new information 0 to Q1. The response of the shift registers to the information.

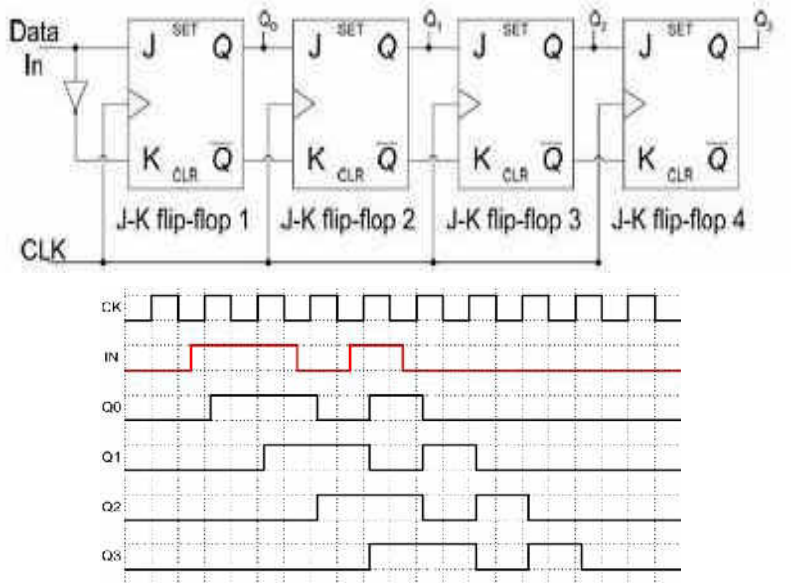


Fig 3: 4-bit Shift Register

We have constructed the programs such that all the blocks in the model can be fully visualized on the screen. This model can demonstrate the activities of 4-bit shift register. Inputs accepted throw input pin such as clock, J, K pin and virtual output will observe on LED. In an experiment we can provide different input values with the combination of J and K pin and observe output. This model provide circuit connection facility to user to made connection properly otherwise the result not generated [6].

The screen shot for studying 4-bit shift register Experiments is shown in fig 4.

Procedure

- Connect Vcc and Ground to respective Pins of IC.
- Connect Inputs to the Input Switches Provided in Virtual Bread board.
- Connect the outputs to the switches of Virtual O/P LED's.
- Apply various combinations of inputs according to the truth table and observed conditions of Virtual LED's.

RESULTS

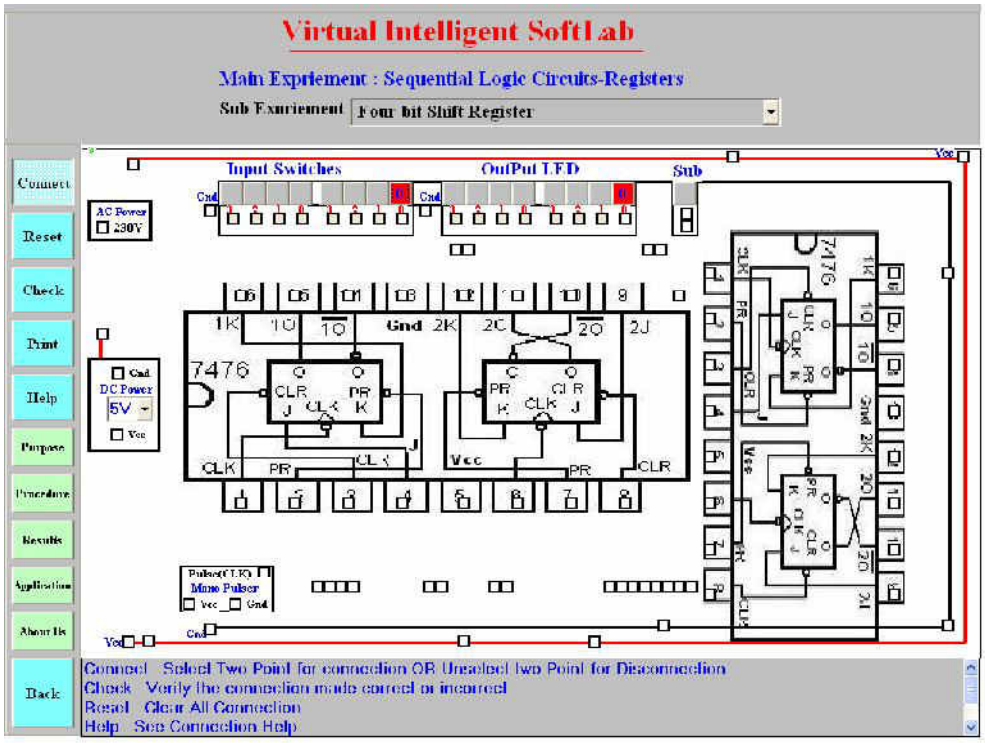
Virtual outputs are totally animated with the combination of software and observed actual outputs virtually.

CONCLUSIONS

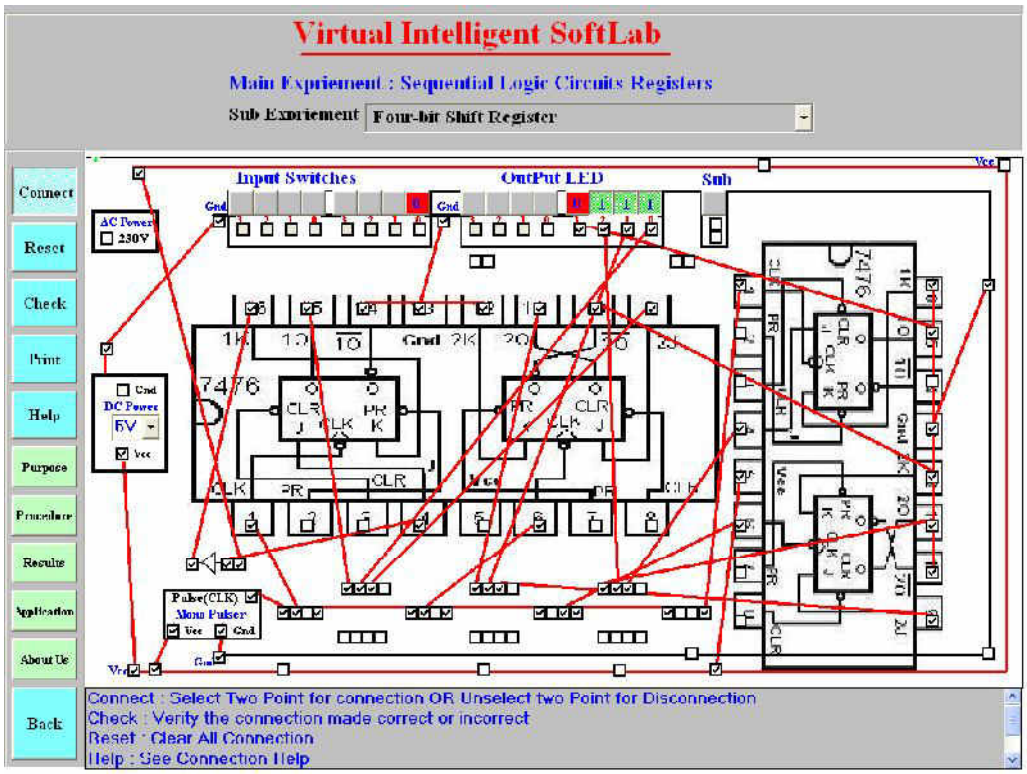
SoftLab will help students of Electronics and Computer science department to perform and practice experiments to improve their understanding of the subject. Virtual Labs is designed in such a way that it's made more effective and realistic by providing visual inputs. For the 'touch and feel' part, the students can possibly visit an actual laboratory

ACKNOWLEDGEMENT

We are very much thankful to Dr. S. M. Bhuskute, Principal Bhawabhuti Mahavidyalaya, Amgaon. I also thanks to Dr. P. K. Butey for his valuable inputs, constant guidance and his extensive support an encouragement for this work.



Before Connection



After Virtual Connection

Fig 4: VIS Experiment on 4-bit Shift Register

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WIRELESS HEARTBEAT PATIENT MONITORING ON GENERAL INTENSIVE CARE UNIT (ICU)

K. Y. Rokde1, S.S.Shende[2], P.B.Dahikar[3], S.M.Ghatole[4]

[1]Assistant Professor, Department of Electronics, S.M.M.Science College, Nagpur, India

[2]Assistant Professor, Department of Electronics, Shivaji Science College, Nagpur, India

[3]Associate Professor, Department of Electronics, Kamla Nehru College, Nagpur, India

[4]Associate Professor, Department of Electronics, Shivaji Science College, Nagpur, India

ABSTRACT

A novel approach which has potential to improve quality of patient care about Heart beat monitoring on general Intensive Care unit is proposed. Patient care is a labour-intensive task that requires high input of human resources. A heart beat Monitoring system is proposed which can go some way towards improving patient monitoring on general Intensive Care unit. Sometimes it becomes necessary to monitor physiological events from a distance monitoring a patient in an ambulance and in other applications away from the hospital, collection of medical data from a home or office and use of telephone links for transmission of medical data. When the patient is in critical condition and is admitted in intensive care unit (ICU) or is being operated upon in the operation theatre (OT), it is crucial to monitor the patient for his physiological parameters such as heart beat, blood pressure, temperature, respiration rate etc. This monitoring is necessitated on account of the immediate response required for support of patients. The monitor provides the healthcare team with the information that is used to make decisions about the patient's treatment.

In these system vital signs i.e. signals are gathered from patients and sent to a control unit for centralized monitoring. The heart beat monitoring system can complement the role of nurses in monitoring patients' vital signs. They will be able to focus on holistic needs of patients thereby providing better personal care. Wireless network technologies, ZigBee, Bluetooth, GSM and Wi-Fi, are utilized for transmission of vital signs in the proposed heart beat monitoring system. They provide flexibility and mobility to patients. The results illustrated the capability, suitability and limitation of the chosen technology.

Keywords: *Embedded, Heartbeat, ICU, Remote patients Monitoring, Wireless.*

INTRODUCTION

"Health is Wealth", is true not only for an individual, but is perhaps equally important for society in large. A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment providing

accurate reproduction of body signals and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research. Although many types of illnesses currently can be managed in an outpatient setting, there are clearly medical conditions that require more intensive care and treatment in a hospital. Generally, patients are either brought to an emergency or urgent care department for accurate diagnosis and management or a ICU to receive non-urgent treatment. The diverse healthcare environments generate different requirements of heart beat monitoring. These requirements should be carefully considered for further development in the healthcare system. In this paper the basic requirements of heart beat monitoring on general ICU will be studied.

HEARTBEAT MONITORING ON GENERAL INTENSIVE CARE UNIT (ICU)

A general ICU is a non-specialist hospital unit offering a range of treatments to a variety of patients. Advances in medical technology have led to patients living with much more complex health issues, leading to an increase in the variety of patients being managed within the ICU setting. Therefore, patients may require different level of care and attention; some require frequent visits by medical personnel whilst others who are in stable condition require less.

Heartbeat monitoring is an essential part of management and care of patients on Intensive care Unit (ICU). The purpose is to identify and record changes that occur to vital signs, as this may be helpful in preventing deteriorations of patients' condition. The frequency of monitoring may also vary depending on the severity of the patient's condition. Varshney (2006) suggested some basic requirements that should be considered in heartbeat monitoring on general intensive care unit (ICU). The following vital signs should be recorded at the initial assessment and as part of routine monitoring. Out of these vital signs, we have studied only Heart rate monitoring.

1. Heart rate
2. Oxygen saturation
3. Systolic blood pressure
4. Respiratory rate
5. Body temperature

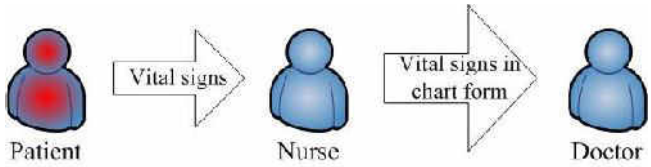

Figure 2.1 - Role of nurse in a Heartbeat monitoring process

Vital sign measurement is the initial and the most important task in Heartbeat monitoring System. The existing instruments are commonly equipped with cable-based sensors, which make them bulky, intrusive and inconvenient. These sensors may not suit for long-term monitoring of vital sign in heartbeat monitoring on general intensive care unit(ICU). To improve comfort and mobility of patients, wireless biomedical sensors are considered. They are normally small in size and have wireless communication capability.

RELATED WORK

The functioning of this work is based on the fact that blood circulation occurs for every heart beat which can be sensed by using a circuit formed by the combination of an LDR and LED. Depending upon the rate of circulation of blood per second the heart beat rate per minute is calculated. This device consists of a microcontroller which takes the input from the heart beat sensor and calculates the heart rate of the patients.

Sensors for Heart Rate Monitoring

Heart rate measurement indicates the soundness of the human cardiovascular system. The heartbeat sensor is based on the principle of photo phlethysmography. Heart rate is very important in patient monitoring. In traditional medicine, heart examination and monitoring was carried out by stethoscopes, through which medical personnel listened to a patient's heart sound and made decisions based on their knowledge and experience. The development of electronics and digital signals processing techniques have made it possible to use a small microphone to record cardiac sound and use a computer to analyze it. However noise cancellation is yet under research to ensure the accuracy of heart sound monitoring. 20 Budinger (2003) indicated that heart rate can also be measured by electrical waveform as well as pressure detection and electromagnetic flow. In this paper, some sensors that can be used to measure heart rate are evaluated; they are ECG, heart-rate chest strap and oximeter.

Fig 3.1 Heart rate Sensor

Electrocardiograph (ECG) sensor

Figure 3.2 Shows such a wireless 12-lead ECG. The hand-held device is for wireless Transmission of ECG signals to a PC nearby or in remote location.

ECG is primarily a tool for examination of cardiac diseases. An ECG sensing device commonly consists of a group of electrodes to detect electrical events of a heart. It is used to indicate that the most prevalent ECG sensor involves the connection of 12 electrodes (also referred to as leads) to a patient's chest, arms and right leg via adhesive foam pads. The sensor records a short sampling (no more than thirty seconds) of the heart's electrical activity between different pairs of leads. Each pair of leads provides a unique and detailed picture of the cardiac rhythm by detect the change of electrical energy and referenced to a ground signal. It is indicated that

computer-based applications and the development of wireless technology had allowed the transmission of 12-lead ECG waveforms from remote locations to a hand-held computer carried by a cardiologist.

Heart-rate Chest Strap

Techchee (2010) stated that "current heart-rate chest strap is based on a tiny piezoelectric sensor to detect heart beat" (as shown in Figure 3.3). A microprocessor is integrated to transfer detected signal into heart rate. The heart rate is then sent by an integrated transmitter to a wrist-mounted device for display. The wrist-mounted device usually has local warning and wireless transmission capability. In the event that the wearer's heart rate goes beyond the threshold of a preset safe range, the wrist-mounted device will warn locally as well as sending an alert signal to a physician. In contrast to ECG sensors, the strap can be simply placed on a patient's chest for measuring heart rate without the assistance of skilled medical personnel. A heart-rate chest strap does not affect a patient's mobility; however the comfort needs consideration for long-term monitoring. Currently it is mainly used for patients with some degree of chronic disease who may require regular exercises and self-monitoring (Casio 2010).

Figure 3.3 - A heart-rate chest strap (adapted from (Techchee 2010))

Pulse Oximeter

The pulse oximeter was invented for patient monitoring in the early 1970s (Tremper and Barker 1989). It can be used to examine two types of vital signs: heart rate and blood oxygen saturation. These parameters yield critical information, particularly in emergencies when sudden changes in the heart rate or reduction in blood oxygen saturation can indicate a need for urgent medical intervention. With advanced warning, patients could get treatments to avoid hypoxemia before they manifests physical symptoms (Shnayder *et al.* 2005).

A pulse oximeter typically incorporates a plastic housing, which contains an array of LEDs and an optoelectronic sensor opposite. By detecting the amount of light absorbed by haemoglobin in blood with two different wavelengths (typically 650nm and 805nm), the level of oxygen saturation can be measured. In addition, heart rate can be determined from the pattern of light absorption over time, since blood vessels contract and expand with the patient's pulse. Computation of heart rate and SpO2 from the light transmission waveforms can be performed using standard digital signal processing techniques. There are two types of oximeters, transmittance pulse oximeters and reflectance oximeters. The applied position of transmittance pulse oximeters is limited to the peripheral tissue, such as the fingertip, ear lobe, or toe.

Figure 3.4 - A wireless oximeter based monitoring system

EXPERIMENTAL WORK

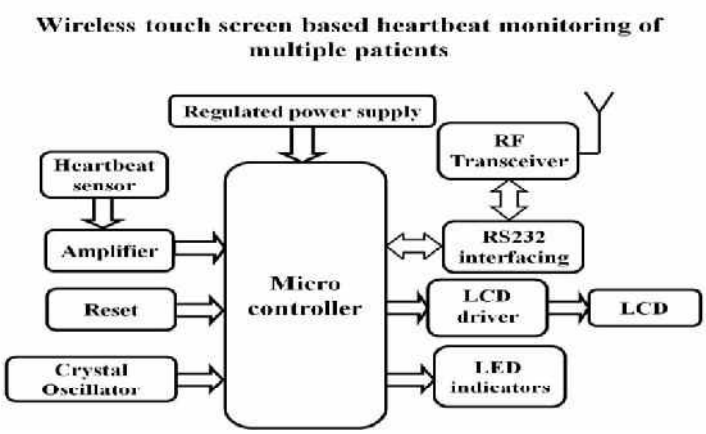

Fig 4.1 Block diagram of Heartbeat monitoring of patients using wireless Technology

For designing of an embedded system for heart beat monitoring of patients using wireless technology, the microcontrollers are to be selected. This system consists of a microcontroller which takes the input from the heart beat sensor and calculates the Heartbeat for the patients. The system design with Microcontroller, power supply, heart beat sensor, LCD, touch screen sensor, crystal oscillator, LED and LDR etc. In addition to this some more resources required like RF transceiver modules, crystal oscillator etc. which will provide additional capability use for the complete system design.

The software aspect requires controlling & observing the Heartbeat of the patients. The controllers used in the research are programmed using Embedded C language and some assembly language programming.

Regulated Power Supply

Requirements of power supply is the main task, power supply of +5V and +12V is required for the circuit. The supply of +12 V needed for the relay connections and 7805 IC which has given +5V to the circuit.

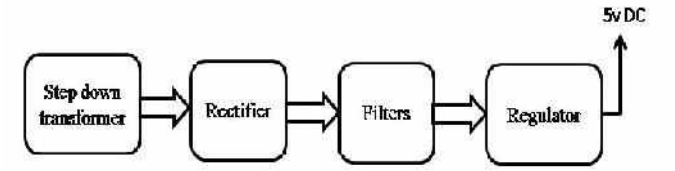

Fig 4.2 Power Supply

Microcontroller (PIC18F252)

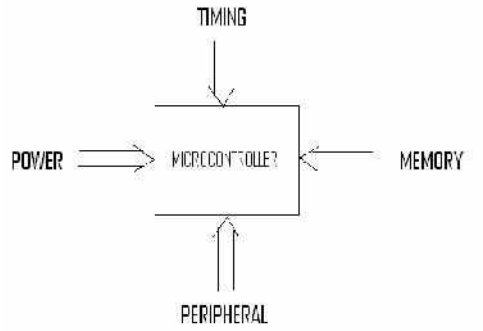

Fig 4.3 Essential block of microcontroller requirement

PIC18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536 bytes. In this work Port A is used for the analog inputs, port B is used as output port for the LCD Display and on Port C there are 4 pins used for push-button and other 4 pins are used for the LED indication.

LCD (Liquid Cristal Display) with driver

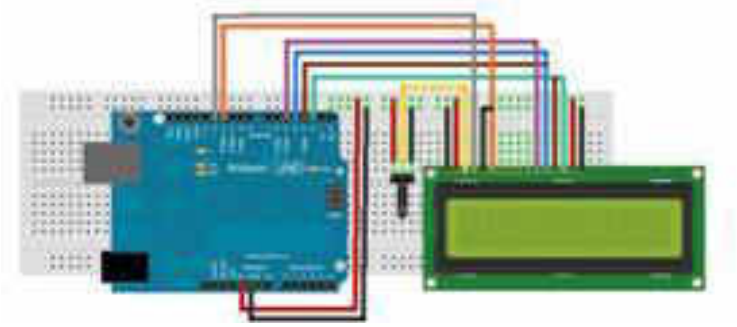

Fig 4.4 LCD (Liquid Crystal Display)

A liquid crystal display is a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light. Monochrome LCD images usually appear as blue or dark gray images on top of a grayish-white background. Color LCD displays use two basic techniques for producing color: Passive matrix is the less expensive of the two technologies.

Rf transceiver modules

Fig. 4.5 RF Module

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. In addition, reliable RF communication circuit requires careful heart beat monitoring of the patients.

GLCD with driver

Fig 4.6. GLCD with Driver

The graphical LCD used in this experiment is based on KS0108B controller, which is a 128×64 pixel monochromatic display. The KS0108B is a dot matrix LCD segment driver with 64 channel output. On the other hand, the KS0107B is a 64-channel common driver which generates the timing signal to control the two KS0108B segment drivers. The KS0108B and KS0107B are very popular controllers and have made their way into many graphical LCDs. The internal block diagram of the GLCD module is shown below.

LED indicators

A Light-Emitting-Diode (LED) is a P-N junction device (diode) that gives off light radiation when biased in the forward direction. LED chip materials are combinations of elements from the III and V columns of the periodic chart. The light emitting phenomenon makes use of the recombination within the P-N junction instead of thermal radiation, therefore, LED's are free of waste and wear and can be expected to have a long life time. The photodiode and LED are used for the photoplethysmography unit. By controlling the forward current, the radiant flux of the LED can be easily controlled. The response time of an LED is very high (a few hundred nanoseconds) and can be pulsed at greater forward currents, to obtain high intensity radiant

peaks. The resin packaging of LED's allow for superb mechanical integrity and can withstand dropping, vibration and shock. These semiconductor devices can be mounted in any position.

CONCLUSION

An automated Heartbeat monitoring system by providing real-time monitoring could go some way towards improving patient care on general wards. Such a system gathers patients' vital signs and sends them to a control room for centralized monitoring. It can provide opportunity to improve the efficiency of patient monitoring and holistic care on general Intensive Care Unit (ICU). Sensors are important components in any Heartbeat monitoring system. Relevant sensors that can be used in Heartbeat were evaluated. The focus was on wireless sensors with the capability of measuring vital signs. A wireless sensor can offer enhanced mobility and comfort to patients during hospitalization. The capability and suitability of two wireless network technologies, Bluetooth and ZigBee were examined. Due to low-power consumption and security features, ZigBee-based wireless sensor networks were adopted. Two alternative approaches of using ZigBee-based sensor networks were discussed. They differed from the network topology deployed as well as the use of master nodes that control the communication progress within the network.

With this kind of approach and resource simple and very cost effective heart beat monitoring patients using wireless technology on general Intensive Care Unit (ICU) can be designed which will be very useful in medical field, laboratories and industries where we can get better and more accurate result as compared to other devices.

FUTURE SCOPE

The Scope of research work intended to design and construct an Embedded System for heart beat monitoring patients using Wireless Technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries where we can get better and more accurate result as compared to other devices.

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DIGITAL WEIGHING SCALE USING WIRELESS TECHNOLOGY FOR COST STANDARDIZATION

Kunal D.Gaikwad[1] Dr.P.B.Dahikar[2]

[1]Department of Electronics, University Campus, RTM Nagpur University, Nagpur

[2]Department of Electronics, Kamla Nehru Mahavidyalaya, Nagpur

ABSTRACT

The Measurement of mass or weight is a fundamental part of the several industries. So design digital weighing scale system that is capable for this type of measurement with wireless technology. This wireless technology is used to maintain cost standardization; this should not vary from region to region. The three IEEE Wireless technologies standard i.e. IEEE 802.15.1 Bluetooth, IEEE 802.15.4 ZigBee and IEEE 802.11 Wi-Fi giving brief introduction about its feature and parameters. This paper gives the idea about the three wireless technologies that should be suited in embedded system .This research work introduced a new method of weight measurements. The load cell, Analog to digital Converter/Amplifier/digitizer board is used in this research work are available in market on commercial basis. This paper gives the general idea about new implementation of weight measurements system based on Amplifier/ADC/Digitizer board and wireless protocols that is used embedded system. This research work has advantage of simple design and errorless, high accuracy measuring systems. The main theme of this paper is not varying the cost from section to section and giving billing of proper quantity for proper quality using wireless technology.

Keywords: *load cell strain gauge, load measurement, analog to digital converter, personal computer. Wireless protocols, Bluetooth, ZigBee, Wi-Fi.*

INTRODUCTION

Measuring weight is a vital and essential part of many industrial and commercial purposes. It is very difficult to measure weight with proper accuracy because of errors, so that it causes many losses like customers revenue. For accurate and errorless weight measurements are to use load cell. A load cell is a transducer that is used to convert a force into electrical signal. The sensor used in weighing scale which gives out digital output is load cell. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge measures the deformation (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire. A load cell usually consists of four strain gauges in a Wheatstone bridge Configuration. Load cells of one strain gauge (Quarter Bridge) or two strain gauges (half bridge) are also available. The load cell provides an output voltage depending on the load placed on it. This cell is one of the most important applications of a strain gauge (SG) in an industrial environment. The main theme of this research work is to display how much load is placed on the cell with accuracy and with a new technique. The figure1.Shows the overall schematic idea of the load measurement system.

The wireless technology used in embedded system in large amount. The advance of wireless technologies has led to the design, progress and use of different types of wireless networks. These networks are classified according to their properties and capabilities. Wireless network technologies can be used for specific applications depend upon their characteristics. Wireless Local Area

Networks (WLANs) used to connect the devices like computer to printer, computer to computer and computer to other resources based on Ethernet technology in a local area environment. The Low-power wireless Network technologies were used to connect small devices that work on battery power within short distance; it is also called as Wireless Personal Area Network (WPAN) technology. The application of WPAN technology in weighing scale system has received increasing interest in recent years. It empowers all nodes in shop to be monitored with enhanced mobility and comfort. In this paper, three types of wireless network technologies are discussed. They include Bluetooth, ZigBee and Wi-Fi.

LOAD CELL

The load cell is the heart of weighing system. Load cells are used for detection of weight or force; it is transducers with highest accuracy in very difficult conditions. Load cells are gives information according to user requirement. Load cell are classified according to their weight measuring technique and output generated signal, then there are fallowing types of load cell: Mechanical cells, strain gauge cells and fibre optic, piezoresistive etc. In this research work strain gauge load cell C3 class IP65is used, because, it is low cost and gives output with accuracy.

AMPLIFIER /ADC/DIGITIZER

This block as shown in fig.1 consist of three circuits that are

1. Instrumentation amplifier
2. Analog to digital converter
3. Digitizer

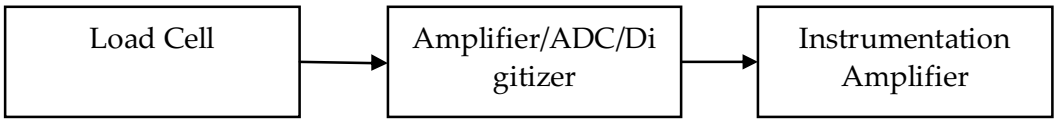

Fig.1 Schematic diagram of load measurement

Instrumentation Amplifier

It is a combination of differential amplifier and input buffers. Due to this arrangement, matching of input impedance problem can be solved. This is biggest advantage instrumentation amplifier, so that instrumentations amplifier used in measurements and testing systems. Instrumentation amplifiers are used where great accuracy and stability of the circuit both short- and long-term are required.

Analog-to-Digital Converter (ADC)

Analog-to-Digital Converter (ADC) is a mixed signal device, has both analog and digital functions. It is considered as an instrument which provides digital output that represents input voltage or current An ADC has an analog reference voltage or current against which the analog input is compared. The Resolution is a property of ADC, can be defined as the number of output bits of ADC. The analog input signal is converted to quantised output form by Analog-to-Digital Converter. The accuracy of ADC is depending on Quantization Error, but Quantization is a term that refers to subdividing a range into small but measurable increments. Quantization error is a difference between actual signal and digitised signal. These errors are measured in a unit called the least significant bit(LSB)It is 24-bit analog-to-digital converters (ADCs),consist of an onboard, low-noise programmable gain amplifier (PGA), precision delta-sigma ADC and internal oscillator, it provide a complete front-end solution for bridge sensor applications including strain gauges, weighing scales and pressure sensors. The onboard, low noise PGA has a selectable gain.

Digitizer

This is last block in above figure1. It takes input from ADC and gives outputs serial data of 9600 bps (Bits per second).This is a direct reading in kilograms. This output is directly connected to the microcontroller for display purpose in display unit. In this research work for display of reading , the output from digitizer block can be directly interface to the PC using RS-232 serial port with MAX-232 driver.

Display

For display purpose, Light Emitting Diodes (LEDs), Seven –segment display, Liquid Crystal Display (LCDs) can be used. In this research work, PC can be used for readings display purpose via serial port techniques. In the computer software, with the help hyper terminal mechanism it can easily showings readings in kilograms whatever load can be placed on the load cell.

The value shows on the display is measured value of particular item but the rate of particular item may vary from region to region so the main system can be connected to the government authority server ,so that the system is upgraded daily with new rate of items. This main system can be connected to the remote port module of weighing scale in the specific area in the ration shop. This remote port module can be connected with main system with wireless technology. Some of these wireless technologies are Bluetooth, Zigbee, Wi-Fi.

Bluetooth

Bluetooth, this slandered is first developed by Ericsson then adopted by IEEE named 802.15.1.This is basically developed to reduced the used of cable in short range applications such as mouse, Printers, keyboard, Headphones, etc. This is type of devices comes under the range of Wireless Personal Area network (WPAN). The vital features of Bluetooth is given in fallowing table I, these features takeout from 802.15.1 IEEE specification (2003)

Zigbee

The IEEE 802.15.4 group and Zigbee alliance are work together for the development of Zigbee technology; these two groups together gives industrial name to this standard is Zigbee. These two groups are work on different layers of Zigbee architecture. The IEEE 802.15.4 group are work on the of Physical (PHY) layer and Medium Access Control (MAC) layer. Zigbee alliance work on the development of upper layers and overall development of this technology. The upper layer includes application profiles layers, application frame work layers and network and security layers. The IEEE 802.15.4 standard has two types' devices Full Function Devices (FFD) and Reduced Function Devices (RFD) .The FFD has three modes of operation in Wireless Personal Area Network (WPAN) as a Coordinator, Router and end device. As far as RFD concern, it is just work as End Device. A FFD can communicate with RFD and other FFDs also, but RFD cannot communicate only with FFD. The RFD is used only for simple applications such as light switch etc., this is not used to send a huge amount of data. There are three main types of data transmission in between FFD and RFD in Wireless Personal Area Network (WPAN) i.e. from Coordinator to an End device, from an End device to Coordinator, and between two Coordinators. In Zigbee two topologies are feasible that are peer to peer and Star topology. With the concept of Peer to Peer topology, mesh and cluster tree topology are possible.

Table-I 802.15.1 Bluetooth Specification

Connection	Spread Spectrum (Frequency Hopping)
Frequency Band	ISM 2.4 GHz
MAC Scheduling	FH-CDMA
Transmission Range	>20dBm
Aggregate Data Rate	0.723-1 Mbps
Typical Transmission Range	1-10m
Supported Stations	8 active devices
Data Security-Authentication key	128 bit key
Data security- Encryption key	8 – 128 bits (Configurable)
Voice Channels	3

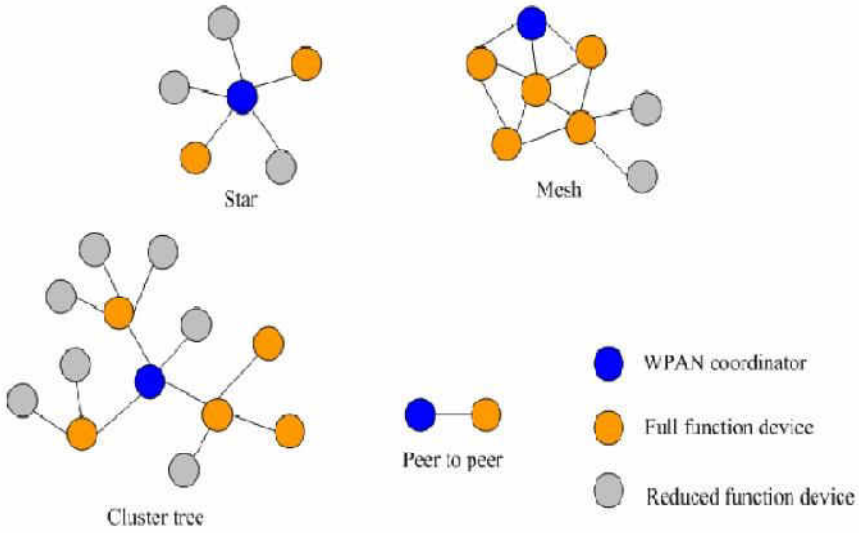

Fig 2. Zigbee network topologies

Wi-Fi

The IEEE Wireless Local Area Network (WLAN) 802.11 standard is also called as Wireless Fidelity (Wi-Fi).This WiFi divides in two mode that is adhoc mode and infrastructure mode. These two modes are divided on the basis of Acsses Point (AP) used. In Adhoc mode only stations (STAs) are used and in Infrastructure Mode stations (STAs) and Access point (AP) both are used. An infrastructure basic service set (BSS) has an access Point (AP) takes the signals from wired local area network and distributes within WLAN. The Access point provides information to all computers within network and also provides information to mobile nodes within the same range of network. The IEEE 802.11WLAN standard has formed some task group like 802.11b, 802.11a, 802.11g and 802.11n for the improvement of performance and its functionalities. Table II gives summery of 802.11 standards. Each standard has developed to words higher data rate. Higher data rate in 802.11g is achieved using orthogonal frequency division multiplexing (OFDM).The 802.11n has some improvement in data transfer rate from 54Mbps to 600 Mbps by using multiple input and multiple output (MIMO) and 40 MHz Channel. This 802.11n standard is work on 5GHz frequency range which may benefit its usage in present of other wireless system using 2.4GHz, such as Bluetooth and ZigBee.

Among all this above network technology comparing it in all standards, as far as industrial and home environments applications are concern which require longer battery life, lower data rates and less complexity than those from existing standards. For such wireless applications, a IEEE 802.15.4 Zigbee(XB) is appropriate and ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. With this type characteristics of Zigbee it used in embedded system for short distance wireless communication. The cost of daily consumer food grains updated government authority in the district main server; it is directly transfer to the ration shop where the digital weighing scale main system is placed. From this system the cost is transfer wirelessly to the remote port module, it is interfaced with the Microcontroller for data processing and sending print command to the thermal printer for final billing.

Fig.3 Remote Port Module

CONCLUSION

It is a new technique for measuring weight with the help of load cell and without using microcontroller. In this technique, it does not require any software programming, adjusting or initialization of any display. This research work was a part of design of weighing scale measurement system for purity and cost standardisations. This work gives the acceptably readings from load cell and Amplifier /ADC/digitizer systems without going for classy precision electronics Instrumentation and this research paper also has presented summery of the three most popular wireless standards, Bluetooth, ZigBee, and Wi-Fi with a comparative evaluation in terms of the transmission time, data coding efficiency, protocol complexity, and power consumption. Furthermore, the radio channels, interference and security are also compared .This paper is not suggest that this one standard is better but the demands of industrial application and suitability of network properties of standard and many other criteria like network reliability ,module price and installation cost that to be considered.

In my research work, Digital weighing scale embedded system used ,IEEE 802.15.4 Zigbee Technology because it low cost, reliable and self healing, flexible and extendable ,low power consumption, easy and inexpensive to deploy, secure, and global with use of unlicensed radio bands. Integrated intelligence for network set-up and message routing ZigBee is the only standards-based technology that addresses the unique needs of most remote monitoring and control sensory network applications.

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ZIGBEE: A WIRELESS COMMUNICATION NETWORK

S. M. Ghatole*, K. Y. Rokde[1], P. B. Dahikar[2]

*Department of Electronics, Shivaji Science College, Nagpur (M.S.) India.

[1]Department of Electronics, M. M. Science College, Nagpur (M.S.) India.

[2]Department of Electronics, Kamala Nehru Science College, Nagpur (M.S.) India.

smghatole@gmail.com

ABSTRACT

In this paper, we aim to highlight one of the most optimum technologies having its wide application in domestic and industrial sectors. ZigBee is the name derived from the waggle dance of honey bees after their return to the beehive assembling to the data transfer in our system. ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standards for networks. ZigBee is far simple and inexpensive than other short range Wireless Personal Area Network such as Bluetooth working with low data transfer rate operated on radio frequency. ZigBee is also incorporated with low power for working resulting in long battery life. ZigBee assures reliability and security in data transfer. It is low-cost, low-power, secured communication wireless mesh networking standard. ZigBee Alliance is a group of companies that maintain and publish the ZigBee standard. ZigBee is a registered trademark of this group, not a single technical standard. For non-commercial purposes, the ZigBee specification is available free to the general public. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. The specification goes on to complete the standard by adding four main components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favor total integration. The current list of application profiles either published, or in the works are: Home Automation, Smart Energy 1.0, Telecommunication Services, Health Care, RF4CE - Remote Control, etc.

Keywords: *ZigBee, RF network, Latency, Sensor, Remote control.*

INTRODUCTION

ZigBee is high level communication protocols used for small, low-power digital radios based on an IEEE 802 standard for personal area networks. It is the most popular industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. The low cost allows the

technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee has a defined rate of 250 kbps best suited for periodic or intermittent data or a single signal transmission from a sensor or input device.

WORKING

ZigBee basically uses digital radios to allow devices to communicate with one another. A typical ZigBee RF network consists of several types of devices as follows:

ZigBee Devices

ZigBee coordinator (ZC)

The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Center & repository for security keys.

ZigBee Router (ZR)

As well as running an application function, a router can act as an intermediate router, passing on data from other devices.

ZigBee End Device (ZED)

It contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

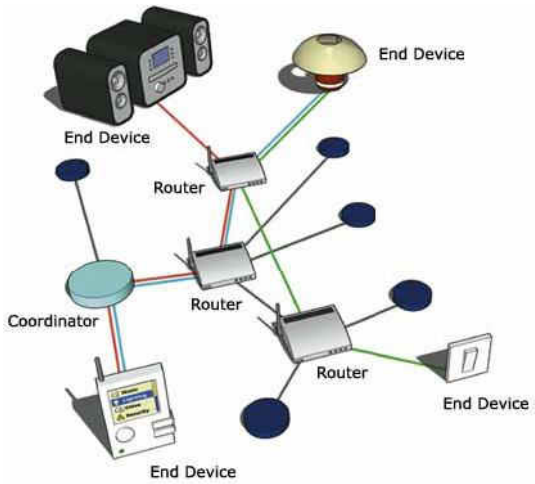

Fig.1A. ZigBee devices

Network Types

The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be

the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level.

Operation of ZigBee

ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 900 kilobits/second.

Short time delay, typically 30 ms for device searching, 15 ms for standby to activation, and 15 ms for channel access of active devices.

MODES OF OPERATION

ZigBee operates in two main modes: non-beacon mode and beacon mode.

Beacon mode

It is a fully coordinated mode in that the entire devices know when to coordinate with one another. In this mode, the network coordinator will periodically "wake-up" and send out a beacon to the devices within its network. This beacon subsequently wakes up each device, who must determine if it has any message to receive. If not, the device returns to sleep, as will the network coordinator, once its job is complete.

Non-beacon mode

It is less coordinated, as any device can communicate with the coordinator at will. However, this operation can cause different devices within the network to interfere with one another, and the coordinator must always be awake to listen for signals, thus requiring more power. In any case, ZigBee obtains its overall low power consumption because the majority of network devices are able to remain inactive over long periods of time.

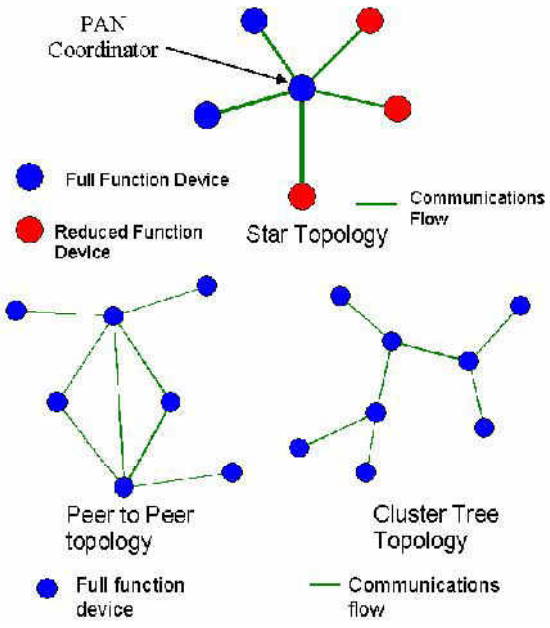

Fig.1B. Network Types

MAIN FEATURES OF ZIGBEE

Low latency

Low latency is another important feature of ZigBee. When a ZigBee device is powered down (all circuitry switched off apart from a clock running at 32 kHz), it can wake up and get a packet across a network connection in around 15 milliseconds. A Bluetooth device in a similar state would take around three seconds to wake up and respond. According to CCL home, the latency gives you some power consumption advantages and it's important for timing-critical messages. A sensor in an industrial plant needs to get its messages through in millisecond.

Low power consumption

Low Data rate

Optimized for low duty-cycle applications (<0.1%)

Range: 50m typical (5-500m based on environment)

ADVANTAGES OF ZIGBEE

Power saving

Low power consumption of communication, and standby mode

Reliability

Collision avoidance is adopted, with a special time slot allocated for those communications that need fixed bandwidth so that competition and conflict are avoided when transmitting data. The MAC layer adopts completely confirmed data transmission, that is, every data packet sent must wait for the confirmation from the receiver.

Low cost

Low cost of the modules and the ZigBee protocol is patent fee free.

Short time delay

Typically 30 ms for device searching, 15 ms for standby to activation, and 15 ms for channel access of active devices

Large network capacity

One ZigBee network contains one master device and maximum 254 slave devices. There can be as many as 100 ZigBee networks within one area

Safety

ZigBee provides a data integrity check and authentication function. AES-128 is adopted and at the same time each application can flexibly determine its safety property.

COMPARISON BETWEEN BLUETOOTH & ZIGBEE

Table 5: Difference between Bluetooth & ZigBee

Key Points	Bluetooth	ZigBee
Range	10m to 100 m	5m to 500m
Networking Topologies	Ad-hoc, very small networks	peer to peer, star, Tree, or mesh
Operating Frequency	2.4 GHz	868 MHz (Europe) 900-928 MHz (NA), 2.4 GHz (worldwide)
Complexity	High	Low
Power Consumption	Medium	Very Low
Applications	Wireless connectivity between devices such as phones, PDA, laptops, headsets	Industrial control and monitoring, sensor networks, building automation, home control and automation, toys.

FUTURE SCOPE

ZigBee Smart Energy 2.0

ZigBee Building Automation

CONCLUSION

The ZigBee technology is going to be the next big communication network. It is expected to hit the market with full force. Even the big companies have already invested millions. So we can conclude that ZigBee is low power consumption, low cost & low latency technology. Though having low data rate, we can implement the technology in many practical applications like Home Automations, Robot Advancement, Healthcare systems and Smart Meters etc.

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RECENT ADVANCES IN APPLICATIONS OF BIOTECHNOLOGY

Dr. Arti Shanware

Rajiv Gandhi Institute of Biotechnology, RTM Nagpur University

INTRODUCTION

Biotechnology can be defined as "using organisms or their products for commercial purposes." Baking bread, brewing alcoholic beverages, and breeding food crops or domestic animals were the early days' biotechnology applications. But recent developments in molecular biology have given biotechnology new dimensions. It is now Modern biotechnology that has captured the attention of the public. Modern biotechnology can have a dramatic effect on the world economy and society. It is a group of technologies that work together. The applications of biotechnology include therapeutics, diagnostics, genetically modified crops for agriculture, processed food, bioremediation, waste treatment etc.

APPLICATION OF BIOTECHNOLOGY IN MEDICINE

Biotechnology has opened up a whole new world of possibilities in the field of medicine. The wide range of applications has in turn added vast potential to the field of medicine. Various 'genetic markers' have been developed to identify malignancies of the breast, colon, bronchus and prostrate. Biotechnology also holds enormous potential for fertility control, Safe organ transplant and manipulation of the body's immune system. Many potential drug targets have already been identified. These include key metabolic enzymes, growth factors, hormones, transmitter substances, oncogene products. The supremacy of r-DNA technology can be directed at these targets to fully characterise them. DNA analysis can be used to predict amino acid sequence of cloned target genes and the effect of changes brought about by the site directed mutagenesis could be demonstrated in terms of structure function. Such knowledge is essential for computer-aided drug designing programmes.

This is another area where r-DNA methods have proved successful. In the past, vaccine development used empirical methods to derive attenuated or killed vaccines to increase safety of the products. Recombinant methods enable the researcher to dissect the gene for the active immunogen from the host organism and to introduce it into a more convenient and benign system for high expression levels [1]. Designer or Tailor made drugs is yet another development, which is specifically personalized to manipulate whole or parts of individual genes and to suppress or induce specific actions.

Insulin used for diabetes was earlier extracted from pancreas of slaughtered cattle and pigs which caused some patients to develop allergy or other types of reactions to the foreign protein. Insulin in humans is synthesized as a pro-hormone which contains an extra stretch called the C peptide. This C peptide is not present in the mature insulin and is removed during maturation into insulin. The main challenge for production of insulin using rDNA techniques was getting insulin assembled into a mature form., Eli Lilly an American company in 1983, prepared two

DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin [2].

Another application in the field of medicine is Gene therapy; it is a collection of methods that allows correction of a gene defect that has been diagnosed in a embryo. Here genes are inserted into a person's cells and tissues to treat a disease [3]. Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene.

BIOTECHNOLOGY IN FOOD AND BEVERAGE INDUSTRY

Enzymes are biological molecules present in various organisms. Microorganisms have been found to be a rich source of industrially important enzymes. One such enzyme is xylanase. Different types of xylanases have been identified and isolated by genetic manipulation. These include digestive enzymes for natural fibers like wood, pulp and cellulose. Xylanases play a very positive role in improving the quality of baked products. Many people have been found to display allergic reactions after eating peanuts. To combat this problem, it is essential to identify the cause of this allergy. For this purpose, a highly sensitive immunological assay has been developed by a Netherland based company to detect peanut proteins in foods. This is the first peanut assay with commercial applications [4] .Acacia gum is predominantly used as an emulsifier in the food industry due to its emulsifying and stabilization properties. Using new molecular tools, emulsifiers are now synthesized from covalently coupled carbohydrates like starch, pectin, sugar and proteins from wheat, milk and soya bean [5].Apart from these food biotechnologies has evolved in making edible mushrooms, algal food products with high protein value and artificial sweeteners [6]

BIOTECHNOLOGY IN AGRICULTURE

The Green Revolution succeeded in increasing the food supply but it was not enough to feed the growing human population. Increased yields have partly been due to the use of improved crop varieties, but mainly due to the use of better management practices and use of agrochemicals.However, agrochemicals are often too expensive, and further increases in yield with existing varieties are not possible using conventional breeding. The discovery of DNA in 1954 led to breakthroughs in Biotechnology. Techniques were developed that would enable individual genes that make up a DNA code to be modified to express or suppress important traits such as fruit yield, wood quality, fat content or disease resistance – a process known as genetic modification (GM).Although early applications of this technique involved the manipulation of a host's own genome .Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO). GM plants have been useful in many ways. Genetic modification has: made crops more tolerant to abiotic stresses (cold, drought, salt,heat), reduced reliance on chemical pesticides (pest-resistant crops), helped to reduce post harvest losses, increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil), enhanced nutritional value of food, e.g. Bt toxin is produced by a bacterium called *Bacillus thuringiensis* (Bt for short). Bt toxin gene has been cloned from the bacteria and been expressed in plants to provide resistance to insects without

the need for insecticides; in effect created a bio-pesticide. Examples are Bt cotton, Bt corn, rice, tomato, potato and soyabean etc.Bt Cotton: Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). *B. thuringiensis* forms protein crystals during a particular phase of their growth. These crystals contain a toxic insecticidal protein [7]. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis and eventually cause death of the insect. Specific Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton.

Several nematodes parasitise a wide variety of plants and animals including human beings. A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi). RNAi takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate [8].

The first GM crops on the market were engineered for herbicide tolerance; these were soon followed by plants engineered for pest resistance. Now almost all commercially approved GM crops still have one or both of these traits. The GM crops fall into four major areas, which can be described as follows [9]:

1. Improved first-generation crops that focuses on input traits but using innovative approaches

2. Novel second-generation crops that aims at delivering better output traits

3. Third-generation crops deliver value added products

The improvement of nutritional quality of crops has been one of the main objectives of plant genetic engineering. The modification of metabolic pathways could lead to the qualitative and quantitative improvement of specific nutritional components one such example is of ''Golden Rice'', a producer of pro-vitamin A [10].

THE GM DISPUTE

Some argue against the principles of genetic modification .Proponents for GM claim that through GM crops, trees, livestock and fisheries, biomass (including food and fiber) production can be enhanced while indirectly reducing environmental impacts, for example, through less use of pesticides or fertilizers. They also challenge that GM can improve the nutritional value of many crops, or reduce the possible food safety risks.

Opponents claim that the potential direct impacts of GM crops on biodiversity and human health are unknown and are potentially so damaging that a pause must be placed on all GM products until more information is available. The governments of all the countries over the world should have uniform regulatory frameworks that presumably meet these criteria. Others emphasise the indirect impacts that GM crops can have on traditional farming patterns, conservation efforts, livelihoods and trade.

While the science supporting biotechnology in general is substantial and growing quickly, the full original function of the modified genes of GM organisms is unknown, or only partially understood. As genes work in tandem with many other genes and are affected by multiple influences both within and beyond the cell, it is difficult to know with precision the function of a modified or transplanted gene, let alone the ecological consequences of its introduction into a plant or animal that is released into the environment. Thus the widespread introduction of GM products could be seen as premature, presenting largely unpredictable risks to both human health and the natural environment.

BIOTECHNOLOGY IN BIOMATERIALS

Metabolite Profiling and Gene Expression are the exploring techniques in Biotechnology. Metabolic profiling measures changes in gene expression such as 2-D gel, mass spectrometric, protein profiling and cDNA microarray analysis .Differential gene expression identifies the genes expressed in response to specific environmental cues or stresses, while metabolic profiling measures the metabolites[11]. When combined, these techniques promise a commanding means of assigning functions to previously uncharacterized genes, as in the field of functional genomics. Biotechnology of biomaterials presents use of metals and chemicals as Biomaterials and bio-soft-materials like Hydroxyapatite (Extracted from garden snail shell (*Helix Aspersa*)), Zirconia, Alumina [12] used in the dental implants .Bioactive glass (BAG) S53P4 is a bone bonding biomaterial, osteoconductive and osteostimulative bone substitute with proven antibacterial properties [13]. One of the best methodologies in the Bioprocessing techniques is Response Surface Methodology (RSM) it has many applications in the modern Processing units and studies. It can make easier optimization of Production of various Proteins [14] and other compounds like pigments or more efficiently Flavonoids [15].Biotechnologists have created an interdisciplinary art to activate biological molecules and cell organelles that are chemo mechanically controlled systems to work as an electronic device leading to construction of micro tubule (MT) molecule which is modeled to function as a diode in electronic parameters [16]. Another innovation of Biotechnology includes development of an Immunosensor which is dependent on immobilization of antibody molecules that can be used in fabrication of immunosensors [17]

CONCLUSION

Biotechnology is research based and multidisciplinary. Successful development and application of biotechnology are possible only when a broad research and knowledge support in several subjects such as, microbiology, biochemistry, molecular biology and plant breeding exists. Biotechnological programs must be fully integrated into a research background. Modern biotechnologies should be used as adjuncts to-and not as substitutes for conventional technologies in solving problems and that their application should be need driven rather than technology-driven.

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IN-VITRO MICROPROPAGATION IN SESMUM NIGRUM

Moghe Sandhya[1], Megha Diwate[2], Dakhore S[2], Laud Dipti[1] , Bansod Ishani[1] , Ade Gauri[1] Padole Mithun[1]

1Department of Biotechnology, Kamla Nehru Mahavidyalaya, Nagpur.

[2]Department of Botany, Kamla Nehru Mahavidyalaya, Nagpur.

ABSTRACT

In vitro shoot regeneration and callus induction was achieved from shoot tip and cotyledonary leaf explants of Sesamum indicum nigrum L. on MS basal medium supplimented with different combinations and concentrations of cytokinins and auxins. The highest percentage (83.44%) of shoot regeneration was observed from shoot tip explant cultured on MS basal medium with BAP+ KIN (1:1) mg/l combination. Cotyledonary leaf explants however reported 20% callusing on MS basal medium with 2,4 D+KIN (0.5+0.5 mg/l).

Key words: *Seasame, Sesamum indicum nigrum, shoot regeneration and callus induction.*

INTRODUCTION

Sesamum indicum L. is one of the oldest oilseed crops known, it belongs to family Pedaliacea. It is an annual plant growing 50-100cm. tall. Leaves are opposite , long with an entire margin . The flowers are yellow, tubular, 3-5 cm long with four lobed mouth. The fruit naturally splits opens to release the seeds. Seeds are small, seeds coat may be smooth or ribbed. The seed coloration are variable may be brown, red , black yellow & white . Sesame seeds are an important source of edible oil and widely used in medicine. The seeds contain 50 - 60 % oil, which had excellent stability due to natural antioxidants such as sesamolin, sesamin and sesamol (Brar and Ahuja, 1979).Sesamolin and sesamin are known to reduce cholesterol level and prevent high blood pressure. Cephalin, a phospholipid from sesame seed has been reported to possess haemostatic activity. Sesame oil is known to maintain high density lipoprotein (HDL) and lower the low density lipoprotein (LDL). It is also used in the production of paints, soap, perfumes, pharmaceutical and insecticidal product (Oplinger *et al*., 1997).

Large scale production of sesame by conventional means is limited due to incidences of diseases and loss of valuable seeds due to the shattering habbits of the pods. Propagation of this plant may help to produce large number of plantlets by tissue culture methods and also to improve pod structures to eliminate wastages brought about by shattering.

Sesame is highly recalcitrant to regeneration under *in -vitro* conditions. However, number of protocols for micropropagation (Rao and Vaidyanath, 1997 Gangopadhyay *et al.,* 1998; Sharma and Pareek, 1998), somatic embryogenesis (Jeyamary and Jayabalan, 1997, Xu *et al.,* 1997) and indirect adventitious shoot regeneration (Taskin and Turgut, 1997, Younghee, 2001) have been achieved with low frequency. However, there are no report on high frequency *in vitro* shoot

regeneration and flowering of *Sesamum indicum* L. Taskin *et al*., (1999) studied the *in vitro* regeneration of sesame while George *et al*.,(1987) worked on in vitro propagation and shoot tip culture of different cultivars. The protoplasts of sesame were isolated, cultured and induced to form calluses (Bapat *et al*., 1989). In present studies, *In-vitro* seed germination, Induction of callus and multiple shoots of *sesamum indicum nigrum* is reported.

MATERIALS AND METHODS

Seeds of *Sesamum indicum nigrum* were collected from market. The healthy seeds were selected from the common seed lot as seeds were infected with bacteria & fungi, and were surface sterilized to avoid contamination. Seeds were washed under running tap water for 2-3 minutes. Transfer the seeds in liquid detergent solution for 10 minutes. Seeds were then washed with autoclaved distilled water for 2-3 times so that all detergent can be removed from the flask. The seeds were transferred in 0.1 % Bavistin solution for 20-30 minute under continuous shaking. Wash the seeds 2-3 times with autoclaved distilled water and later were transferred in 0.1 % mercuric chloride solution for 7-8 minutes. Wash the seeds 2-3 times with autoclaved distilled water. Soak surface sterilized seeds on sterilized tissue paper and inoculated one by one on pre-sterilized seed germination medium (Half MS).

From *In-vitro* raised seedlings shoot tip and Cotyledonary leaves were dissected. The explants were collected in petri plates and dried by placing them on sterile filter paper. Murashige and Skoog, 1962(MS) medium dispensed in glass test tube (15x125 mm) autoclaved 15 psi and at 121°C for 15 min. was used for inoculation.

Explants were inoculated under aseptic conditions in test tubes containing Murashige and Skoog (MS) medium with different hormone combinations. For shoot tip culture (BAP+ Kinetin (2.0mg + 1.0mg/L) and BAP + Kinetin (1.0mg + 1.0mg/L)) were used. All these explants inoculated one by one in shoot multiplication medium. After isolation and inoculation culture flask & bottles were incubated in culture room at 27±2 º c at 16:8h photoperiod. Cotyledonary leaves explants were used for callus induction to determine callus induction percentage and also to see response of somatic embryogenesis. For callus induction MS medium with 2, 4, D+Kinetin (0.5+0.5 mg/L) was used. Cotyledonary leaves were cut into small pieces with the help of sterile scalpel and forceps aseptically in laminar air flow cabinet and cultured them with MS medium having 2,4,D+Kinetin 0.5+0.5 mg/L phytohormone combination. After isolation and inoculation culture flask and bottles were incubated in culture room at 27± 2 ºc at 16:8 hrs. Photoperiod.

RESULTS & DISCUSSION

The evaluation of seed germination percent was done for sesamum *indcum nigrum L.* using healthy seeds. From the observations it was seen that out of total 565 seeds 355 were germinated. 62.83% seed germination was seen (Table No.1) (Photo plate No.1, Photo plate No.2)

Shoot tip and Cotyledonary leaves explants from germinated seedlings were further evaluated for shoot induction and callus induction. Evaluation for shoot tip induction was done using two different combinations of auxin and cytokinin.

Table 1. In-*vitro* seed germination response in *Sesamum indicum nigrum*

Lot no.	No. of seed inoculated	No. of seed germinated	Germination (%)
1	100	80	80
2	100	75	75
3	90	45	50
4	75	40	53.33
5	100	55	55
6	100	60	60
Total	565	355	62.83

In BAP +Kin (1.00 mg/L each) (Table No.2) 145 shoot tip explants were inoculated. Out of 145, 121 explants responded to regeneration. The percentage of explants showing regeneration was recorded as 83.44%.

In another combination BAP (2.00 mg/L) +Kin (1.00 mg/L) (Table No.3) 135shoot tip explants were inoculated. Out of which 107 explants responded to regeneration. The regeneration percent of explants was recorded as 79.25%.

Table 2. Effect of MS + BAP+Kin(1.00 mg/L each) concentration on Multiple shoot induction from shoot tip explants

Lot no.	No. of explants inoculated	No. of explants responded to multiple shoot induction	Multiple shoot induction%
1	30	28	93.33
2	25	22	88
3	30	21	70
4	25	20	80
5	35	30	85.71
Total	145	121	83.44

Table 3. Effect of MS+BAP (2.00 mg/L)+Kin(1.00 mg/L) concentration on in –vitro Multiple shoot induction from shoot tip explants

Lot no.	No. of explants inoculated	No. of explants respond to multiple shoot induction	Multiple shoot induction%
1	25	21	84
2	30	25	83.33
3	30	24	80
4	30	19	63.33

5	20	18	90
Total	135	107	79.25

It is observed that in-vitro multiple shoot regeneration percent is enhanced when concentration of BAP was double while it reduces when equal concentration of kinetin and BAP was used. BAP(1.00 mg/L)+Kin(1.00 mg/L) was seen to have regeneration percent upto 83.44% where as BAP (2.00 mg/L)+Kin(1.00 mg/L) showed 79.25% shoot regeneration.(Table No.4) (figure No.3, figure No.4)

Cotyledonary leaves as explants were inoculated on MS (Murashige & Skoog,1962) medium containing 30 gm/L glucose, 100 mg/L inositol and 10 mg/L thiamine with 2,4,D and Kinetin (0.5+0.5 mg/L). The callus induction percent was evaluated for these explants (Table No.5)

Table 4. In-vitro response of shoot tip explants for multiple shoot induction

Lot no.	Media Composition	No. of explants inoculated for multiple shoot induction	No. of explants responded to multiple shoots	Multiple shoot induction%
1	BAP + KIN 1:1 (mg/L)	145	121	83.44
2	BAP + KIN 2:1 (mg/L)	135	107	79.25

Table 5. In-vitro callusing efficiency of cotyledonary leaf explants

Media Composition	Lot no.	No. of explants inoculated	No.of explants responded to callus induction	Callus induction%
2,4,D+Kinetin 0.5+0.5 mg/L	1	15	3	20
	2	20	0	0
	3	25	1	4

Highest percentage for callus induction for the combination was recorded as 20%

DISCUSSION

In the present study seeds were sterilized using 1.0 % Bavistin solution (w/v) and 0.1 % mercuric chloride (w/v). Seeds were inoculated on half MS media for germination. Seed germination percentage was found to be 62.83%. (Beatrice A. et.al. 2006) also performed seed sterilization by treating seeds with 70% ethanol,50% commercial bleach containing 0.05% between 20 and inoculated them on half MS media in perti plates for germination. Similarly (Chattopadhyay et.al. 2009) also treated seeds with 0.2% $HgCl_2$ and were germinated on hormone free MS medium. They used 4-6 week old seedlings for further regeneration. However, (Raja & N. Jayabalan , 2011) did sterilization with 2% teepol,70% ethanol and 0.1% aqueous mercuric chloride and inoculated in tubes containing moistened cotton for germination. In the present study 7-15 days old seedlings were used for shoot isolation.

The media used for regeneration was MS media supplemented with 30 gm/L glucose, 100 mg/L inositol, 10 mg/L thiamin and different concentration and combination of plant growth regulators such as 2,4-D(2,4-dichlorophenoxyacetic acid) and kinetin for callus induction and BAP(Benzylaminopurine), Kinetin for multiple shoot induction. (Raja & N. Jayabalan 2011) carried out studies on shoot regeneration using shoot tip explant on MS medium containing 3 % (w/v) sucrose, 0.8 % (w/v) agar,and supplemented with BAP and Kin (1.0 - 3.0 mg/l) alone or in combination with NAA (0.1 - 0.5 mg l-1).

In the present study two different explants were used for screening of regeneration potentiality. Shoot tip explants were used for induction of multiple shoots and cotyledonary leaf explants used for the callus induction. Shoot proliferation were studied the two combinations of growth regulators such as BAP and kinetin(2:1 & 1:1 mg/l) out of which BAP+ Kinetin 1:1 *mg/l* was observed to have more shoot induction percent. Multiple shoot bud induction was favorable when MS medium supplement with BAP (1 mg/L) and Kinetin (1 mg/L) was used. Such studies were reported by A. Raja and N. Jayabalan(2011)using BAP and NAA.(Chattopadhyaya et.al.2009) reported shoot organogenesis on MS medium supplemented with 3% sucrose and phytohormones alone or in different combination such as 6-benzyladenine (BA), kinetin,2,4 –D, 2,4-D+BA; 2,4-D+kinetin; IAA+kinetin; IAA+BA; NAA+BA. The result for shoot regeneration was seen in NAA+BA combination only.

The studies carried out by (Shilpa V. Malaghan *et.al*,(2013) used de-embryonated cotyledonary explant. The simple cotyledonary explant was used by (Samuel *et.al*,(2006)).

For the callus induction MS medium with phytohormones 2,4,D and Kinetin (0.5+0.5 mg/L)were observed to be the best .The callus regeneration percentage for the present study was seen to be 20%. Callus induction was also observed by (Sina Ghanbari *et.al* (2014)) using MS medium.

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Sesame Plant

Black sesame seeds

Photoplate No.1

Photoplate No.2

Photoplate No.3 BAP+KIN 1:1 mg/l

Photoplate No.4 BAP+KIN 2:1 mg/l

Cotyledonary explant

Callus induction 2,4-D+kinetin 0.5+0.5 mg/l

Photoplate No.5

ALGAL FLORA'S RELATION WITH PHYSICO-CHEMICAL PROPERTIES OF VEGETABLE FIELD SOIL OF NAGPUR

Vaishali Charjan and J.L.Tarar

Botany Department, Kamla Nehru Mahavidyalaya, Nagpur.

ABSTRACT

Soil constitutes the envelope of earth which consists of loosely arranged layers of materials composed of inorganic and organic constituents in different stages of organization, the soil which is formed as a result of the weathering of rocks, harbors diverse microorganisms, such as viruses, bacteria, fungi and algae etc. These organisms play a key role in soil ammonification, nitrification and nitrogen fixation. The combined effect of all these reactions is that the soil becomes a fertile medium for the growth of plants. Thus there is a very close relation between algal flora and physio-chemical properties of soil.

The factors most influential in determining the growth and distribution of soil algae are sufficiently porous soil, soil pH (alkalines8.0-8.4) and the physical and chemical properties of the soils. From this it can be concluded that the soil conditions of vegetable crop fields of Nagpur are quite suitable for the growth of soil algae, especially BGA.

INTRODUCTION

Soil is a dynamic system comprising of physical, chemical and biological components. While physical and chemical status of the soil have a bearing on the fertility level of the soil. Very close relationships present in nature between plants and soil. Particular types of soils favoring the growth of the particularly species of plants. Thus the distribution peculiarities are determined by edaphic factor.

The important role played by microorganisms in relation to the soil and plant growth, it is no surprise that they have been studied extensively. The factor determining the composition of these organism in the soil and the chemical, physical and physiological changes brought about by various microbial activities which in turn have a profound effect on the surface and fertility of the soil have been worked out in considerable details by Bristol, 1926, 1927; Martin and Waksman, 1940;Lund, 1947; Martin, et. al., 1955. Tarar and Kottawar, 1985.

For good plant growth the soil should also be in good physical condition which ensures proper supply of air and water Prakash and Kumar (2014), Mishra et.al. (2013). Goyal, 1997; reported that the productivity of the soil largely depends upon the availability of the nutrients which in turn is regulated by the microbial population. Present investigation was therefore undertaken to study the relation between algal flora and physico-chemical properties of soil.

MATERIAL AND METHODS

For physic-chemical analysis, soil samples were collected from dozen of places from the area around the plant from the agriculture college vegetable field, Nagpur and were thoroughly mixed, a grab sample weighing about 1 kg. Was taken from this mixture and was brought to the laboratory.

Mechanical compositions of soil

Air dried soil samples were crushed in a morter and sieved thro2mm sieve for analysis. The sieved material was mixed thoroughly and preserved in labeled bag for further analysis. Physical and chemical analysis was carried out from above soil samples.

Texture of soil

Mechanical analysis of soil consists of determination of percentage of particles of different sizes (sand, fine sand and clay) as they exist in the soil. Known quantity of air dried soil was passed through different grades of standard sieve used for mechanical analysis.

Determination of soil pH

pH measures the hydrogen ion concentration in the soil water 20 gms. Of the soil was taken in a 100ml. beaker and boiled water was added in the ratio 1:4 and stirred with glass rod to attain uniformity. The beaker was gently tapped on the table and electrodes (glass and calomel) were passed into the soil. Several reading was taken and constant reading was taken down.

Moisture determination

It was determined by taking 10gms. Of air dried soil in weighed aluminum box kept in an oven at 105C for 24hours. The aluminum box along with soil sample was weighed again. Difference in weight gave the corresponding loss of moisture. The heating was repeated again for 2 to 3 days more till constant loss in weight was obtained. The difference in initial and final weight gave the amount of moisture lost from the respective soil. From this moisture was calculated.

Apparent density or bulk density

The bulk density of soil is the mass of the soil per unit volume and porosity of soil is the fraction of soil volume not occupied by soil particles.

A large weighing bottle of about 50mL. Capacity without the stopper was weighed. The bottle was filled with soil by tapping the bottle about 20 times and weighed again. The soil was removed and the bottle and the exact volume of the water needed to fill the bottle were noted. The apparent of bulk density is obtained baby dividing the weight of the soil with volume of soil.

$$\text{Apparent density} = \frac{w1 - w2}{v} \times \text{g/cm3}$$

Where, w1 = weight of empty bottle

w2 = weight of bottle and soil

v = volume of soil or volume of water needed to fill the bottle

Absolute specific gravity

100ml specific gravity bottle was weighed and then filled with water completely, all moisture from outside was wiped out and weighed again. 10grms. of air dried soil was taken in beaker and few ml of water was added and boiled for a short time in order to expel all air. Bottle was filled with soil transferring and filled with water. Wiped out all the moisture from outside and weighed. Absolute specific gravity calculated with the help of following equation:-

$$\text{Absolute specific gravity} = \frac{10}{w2 + 10 - w3}$$

Where w2 = wt. of bottle + water

w3 = wt. of bottle +soil + water

Available phosphoric acid, total nitrogen content, calcium carbonate, organic carbon, available potassium, exchangeable sodium, exchangeable calcium, exchangeable magnesium was also analyzed by suitable method.

RESULT AND DISCUSSIONS

The results of the physical and chemical analysis of soil and number of algal taxa observed have been tabulated in table 1and 2.

Available moisture

The results indicate that the samples with good number of algal species. The moisture content of brinjal field was 7.85 and the soil showed comparatively less number of algal species i.e. 110. In the soil of tur moisture content was 8.10 and the soil showed comparatively more number of algal taxa i.e. 182. In case of chilly, in spite of less moisture content 7.50 as compared to brinjal (7.85) the growth of fairly good no. (141) of algal species was noticed, which might have been due to the influence of others factors like phosphate nitrogen content and texture of soil content etc.

Subba Raju, 1967; reported that the development of algal flora was generally correlated with high water holding capacity. High moisture contents and water holding capacity encourage algal growth (Goyal, 1997). Tsujimura, ET. al., 1998 conducted that water content in soil was more important than the effect of soil salinity for the distribution of Nostocacean Cyanobacteria.

Texture of soil

It is second important factor. The sand content in chilly field's soil was observed 22%. The number of soil algae was also good in this soil. Due to the porous nature of soil, light rays can penetrate deeper, and the algal spores can also be carried down along with the percolating water maximum pore space was observed in tur field soil .i.e. 35.6% with 182% algal species. In brinjal field sand, clay and slit constitute 64.83% which was highest in the present study. The relatively poor algal flora substantiates the above observation. Similar observation was made by Marathe (1996) and Chaudhari (1979). Soil algal communities are primarily depends upon the nature of soil reported by Kushwaha and Agarkar, 1993.

Effect of ph

All the soil samples collected from vegetable fields had a favorable range of pH 8.2-8.5 within this range; it was very difficult to assess the effect of pH on the soil algae. However it was seen that this pH range favored the growth of soil algae. Soil sample from tur field with high pH i.e. 8.5 supported large number of algal species, particularly BGA (132), members of chlorophyceae (29) obtained were comparatively less, which was probably due to alkaline nature of soil. Most of the workers obtained more blue green in alkaline soils and green in acidic soil. Bhattacharya, ET. al., 1998 reported that increase of the pH values of the red and lateritic rice soils through application of lime, improved growth and relevant physiological properties of cyanobacteria.

Temperature of humidity

During the period of investigation i.e. 1998-99 humidity % during the months of July and November was very high (69-87%) and maximum temperature ranged from 29C-33C. both humidity and temperature was favorable for the growth and establishment of blue green algae. Similar observations were made by Bokhe, 2000.

Soil nutrients

Soil nutrients always influence the nature of soil algal flora when other factors such as moisture and pH are not limiting. Soil samples with rich algal population were either rich in nitrogen or phosphate or both. In addition it was observed that less amount of potassium was and organic matter supported less number of algal species (brinjal field).merbach, et.al. 1999 reported that the root borne carbon and nitrogen compounds influences the nutrient balance of soil and plant directly or indirectly by microbes.

CONCLUSIONS

From all the factors discussed above, it may be concluded that, there was close relationship between algal flora and physic-chemical properties of vegetable properties of vegetable field soil. The factors most influential in determining the growth and distribution of soil algae are sufficiently porous soil, good moisture supply in soil, soil pH (alkaline pH 8.0-8.4, which is most favorable for the growth and predominance of BGA in these soils) and the physical and chemical properties of the soil. However no single factor can alone determine the algal composition of a particular soil. When all the factors are optimum of a particular soil good algal growth was obtained in the soil. Since large number of algal species were found in soil samples studied in the investigation it can be concluded that soil condition in these vegetable crop field are quite suitable for the growth of the soil algae.

Nagpur soils are rich in BGA and they show a marked diversity in flora. Chroococcus, aphanocapsa, Aphanothec, Oscillatoria, Phormidium, Lyngbya, Cylindrospermum, Nostoc, Anabaena, Auslosira, Scytonema, Calothrix, Westiollopsis, Chloroccoccum, Chlorella, Navicula, Nitzschia are common genera of the fields.

Table –1 Physical analysis of the soils from different crop field

Samples		**Brinjal**	**chilly**	**tur**
mechanical	Coarse sand %	10.83	10.10	18.1
composition	Fine sand%	9.20	11.90	17.5
	Silt %	20.93	25.10	21.61
	Clay %	43.90	37.25	35.40
Air dry moisture		7.85	7.50	8.10
Maximum water holding capacity%		21.72	19.50	24.5
Apparent density		1.56	2.5	2.00
Absolute specific gravity		1.93	1.55	1.90
Pore space%		36.82	31.50	37.85
Volume expansion%		13.71	13.60	12.40

Table – 2 Chemical analysis of the soils from different crop field

Samples	**Brinjal**	**Chilly**	**Tur**
Soil pH	8.2	8.4	8.5
Caco3	5.25	5.50	4.90
EC	0.14	0.14	0.25
Organic matter	0.620	0.616	0.655
Total carbon %	0.41	0.43	0.46
Total nitrogen %	0.041	0.043	0.046
P2O5 Kg/ha	25.0	27.9	47.4
K2O Kg/ha	276.0	308.0	337.0
Exchangeable Na/100g	1.629	1.793	1.783
Ca meq	30	22.10	19.90
Mg meq	3.75	6.50	4.50
Number of total algal species	110	141	182

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TO DETECT THE PREVALENCE OF SICKLE CELL DISEASE AMONGST STUDENTS OF HISLOP COLLEGE NAGPUR, COMING FROM VARIOUS REGIONS OF INDIA

Hemlata A. Job

Head Department of Biochemistry, Hislop College, Nagpur.

INTRODUCTION

Sickle-cell disease or **sickle-cell anemia** or **drepanocytosis** is a genetic life-long blood disorder characterized by red blood cells that assume an abnormal, rigid, sickle shape. Sickling decreases the cells' flexibility and results in a risk of various complications. Healthy red blood cells typically live 90-120 days, but sickle cells only survive 10–20 daysThe sickling occurs because of a mutation in the hemoglobin (Hb) gene giving rise to HbS (sickled Hb). Sickle-cell anaemia is also referred to as "HbSS", "SS disease", "haemoglobin S" if the mutation is homozygous. In heterozygous people, who have only one sickle gene and one normal adult hemoglobin gene, it is referred to as "HbAS" or "sickle cell trait". Other, rarer forms of sickle-cell disease include sickle-haemoglobin C disease (HbSC), sickle beta-plus-thalassaemia (HbS/β^+) and sickle beta-zero-thalassaemia (HbS/β^0). These other forms of sickle-cell disease are compound heterozygous states in which the person has only one copy of the mutation that causes HbS and one copy of another abnormal haemoglobin allele.

INHERITANCE

Sickle-cell anaemia is caused by a point mutation of a single nucleotide (single nucleotide polymorphism) in the β-globin chain of haemoglobin, causing the hydrophilic amino acid glutamic acid to be replaced with the hydrophobic amino acid valine at the sixth position. The β-globin gene is found on the short arm of chromosome 11.It is inherited in the autosomal recessive pattern.The association of two wild type α-globin subunits with two mutant β-globin subunits forms haemoglobin S (HbS) as opposed to the normal adult HbA.

The inheritance pattern is as follows:

- If one parent has sickle-cell anaemia (SS) and the other has sickle-cell trait (AS), there is a 50% chance of a child's having sickle-cell disease (SS) and a 50% chance of a child's having sickle-cell trait (AS).
- When both parents have sickle-cell trait (AS), a child has a 25% chance (1 of 4) of sickle-cell disease (SS).
- If both parents have sickle cell disease, which is rare, then all their offsprings will have sickle cell anemia (SS).
- A person that receives one defective and one healthy allele remains healthy, but can pass on the disease and is known as a carrier.

OCCURRENCE

The SCD is a commonest single gene disorder; 50% of world population of SCD resides in India. The average frequency of SCD gene ranges between 22 to 44 % . Approximately 3.2 million populations belong to high risk communities in Central India. The disease is found predominantly amongst certain high-risk communities belonging to schedule caste, schedule tribe and other backward classes

The possibilities of existence of abnormal types of hemoglobins in various combinations with the S-gene, resulting in different hemoglobinopathies, are potentially present.

It may be mentioned that reports of sickle cell anemia in India are rare because there has been a lack of awareness of the disease entity in these regions, together with the difficulty in making a rapid and certain diagnosis. In a study carried out at Nagpur the occurrence of cases of sickle cell disease and sickle cell trait in some families in Marathi speaking population mostly drawn from the low economic groups & mostly from the Mahar and Koshti communities was reported. This indicates the existence of another focus in this region of our country **(Nagpur** and surrounding districts)**.**

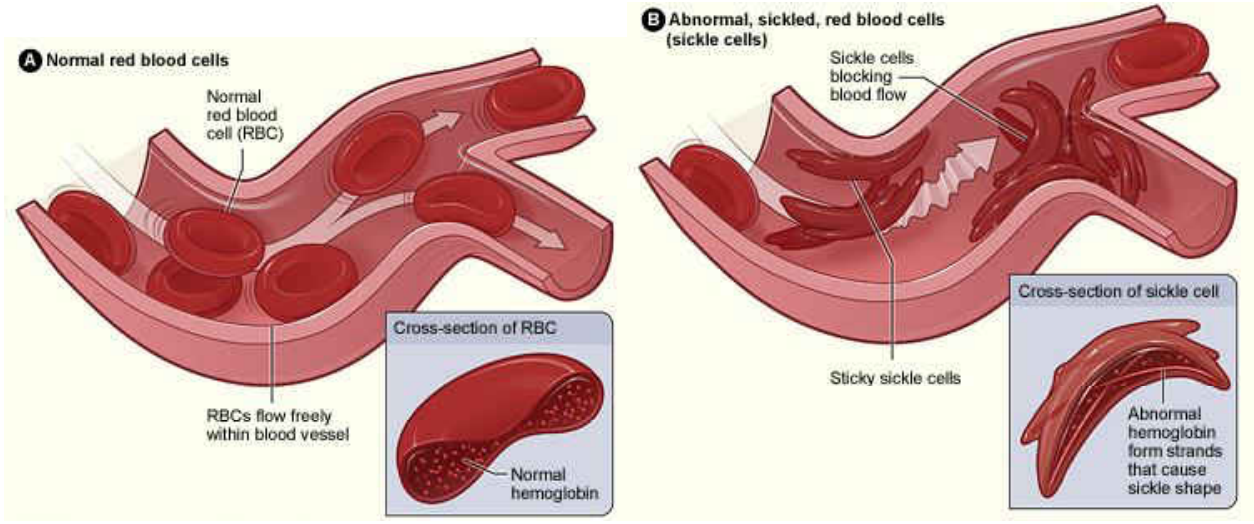

Fig. 1

It must he emphasized that reports of sickle cell anemia in India are rare. This is because there has been a lack of awareness of the disease entity in these regions, together with the difficulty in making a rapid and certain diagnosis. Especially in view of other forms of anemia which occur so commonly here. The possibility of existence of sickle cell anemia seems to be greater than has been suspected hitherto. The cases which *we* discovered belonged to Mahar and Kosthi comniunities. The Mahars are the "schedule-castes" of Maharashtra. They extend from the Arabian sea coast to the jungles of Raipur and Bastar. It is a mixed community ranging in skin color from very fair to dark, and they cannot he easily distinguished from other communities. The Kosthis are residents of Nagpur and adjoining areas and are skilled weavers. They are well built, of medium height, dark in color and comparatively big-headed. Their real origin is not known. According to anthropological studies, Mahars occupy a position midway between Marathas and the primitives. In the ancient past there may have been a possible admixture of

Veddian tribes and primitives of the Eastern region, the primitives entering through the eastern gaps of Chhatisgarh into Narbada and Tapti Valley and the Veddian advancing from the South, thus producing a middle race of the above community.21 (See map, The presence of sickle cell gene in this focus near Nagpur has significance in that the cases reported above belong to the present days' schedule caste and other communities and not to the al)original tribes **(** which have so far shown a high frequency of sickle cell gene in India). A subsequent survey at Nagpur has revealed 22.2 per cent of sickle cell trait in the Mahar community.

OBJECTIVE

Since Hislop College represents the focal point & a microcosm where students from all over central India come together for education, it was felt imperative to screen the students especially coming to the Department of Biochemistry, for occurrence of the disease or trait.

The objective was to find which region of India & which caste or community shows more predisposition or prevalence of occurrence.

MATERIAL & METHOD

Total 130 students coming to the department of Biochemistry for their B.Sc. & M. Sc. course were evaluated for presence of sickling. Family history was obtained from each student to evaluate the inheritance pattern. Venous blood samples were collected in EDTA from each student for the following diagnostic tests:

Microscopic examination of blood film to observe for sickling

Sickling solubility test: A drop of blood was mixed with a drop of the reducing solution of sodium dithionite. Sickled haemoglobin (HbS) gave a turbid appearance, whereas normal Hb gave a clear solution.

Whole blood haemoglobin count was done to obtain Hb %, reticulocyte count etc.

To ascertain the Hb pattern, Hb Electrophoresis was carried out on hemolysate prepared from EDTA sample on gel at pH 8.6.

An acute sickle-cell crisis is often precipitated by infection. Therefore, a urinalysis to detect an occult urinary tract infection was also performed in case of students who showed sickling disease or trait.

Though diagnosis is also sometimes confirmed with high performance liquid chromatography (HPLC) and rarely also by genetic testing we did not perform these as other investigations seemed to be highly specific for HbS and HbC.

SIGNS AND SYMPTOMS

Sickle-cell disease may lead to various acute and chronic complications, several of which are potentially lethal.

VASO-OCCLUSIVE CRISIS

The vaso-occlusive crisis is caused by sickle-shaped red blood cells that obstruct capillaries and restrict blood flow to an organ, resulting in ischemia, pain, and often organ damage. The frequency, severity, and duration of these crises vary considerably. Painful crises are treated with hydration and analgesics; pain management requires opioid administration at regular intervals until the crisis has settled. For milder crises, a subgroup of patients manage on NSAIDs (such as diclofenac or naproxen). For more severe crises, most patients require inpatient management for intravenous opioids; patient-controlled analgesia (PCA) devices are commonly used in this setting. Diphenhydramine is sometimes effective for the itching associated with the opioid use. Incentive spirometry, a technique to encourage deep breathing to minimise the development of atelectasis, is recommended.

Because of its narrow vessels and function in clearing defective red blood cells, the spleen is frequently affected. It is usually infarcted before the end of childhood in individuals suffering from sickle-cell anaemia. This autosplenectomy increases the risk of infection from encapsulated organisms; preventive antibiotics and vaccinations are recommended for those with such asplenia.

One of the earliest clinical manifestations is dactylitis, presenting as early as six months of age, and may occur in children with sickle trait The crisis can last up to a month.

Another recognised type of sickle crisis is the acute chest syndrome, a condition characterised by fever, chest pain, difficulty breathing, and pulmonary infiltrate on a chest X-ray. Given that pneumonia and sickling in the lung can both produce these symptoms, the patient is treated for both conditions.It can be triggered by painful crisis, respiratory infection, bone-marrow embolisation, or possibly by atelectasis, opiate administration, or surgery.

Most episodes of sickle cell crises last between five and seven days.

COMPLICATIONS

Sickle-cell anaemia can lead to various complications, including:

- Overwhelming post-(auto)splenectomy infection (OPSI), which is due to functional asplenia, caused by encapsulated organisms such as *Streptococcus pneumoniae* and *Haemophilus influenzae*. Daily penicillin prophylaxis is the most commonly used treatment during childhood, with some haematologists continuing treatment indefinitely. Patients benefit today from routine vaccination for *H. influenzae*, *S. pneumoniae*, and *Neisseria meningitidis*.
- Stroke, which can result from a progressive vascular narrowing of blood vessels, preventing oxygen from reaching the brain. Cerebral infarction occurs in children, and cerebral hemorrhage in adults.
- Cholelithiasis (gallstones) and cholecystitis, which may result from excessive bilirubin production and precipitation due to prolonged haemolysis.

- Jaundice, yellowing of the skin, may occur due to the inability of the liver to effectively remove bilirubin from the filtering of damaged red blood cells out of the blood supply as well as blocks in the organ's blood supply.
- Avascular necrosis (aseptic bone necrosis) of the hip and other major joints, which may occur as a result of ischemia.
- Decreased immune reactions due to hyposplenism (malfunctioning of the spleen).
- Priapism and infarction of the penis.
- Osteomyelitis (bacterial bone infection), *Salmonella* is the second most common organism behind Staphylococcus Aureus which remains first in both the general population and those with sickle cell. organism
- Opioid tolerance, which can occur as a normal, physiologic response to the therapeutic use of opiates. Addiction to opiates occurs no more commonly among individuals with sickle-cell disease than among other individuals treated with opiates for other reasons.
- Acute papillary necrosis in the kidneys.
- Leg ulcers.
- In eyes, background retinopathy, proliferative retinopathy, vitreous haemorrhages and retinal detachments, resulting in blindness. Regular annual eye checks are recommended.
- During pregnancy, intrauterine growth retardation, spontaneous abortion, and pre-eclampsia.
- Chronic pain: Even in the absence of acute vaso-occlusive pain, many patients have chronic pain that is not reported
- Pulmonary hypertension (increased pressure on the pulmonary artery), leading to strain on the right ventricle and a risk of heart failure; typical symptoms are shortness of breath, decreased exercise tolerance and episodes of syncop.
- Chronic renal failure—manifests itself with hypertension (high blood pressure), proteinuria (protein loss in the urine), hematuria (loss of red blood cells in urine) and worsened anaemia. If it progresses to end-stage renal failure, it carries a poor prognosis.

HETEROZYGOTES

The heterozygous form (sickle cell trait) is almost always asymptomatic, and the only usual significant manifestation is the renal concentrating defect presenting with isosthenuria.

DIAGNOSIS

In HbSS, the full blood count reveals haemoglobin levels in the range of 6–8 g/dL with a high reticulocyte count (as the bone marrow compensates for the destruction of sickle cells by producing more red blood cells). In other forms of sickle-cell disease, Hb levels tend to be higher. A blood film may show features of hyposplenism (target cells and Howell-Jolly bodies).

Sickling of the red blood cells, on a blood film, can be induced by the addition of sodium metabisulfite. The presence of sickle haemoglobin can also be demonstrated with the "sickle solubility test". A mixture of haemoglobin S (Hb S) in a reducing solution (such as sodium dithionite) gives a turbid appearance, whereas normal Hb gives a clear solution.

Abnormal haemoglobin forms can be detected on haemoglobin electrophoresis, a form of gel electrophoresis on which the various types of haemoglobin move at varying speeds. Sickle-cell haemoglobin (HgbS) and haemoglobin C with sickling (HgbSC)—the two most common forms—can be identified from there. The diagnosis can be confirmed with high-performance liquid chromatography (HPLC). Genetic testing is rarely performed, as other investigations are highly specific for HbS and HbC

An acute sickle-cell crisis is often precipitated by infection. Therefore, a urinalysis to detect an occult urinary tract infection, and chest X-ray to look for occult pneumonia should be routinely performed

TREATMENT

Cyanate

Dietary cyanate, from foods containing cyanide derivatives, has been used as a treatment for sickle- cell anemia In the laboratory, cyanate and thiocyanate irreversibly inhibit sickling of red blood cells drawn from sickle cell anemia patients However, the cyanate would have to be administered to the patient for a lifetime, as each new red blood cell created must be prevented from sickling at the time of creation. Cyanate also would be expelled via the urea of a patient every cycle of treatment. Also see nicosan.

Painful (vaso-occlusive) crisis

Most people with sickle-cell disease have intensely painful episodes called vaso-occlusive crises. The frequency, severity, and duration of these crises, however, vary tremendously. Painful crises are treated symptomatically with analgesics; pain management requires opioid administration at regular intervals until the crisis has settled. For milder crises, a subgroup of patients manage on NSAIDs (such as diclofenac or naproxen). For more severe crises, most patients require inpatient management for intravenous opioids; patient-controlled analgesia (PCA) devices are commonly used in this setting. Diphenhydramine is also an effective agent that is frequently prescribed by doctors in order to help control any itching associated with the use of opioids.

Folic acid and penicillin

Children born with sickle-cell disease will undergo close observation by the pediatrician and will require management by a hematologist to assure they remain healthy. These patients will take a 1 mg dose of folic acid daily for life. From birth to five years of age, they will also have to take penicillin daily due to the immature immune system that makes them more prone to early childhood illnesses.

Acute chest crisis

Management is similar to vaso-occlusive crisis, with the addition of antibiotics (usually a quinolone or macrolide, since wall-deficient ["atypical"] bacteria are thought to contribute to the syndrome) oxygen supplementation for hypoxia, and close observation. Should the pulmonary infiltrate worsen or the oxygen requirements increase, simple blood transfusion or exchange transfusion is indicated. The latter involves the exchange of a significant portion of the patient's red cell mass for normal red cells, which decreases the percent of haemoglobin S in the patient's blood.

Hydroxyurea

The first approved drug for the causative treatment of sickle-cell anaemia, hydroxyurea, was shown to decrease the number and severity of attacks in a study in 1995 (Charache and shown to possibly increase survival time in a study in 2003 This is achieved, in part, by reactivating fetal haemoglobin production in place of the haemoglobin S that causes sickle-cell anaemia. Hydroxyurea had previously been used as a chemotherapy agent, and there is some concern that long-term use may be harmful, but this risk has been shown to be either absent or very small and it is likely that the benefits outweigh the risks

Bone marrow transplants

Bone marrow transplants have proven to be effective in children.

Future treatments

Various approaches are being sought for preventing sickling episodes as well as for the complications of sickle-cell disease. Other ways to modify hemoglobin switching are being investigated, including the use of phytochemicals such as nicosan. Gene therapy is under investigation.

Another treatment being investigated is Senicapoc

Gene Therapy

Gene therapy is being studied as a possible treatment for sickle cell anemia. Researchers want to know whether a normal gene can be put in the bone marrow of a person who has sickle cell anemia. This would cause the body to make normal red blood cells.

Researchers also are studying whether they can "turn off" the sickle cell gene or "turn on" a gene that makes red blood cells behave normally.

New Medicines

Researchers are studying several new medicines for sickle cell anemia. These include:

- Butyric acid. This is a food additive that may increase normal hemoglobin in the blood.
- Nitric oxide. This medicine may make sickle cells less sticky and keep blood vessels open. People who have sickle cell anemia have low levels of nitric oxide in their blood.
- Decitadine. This medicine increases hemoglobin F levels (this type of hemoglobin carries more oxygen). It may be a good choice instead of hydroxyurea

HOW CAN SICKLE CELL ANEMIA BE PREVENTED?

You can't prevent sickle cell anemia because it's an inherited disease. However, you can take steps to reduce its complications.

People who are at high risk for sickle cell anemia and are planning to have children may want to consider genetic counseling. A counselor can help you understand your risk of having a child who has the disease and help explain the choices that are available to you.

You can get information about genetic counseling from health departments, neighborhood health centers, medical centers, and clinics that care for people who have sickle cell anemia.

Living with Sickle Cell Anemia

With good health care, many people who have sickle cell anemia can live productive lives. They also can have reasonably good health much of the time and live longer today than in the past. Many people who have sickle cell anemia now live into their forties, fifties or longer.

If you have sickle cell anemia, it's important to:

- Adopt or maintain a healthy lifestyle
- Take steps to prevent and control complications
- Learn ways to cope with pain

If you have a child or teen that has sickle cell anemia, you can take steps to learn about the disease and help your child manage it.

Adopt or Maintain a Healthy Lifestyle

To take care of your health, you should adopt or maintain healthy lifestyle habits.

Follow a healthy eating plan. Your doctor may suggest that you take folic acid (a vitamin) every day to help your body make new red blood cells. You also should drink at least 8 glasses of water every day, especially in warm weather. This will help prevent dehydration (a condition in which your body doesn't have enough fluids).

Your body needs regular physical activity to stay healthy. However, you should avoid exercise that makes you very tired. Drink lots of fluids when you exercise. Talk with your doctor about how much and what kinds of physical activity are right for you.

You also should get enough sleep and rest. Tell your doctor if you think you may have a sleep problem, such as snoring. Sleep apnea is a common disorder in which you have one or more pauses in breathing or shallow breaths while you sleep.

Talk to your doctor about whether you can drink alcohol and what amount is safe for you. If you smoke, quit. Talk to your doctor about programs and products that can help you quit smoking.

Take Steps To Prevent and Control Complications

Along with healthy lifestyle habits, you can take other steps to prevent and control painful sickle cell crises. A number of factors can cause sickle cell crises. Knowing how to avoid or control these factors can help you manage your pain.

You may want to avoid decongestants, such as pseudoephedrine. These medicines can tighten blood vessels and further prevent red blood cells from moving smoothly through the vessels.

Avoid extremes of heat and cold. Wear warm clothes outside in cold weather and inside of air-conditioned rooms. Don't swim in cold water or climb at high altitudes without extra oxygen.

Reduce the stress in your life. Talk to your doctor if you're depressed or having problems on the job or with your family. Support from family and friends as well as a support group can help you cope with daily life.

If possible, avoid jobs that require a lot of physical labor, expose you to extremes of heat and cold, or involve long work hours.

Also, don't travel in airplanes where the cabins aren't pressurized (that is, no extra oxygen is pumped into the cabin). If you must travel in such an airplane, talk to your doctor about how to protect yourself.

Get a flu shot and other vaccines to prevent infections. You also should see your dentist regularly to prevent infections and loss of teeth. Contact your doctor if you have any signs of an infection, such as fever or trouble breathing. Getting treatment right away is important.

Regular medical checkups and treatment are also important. Checkups may include tests for possible kidney, lung, and liver diseases. See a sickle cell anemia expert regularly. Also, see an eye doctor regularly to check for damage to your eyes.

Learn the signs and symptoms of a stroke. They include a lasting headache, weakness on one side of the body, limping, and sudden changes in speech, vision, or hearing. If you have any of these symptoms, report them to your doctor promptly.

Get treatment and control any other medical conditions you have, such as diabetes.

Talk to your doctor if you're pregnant or planning to become pregnant. You will need special prenatal care. Sickle cell anemia can worsen during pregnancy.

Women who have sickle cell anemia also are at an increased risk for an early birth or a low-birth-weight baby. However, with early prenatal care and frequent checkups, you can have a healthy pregnancy.

(Counseling of parents) ….Calling the Doctor

Ask your child's doctor about when you should call him or her right away. For example, he or she may want you to call right away if your child has any signs of a stroke or infection. You also may need to call if your child has:

- Swelling of the hands or feet.

- Swelling of the stomach. If the spleen gets larger than normal, you may see or feel swelling below the lower left rib. Your child may complain that the area feels tender.
- Pale skin or nail beds or a yellowish color on the skin or on the whites of the eyes.
- Sudden fatigue (tiredness) with no interest in his or her surroundings.
- An erection of the penis that won't go away.
- Pain in the joints, stomach, chest, or muscles.
- A fever.

Teens who have sickle cell anemia must manage their condition, while also dealing with the stresses of the teen years. These teens also face some specific stresses related to sickle cell anemia, including:

- Body-image problems caused by delayed sexual maturity.
- Coping with pain and fear of addiction from using narcotic pain medicines.
- Living with uncertainty. (Sickle cell anemia is unpredictable and can cause pain and damage to the body at any time.)

RESULTS

3 cases of sickle cell trait & 1 case of sickle cell disease were detected among this group.

Blood sample of 1 student suffering from sickle cell disease could not be obtained as she was very weak & frail.

The family history of these 4 students was obtained to find out the gene relationship.

Case 1: M.D. 20 years old, from Nagpur ,Mahar by caste.

Father was dead

Mother 45 years old healthy and showed presence of sickle cell trait

Sister 25 years old and healthy.

Case 2: V.B. 20 years old from Nagpur , Mahar by caste.

Father 60 years old, Mother 50 years old Both healthy but showed the presence of sickle cell trait.

Two sisters one 27 years old and other 15 years old, both healthy.

Case 3: N.G. 18 years old from Chandrapur (a district bordering Nagpur) Caste could not be found out as her great grand parents were converted from schedule caste.

Father 49 years old healthy

Mother 47 years old having sickle cell disease

Brother 22 years old having sickle cell trait.

Case 4: S.J. 20 years old from Nagpur Caste Christian native place remote area of Chhattisgarh

Father 49 years old healthy

Mother 45 years old having sickle cell trait

Brother 16 years old, showed presence of sickle cell trait

ELECTROPHORETIC PATTERN

Phenotype	Genotype	Electrophoretic pattern	Hemoglobin types
Normal	A A Hb Hb		A
Sickle cell trait	S A Hb Hb		SA
Sickle cell anemia	S S Hb Hb		SS

HEMOGLOBIN ELECTROPHOROSIS

INVESTIGATIONS	MD Findings	VB Findings	NG Findings	SJ Findings
MEDIA	Agarose	Agarose	Agarose	Agarose
BUFFER	P H 8.0	P H 8.0	P H 8.0	P H 8.0
BAND A	Seen	Not seen	Seen	Seen
BAND S	Seen	Seen	Seen	Seen
IMPRESSION	AS Pattern	SS Pattern (Sickle cell disease)	AS Pattern	AS Pattern

Family studies – the members of the families of these cases were studied as far as possible hematologically with a view to find out the gene relationship .

Case 1: M.D. 20 years old, from Nagpur ,Mahar by caste. The following members of her family could be traced and examined. Father was dead, mother 45 years old healthy and showed presence of sickle cell trait, sister 25 years old and healthy.

Case 2: V.B. 20 years old from Nagpur, Mahar by caste.Both the parents are healthy father 60 years old and mother 50 years old and they both showed the presence of sickle cell trait. Having two sisters one 27 years old and other15 years old, both are healthy.

Case 3: N.G. 18 years old from Chandrapur (a district bordering Nagpur) Caste could not be found out as her great grand parents were converted from schedule caste.. Father 49 years old healthy, mother 47 years old having sickle cell disease, brother 22 years old having sickle cell trait.

Case 4: S.J. 20 years old from Nagpur Caste Christian, father 49 years old healthy, mother 45 years old having sickle cell trait, native place remote area of Chhattisgarh, brother 16 years old, showed presence of sickle cell trait

CONCLUSION

The incidence of occurrence of sickle cell anemia even in this small group was found to be 3.85% (5/130). However, though the studied students represented various regions of India, the occurrence was predominantly observed in students belonging to areas in and around Nagpur. Also, the occurrence was restricted to the backward class scheduled caste & scheduled tribes of Vidarbha region.

Three cases of sickle cell trait and one case of sickle cell disease were found out. Hemoglobin electrophoresis showed three girls had AS pattern, and one girl had SS pattern . Sickle cell students were counseled as to how sickle cell conditions are acquired genetic basis.

What is the difference between SCT and SCD were explained, health problems that can occur in SCD were also explained.

Sickle cell trait SCT is not considered to be a health problem, but individuals who tested positive were informed about the implications for their health and family planning.

Students suffering from SCD were counseled to adopt and maintain healthy lifestyle habits in order to lead productive and longer lives.

Clinical data of 4 cases of SCD

Case no	1 M.D.(Nagpur)	2 V.B.(Nagpur)	3 N.G.(Chandrapur)	4 S.J.(Nagpur)
Age	20	20	18	20
Sex	F	F	F	F
Caste	Mahar	Mahar	Schedule Caste	Christian
Fever	__	++	++	++
Hemoglobin %	8.5	8.0	8.0	7.0
Abdominal pain	+	_	+	++
Swelling of joints	_	++	+	++
Pain in bones	_	++	+	++
Jaundice	+	_	_	+
Hematocrit %	29	25	28	23
Hyposplenism (target cells and Howell-Jolly bodies	+	+	+	++
Abdominal pain	+	_	+	++
Swelling of joints	_	++	+	++
Pain in bones	_	++	+	++
Jaundice	+	_	_	+
Tendency to ulceration of legs	_	_	_	_

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STUDY OF CLOVE OIL AS ANTIMICROBIAL AGENT AGAINST COSMETICALLY IMPORTANT MICROORGANISMS

K. Misar, S. Kulkarni, V. Meghre, A. Chandak

Department of Cosmetic Technology, L.A.D. and Smt. R.P. College for Women, Seminary Hills, Nagpur – 440006

ketkimisar@yahoo.com

ABSTRACT

The aim of this study is to investigate the antimicrobial activity of Clove oil by agar diffusion method and measurement of zone of inhibition. Cloves i.e. dried flower buds of Syzigium aromaticum, (Linn.), Merryl and Perril, family Myrtaceae, were collected from local market of Nagpur, Maharashtra, India and subjected to steam distillation, by using Clevenger apparatus to obtain clove oil [1, 2]. The results showed that the oil is effective against cosmetically important microorganisms.

Keywords: - *Clove oil, antimicrobial activity.*

INTRODUCTION

Spices are one of the most *commonly* used natural antimicrobial agents in foods and have been used *traditionally* for thousands of years by many cultures for preserving foods and a food additive to enhance aroma and flavor. The antimicrobial properties of some spices and their components have been documented. Studies done previously confirm that cloves and other spices inhibit the growth of both Gram-positive and Gram-negative pathogens or spoilage bacteria, yeasts and molds [3].

Clove consists of dried flower buds of *Syzigium aromaticum*, family *Myrtaceae*. Clove bud contains about 15-20 % of volatile oil which contains eugenol (about 70-90%), eugenol acetate, caryophyllene, and small quantities of esters, ketones and alcohols [4, 5, 6].

Fig. 1 – Dried Clove Buds

Cloves have been used in foods since long time. It is routinely used in oral care preparations. Hence, in this study attempt have made to assess the antimicrobial activity of clove oil against cosmetically important microorganisms so as to use it as natural preservative for cosmetic preparations.

EXPERIMENTAL

The dried clove buds were collected from the local market of Nagpur, Maharashtra, India and were authenticated from the Department of Botany, Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur. The authentication number is 9863.

Extraction

Dried flower buds of clove were subjected to size reduction followed by steam distillation for the separation of volatile constituents from crude drug. It was done by the distillation of 50 gm of powdered clove buds with water (300ml) by using Clevenger's apparatus [1, 2]. Distillation was continued for 5 hours and the oil was obtained. Extractive values are shown in Table 1

Table 1: % Extractive values of Oil of Clove

Sr. No.	Name of Oil	Wt. of Crude Drug	Wt. of Oil Obtained	% Extractive value
1.	Clove Oil	50 gm	8.1233 gm	16.2466 %

Qualitative Analysis of Clove Oil

The qualitative analysis of the laboratory extracted clove oil was carried out for color, odor, specific gravity[7] and refractive index[8]. The results are shown in Table 2.

Evaluation of Antimicrobial activity of Clove oil

Five different concentrations of Clove oil were subjected to well agar diffusion method to evaluate their anti-microbial activity. This method is based on zones of inhibition.[10]

The cultures of six microorganisms namely *Pseudomonas aeruginosa*(MTCC 1688), *Escherichia coli*(MTCC 1687), *Staphylococcus aureus*(MTCC737), *Candida albicans* (MTCC 227), *Aspergillus niger* (MTCC 10180), *Staphylococcus epidermidis* (MTCC 6810), were procured from MTCC (Institute of Microbial Technology, Chandigarh, India), and maintained on suitable growth medium, for prescribed time interval. First five microorganisms are recommended by BIS [11] for evaluating the efficacy of preservatives in cosmetic preparations. *S. epidermidis* is the member of skin flora. The growth medium and time interval for incubation of microorganisms are given in Table 3.

Table 2: Qualitative analysis of Laboratory Extracted Clove oil

Sr. No.	Parameter	Standards[9]	Laboratory Extracted Oil
1.	Color	Pale yellow	Pale yellow
2.	Odor	Strong aromatic Spicy	Strong aromatic Spicy
3.	Refractive Index at 200 C	1.527 to 1.535	1.529
4.	Specific Gravity	1.038 to 1.060	1.040

Table 3: Growth medium and incubation period for microorganisms

Sr. No.	Micro organisms	Growth medium used for preparing stock cultures and working culture slants	Medium used for Screening antimicrobial activity	Incubation Period	Incubation Temperature
1.	P. aeruginosa	Nutrient Agar Medium	Muller Hinton Agar Medium	24 Hours	370C
2.	E. coli	Nutrient Agar Medium	Muller Hinton Agar Medium	24 Hours	370C
3.	S. aureus	Nutrient Agar Medium	Muller Hinton Agar Medium	24 Hours	370C
4.	C. albicans	Malt Yeast Agar	Malt Yeast Agar	48 Hours	250C
5.	A. niger	Potato Dextrose Agar	Potato Dextrose Agar	7 Days	370C
6.	S. epidermidis	Nutrient Agar Medium	Muller Hinton Agar Medium	24 Hours	370C

Following concentrations of clove oil were used –

I) 1% Clove oil v/v in sterile Tween 80 (Himedia)

II) 0.75% Clove oil v/v in sterile Tween 80 (Himedia)

III) 0.50% Clove oil v/v in sterile Tween 80 (Himedia)

IV) 0.25% Clove oil v/v in sterile Tween 80 (Himedia)

V) 100% Clove oil

VI) 100% Tween 80

For *P. aeruginosa, S. aureus, S. epidermidis, E. coli* Muller Hinton Agar medium was used for screening antimicrobial activity. The melted and cooled medium was inoculated at 45^0C with 24 hours fresh cell suspension of respective microorganisms (0.2ml suspension was used for 20 ml agar medium).For *C. albicans* Malt Yeast Agar medium and 48 hours cell suspension was used *for* inoculation. For *A. niger* Potato Dextrose Agar Medium was used and it was inoculated with 7 days old spore suspension. Inoculated media was poured in petri plates and allowed to solidify. By using sterilized cork borer of 8 mm diameter wells were bored on solidified agar plates of different microorganisms and these wells were filled with different concentrations of Clove oil mentioned above by using sterile pipettes. The experiments were performed in triplicates. The plates were then incubated at prescribed temperature and time interval.

The activity of the test samples was indicated by a clear zone of inhibition around the wells, diameter of zones of inhibition were measured and recorded.

The results are summarized in table 4.

DISCUSSION AND CONCLUSION

From the study of clove oil against six cosmetically important microorganisms it was found that clove oil was effective against five microorganisms namely *P. aeruginosa, S. aureus, S. epidermidis, E. coli,* and *C. Albicans* except against *A. niger.* All the four concentrations namely 0.25 %. 0.5%, 0.75%, and 1% of clove oil showed activity against the five microorganisms. The activity was found to be increasing with the increasing concentrations of oil used. Out of five microorganisms clove oil was found to be most effective against C. *albicans*.

Table 4: Evaluation of antimicrobial activity of clove oil

Sr. No.	Micro organism	Concentration of Clove Oil					100% Tween 80 (Control)
		1%	0.75%	0.5%	0.25%	100%	
1.	*P. aeruginosa*	16	15	14	12	19	-
2.	*E. coli*	15	14	13	11	20	-
3.	*S. aureus*	16	15	13	12	18	-
4.	*C. albicans*	18	17	15	14	20	-
5.	*A. niger*	-	-	-	-	-	-
6.	*S. epidermidis*	14	13	11	10	15	-

Diameter of cork borer used – 8 mm , '-'– indicates no zone of inhibition

All zones of inhibition are in mm

Hence, it can be concluded that clove oil possesses antimicrobial activity against cosmetically important microorganisms. Methyl paraben and propyl paraben are p-hydroxybenzoic acid ester compounds widely used as preservatives in cosmetics. [12] It is reported that parabens could contribute to adverse health effects and can cause contact dermatitis reactions in some individuals on cutaneous exposure. [13] Therefore further studies will be directed towards the use of clove oil as an antimicrobial agent in cosmetic preparations.

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SURVEY ON PLASTIC WASTE DISPOSAL METHODS

M.A. Chandak [1], A.M.Chandak[2]

[1]Assistant professor Priyadarshini Institute of Engineering and Technology/ RTMNU,Nagpur, India

[2]Assistant professor Kamala Nehru Mahavidyalaya/ RTMNU,Nagpur, India

ABSTRACT

Plastics have become an important part of modern life and are used in different sectors of applications like packaging, building materials, consumer products and much more. Each year about 100 million tons of plastics are produced worldwide. Lack of degradability and the closing of landfill sites as well as growing water and land pollution problems have led to concern about plastics. With the excessive use of plastics and increasing pressure being placed on capacities available for plastic waste disposal, the need for biodegradable plastics and biodegradation of plastic wastes has assumed increasing importance in the last few years. Awareness of the waste problem and its impact on the environment has awakened new interest in the area of degradable polymers. The interest in environmental issues is growing and there are increasing demands to develop material which do not burden the environment significantly. The paper discusses prospects of plastic waste disposal methods and their limitations in order to dispose of or at least reduce the accumulation of plastic waste.

Keywords: *Biodegradation, Microorganism, Plastic, Plastic Waste, Recycling, Reuse.*

INTRODUCTION

A modern lifestyle, alongside the advancement of technology has led to an increase in the plastic waste being generated, leading to a waste disposal crisis. The amount of plastic waste in our surroundings is steadily increasing. More than 90% of the articles found on the sea beaches contain plastic. Plastic waste is often the most objectionable kind of litter and will be visible for months in landfill sites without degrading. Man's struggle for comfort has brought him from Stone Age to plastic age .The basic needs of life like food clothing and shelter got altered through these ages based on man's effort to search and improve the qualities of raw materials needed for above three necessities. Today's age is plastic age. Plastics because of exclusive qualities like light weight, yet equally strong, economical and easily molded in any shape had found its use everywhere. Plastic consumption has grown at a tremendous rate worldwide,. Plastics now play an increasingly important role in all aspects of modern life and used in the manufacture of all sorts of items including protective packaging, mobile phones, domestic appliances, furniture items, medical devices etc. Each year around 1trillon plastic bags are used worldwide with most of them ending up in landfills, dumpsites and water bodies. Due to the rising demand, the global plastic consumption is expected to reach 300 million tons by 2015. Per capita consumption of plastics is estimated to be 33 kg per annum which is much above the world average. Every coin has two sides. As we look for the cheap and

easily material for our use, it gets so accumulated that in few days we find it difficult to dispose it off. Thus the use of plastic all around the world has passed a serious problem of its disposal. Its spread on earth, water has created the environmental problem, as loss of fertility of land, killing of sea animals. More over these materials takes nearly thousand years to completely degraded.

The present scenario of civilization is very much is alarming .The collection and disposal of these plastic and E-waste has created an environmental impact.

METHODOLOGY

Today most of our scientific research is focused on the reuse and disposal of this plastic waste.

Few of the methods suggested are:

1) Use of plastic powder, fibers, coirs along with sand, fly ash to improve the quality of concrete in civil work [1,2,3,4].
2) Fiber reinforced plastic composites [5,6].
3) Land fill[7]
4) Incineration
5) Reuse by remolding
6) Recycling
7) Degradation using microorganisms[8]

Extensive laboratory work is in progress for all above mentioned methods of plastic waste disposal.

Few of the conclusions on above methods of plastic waste disposal are as follows.

- Up to 1% addition of plastic waste improved the splitting tensile strength of concrete but has reduced its compressive strength by 20% in 28 days. At the same time addition of E-plastic aggregate up to 15% by weight with fly ash was used effectively in concrete.
- Fiber reinforced plastic (FRP) comprises of polymeric resin and reinforcement usually in fiber form with other additives like filler, catalyst, etc. Here the fibers are continuous and long enough and can be arranged to produce higher strength properties in one direction. These FRP are useful in geothermal engineering, sports , automobiles, highway infrastructure, construction industries, cooling towers. It is the most emerging technology with low processing cost and number of applications due to its properties like dimensional stability, flexibility, high strength, light weight and corrosive resistance. These composite materials basically consists of three systems namely matrix, fiber and additive.
- A landfill is a disposed area where garbage is piled up and eventually covered with dirt and topsoil. Fraction of E-waste is most often dumped into landfills. But this can very often lead to ground water contamination.

- Incineration: E- waste and other plastic waste burnt incinerators under controlled conditions to separate the toxic gases like dioxins. Looking only at CO_2 emissions, incineration of plastics produces a much greater amount of CO_2 than landfill However, in the special case when incineration is performed with high-efficiency energy recovery, it provides power normally generated by plants burning fossil fuels, and can produce less CO_2 than would otherwise have been released into the atmosphere, making the overall process CO2-negative. Incineration may also be implemented without energy and materials recovery. Recently work is in progress to carbonize this waste in absence of air to produce fuel and lubricant of low grade qualities. Many researcher claims to produce diesel from these waste.
- Recycling and reuse of plastics is gaining importance as a sustainable method for plastic waste disposal. Unfortunately, plastic is much more difficult to recycle than materials like glass, aluminum or paper. A common problem with recycling plastics is that plastics are often made up of more than one kind of polymer or there may be some sort of fiber added to the plastic (a composite).

  Plastic polymers require greater processing to be recycled as each type melts at different temperatures and has different properties, so careful separation is necessary. Moreover, most plastics are not highly compatible with one another. Apart from familiar applications like recycling bottles and industrial packaging film, there are also new developments e.g. the Recovinyl initiative of the PVC industry (covering pipes, window frames, roofing membranes and flooring).

  Polyethlene terephthalate (PET) and high density polyethylene (HDPE) bottles have proven to have high recyclability and are taken by most curbside and drop-off recycling programs. The growth of bottle recycling has been facilitated by the development of processing technologies that increase product purities and reduce operational costs. Recycled PET and HDPE have many uses and well-established markets.

  In contrast, recycling of polyvinyl chloride (PVC) bottles and other materials is limited. A major problem in the recycling of PVC is the high chlorine content in raw PVC (around 56 percent of the polymer's weight) and the high levels of hazardous additives added to the polymer to achieve the desired material quality. As a result, PVC requires separation from other plastics before mechanical recycling.

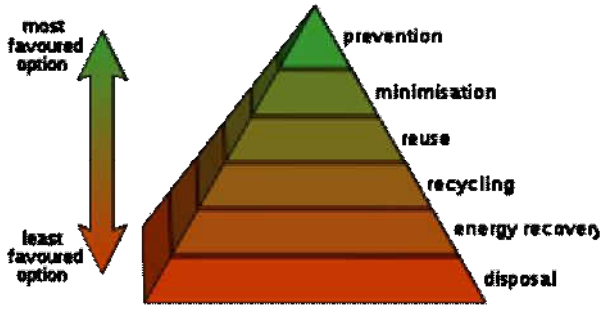

Fig.1 Pyramid of plastic waste

- Plastic Biodegrading Microbes

Fungi had been found more in comparison to bacteria for degrading the plastics. Some of those bacteria that can degrade polyester in vitro and which utilize the Polyurethane as sole carbon source have been identified from the genera *Pseudomonas, Comamonas,* and *Bacillus.Brevibacillus borstelensis* strain isolated from soil, a thermophillic bacterium, recovered for the degradation of branched low- density polyethylene by utilizing it as the sole carbon source and energy source. Number of fungi isolates were identified from the surface of polyester PU foam as a sole carbon source, buried for 28 days, from the genera *Emericella, Trichoderma, Aspergillus, Fusarium, Gliocladium* and *Penicillium* 9]. *Geomyces pannorum* was found to be the predominant fungi consisting 22-100% of the polyester PUR degrading fungi [10]. The other genera of the fungi including the majority of the organisms found in soil for the degradation of polyurethane like *Plectosphaerella, Nectria, Neonectria, Phoma and Alternaria*. The reported biodegradation activity with *Aspergillus niger* was observed to be quite slow with visible signs of deterioration occurring only after 30 days [11].Enzymes Varies with PlasticsEnzymes exist in every living cell and hence in all microbes. Relative amounts of the various enzymes produced by the microorganisms vary with species and even between strains of the same species. Enzymes are very specific in their action on substrates, so the different enzymes help in the degradation of various types of enzymes [12]. Laccase can help in the oxidation of the hydro-carbon backbone of polyethylene. Gel permeation chromatography determine that cell-free laccase incubated with polyethylene helps in the reduction of average molecular weight and average molecular number of polyethylene by 20% and 15 % respectively . Laccase produced by the actinomycete R.ruber, involved in biodegradation of polyethylene. Laccases are mostly present in lignin- biodegrading fungi, where they catalyze the oxidation of aromatic compounds. Laccase activity is known to act on non-aromatic substrates [13].Papain and urease are the two proteolytic enzymes were found to degrade medical polyester polyurethane. Polymer degraded by papain was due to the hydrolysis of urethane and urea linkages producing free amine and hydroxyl groups [14].Lignin and manganese-dependent peroxidases (LiP and MnP, respectively) and laccases are the three main enzymes of ligninolytic system [15]. The enzymes catalyze the hydrolysis of polylactic acid (PLA), which is the plastic obtained from renewable resources and the hydrolysate can be recycled as material for polymers. Lipase from *Rhizopus delemar* and polyurethane esterase from *Comamonas acidovorans* has been investigated for the degradation of low molecular weight PLA and high molecular weight PLA have been found to be degraded with the strains of *Amycalotopsis sp*. [16].Some strains which are capable of degrading the polyethylene are *Brevibacillus spp., Bacillus spp.,* where proteases are responsible for degradation . The enzymes responsible for biodegradation by *Pseudomonas spp.* are serine hydrolases, esterases and lipases. PHA depolymerases are serine hydrolases which are able to attack on the branching chains and the cyclic components of the polymers. *R. delemar* lipase degraded 53% of the polyester type-polyurethanes (ES-PU) film after 24h reaction. *C. acidovorans* degrade the ES-PU made up of poly (diethylene adipate) contained a type of *Pseudomonas chlororaphis* and Comomonas acidovorans as

well as the fungus *Candida rugosa* are the source of proteins and enzymes like putative polyurethanases which have been isolated and characterized. The active enzymes have been grouped as esterases, lipases, proteases and ureases which degrade the polyurethane substrate by cleaving the ester bonds. *Pestalotiopsis microspora*, the endophytic fungi has been isolated containing serine hydrolase utilize the polyurethane as a substrate, source of carbon and degrade it within a few number of days .Lignin degrading fungi and manganese peroxidase, partially purified from the strain of *Phanerochaete chrysosporium* also helps in the degradation of high molecular weight polyethylene under nitrogen limited and carbon limited conditions.

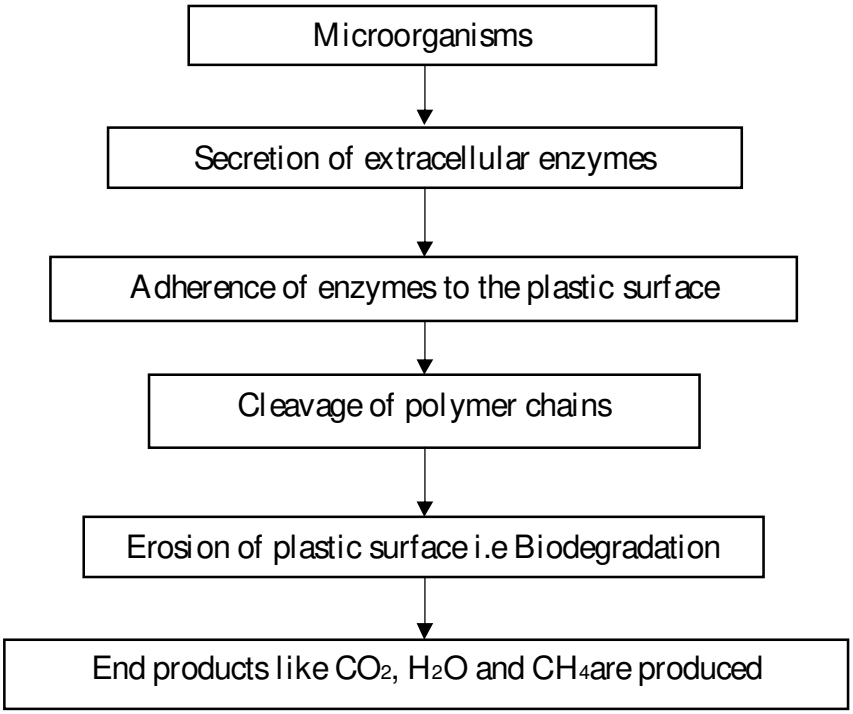

Figure 2: Mechanism of Enzymatic Biodegradation of Plastic [17]

CONCLUSION

Disposal of plastic waste is a serious concern in India and such no technology has been validated, however, several experiments have been conducted on reuse of plastic waste in road construction, co-processing of plastic waste in cement kilns. Currently, Worldwide accepted technology used for the plastic disposal is incineration, however, due to poor maintenance of incinerators, it releases several harmful gases including dioxins and furans in case of chlorinated and brominated plastic waste therefore, raising several environmental issues.

Fig. 1. shows the least favored option and most favored option for plastic waste. Plastic is now an integral part of the everyday activity of human life and one cannot out rule out the advantages of plastic but the disadvantages can be reduced to some extent if certain tips to deal with plastic waste are followed and these are:

1. Plastic Recycling: Separating the plastic products from the garbage and at home and handling over this plastic for recycling can reduce the impact of environmental pollution due to plastic waste. Plastic recycling industry is now a billion dollar industry in developed economies. Recycled plastic is usually used for laying down roads in place of bitumen, bottles, benches etc. Buying recycled plastic also helps with plastic management.
2. Using incinerators: Plastic waste is being burned in incinerator centers located outside the city limits in developed economies and this practice is now being followed by developing economies as well. This technique eliminates huge volumes of plastic material but there are some concerns related with air pollution due to such burning but efforts are being made to improve technology to reduce such air pollution in future.
3. Prohibition on manufacturing/selling of certain plastic material/bags: Some governments in the developed and developing countries has prohibited the manufacture and selling of plastic bags or material that contains more than the standard prescribed microns of plastic. By this way, the excessive dependence on plastic has been controlled to some extent.
4. Using paper bags and other cloth materials as shopping bags for a customer can be useful. It is suggested to use paper bags and bags made with cloth material such as jute, cotton etc while going for shopping or for purchasing grocery items. In this way, we as individuals can rely less on the plastic bags while going on a shopping spree.
5. Implementing the best civic practices: As the citizens of a community or country the best tip for proper disposal of plastic is follow the below mentioned practices:
    a. Using garbage bins/dust bins at public places for disposing of the plastic water bottles, food containers and other plastic material.
    b. Avoid throwing plastic garbage in open spaces, public places, water channels, rivers, sea beaches and other fragile natural resources or environment.
    c. Follow the government regulations relating to plastic management and help the government agencies in dealing with plastic waste.
    d. Create awareness among the people about safe practices of plastic waste management and run a campaign if possible with the help of other agencies who are involved in plastic waste management programs.
6. Biodegradation process is very eco-friendly. The growth of the microbes responsible for biodegradation must be optimized by controlling the temperature, humidity, incubation time and the substrate like polyethylene, polyurethane which are consumed as a carbon and energy source. This helps in the production of large amount of enzyme. These microbial enzymes induce the rate of biodegradation of plastics very effectively without causing any harm to the environment

Thus the use of plastics can be controlled and we can also give a lending heart for an effective plastic waste disposal system.

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