

# Kinetics of Oxidation of Triaryl Methane Dye, Brilliant Blue-R with Chlorine Dioxide

E. Swarna Gowri <sup>a\*</sup>, Y. B. Kiran<sup>b</sup>, V. Madhu Mohan<sup>b</sup>, A.B.V. Kiran Kumar<sup>b</sup>

<sup>a</sup>Department of Humanities and Science, G. Pullaiah College of Engineering & Technology, Nandikotkur Rod, Kurnool, India 518 452.

<sup>b</sup>Centre for Applied Sciences, Department of Basic Science and Humanities, Mohan Babu University, A. Rangampet, Sree Sainath Nagar, Tirupati, India 517502.

Received 12 September 2018, revised 16 December 2018, accepted 16 December 2018

## ABSTRACT

The fast decolourization of multi-purpose dye, Brilliant blue (BB<sup>-</sup>) oxidized by chlorine dioxide was investigated using the stopped flow technique under varied pH conditions by monitoring its oxidation kinetics. The products were identified and reaction mechanism is described, which is confirmed by kinetic simulations. Under  $[\text{ClO}_2]_0 > [\text{OH}^-]_0 > [\text{BB}^-]_0$  conditions, the oxidation kinetics showed first-order dependence on BB<sup>-</sup> and chlorine dioxide. The overall second-order rate coefficient enhanced with increasing pH, and values were  $30.2 \pm 0.2 \text{ M}^{-1} \text{ s}^{-1}$ ,  $42.5 \pm 0.8 \text{ M}^{-1} \text{ s}^{-1}$  and  $117.9 \pm 0.8 \text{ M}^{-1} \text{ s}^{-1}$  at pH 7.0, 8.0 and 9.0, respectively. In the pH range 7.0 to 9.0, the catalytic constant for [OH<sup>-</sup>] catalyzed reaction was  $9.0 \times 10^6 \text{ M}^{-2} \text{ s}^{-1}$  with energy of activation of  $50.06 \text{ kJ mol}^{-1}$ . Observed negative entropy of activation of  $-658.73 \text{ J K}^{-1} \text{ mol}^{-1}$  suggests the formation a compact transient activated complex.

## KEYWORDS

Dye, oxidative degradation, chlorine dioxide, tertiary treatment, stopped flow study, fast kinetics.

## 1. Introduction

Virtually every manmade material comprises either a dye or pigment. A wide range of modified natural and synthetic dyes are used to colour fabrics, leather, paper, ink, lacquers, varnishes, plastics, cosmetics, and many other odd items.<sup>1</sup> Robinson *et al.* in their review, reported that over ten thousand types of dyes or pigments are in use for various purposes.<sup>2</sup> Approximately ten million tons of various dyes and pigments are produced and used per annum.<sup>3</sup> Huge quantities of these dyes and pigments entering the wastewaters pose severe health risks and contribute to environmental disasters.<sup>2</sup> Approximately two-thirds of the dyes consumed are used by the textile industry to dye fabrics, about one-sixth are used for colouring paper; and the rest are used primarily in the production of organic pigments and in the dyeing of leather and plastics.<sup>4</sup> Due their refractory and toxic nature, many dyes are not easily degradable, hence remain in water systems for longer periods.<sup>5</sup>

Reportedly in textile industry, among various synthetic dyes, triarylmethane type dyes are more popularly used due their cost effectiveness, which contribute to about 30–40 % of the total dyes and pigments used.<sup>6</sup> These dyes are mainly derivatives of colourless triphenylmethane and diphenylnaphthylmethane and are characterized by a central carbon atom joined to three aromatic rings. In addition to textile dyeing, these chemicals have wide range of applications including as colouring agents in foodstuffs, cosmetics, paper, leather, varnish, etc., to mention a few.<sup>7,8</sup> Some triaryl dyes are used as for staining biological and bacteriological specimens and as targetable photo sensitizers.<sup>7</sup> Many triarylmethane dyes are eco-toxic. Crystal violet (CV) is used to dye paper and for printing, in ball pens and inkjet printers, but it is reported to be toxic and may cause human bladder cancer, renal, hepatic and lung tumours. The intake of Malachite green (MG), a commonly used triarylmethane dye, could cause carcinogenic symptoms and lung adenomas. Photo-catalyzed

\* To whom correspondence should be addressed.  
E-mail: [jonnalagaddas@ukzn.ac.za](mailto:jonnalagaddas@ukzn.ac.za)

# Kinetics of Oxidation of Triaryl Methane Dye, Brilliant Blue-R with Chlorine Dioxide

Srinivasu Nadupalli, Venkata D.B.C. Dasireddy, Neil A. Koorbanally and  
Sreekantha B. Jonnalagadda\*  

*School of Chemistry & Physics, University of KwaZulu-Natal, Westville campus, Durban, 4000, South Africa.*

Received 12 September 2018, revised 16 December 2018, accepted 16 December 2018

## ABSTRACT

The fast decolourization of multi-purpose dye, Brilliant blue (BB<sup>-</sup>) oxidized by chlorine dioxide was investigated using the stopped flow technique under varied pH conditions by monitoring its oxidation kinetics. The products were identified and reaction mechanism is described, which is confirmed by kinetic simulations. Under  $[\text{ClO}_2]_0 > [\text{OH}]_0 > [\text{BB}^-]_0$  conditions, the oxidation kinetics showed first-order dependence on BB<sup>-</sup> and chlorine dioxide. The overall second-order rate coefficient enhanced with increasing pH, and values were  $30.2 \pm 0.2 \text{ M}^{-1} \text{ s}^{-1}$ ,  $42.5 \pm 0.8 \text{ M}^{-1} \text{ s}^{-1}$  and  $117.9 \pm 0.8 \text{ M}^{-1} \text{ s}^{-1}$  at pH 7.0, 8.0 and 9.0, respectively. In the pH range 7.0 to 9.0, the catalytic constant for [OH<sup>-</sup>] catalyzed reaction was  $9.0 \times 10^6 \text{ M}^{-2} \text{ s}^{-1}$  with energy of activation of  $50.06 \text{ kJ mol}^{-1}$ . Observed negative entropy of activation of  $-658.73 \text{ J K}^{-1} \text{ mol}^{-1}$  suggests the formation a compact transient activated complex.

## KEYWORDS

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## 1. Introduction

Virtually every manmade material comprises either a dye or pigment. A wide range of modified natural and synthetic dyes are used to colour fabrics, leather, paper, ink, lacquers, varnishes, plastics, cosmetics, and many other odd items.<sup>1</sup> Robinson *et al.* in their review, reported that over ten thousand types of dyes or pigments are in use for various purposes.<sup>2</sup> Approximately ten million tons of various dyes and pigments are produced and used per annum.<sup>3</sup> Huge quantities of these dyes and pigments entering the wastewaters pose severe health risks and contribute to environmental disasters.<sup>2</sup> Approximately two-thirds of the dyes consumed are used by the textile industry to dye fabrics, about one-sixth are used for colouring paper; and the rest are used primarily in the production of organic pigments and in the dyeing of leather and plastics.<sup>4</sup> Due their refractory and toxic nature, many dyes are not easily degradable, hence remain in water systems for longer periods.<sup>5</sup>

Reportedly in textile industry, among various synthetic dyes, triarylmethane type dyes are more popularly used due their cost effectiveness, which contribute to about 30–40 % of the total dyes and pigments used.<sup>6</sup> These dyes are mainly derivatives of colourless triphenylmethane and diphenyl-naphthylmethane and are characterized by a central carbon atom joined to three aromatic rings. In addition to textile dyeing, these chemicals have wide range of applications including as colouring agents in foodstuffs, cosmetics, paper, leather, varnish, etc., to mention a few.<sup>7,8</sup> Some triaryl dyes are used as for staining biological and bacteriological specimens and as targetable photo sensitizers.<sup>7</sup> Many triarylmethane dyes are eco-toxic. Crystal violet (CV) is used to dye paper and for printing, in ball pens and inkjet printers, but it is reported to be toxic and may cause human bladder cancer, renal, hepatic and lung tumours. The intake of Malachite green (MG), a commonly used triarylmethane dye, could cause carcinogenic symptoms and lung adenomas. Photo-catalyzed

degradation of MG and CV in water treatment by using BaO<sub>3</sub>TiO.SrO<sub>3</sub>TiO as catalyst has been reported.<sup>9</sup> Gentian violet (GV), another normally used triaryl-methane dye with antiseptic properties, has been used in medicine for over 100 years, is a component of surgical marking pens. GV causes cell and tissue death and potentially impairs cell migration.<sup>10</sup> Another frequently used dye of this class, Light green SF (LG) reportedly could interfere with metabolic systems.<sup>11</sup> LG causes irritation, when inhaled or consumed, and on contact it could also permeate the skin and accumulate in the body.<sup>12</sup> LG and its metabolites reportedly could prompt carcinogenicity in organisms<sup>13</sup> and produce sarcomas. A longer exposure to LG is reported to cause a blood disorder namely methemoglobinemia.<sup>14,15</sup> Taking into consideration the detrimental effects and potential toxicity of these dyes, it is of paramount importance to understand their degradation mechanisms and to remove these dyes from wastewaters and aquatic bodies.

Forgacs *et al.*<sup>16</sup> reviewed the methods of removal of synthetic dyes from wastewater. Over the years, various techniques including the use of absorbents,<sup>14–17</sup> oxidative degradation,<sup>18</sup> photo-degradation,<sup>19</sup> electrolysis,<sup>20</sup> electrocoagulation,<sup>21</sup> degradation using fungi,<sup>22</sup> enzymes,<sup>23</sup> microbes<sup>24</sup> and biochemical degradation<sup>25</sup>, have been reported for the removal of dyes and toxic organics from water systems, to mention a few. Due to the toxic nature of the effluents, many times biological degradation methods either fail or have limited success. Due to non-biodegradability associated with their toxicity, conventional biological treatment methods will be futile in degradation of dye materials and removal of colour from wastewaters. Hence, chemical approaches has to be adopted.<sup>26</sup> Earlier, we reported the oxidative decolourization of MG with peroxydisulfate,<sup>27</sup> triaryl methane dyes – Thymol blue and Aniline blue by acidic bromate in aqueous solutions.<sup>28,29</sup> We have also reported the scope of ozone and hypochlorite as oxidants in degradation of Amaranth, an azo dye.<sup>30,31</sup> The extent of degradation of the dyes in these studies varied with nature of oxidant and oxida-

\* To whom correspondence should be addressed.  
E-mail: [jonnalagaddas@ukzn.ac.za](mailto:jonnalagaddas@ukzn.ac.za)



## New reactions and reactive intermediates in the pyrolysis of cyclic phosphonium ylides

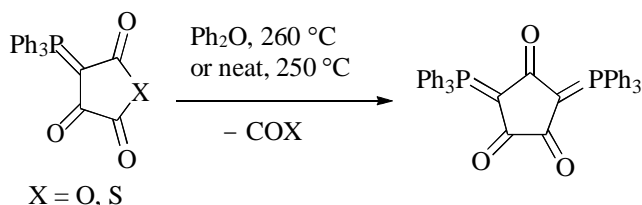
P.Malathi <sup>a\*</sup>, V. Madhu Mohan<sup>b</sup>, Y. B. Kiran<sup>b</sup>, A.B.V. Kiran Kumar<sup>b</sup>

<sup>a</sup>Department of Humanities and Science, G. Pullaiah College of Engineering & Technology, Nandikotkur Rod, Kurnool, India 518 452.

<sup>b</sup>Centre for Applied Sciences, Department of Basic Science and Humanities, Mohan Babu University, A. Rangampet, Sree Sainath Nagar, Tirupati, India 517502.

### Abstract

Pyrolysis, either neat or in diphenyl ether solution, results in the conversion of both 4-triphenylphosphoranylidene-tetrahydrofuran-2,3,5-trione and 4-triphenylphosphoranylidene-tetrahydrothiophene-2,3,5-trione into 3,5-bis(triphenylphosphoranylidene)cyclopentane-1,2,4-trione. These reactions involve extrusion of CO<sub>2</sub> or COS to give 3-triphenylphosphoranylidene-cyclopropane-1,2-dione which further loses CO to give triphenylphosphoranylidene-ketene. The precise way in which these two reactive phosphorus compounds combine to give the observed product has been examined by chemical and isotopic labelling studies. Cyclotrimerization of triphenylphosphoranylidene-ketene upon thermolysis in diphenyl ether has also been observed for the first time. The erroneous literature interpretation of the <sup>13</sup>C NMR spectrum for triphenylphosphoranylidene-ketene is corrected.



**Keywords:** Cyclic ylides, pyrolysis, phosphoranes, reactive intermediates

# Anisotropy of Single Crystal Lithium Sulphur Binary Alloys

J.Mamatha<sup>1</sup> E.Swarna Gowri<sup>2</sup>

<sup>1</sup>Associate Professor, Department of H&S,G.Pullaiah College of Engineering & Technology, Kurnool

<sup>2</sup> Assistant Professor, Department of H&S,G.Pullaiah College of Engineering & Technology, Kurnool

## ABSTRACT

The norm of elastic constant tensor and the norms of the irreducible parts of the elastic constants of the single crystal magnesium lithium alloys Mg-Li at two different percentages (wt. %) of lithium are calculated. The relation of the scalar parts norm and the other parts norms and the anisotropy of these alloys are presented. The norm ratios are used as a criterion to present the anisotropy degree of these alloys.

**Keywords :** Single Crystal, Norm, Anisotropy, Elastic Constants, Magnesium-Lithium Alloys, Irreducible parts, and Binary Alloys.

## I. INTRODUCTION

It was settled that the biocompatibility and biodegradability of binary alloys Mg-Li together with medium modulus of elasticity, and a good corrosion resistance offer binary magnesium-lithium alloys hopeful for use in bio-medical applications [1] and the high strength together with low density of magnesium lithium alloys makes them likable to use in the aerospace and transportation industries [2]. The decomposition procedure and the decomposition of elastic constant tensor (Elastic constant tensor can be decomposed into two scalar parts, two deviator parts and one nonor part) is given in [3,4], also the definition of norm concept and the norm ratios and

the relationship between the anisotropy and the norm ratios are given in [3,4]. As the ratio  $N_s / N$  (Norm of the scalar part of the elastic constant tensor/Norm of the elastic constant tensor) becomes close to one the material becomes more isotropic, and as the sum of the ratios  $N_d / N$  (Norm of the deviator part of the elastic constant tensor/Norm of the elastic constant tensor) and  $N_n / N$  (Norm of the nonor part of the elastic constant tensor/Norm of the elastic constant tensor) becomes close to one the material becomes more anisotropic as explained in [3-15].

## II. DATA AND CALCULATIONS

Table 1. Elastic constants in GPa

single crystal magnesium lithium binary alloy	$C_{11}$	$C_{12}$	$C_{13}$	$C_{33}$	$C_{44}$
Magnesium lithium binary alloy, Mg-Li at (wt. %) Li.					
5.0, [16]	51.2	20.1	17.1	64.7	19.8
15.0, [17]	92.0	10.0	5.0	103.0	42.0

# Ethyl (2z) - 2 - (aryl) - 5 - (4- methoxyphenyl)- 7 -methyl - 3 - oxo-2, 3, 8, 8a-tetrahydro-5h- [1,3] thiazolo[3,2-a]pyrimidine-6-carboxylate Synthesis and Characterizations

Dr.J. Mamatha

Associate professor , Department of Chemistry,G.Pullaiah College of Engineering ,Kurnool,AP, India

## ABSTRACT

Pyrimidine plays a significant role among other heterocycles. Literature survey reveals that partially reduced pyridine and Pyrimidine derivatives are known to have antihypertensive property. Pyrimidine nucleus was synthesized by Biginelli reaction. The purpose of this study was to synthesize several title compounds (2a-2k) evaluate them for their antibacterial activity. The structures of all title compounds have been confirmed on the basis of their analytical, IR spectral data. The title compounds have been tested for antibacterial activities against different strains of bacteria.

**Keywords:** ThiazoloPyrimidine, Antibacterial Activity, Biginelli Reaction

## I. INTRODUCTION

Medicinal chemistry is introduced as principles of chemistry and biology. It is also give knowledge which leads to the introduction of new therapeutic agents. Pyrimidines are those molecules that make our life possible being the building blocks of DNA and RNA. Also there are some thiouracil derivatives and compounds, which produce adverse reaction in susceptible patients are being widely used<sup>1</sup>. There are many other vital groups of pyrimidines with medicinal uses<sup>11</sup>.

In the past decades, the pyrimidines have attracted increasing interest in the realms of natural organic chemistry because of their diverse therapeutic and pharmacological properties. These non-planer heterocyclic compounds have emerged as the integral backbones of calcium channel modulators, antihypertensive agents,  $\alpha_{1a}$ - adrenergic receptor antagonists, neuropeptide Y (NPY) antagonist, hepatitis B virus replication inhibitors, several marine derived natural products such as Crambine, Betzelladine  $\beta$  (potent hivgp-120 CD<sub>4</sub> inhibitors)<sup>11</sup>. Ptilomycalin alkaloids have been reported to contain dhpms and thpms moiety<sup>12</sup>.

Several analogs of pyrimidines have been used with the synthesis and functioning of nucleic acids e.g. Fluorouracil, which is used in cancer treatment, cancer antibiotic and cancer drugs<sup>9-10</sup>. One such compound is Monastrol, which has been shown to be a cell-permeable molecule that blocks a normal bipolar spindle assembly in mammalian cells and, therefore, causes cell cycle arrest. Research in this field is in progress for the development of Monastrol as an anti-cancer<sup>15</sup> drug.

## II. METHODS AND MATERIAL

### 1. Biginelli Reaction

A simple and direct producing compound method, first reported by Biginelli in 1893, involves a three Component, one-pot condensation of an aldehyde, a  $\beta$ -ketoester and urea or thiourea Under strongly acidic condition. This has lead to the development of multi-step Strategies that produce overall higher yield, but lack of the simplicity of the Biginelli synthesis. As a result, many improved procedures for the preparation of given product. The **Biginelli reaction** is a reaction that creates 3,4-dihydropyrimidin-2(1H)-ones<sup>2-3-4-5</sup>, an aryl aldehyde,



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

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## ENGLISH LANGUAGE AND LITERATURE TEACHING

**G. Sashi Kumar**

Associate Professor and Head

Department of Humanities and  
Sciences, GPCET, AP.

### ABSTRACT

Education is the dynamic side of philosophy. It is the active aspect and the practical means of realizing the ideals of life. Education is necessity of life, both from the biological and sociological point of view. It is undeniably true that education works like a catalyst or a better life, a social desirable life. Human being is born and grows with inherited properties which no doubt, determines the basic traits of man but education paves a long way for his success in life. Education according to Indian tradition is not merely a means to earn living, for it is only nursery of thought or a school for a citizenship. It is rather the initiation into the life of spirit, a training of human souls in pursuit of truth and the practice of virtue. It is a second birth.

**Keywords : Education, Language, Teaching , Practical**

It is philosophy which provides the purpose or the aim and it is education which makes it practical. Philosophy shows the way and education proceeds in that direction. When we define education as the modification of behaviour, the direction in which modification to be carried out is determined by philosophy. Thus philosophy deals with the end, the education with the means. Infact, it cannot be denied that the great philosophy of all times have been also great educators. Greek philosophers like Socrates and Plato were famous educators. Experience docs everything and it is nothing but education. Experience is nothing but education. Rousseau's philosophy of natural education and Dewer's pragmatism are the bright examples of education expression.

## INTERNATIONAL JOURNAL OF ENGLISH LANGUAGE, LITERATURE AND TRANSLATION STUDIES (IJELR)

### CONFLICTS OF CULTURAL AND IDENTITY IN KIRAN DESAI'S THE INHERITANCE OF LOSS

G. Sashi Kumar, Head of the Department, H&S , GPCET, AP

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**ABSTRACT:** This paper aims in presenting how Kiran Desai in her Man Booker Prize winning novel *The Inheritance of Loss* set in India, England and the USA, delves into various issues associated with identity crisis and cultural conflicts. The characters in the novel often face the problem of identity and alienation and become frustrated at the end. Even they come back to their own country, like the judge in the novel; they develop a sense of distrust and anger. They are in the state of confusion from which they will find it difficult to come out. The novel mainly focuses on the difficulties faced by immigrants who occupy a marginal space in a foreign land and culture. In the novel Desai exhorts the importance of maintaining individual, national and cultural identity, along with enjoying the benefits of cultural amalgamation. Many of the characters in the novel are displaced individuals who try to re-invent their identities far away from their ancestral homes and homelands.

**Key words:** Kiran Desai, *The Inheritance of Loss*, Identity, Culture, Conflicts, Immigrants.

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Kiran Desai's *The Inheritance of Loss* covers countries like Britain, US, India and the past and the present, and the social, religious, linguistic and ethnic diversity. The novel, set in India, shows the master craftsmanship of Desai in portraying a wide range of characters. "A retired judge, his granddaughter, her tutor, the cook, his son and myriad supporting characters have a lively apprehension of different cultures" (Mishra 4). The story takes place in Kalimpong, a peninsular extension of India into the surrounds of Nepal, Tibet and Bhutan. It directly mentions the life and people of different states of India as well as of different nationalities.

Biju's experiences at various restaurants show the multiculturalism of a place as a result of the harmonious existence of various national cultures. At the Baby Bistro, "Above, the restaurant was French, but below in the kitchen it was Mexican and Indian. And, when a Paki was hired, it was Mexican, Indian, Pakistani" (Desai 21). At Le Colonial, "On top, rich colonial, and down below, poor native. Colombian, Tunisian, Ecuadorian, Gambian" (Desai 21). The Stars and Stripes Diner is shown as a place where the American, Indian and Guatemalan flags fly together. The novel also shows how Indians get accustomed to various cultures all over the world.

Sai's life is a perfect example for unity in diversity. The contradictions, "Lochinvar and Tagore, economics and moral science, highland fling in tartan and Punjabi harvest dance in dhotis, national anthem in Bengali and an impenetrable Latin motto" (Desai 30), have been absorbed by her.

*The Inheritance of Loss* presents people who believe in different religions and exhibiting diverse food

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## INTERNATIONAL JOURNAL OF ENGLISH LANGUAGE, LITERATURE AND TRANSLATION STUDIES (IJELR)

### PARTHASARATHY'S 'THE RIVER OF BLOOD' TRANSLATED BY KA. NAA. SUBRAMANYAN

M.Sridevi

Asst. Professor, Dept. of .H & S ,GPCET, AP

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**ABSTRACT:** *The River of Blood* by A. Parthasarathy is a replica of the then society where rich politicians implement their draconian law by setting fire to the houses of down trodden people who are neither supported by law nor safe guards of law and order (police force). This pathetic situation is picturesquely portrayed in the novel. It is the case of suppression of the oppressed where domination leads on to dehumanization and takes its ruthless stance when the well to do leader Naidu turned antagonistic towards the people of the weaker sections. He plotted against all people who are in one way or the other related to the communist group. Down trodden people and widows of low caste people are the ones who suffered a lot and have become the scapegoats for no fault of theirs. It is a satire on existing law and order which seem to be supporting the whims and fancies of rich people like Naidu. It is an example of how uncouth are the ways of rich in dismantling and dismembering the poor and helpless. Thus, it is the demonstration of the dominance of the rich and destruction of the weak.

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Parthasarathy was born in 1930 in Chennai. He published about thirty-five novels, plays, short stories and essays. He received the Sahitya Akademi prize for *Kurudhippunal* (Blood Stream, 1977), the Saraswati Sammam Prize (1999), and the Sangeeth Natak Academy Award (2004) for his play *Ramanujan* (*Ramanujan: The Life and Times of Ramanujan*). Parthasarathy is one of the most eminent and critically acclaimed playwrights in Tamil and his work resonates with contemporary world trends: he has infused modern Tamil drama with vitality and sensibility drawn from both the Native and outside sources. In *Nandan Kathai* (The Story of Nandan) Parthasarathy depicts the stigmatized world of the Scheduled Caste Dalit communities and it not only challenges existing forms of Tamil theater, but also questions the socio-political situation in Tamil Nadu. In *Kongai Thee* (Kongai Fire) he portrays two female protagonists of the Tamil epic, Kannagai and Madhavi, and attempts a psychological study of characters. *Eruthi Attam* (The Last Dance), on the other hand, is an adaptation of Shakespeare's *King Lear* in the fashion of Beckett's *Endgame* as done by Peter Brooks in the London RSC production, based on Antonin Artaud's theater of cruelty.



# English Language Teaching: A Study

M. Sridevi

Assistant Professor Of English  
Department of H & S, GPCET, AP.

## Abstract

English could be reframed as ‘a universal basic skill’ and it is increasingly taught from or before the age of 5 together with literacy and numeracy. It is also ‘the most commonly taught foreign language all over the world’ with a ‘special status’ as a border-crossing channel for trans-cultural communication. New technologies and communications “are enabling immense and complex flows of people, signs, sounds and images across multiple borders in multiple directions.” In this chapter we attempt to harness the ‘strong driving force’ of this impetus for language learning by providing some insights, guidelines and resources to support the design of effective mobile teaching and learning.

Our primary focus in this chapter is the provision of reflective guidance for a mobile and technology supported pedagogy for English language teacher development. However, it is likely that the resources and reflections throughout will be of relevance to teachers of other languages, their educators and more broadly to those working with teachers from a wider variety of subjects interested in mobile learning. Teachers from all sectors are encouraged to develop confidence in their evolving pedagogic and digital practices via the application of 21st Century skills and by becoming familiar with continuing professional development frameworks where design of learning is linked to task and technology. We aim to help those involved in discussions around teaching practices for effective learning with the principled use of mobile devices, and to that end we include examples of good practice and reflections from a variety.

**Key Words:** Pedagogic Possibilities, Mobile Pedagogy, Collaboration adoptive.

## Introduction

Extensive research and published literature in the field of Mobile Assisted Language learning and more recently Mobile Assisted Language Use is yet to be fully incorporated into initial training programmes, curricula and professional development frameworks. Baran’s review of research on mobile learning in teacher education, based on a synthesis of 37 articles, found “an increasing interest in the integration of mobile technologies into teacher education contexts. It is not known how many of these contexts were related to language teaching. Although an increased interest is a positive indication, there is also the issue of how mobile technologies are integrated into teacher education or into learning activities inside and outside of class. Crompton, Burke and Gregory’s (2017)

# COURSE AND STRUCTURE OF ENGLISH LANGUAGE

**L. Tehseen Khanam**

**Assistant Professor Of English  
Dept. of H & S, GPCET, AP.**

## **Abstract**

The English major offers excellent preparation for advanced work in graduate or professional school and for a wide array of options in business and industry. Students considering graduate school in English should confer with their advisors to be sure they have planned an appropriate curriculum. Since most graduate schools require at least one modern language and some require a classical language as well, the student should be proficient in at least one foreign language at the time of graduation. There is only one major in the department: the English major. Students may choose to emphasize either creative writing or literature, but the department is firmly committed to the mutual support and dependence of the two emphases, both of which engage the student in reading, writing, and critical and creative thinking. Every effort is made to insure that students who elect the one emphasis will both contribute to and learn from those who elect the other.

A degree in English language and literature is designed to get you reading books, analyzing theories, critiquing prose and verse, and taking a more critical look at the signs and words surrounding us every day. The aim is to get students thinking creatively and analytically about the English language; this differs from other modern language degrees as it is intended for students already proficient in written and spoken English. An English degree can focus equally on the literature and language sides, while others specialize in one or the other; this will usually be clear from the course title. A course with a focus on English literature typically allows students to study literary texts from throughout history.

## **Introduction**

M.A. in English Literature can be completed as a terminal degree or as a stepping-stone to a Ph.D. program. Master's programs can offer a thesis or non-thesis option; non-thesis students typically must take a comprehensive exam. Ph.D. programs require a dissertation and are typically tailored to a student's area of interest, like American or British literature, and graduates of these programs generally pursue careers in academia or look for post-doctoral fellowships.



**RESEARCH ARTICLE**

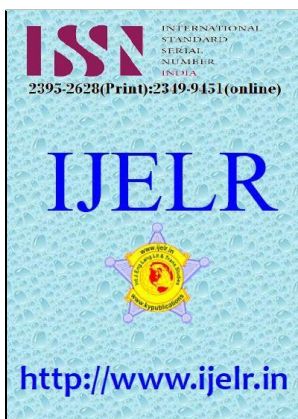
Vol.1. 2.,2018

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA  
2395-2628(Print):2349-9451(online)

**A STUDY OF WOMEN IN WORLD CLASSICS**

**L. TEHSEEN KHANAM**

Assistant Professor, Department of H & S, Sun, GPCET, AP.



**ABSTRACT**

From time immemorial, gender discrimination has remained an unwritten social code or even a legitimate convention all over the world. The various religions and communities of the world .The various religions and communities of the world have always held that women are subservient to men as members of a social order. While sex is the creation of god and sexual differences are essential for procreation, gender is the creation of man. It is the creation of patriarchy, and serves the male flair for domination. A patriarchal social set-up firmly asserts men’s superiority over women and is based not on mutuality but on oppression.

**Keywords:** Socialism and Marxism, masculine treachery, predicament of woman

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Although women have also played a vital role in the creation of society and have been active agents in the making of the world, the patriarchal thought has always tried to relegate them to margins and obscure their history, in this connection, Gerda Lerner has observed, ‘women had no history-so they were told and so they believed .and because they had no history they had no future alternatives” (Gerda Lerner 222).

Though sex differences do not imply sexual inequality and male dominance in a patriarchal social set-up, masculinity is associated with superiority whereas femininity is linked with inferiority and while masculinity implies strength, action, self-assertion and domination, femininity implies strength, action, self-assertion and domination, femininity implies weakness, passivity, docility, obedience and self- negation. Thus, patriarchy undermines women’s sense of self worth and makes them believe that their inferiority is preordained and they are expected to play a subservient role to men. While commenting on the secondary status assigned to women in society, Virginia wolf points out

I want, therefore, to the shelf where the histories stand and took down one of the latest, Professor Trevelyan’s history of England .once more I looked up women found ,’position of and returned to the pages indicated. ‘Wife-beating ‘,i read ,’ was a recognized right of man , and was practiced without shame by high as well as low. . . similarly, the historian goes on the daughter who refused to marry the gentleman of her parents’ choice was liable to be locked up. Beaten and flung about the room, without any shock of being



## A Study of Kavita Daswani's Selected Novels

Dr.T. Sujatha

Sr. Asst. Prof. H & S Department. GPCET, AP.

### Abstract

Diasporic literature deals with the themes such as alienation, exile, loneliness, cultural conflicts and attempts to absorb into the foreign culture. A study of the diasporic writings exposes that the common characteristics in the writings of the old diaspora and the new diaspora include nostalgia, homesickness, and the pains owing to being far from the homeland. There are a large number of writers in Indian English literature who talk about various diasporic experiences in their writings. The field of Indian Chick Literature also includes the diasporic experiences of Indian heroines. Indian Chick Literature illustrates the struggle of the female protagonists for their career as well as to search Mr. Right. But it depicts all these issues with a lighthearted and often comical tone. This paper tries to analyze various diasporic experiences by discussing the novels *Salaam Paris* and *The Village Bride of Beverly Hills* by Kavita Daswani who is one of the contemporary diasporic writers. Daswani, a California-based writer, discovers interesting shades of diaspora in Indian Chick Lit. Her novels embody the changes taking place in the Diaspora Indian communities, particularly concerning the institutions like marriage, role of wife in the families, and growing opportunities for women.

Key Words: Diaspora# Indian Chick Literature# Loneliness# Nostalgia# Marriage

Diasporic literature has two associations: first, its association with the homeland that gives birth to nostalgia, and second, a counterfeit association with the foreign land that becomes a basis for such as alienation, exile, loneliness, cultural conflicts and attempts at assimilation with the alien culture.

Diasporic writing occupies a significant place in the field of literature and has been discussed by a number of writers in their writings. The diasporic writers in India and other countries have contributed by writing the experiences of

# Essential Qualities of English Language Teacher

**T. Sujatha**

Sr. Asst Professor, H & S Dept. GPCET, AP

## Abstract

Some students need extra attention. Teacher should take job seriously because one day teacher would like to be proud with their students. Suppose these things, good teachers should know well how to talk to their students. Teachers must use multiple lectures, because students need surprises, they get bored writing all the time or listening all the time. Although teachers need to be careful, they have to discover a balance in which all students will feel good and satisfied. Some students like changes some not. Some of them feel unsafe in these changes and are afraid to speak or be part of classroom activities. Now days teachers use plans for each class, but in my opinion we should not use plans, because good teachers should be always prepared or better say they should be flexible. Students like changes some not. Some of them feel unsafe in these changes and are afraid to speak or be part of classroom activities. Now days teachers use plans for each class, but in my opinion we should not use plans, because good teachers should be always prepared or better say they should be flexible.

English teachers need to teach reading, writing, viewing, listening, and speaking. These are five distinct areas, and each has its own set of benchmarks and indicators. Simply put, English teachers have a great deal of content to juggle in the classroom. The list of indicators for their content is quite long. They need to be knowledgeable of grammar, vocabulary, writing, literary elements, great novels, researching techniques, speech strategies,

**Key Words: Management Techniques, Personality Traits, Dedication to teaching**

## Introduction

When we talk about teaching, should be said that there are a multitude of elements that satisfy it. In my future as a teacher, I would like to be a teacher that inspires students to love learning, explore new fields of study, and miss the school, not the other one who does just the opposite. Of course I would like to be defined as a good teacher, and as a good teacher I would like let my students know that I am the one who pushes them to do their best and at the same time I'll try to make learning interesting as well as creative. I would like my student to be

## CARBON NANO TUBES: A PROPITIOUS TOOL IN DRUG DELIVERY

B Suneetha\*<sup>1</sup>, Dr. G Ramachandrareddy<sup>2</sup>

<sup>1</sup>Sr. Asst. Prof. of Physics, Dept. of Humanities and Sciences, G. Pullaiah College of Engineering and Technology (A), Kurnool, India.

<sup>2</sup>Prof. of Physics, Dept. of Humanities and Sciences, G. Pullaiah College of Engineering and Technology (A), Kurnool, India.

### ABSTRACT

Nano materials take a front seat in the development of nano science and technology because of their size dependent properties and increasing surface area. Nanotechnology is a promising field for generating new applications in medicine. Carbon nano tubes exhibit many unique physical, chemical properties and have been explored for biological and biomedical applications. Carbon nano tubes (CNTs) have been emerged as a novel drug delivery systems for anti-cancer therapy, Gene therapy, bio molecular sensor, targeted drug delivery etc., due to their high surface area that is capable of adsorbing or conjugating with a wide variety of therapeutic and diagnostic agent. This paper will discuss the applications of carbon nano tubes in drug delivery systems.

**Keywords:** Carbon nano tubes (CNTs); anti-cancer therapy; Gene Therapy; Bio-molecule sensor, drug delivery

### 1. INTRODUCTION

Carbon nano tubes (CNTs) emerged in the field of nanotechnology because of their nano size and unique properties. Carbon nano tubes are hollow cylinders made of graphite carbon atoms with nano scale ( $10^{-9}$  m) which is much smaller than the human hair width [1]. These CNTs are the members of fullerene structural family with their ends capped with a hemisphere of Bucky ball structure [2]. CNTs have a broad range of electronic, thermal, and structural properties because of their nano size which may vary with their length, diameter, and chirality [3]. CNTs made from a single graphene sheet results in a single-walled nano tubes (SWNT) while several graphene sheets make up multiwall carbon nano tubes (MWNTs) [4] (Figure 1). Ever since their discovery in 1991 by Iijima [4], Due to their high surface area, they are capable of adsorbing or conjugating with a wide variety of therapeutic molecules. Thus, CNTs can be surface engineered (i.e., functionalized) in order to enhance their dispersability in the aqueous phase or to provide the appropriate functional groups that can bind to the desired therapeutic material or the target tissue to elicit a therapeutic effect. CNTs might help the attached therapeutic molecule to penetrate through the target cell to treat diseases [3–6] and a recent example of CNTs with a variety of functional groups relevant to cancer therapy [7] is shown in Figure 2. Here, we provide an overview of the therapeutic applications of CNTs with a major focus on their use in the treatment of cancer. SWCNTs and MWCNTs have strong tendency to bundle together in ropes as a consequence of attractive Vander Waals forces. Bundles contain many nano tubes and can be considerably longer and wider than the original ones from which they are formed. This phenomenon could be of important toxicological significance [6,7]. CNTs exist in different forms depending upon the orientation of hexagons in the graphene sheet and possess a very high aspect ratio and large surface areas. The available surface area is dependent upon the length, diameter, and degree of bundling. Theoretically, discrete SWCNTs have special surface areas of approximately  $1300 \text{ m}^2/\text{g}$ , whereas MWCNTs generally have special surface areas of a few hundred square meters per gram. The bundling of SWCNTs dramatically decreases the special surface area of most samples of SWCNT to approximately  $300 \text{ m}^2/\text{g}$  or less, although this is still a very high value [8,9]. The markedly CNTs have various lengths from several hundreds of nano meters to several micrometers and can be shortened chemically or physically for their suitability for drug carriers (Figure 1B) [10] by making their two ends open with useful wall defects for intra tubal drug loading and chemical functionalization (Figure 1B)

# SPECTRAL ANALYSIS OF $\text{Sm}^{3+}$ AND $\text{Dy}^{3+}$ IONS DOPED CADMIUM LEAD BORO ALUMINIUM FLUORIDE GLASSES

B.Suneetha<sup>1</sup>, S. Sailaja<sup>2</sup>, G.Moulika<sup>3</sup>, M.Venkata Ramanaiah<sup>3</sup>, B. Sudhakar Reddy<sup>3\*</sup>

<sup>1</sup>Research Scholar, Department of Physics, Rayalaseema University, Kurnool- 518007, India  
and Assistant Professor, Department of Humanities and Sciences, G.Pullaiah College of  
Engineering and Technology(Autonomous), Kurnool.

<sup>2</sup>Department of Humanities and Basic Sciences, G. Pulla Reddy Engineering College (Autonomous), Kurnool- 518007, India

<sup>3</sup>Department of Physics, SKR&SKR Government Degree College for Women (Autonomous), Kadapa-516001, India

**Abstract :** Photoluminescence properties of cadmium lead boro aluminium fluoride (CdPbBAIF) glasses doped with  $\text{Sm}^{3+}$  and  $\text{Dy}^{3+}$  ions as a function of various doping concentrations have been synthesized by melt quenching technique. Moreover, the spectroscopic properties of the prepared glasses have been studied by Fourier transform infrared spectroscopy (FTIR), optical absorption analysis, photoluminescence excitation (PLE) and Photoluminescence (PL) analysis. The emission spectra of  $\text{Sm}^{3+}$ : CdPbBAIF glasses have shown an intense orange-red emission and  $\text{Dy}^{3+}$ : CdPbBAIF glasses exhibited yellow emission with the excitation at 402 nm and 385 nm respectively. The luminescence quenching behavior of the prepared glasses as a function of the doping molar concentration of  $\text{Sm}^{3+}$  and  $\text{Dy}^{3+}$  ions was analyzed, which could be useful for optimizing the potential composition towards the novel optical applications. Energy level diagram representing the emission lines and decay curves of the prominent emission transitions of the glasses have been presented.

**IndexTerms** - Spectral analysis; CdPbBAIF glasses;  $\text{Sm}^{3+}$  and  $\text{Dy}^{3+}$  ions; Photoluminescence properties; emission; excitation

## I. INTRODUCTION

Recently, rare-earth ions doped inorganic glasses, ceramics or phosphors are considerably significant due to their high chemical stability and high luminescence efficiency. From the literature it is known that, compared to the ceramics and phosphors, glasses are considered as the excellent host materials because of their features such as good mechanical, chemical and thermal stability, flexibility to add rare earth ions in different concentrations, easy preparation, possibility of obtaining bulk samples and the low cost. Besides the properties, the preparation of rare earth ions doped glasses has also gripped the researchers with their applications in different fields such as solid state lasers, light converters, sensors, channel waveguides, infrared to visible up-converters, field emission displays and optical fiber amplifiers for optical communications, optoelectronics and magento optical devices [1-8]. We have earlier reported on the preparation and the optical characterization of different glasses based on tellurites, phosphates, borates [9–14]. In the present work, as the host we have chosen the inorganic luminescent combination of boro and aluminium fluoride glasses to study the luminescence performance with respect to the dopant concentration. In this combination of cadmium lead boro aluminum fluoride glasses,  $\text{B}_2\text{O}_3$  could be found as a network former (NWF) and the other oxides such as CdO, PbO and  $\text{AlF}_3$  are used as the network modifiers (NWM) when those were added to the  $\text{B}_2\text{O}_3$  based structure which can boost up certain electrical, chemical, thermal and optical properties [15]. With these enhanced properties due to network modifiers such as PbO and  $\text{AlF}_3$ , these synthesized glasses were considered as the capable materials for various optical applications [14]. These glasses have good optical quality and are stable against atmospheric moisture [15]. Rare-earth ions doped phosphate glasses with various visible emissions are useful in developing new light sources, display devices, UV-sensors and tunable visible lasers [16-19]. One of the most important concerns in rare earth doped glasses is to define the dopant environment. Hypersensitive transitions are observed in the spectra of all rare earth ions having more than one f electron. Hypersensitive transitions of rare earth ions manifest as anomalous sensitivity of line strength to the character of the dopant environment [20, 21].  $\text{Sm}^{3+}$  is one of the significant rare earth ion due to its increasing demand in various fluorescent devices, high density optical storage, under sea communication, color display and visible solid-state lasers due to its bright emission in orange or red regions [22, 23]. The  $^4\text{G}_{5/2}$  level of  $\text{Sm}^{3+}$  exhibits relatively high quantum efficiency and shows various populating and quenching emission channels resulting interesting fluorescence properties [24].  $\text{Dy}^{3+}$  ( $4f^9$ ) ion is the best choice for developing the full colour optical display systems. The analysis of luminescence from the  $^4\text{F}_{9/2}$  level of  $\text{Dy}^{3+}$  ions is very interesting as it ranges in the visible and NIR regions. Limited attention has been paid to the visible emission originating from the  $^4\text{F}_{9/2}$  state because of the complicated electronic structure of the  $4f^9$  configuration of  $\text{Dy}^{3+}$  ions and the large number of energy levels lying close to each other makes the interpretation of the spectra cumbersome [25-30].

In this article, our aim is to study the emission properties for different concentrations of  $\text{Sm}^{3+}$  and  $\text{Dy}^{3+}$  ions doped CdPbBAIF glasses and observe the luminescence quenching behavior of the prepared glasses as a function of the activator molar concentration to evaluate the potential glass among different concentrations of  $\text{Sm}^{3+}$  and  $\text{Dy}^{3+}$ : CdPbBAIF glasses for novel optical applications.

A bioelectrochemical is used to make hydrogen and ethanol by microorganisms from wastewater discharged from a biodiesel fuel production plant.

1 S.LOKA RAGHAVENDRA, B.LAVANYA ,B.SUNEETHA.

1.G.PULLAIAH COLLEGE OF ENGINEERING & TECHNOLOGY,KURNOOL

Published online 27 March 2018 in Wiley InterScience (www.interscience.wiley.com). DOI 10.111002/bit.21427

**ABSTRACT:** H<sub>2</sub> and ethanol production from glycerol-containing wastes discharged from a biodiesel fuel production plant by *Enterobacter aerogenes* NBRC 12010 was demonstrated in bioelectrochemical cells. Thionine as an exogenous electron transfer mediator was reduced by *E. aerogenes*, and was re-oxidized by a working electrode applied at 0.2 V against a Ag/AgCl reference electrode by a potentiostat (electrode system). At the initial glycerol concentration of 110 mM, 92.9 mM glycerol was consumed in the electrode system with 2 mM thionine after 48 h. On the other hand, the concentration of glycerol consumed was only 50.3 mM under the control conditions without thionine and the electrodes (normal fermentation). There are no differences in the yields of H<sub>2</sub> and ethanol against glycerol consumed between the control conditions and the conditions with the electrode system. A pH of 6.0 was suitable for the H<sub>2</sub> production in the range between pH 6 and pH 7.5 in the electrode system. At pH values of 7.0 and 7.5, H<sub>2</sub> production decreased and formate was remarkably produced in the reaction solution. The rates of both glycerol consumption and the H<sub>2</sub> and ethanol production increased as the thionine concentration and the surface area of the working electrode increased. After 60 h, 154 mM of the initial 161 mM glycerol concentration in the wastes was consumed in the electrode system, which is a 2.6-fold increase compared to the control experiment.

Biotechnol. Bioeng. 2007;98: 340–348.

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**KEYWORDS:** glycerol; hydrogen production; ethanol production; mediator; thionine; bioelectrochemical reactor

## Introduction

It is expected that the use of alternative fuels from biomass, such as bioethanol and biodiesel fuel (BDF), will reduce CO<sub>2</sub> emissions. BDF consists of simple alkyl esters of fatty acids from vegetable oils, used food oils, and animal fats, etc. The most common method is the transesterification of fatty acids with a simple monohydric alcohol such as methanol or ethanol using an alkali catalyst, acid catalyst, lipase, or supercritical methanol (Fukuda et al., 2001; Lotero et al., 2005; Saka and Kusidiana, 2001). Under all these conditions, glycerol is simultaneously produced as a by-product, and is a high proportion of the discharged wastes after the production process for BDF. If virgin oils such as rapeseed oil and sunflower oil are used for the BDF production, pure glycerol can be recovered from the reaction solution and utilized as a chemical material. However, most of BDF in Japan is produced from used food oils, and the glycerol-containing wastes are treated as industrial wastes. In addition, it is expected that the production of BDF will dramatically increase in Japan and other countries in the near future. This will cause an excess supply of glycerol in the world markets. Therefore, developing new methods to treat the wastes containing glycerol are needed.

Several biological treatments of glycerol-containing wastes have been reported. Suehara et al. (2015) have investigated the treatment of glycerol wastes using an oil-degradable yeast *Rhodotorula mucilaginosa*. The biological conversion of glycerol wastes into various materials such as butanol (Andrade and Vasconcelos, 2003), lipids (Papanikolaou and Aggelis, 2002), and 1,3-propanediol (1,3-PD) (González-Pajuelo et al., 2004) has also been investigated.



# Hydrogen fuel production can be achieved through the splitting of dye-sensitive hydrobromic acid.

S.LOKA RAGHAVENDRA, B.LAVANYA, B.SUNEETHA

G.Pullaiah College Of Engineering &amp; Technology, Kurnool

\* Supporting Information

**ABSTRACT:** Hydrobromic acid (HBr) has significant potential as an inexpensive feedstock for hydrogen gas (H<sub>2</sub>) solar fuel production through HBr splitting. Mesoporous thin films of anatase TiO<sub>2</sub> or SnO<sub>2</sub>/TiO<sub>2</sub> core-shell nanoparticles were sensitized to visible light with a new Ru<sup>II</sup> polypyridyl complex that served as a photocatalyst for bromide oxidation. These thin films were tested as photoelectrodes in dye-sensitized photoelectrosynthesis cells. In 1 N HBr (aq), the photocatalyst undergoes excited-state electron injection and light-driven Br<sup>-</sup> oxidation. The injected electrons induce proton reduction at a Pt electrode. Under 100 mW cm<sup>-2</sup> white-light illumination, sustained photocurrents of 1.5 mA cm<sup>-2</sup> were measured under an applied bias. Faradaic efficiencies of 71 ± 5% for Br<sup>-</sup> oxidation and 94 ± 2% for H<sub>2</sub> production were measured. A 12 μmol h<sup>-1</sup> sustained rate of H<sub>2</sub> production was maintained during illumination. The results demonstrate a molecular approach to HBr splitting with a visible light absorbing complex capable of aqueous Br<sup>-</sup> oxidation and excited-state electron injection.

Conversion of sunlight into electrical power using photovoltaics has shown significant potential to provide sustainable energy while minimizing greenhouse gas-producing fossil fuel usage.<sup>1</sup> However, the inability to generate power at night and inconsistent day-to-day photovoltaic performances present their own unique challenges. Through catalytic reactions, solar energy can be converted into chemical bonds

that can serve as solar fuels.<sup>2</sup> One means of generating solar fuels is through hydrohalic acid (HX) splitting. Similar to water splitting, HX splitting is the concurrent reduction of H<sup>+</sup> to H<sub>2</sub> and oxidation of X<sup>-</sup> to X<sub>2</sub>. HBr splitting in particular has many advantages, including the largest theoretical solar-to-hydrogen efficiency and its use in high-performance fuel cells and flow batteries.<sup>3–8</sup> Thus, Br<sup>-</sup> is not a sacrificial reductant, but a regenerative fuel source that complements H<sub>2</sub> production in ways that other hydrohalic acids cannot. A molecular approach

to designing an appropriate Br<sup>-</sup> oxidation photocatalyst

provides significant control over the photophysical and electrochemical properties of the catalyst.<sup>9</sup> Ruthenium polypyridyl complexes are an attractive photocatalyst choice due to their visible-light absorption with high extinction coefficients, tunable redox potentials, and acid stability.<sup>10–13</sup> Herein it is

reported that visible light excitation of a new Ru<sup>II</sup> polypyridyl complex allows for Br<sup>-</sup> oxidation and subsequent Br–Br bond formation for sustainable HBr splitting while simultaneously

providing electrons for the reduction of protons to yield H<sub>2</sub> gas in a dye-sensitized photoelectrosynthesis cell (DSPEC).<sup>14</sup>

Similar to a dye-sensitized solar cell<sup>15,16</sup> the DSPECs utilized a dye-sensitized mesoporous nanocrystalline thin film, but produced fuels in compartments of an H-cell separated by a Nafion proton exchange membrane that can be collected and stored. The mesoporous thin films were either anatase TiO<sub>2</sub> or SnO<sub>2</sub>/TiO<sub>2</sub> core-shell (CS) nanostructures, which consisted of SnO<sub>2</sub> nanoparticles with a 4.5 nm thick amorphous ALD-deposited TiO<sub>2</sub> shell as previously described.<sup>14</sup> Unless otherwise stated, 100 mW cm<sup>-2</sup> white-light illumination truncated with a 400 nm long-pass filter to inhibit semiconductor direct bandgap excitation was utilized in 1 N HBr aqueous solutions sparged with N<sub>2</sub> and kept under an inert atmosphere with an external bias of +0.6 V vs NHE.

The light absorber and photocatalyst employed was [Ru(btmbf)P]<sup>2+</sup>, where btmbf is 4,4'-bis(trifluoromethyl)-2,2'-bipyridine and P is 2,2'-bipyridyl-4,4'-diphosphonic acid, abbreviated herein as Ru(btmbf)<sub>2</sub>P (Figure 1a). The absorption

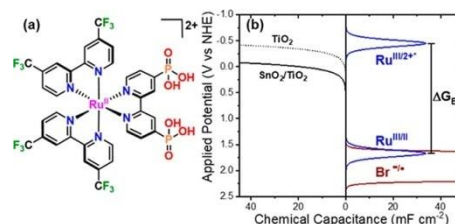


Figure 1. (a) Ru(btmbf)<sub>2</sub>P photocatalyst. (b) Density of states for ground and excited states of surface-bound Ru(btmbf)<sub>2</sub>P photocatalyst

(blue), the one-electron Br<sup>-</sup> redox couple (brown), and the mesoporous thin acceptor states of TiO<sub>2</sub> and SnO<sub>2</sub>/TiO<sub>2</sub> CS (gray).

and photoluminescence spectra measured in 0.1 M HClO<sub>4</sub> (aq) are given in Figure S1, displaying a characteristic metal-to-ligand charge transfer (MLCT) band centered at 460 nm. Light excitation into the MLCT transitions resulted in room temperature photoluminescence (PL). Pulsed light excitation yielded exponential PL decays with a lifetime  $\tau = 510$  ns. A PL

quantum yield ( $\Phi_{PL}$ ) of 0.021 enabled the radiative and

nonradiative rate constants to be extracted (Table 1). Mesoporous thin films of TiO<sub>2</sub> and SnO<sub>2</sub>/TiO<sub>2</sub> CS were sensitized to visible light by overnight reactions with Ru(btmbf)<sub>2</sub>P and are abbreviated as Ru(btmbf)<sub>2</sub>P|TiO<sub>2</sub> and Ru(btmbf)<sub>2</sub>P|CS, respectively. A plot of the Nernstian density

Received: September 1, 2018

Published: October 23, 2018

# Dye-sensitized hydrobromic acid splitting is used to produce hydrogen fuel.

B.LAVANYA,S.LOKA RAGHAVENDRA,B.SUNEETHA

G.Pullaiah College Of Engineering &amp; Technology,Kurnool

✦ Supporting Information

**ABSTRACT:** Hydrobromic acid (HBr) has significant potential as an inexpensive feedstock for hydrogen gas (H<sub>2</sub>) solar fuel production through HBr splitting. Mesoporous thin films of anatase TiO<sub>2</sub> or SnO<sub>2</sub>/TiO<sub>2</sub> core-shell nanoparticles were sensitized to visible light with a new Ru<sup>II</sup> polypyridyl complex that served as a photocatalyst for bromide oxidation. These thin films were tested as photoelectrodes in dye-sensitized photoelectro-synthesis cells. In 1 N HBr (aq), the photocatalyst undergoes excited-state electron injection and light-driven Br<sup>-</sup> oxidation. The injected electrons induce proton reduction at a Pt electrode. Under 100 mW cm<sup>-2</sup> white-light illumination, sustained photocurrents of 1.5 mA cm<sup>-2</sup> were measured under an applied bias. Faradaic efficiencies of 71 ± 5% for Br<sup>-</sup> oxidation and 94 ± 2% for H<sub>2</sub> production were measured. A 12 μmol h<sup>-1</sup> sustained rate of H<sub>2</sub> production was maintained during illumination. The results demonstrate a molecular approach to HBr splitting with a visible light absorbing complex capable of aqueous Br<sup>-</sup> oxidation and excited-state electron injection.

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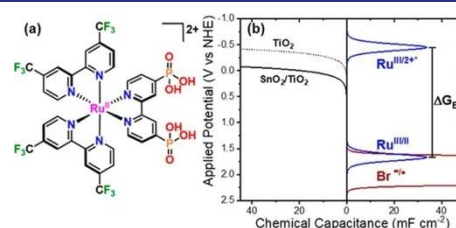


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Received: September 1, 2018

Published: October 23, 2018

- **Hydrogen and ethanol production is a biological process that involves producing both hydrogen and ethanol from waste glycerol discharged from a biodiesel fuel production plant in a bioelectrochemical.**

1 B.LAVANYA, S.LOKA RAGHAVENDRA,B.SUNEETHA.

1.G.PULLAIAH COLLEGE OF ENGINEERING & TECHNOLOGY,KURNOOL

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**ABSTRACT:** H<sub>2</sub> and ethanol production from glycerol-containing wastes discharged from a biodiesel fuel production plant by *Enterobacter aerogenes* NBRC 12010 was demonstrated in bioelectrochemical cells. Thionine as an exogenous electron transfer mediator was reduced by *E. aerogenes*, and was re-oxidized by a working electrode applied at 0.2 V against a Ag/AgCl reference electrode by a potentiostat (electrode system). At the initial glycerol concentration of 110 mM, 92.9 mM glycerol was consumed in the electrode system with 2 mM thionine after 48 h. On the other hand, the concentration of glycerol consumed was only 50.3 mM under the control conditions without thionine and the electrodes (normal fermentation). There are no differences in the yields of H<sub>2</sub> and ethanol against glycerol consumed between the control conditions and the conditions with the electrode system. A pH of 6.0 was suitable for the H<sub>2</sub> production in the range between pH 6 and pH 7.5 in the electrode system. At pH values of 7.0 and 7.5, H<sub>2</sub> production decreased and formate was remarkably produced in the reaction solution. The rates of both glycerol consumption and the H<sub>2</sub> and ethanol production increased as the thionine concentration and the surface area of the working electrode increased. After 60 h, 154 mM of the initial 161 mM glycerol concentration in the wastes was consumed in the electrode system, which is a 2.6-fold increase compared to the control experiment.

Biotechnol. Bioeng. 2007;98: 340–348.

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**KEYWORDS:** glycerol; hydrogen production; ethanol production; mediator; thionine; bioelectrochemical reactor

## Introduction

It is expected that the use of alternative fuels from biomass, such as bioethanol and biodiesel fuel (BDF), will reduce CO<sub>2</sub> emissions. BDF consists of simple alkyl esters of fatty acids from vegetable oils, used food oils, and animal fats, etc. The most common method is the transesterification of fatty acids with a simple monohydric alcohol such as methanol or ethanol using an alkali catalyst, acid catalyst, lipase, or supercritical methanol (Fukuda et al., 2001; Lotero et al., 2005; Saka and Kusidiana, 2001). Under all these conditions, glycerol is simultaneously produced as a by-product, and is a high proportion of the discharged wastes after the production process for BDF. If virgin oils such as rapeseed oil and sunflower oil are used for the BDF production, pure glycerol can be recovered from the reaction solution and utilized as a chemical material. However, most of BDF in Japan is produced from used food oils, and the glycerol-containing wastes are treated as industrial wastes. In addition, it is expected that the production of BDF will dramatically increase in Japan and other countries in the near future. This will cause an excess supply of glycerol in the world markets. Therefore, developing new methods to treat the wastes containing glycerol are needed.

Several biological treatments of glycerol-containing wastes have been reported. Suehara et al. (2015) have investigated the treatment of glycerol wastes using an oil-degradable yeast *Rhodotorula mucilaginosa*. The biological conversion of glycerol wastes into various materials such as butanol (Andrade and Vasconcelos, 2003), lipids (Papanikolaou and Aggelis, 2002), and 1,3-propanediol (1,3-PD) (González-Pajuelo et al., 2004) has also been investigated.

## Aluminum of Welded Duplex Stainless Steel

S. Neelakanta Reddy<sup>1, a</sup>,

<sup>1</sup>Humanities and Sciences, G. Pullaiah college of engineering and technology, Kurnool, Andhra Pradesh, India  
pradeshsnreedy@gmail.com

**Key words:** Stress corrosion cracking, stainless steel weldments, heat input, slow strain rate, acidic chloride solution.

**Abstract.** This study investigated stress corrosion cracking of two welded stainless steel alloys, austenitic 304L and duplex 2205, in an acidic chloride solution. Different heat inputs are selected for welding the alloys, using tungsten inert gas, with and without filler metal. The slow strain rate technique is utilized to estimate the susceptibility of each weldment to stress corrosion cracking. Different strain rates are used, and the experiments showed that the strain rate equal to  $1.66 \times 10^{-6}$ /sec is a critical value that can be used for assessing the susceptibility of the alloys to corrosion cracking. A numerical index used in this study to evaluate this susceptibility, which is based on a ratio between elongation percent of each alloy in the solution to that in the air.

The results showed that the austenitic alloy has higher ductility than duplex in air, while there was not a big difference between both alloys in the solution. Increasing the heat input in autogenous welding caused a brittleness, i.e. less elongation, for both alloys. The results showed that the austenitic alloy is exposed to stress corrosion cracking in the solution, before and after welding, with or without filler metals. On the other hand, the duplex alloy showed higher resistance to stress corrosion cracking than the austenitic alloy due to the high chromium content, and it is dual phase.

### Introduction

Austenitic stainless steel alloys expose to weld decay and intergranular corrosion due to carbide precipitation phenomenon. This precipitation occurs when the alloy passes through the sensitization temperature ranges, i.e. 550 and 850°C, during welding or heat treatments. For example, chromium carbide is formed in 314 austenitic alloy by withdrawing an amount of chromium from the solid solution around the grain boundaries, which leads to form two different regions, i.e. low and high chromium contents. Therefore, when the alloy is exposed to aggressive environments, due to galvanic effects, the intergranular corrosion is occurred [1].

Duplex stainless steel alloys, consisting primarily of ferrite and austenite, has become an alternative of conventional austenitic alloys in many industrial applications because of its combined advantages of mechanical and corrosion properties, particularly its resistance to stress corrosion cracking (SCC) [2-3]. This type of failure occurs in materials under combined actions of environment and tensile stress. Many investigators [4-7] referred high resistance of SCC of duplex stainless steel to the metallurgical composition, i.e. dual phase of ferrite and austenite.

Different methods are used for assessing the stress corrosion cracking (SCC) susceptibility in stainless alloys, such as U bend, small punch (SP), and slow strain rate technique (SSRT) [8-11]. The latter technique provides accurate results. The rate that gives the fastest failure due to SCC is called the critical strain rate. This value depends on many parameters such as chemical composition of the material, the environment, pH and temperature. For example, Tsai [4,5] used a strain rate  $4.1 \times 10^{-6}$ /sec, for 2205 duplex alloy, under controlled potential conditions were conducted in 26% NaCl solution at 90°C, Chung [8] used a strain rate equals  $1.65 \times 10^{-7}$ /sec for welded austenitic stainless steel in simulated boiling water reactors at 298°C, while Li [9], used  $6.4 \times 10^{-6}$ /sec in a boiling MgCl<sub>2</sub>. On the other hand, investigators used different solutions for assessing SCC resistance of alloys, Huang [10] used 5%HF+20%HNO<sub>3</sub> solution for AISI 321, Son [11] used 3.5% NaCl+5% H<sub>2</sub>SO<sub>4</sub> for CD4MCU (Fe-25Cr-5Ni-2.8Cu-2Mo) cast duplex stainless steel.

## well defined grain boundary modification by Silicon based doped to the Nd-Fe-B two sintered magnets

S.Neelakanta Reddy<sup>1, a</sup>, Zhag<sup>2</sup>, Shan<sup>2</sup>, J. Wu<sup>2</sup>,

<sup>1</sup>Department of Humanities and sciences, G. Pullaiah college of engineering and technology, Kurnool, Andhra Pradesh, 518452.

<sup>2</sup>Advanced Research Laboratory, Hitachi Ltd., Hitachi-shi, Ibaraki-ken, 319-1292, Japan

<sup>a</sup>snreddy@gmail.com

**Keywords:** neodymium-iron-boron magnets, magnetic properties, corrosion resistance, microstructure

**Abstract.** Two sintered magnets  $Nd_{15}Dy_{1.2}Fe_{77}Al_{0.8}B_6$  and  $Nd_{22}Fe_{71}B_7$  were modified by intergranular additions of  $Si_3N_4$ . The remanence as well as sintering density of the two magnets increased slightly with appropriate amount of  $Si_3N_4$  additives. Meanwhile, there was an obvious increase in coercivity of the Nd-rich  $Nd_{22}Fe_{71}B_7$  magnet after 0.3 wt. %  $Si_3N_4$  was added to magnets. Besides the effects on magnetic properties, an improved corrosion resistance was observed. Compared with the native magnets without any additions, corrosion potential of the magnets with  $Si_3N_4$  additives is more positive and the current density in the anodic branch of the polarization curve is reduced. Microstructure observation reveals that  $Si_3N_4$  additives have been incorporated into the intergranular phases in the magnets. Si is found to enrich in the Nd-rich intergranular phase with low oxygen content. With the introduction of  $Si_3N_4$  additives, more intergranular phase with high oxygen content is formed, which may contribute to improved corrosion resistance. In addition, addition of  $Si_3N_4$  refines the grain size of  $Nd_{22}Fe_{71}B_7$ .

### Introduction

Since its invention in 1983, sintered rare-earth NdFeB magnets have occupied a huge market in the last two decades ranging from voice coil motor for hard disc drive, magnetic resonance imaging devices to motors for automobile and power generator [1, 2]. The growing demands for NdFeB magnets require not only its superior magnetic properties but also additional properties such as corrosion resistance, thermal stability and mechanical properties etc. However, the multi-phase microstructure of sintered NdFeB magnets results in weak corrosion resistance of this material. The sintered NdFeB magnets suffer from intergranular corrosion where the Nd-rich grain boundary phase reacts with surroundings preferentially. Coating is one of the ways to address this problem. Modification of the intergranular phase by alloying elements is another method to improve the corrosion resistance of NdFeB magnet. Previous works have shown that additions of Co, Al, Dy, Nb, Cr, Ti, Zr, Pb, V, and Mo in the alloying step improve the corrosion resistance of NdFeB [3-9]. Unfortunately, this improvement is likely to be associated with sacrificing the magnetic properties of magnet, i.e. remanence, coercivity, since the alloying elements may dissolve in the  $Nd_2Fe_{14}B$  matrix phase as well as in the Nd-rich intergranular phase. However, the alloying elements would mainly or exclusively enter into the grain boundary region if they were mixed with NdFeB in the form of powder during processing.

Previous works [10, 11] by Z.M. Chen et al. found new grain boundary phase after oxide additions to an  $Nd_{22}Fe_{71}B_7$  magnet. The formation of Nd-O-Fe-M grain boundary phase is associated with increased coercivity and improved thermal stability of the magnet. An early work by Ghandehari [12] revealed that addition of  $Dy_2O_3$  instead of Dy metal to  $Nd_{15}Fe_{77}B_8$  resulted in an enhanced coercivity. Besides oxide additions, a small amount of BN additions has been shown to

## A New Method to Describe Image Theory for an Imperfect Conductor

<sup>1</sup>Siddesh. And <sup>2</sup>Nikath Department of Humanities and  
Science

G.Pullaiah College of Engineering And Technology,  
Nandikotkur Road, Kurnool

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**Abstract: Problem statement:** Modify the equations associated with image theory in order to account for perfect and imperfect conductors. **Approach:** A novel approach for describing the application of image theory for an imperfect conductive surface was presented. The method presented here purposely downplays the physics of how image theory was employed to account for a charge which is in the presence of an imperfect conductive surface. In turn, it adopted an approach which focused on the geometry that existed between the charged particle and surface ground. In doing so, the proposed method formulated a solution that had minimized the complexity of the original problem while providing an approximation founded upon a geometric relationship. **Results:** The equations derived had elicited the concept of using plane geometry to augment image theory. **Conclusion:** A method for evaluating image theory for the imperfect conductor had been presented. As the results had shown, the equations derived had provided an augmented approach to account for surfaces which were both perfect and imperfect.

**Key words:** Image theory, degraded image, electromagnetic fields and imperfect conductors

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### INTRODUCTION

Image theory, in its current form, assumes that an imaged charge is in the presence of perfect conductor. By assuming the material is a “perfect conductor” allows one to account for all of the charge constituents. Therefore, one can assume that a charge over an

infinitely conductive ground has a perfect mirror image. This “mirror image” can be quantified by taking the charge’s spatial coordinates which are perpendicular to the surface and rotating or projecting them by 180°

(Balanis, 1989). Taking the cosine of this angle gives rise to an image charge that is equal in magnitude but opposite in polarity. However, in reality the surface in the presence of a charged particle is not a perfect conductor. With this in mind, one must presume that formulas which leverage this “perfect conductor” assumption will lose accuracy as the surface becomes increasingly non-conductive. For the purposes of this study, we introduce and modify an approach originally proposed by Meredith and Earles (2010) to develop equations which account for both perfect and imperfect surfaces. In doing so, this approach has downplayed the physics of image theory in order to develop a solution which has minimized the complexity of the original problem.

### MATERIALS AND METHODS

The electric field  $E$  is defined as the force per unit charge. Equation 1 describes the electric field as it would be experienced by the small stationary charge  $q_0$  (Jackson, 1999):

$$E = \frac{F}{q_0} \quad (1)$$

Where:

$F$  = The force experienced by the stationary test charge

$E$  = The field wherein the particle is located

A conductor by definition, contains charges capable of moving freely under the action of an applied electric field. In principle, this states that the strength of the electric field dictates the speed at which the charge particles will travel within the conductive material. Furthermore, if charged particles can no longer be accelerated, then the electric field must equal zero. Given a basic expression between an electric field and particle has been described, one can now expand this idea to consider the effects of multiple charges.

Coulomb's law states that the magnitude of the electrostatic force between two point charges is directly

## Boundary Distributions with Respect to Chebyshev's Inequality

<sup>1</sup>Siddesh. And <sup>2</sup>Nikath Department of Humanities and  
 Science  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** Variables whose distributions achieve the boundary value of Chebyshev's inequality are characterized and it is found that non-constant variables with this property are symmetric discrete with at most three values. Nevertheless, the bound of Chebyshev's inequality remains optimal for the class of continuous variables.

**Key words:** Chebyshev's inequality, k-boundary variable, k-condensed variable, nearly k-boundary variable

### INTRODUCTION

The familiar inequality of Chebyshev encountered in most elementary statistics courses affirms that for every random variable  $x$  with mean  $\mu_x$  and standard deviation  $\sigma_x$  and for every  $k \geq 1$ , the probability that  $x$  lies strictly within  $k$  standard deviations of the mean is at least  $1 - \frac{1}{k^2}$ . Equivalently:

$$P\left(|x - \mu_x| \geq k\sigma_x\right) \leq \frac{1}{k^2}$$

The inequality is trivial if  $k \geq 1$  so a proof for  $k > 1$

suffices. Elegant short proofs of this inequality can be found in standard texts such as Hogg and Craig (1995) and Larson and Farber (2009). The proof given below and found in (Rui, 1973) does not require separate cases for discrete and continuous variables.

**Proof:** Define a new variable by:

$$y = \begin{cases} k\sigma_x^2 & \text{if } |x - \mu_x| \geq k\sigma_x \\ 0 & \text{if } |x - \mu_x| < k\sigma_x \end{cases}$$

Dividing by  $k^2\sigma_x^2$  yields the result.

To show that the bound in Chebyshev's inequality cannot be improved, the following example is provided in (Hogg and Craig, 1995).

**Example 1:** Let  $x$  have the following distribution:

$x$	$P(x)$
-1	$\frac{1}{8}$
0	$\frac{3}{4}$
1	$\frac{1}{8}$

It is evident (by symmetry) that  $\mu_x = 0$  and that  $\sigma_x^2 = \sum x^2 P(x) = \frac{1}{4}$  so that  $\sigma_x = \frac{1}{2}$ . Thus, for  $k = 2$ ,

$$k\sigma_x = 1 \text{ and } P(|x - \mu_x| < k\sigma_x) = P(|x| < 1) = \frac{3}{4} = 1 - \frac{1}{2^2}.$$

The following questions arise:

- What other variables might satisfy Chebyshev's

## A New Block Method for Special Third Order Ordinary Differential Equations

<sup>1</sup>Nikath and <sup>2</sup>Siddesh Department of Humanities and Science  
G.Pullaiah College of Engineering And Technology,  
Nandikotkur Road, Kurnool

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**Abstract:** A linear multistep method for the direct solution of initial value problems of ordinary differential equations was presented in this article. Collocation approximation method was adopted in the derivation of the scheme and then the scheme was applied as simultaneous integrator to special third order initial value problem of ordinary differential equations. The new block method possessed the desirable feature of Runge-Kutta method of being self-starting and eliminated the use of predictors. The 3-step block method is P-stable, consistent and more accurate than the existing one. Experimental results confirmed the superiority of the new scheme over the existing method.

**Key words:** Linear multistep method, P-stable, third order IVPS of ODES, Interval of periodicity, corrector and predictor

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### INTRODUCTION

The mathematical formulation of physical phenomena in science and engineering often leads to initial value problems of the form:

$$y''' = f(x,y), y(a) = y_0, y'(a) = \eta_0, y''(a) = \eta_1 \quad (1)$$

However, only a limited number of analytical methods are available for solving (1) directly without reducing to a first order system of initial value problems. Some authors have proposed solution to higher order initial value problems of ordinary differential equations using different approaches<sup>[1-5]</sup>. In particular Awoyemi and Idowu<sup>[2]</sup> developed a class

hybrid collocation method for third order of ordinary differential equations. Awoyemi<sup>[1]</sup> derived a p-stable linear multistep method for general third order initial

value problems of ordinary differential equations which is to be used in form of predictor-corrector forms and like most linear multistep methods, they require starting

values from Runge-Kutta methods or any other one-step methods. The predictors are also developed in the same way as correctors. Moreover, the block methods in Fatunla<sup>[3]</sup> are in form of discrete and are proposed for non-stiff special second order ordinary differential

formula but they are not self-starting; and they advance the numerical integration of the ordinary differential equations in one-step at a time, which leads to overlapping of the piecewise polynomials solution model.

There is the need to develop a method which is self-starting, eliminating the use of predictors with better accuracy and efficiency. This study, therefore propose a block multistep method for the direct solution of third order initial value problems of ordinary differential equations.

### MATERIAL AND METHOD

A power series of a single variable  $x$  in the form:

$$P(x) = \sum_{j=0}^{\infty} a_j x^j \quad (2)$$

is used as the basis or trial function, to produce the approximate solution as:

$$y(x) = \sum_{j=0}^{k+2} a_j x^j \quad a_j \in \mathbb{R}, j=0(1)k+2, y \in C^m(a, b) \subset P(x) \quad (3)$$

equations in form of a predictor-corrector integration



## Estimation of the Mean of Truncated Exponential Distribution

<sup>1</sup>Nikath and <sup>2</sup>Siddesh Department of Humanities and  
 Science

G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract: Problem statement:** In this study, the researcher considers the problem of estimation of the mean of the truncated exponential distribution. **Approach:** This study contracted with maximum likelihood and unique minimum variance unbiased estimators and gives a modification for the maximum likelihood estimator, asymptotic variances and asymptotic confidence intervals for the estimators. The properties of these estimators in small, moderate and large samples were investigated via asymptotic theory and computer simulation. **Results:** It turns out that the modified maximum likelihood estimator was more efficient than the others and exists with probability 1. **Conclusion:** The modified maximum likelihood estimator was always exist, fast and straightforward to compute and more likely to yield feasible values than the unique minimum variance unbiased estimator. Its variance was well approximated by the large sample variance of the other estimators.

**Key words:** Truncation modified maximum likelihood estimator, fisher information, simulation, exponential distribution

### INTRODUCTION

Suppose that  $X$  be a random variable with exponential Probability Density Function (PDF) of mean  $(1/\theta)$ , then the PDF of the random variable  $Y$ , the truncated version of  $X$  truncated on the right at  $b$ , is given by:

$$f(y;\theta) = \begin{cases} \theta e^{-\theta y} (1 - e^{-\theta b})^{-1}, & \text{if } 0 < y \leq b \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where,  $b$  is a known constant.

In practice, the exponential distribution has been widely used as a model in areas ranging from studies on the lifetimes of manufactured items<sup>[1,2]</sup> to research involving survival or remission times in chronic diseases<sup>[3]</sup>. But in some situations, an estimate is desired of the mean among the elements of the population belonging to a certain group. For example, in life testing problems from an exponential distribution, separate estimate for the lifetime mean

might be required for bulbs whose survival times are limited to be less than a constant  $b$ . In this case these survival times might follow a truncated exponential

distribution. The families of truncated distributions provide densities that are useful in modeling such

underlying distribution is assumed to follow the exponential distribution<sup>[6,9]</sup>. There are different approaches for sampling selection from a subset of a larger population<sup>[10,11]</sup>.

This study deals with Maximum Likelihood estimator, (ML) and unique minimum variance unbiased estimator, (UM), of the mean of truncated exponential distribution and shows that the maximum likelihood estimator does not always exist, its existence

depends upon the value of the mean of the random sample and exists with probability approaching 1 as  $n \rightarrow \infty$ . A Modified Maximum Likelihood estimator,

(MML), is considered and compared with the other estimators. The results of a large scale simulations indicate that the modified maximum likelihood estimator is more efficient and more likely to satisfy the feasibility condition, namely  $0 < \hat{\mu} < b/2$  for  $0 < \theta < \infty$ .

Before proceeding with the estimation problem, it can be shown that the mean, say  $\mu(\theta)$ , of the truncated exponential distribution given in (1) is:

$$\mu(\theta) = \frac{1}{\theta} - b(e^{\theta b} - 1)^{-1} \quad (2)$$

populations<sup>[4-8]</sup>.

The truncated exponential distribution can occur in a

## Numerical Solution of Linear Integro-Differential Equations

<sup>1</sup>MahaRani, <sup>2</sup>Suresh Babu Department of Humanities and Sciences

G.Pullaiah College of Engineering And Technology,  
Nandikotkur Road, Kurnool

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**Abstract: Problem Statement:** Integro-differential equations find special applicability within scientific and mathematical disciplines. In this study, an analytical scheme for solving Integro- differential equations was presented. **Approach:** We employed the Homotopy Analysis Method (HAM) to solve linear Fredholm integro-differential equations. **Results:** Error analysis and illustrative examples were included to demonstrate the validity and applicability of the technique. MATLAB 7 was used to carry out the computations. **Conclusion/Recommendations:** From now we can use HAM as a novel solver for linear Integro-differential equations.

**Key words:** Homotopy analysis method, integro-differential equations

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### INTRODUCTION

In recent years, there has been a growing interest in the Integro-Differential Equations (IDEs) which are a combination of differential and Fredholm-Volterra integral equations. IDEs play an important role in many branches of linear and nonlinear functional analysis and their applications in the theory of engineering, mechanics, physics, chemistry, astronomy, biology, economics, potential theory and electrostatics. The mentioned integro-differential equations are usually difficult to solve analytically; so a numerical method is required. Therefore, many different methods are used to obtain the solution of the linear and nonlinear IDEs such as the successive approximations, Adomian decomposition, Homotopy perturbation method, Chebyshev and Taylor collocation, Haar Wavelet, Tau and Walsh series methods.<sup>[1-4,8-16]</sup>

In this study, by means of the homotopy analysis method (HAM), presented by Liao<sup>[5-7]</sup>, a general analytic approach is presented to obtain series solutions of linear IDEs:

$$y'(x) = p(x)y(x) + g(x) + \lambda \int_a^b K(x,t)y(t)dt \quad (1)$$

under the initial condition:

$$y(a) = \alpha \quad (2)$$

where, the upper limit of the integral is constant or variable,  $\lambda$ ,  $\alpha$ ,  $a$  are constants,  $g(x)$ ,  $p(x)$  and  $K(x,t)$  are given functions, whereas  $y(x)$  is to be determined.

The Homotopy Analysis Method (HAM) is based on homotopy, a fundamental concept in topology and differential geometry. Briefly speaking, by means of the HAM, one constructs a continuous mapping of an initial guess approximation to the exact solution of considered equations. An auxiliary linear operator is chosen to construct such kind of continuous mapping and an auxiliary parameter is used to ensure the convergence of solution series. The method enjoys great freedom in choosing initial approximations and auxiliary linear operators. By means of this kind of freedom, a complicated nonlinear problem can be transferred into an infinite number of simpler, linear sub-problems.

The Homotopy Analysis Method (HAM) is a general analytic approach to solve various types of nonlinear equations, including algebraic equations, ordinary differential equations, partial differential equations, differential-difference equation. More importantly, different from all perturbation and traditional non-perturbation methods, the HAM provides us a simple way to ensure the convergence of solution series and therefore, the HAM is valid even for

strongly nonlinear problems.

### MATERIALS AND METHODS

Consider:

$$N[y(x)] = 0$$

Where:

$N$  = An operator

## A Study on the Increase of Numerical Stability and Accuracy of the Transfer Matrix Method

<sup>1</sup>MahaRani, <sup>2</sup>Suresh Babu Department of Humanities and Sciences  
G.Pullaiah College of Engineering And Technology,  
Nandikotkur Road, Kurnool

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**Abstract: Problem Statement:** The transfer matrix method is a very useful tool for the static and dynamic analysis of structures. There are a number of issues though that worsens the numerical stability and the accuracy of this method. **Approach:** This study proposed a simple technique that can be used to handle these numerical difficulties and overcome the problems they give. Its main idea was to apply the method twice starting from two far ends of the structure. **Results:** An example from the calculation of the sensitivity function between two points in a dynamic system is presented. The results presented the very big potential of the proposed method. The improvement of the stability was clear in the graphs of the results. An initial study on the limitations of the proposed technique was also briefly given, together with some initial thoughts on how to overcome them. Finally, an idea of a possible use of the method for the maintenance studies of a high-speed rotor is presented, showing the very big variety of applications this methodology can be applied into. **Conclusions:** The proposed technique was very simple and effective, and hence it should be applied whenever the transfer matrix method was used.

**Key words:** Transfer matrix method, numerical stability, dynamic analysis, sensitivity function

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### INTRODUCTION

The transfer matrix method is a very efficient method for the solution of the differential equations describing the dynamic behavior of engineering systems. According to <sup>[1]</sup>, it can be used for the analysis of continuous beams, plates and shells, turbine-generator shafts, crank shafts, and many other structures. It is a method widely accepted in practice and many books have been written that adapt it to different applications, as for example rotor dynamics<sup>[2]</sup>, or panels and aircraft structures<sup>[3]</sup>.

Despite the fact that this method can be used in such a big variety of applications, it has a very big drawback that finally limits its use. When the frequency of the examined system is high, there appear a number of numerical instabilities, leading to inaccurate results or even complete inability of the method to reach a solution. This problem was pointed out since the initial steps of the method development<sup>[1]</sup> and the limitations imposed were highlighted by almost everyone who dealt with it thereafter.

The aim of this study is to propose a new idea for solving the inherent numerical problems of the transfer matrix method. A detailed theoretical analysis of the

proposed idea is given by using a representative example, the analytical solution of which is known and can be used for the presentation of the very promising results and potential of the proposed method.

### MATERIALS AND METHODS

The idea behind the transfer matrix method is the split of the modeled structure into a number of elements, each being described by a matrix quantity, which relates the state vector at one side of the element to the state vector at the other. The state vector describes the state of the internal forces and displacements at the points where the divisions of the system have been made. The matrices connecting the state vectors can be either so called point matrices that describe discontinuities along the structure (e.g. inertia forces, shape discontinuities, reactions), or field matrices that describe the elastic behavior of the structure. More information on the formulation and theory of the method are given in <sup>[1]</sup> and are also briefly presented in the following paragraphs.

Figure 1 presents schematically all the notation used in the transfer matrix method:  $Z$  is the state vector,  $V$  is the vertical load,  $M$  is the moment,  $\omega$  is the rotational frequency,

## On the Stability and Ultimate Boundedness of Solutions for Certain Third Order Differential Equations

<sup>1</sup>Suresh Babu and <sup>2</sup>MahaRani

Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract: Problem Statement:** With respect to our observation in the relevant literature, work on stability and boundedness of solution for certain third order nonlinear differential equations where the nonlinear and the forcing terms depend on certain variables are scarce. The objective of this study was to get criteria for stability and boundedness of solutions for these classes of differential equations. **Approach:** Using Lyapunov second or direct method, a complete Lyapunov function was constructed and used to obtain our results. **Results:** Conditions were obtained for: (i) Uniform asymptotic stability and, (ii) Uniform ultimate boundedness, of solutions for certain third order non-linear non-autonomous differential equations. **Conclusion:** Our results do not only bridge the gap but extend some well known results in the literature.

**Key words:** Asymptotic stability, uniform ultimate boundedness; third order; complete Lyapunov function.

### INTRODUCTION

We shall be concerned here, with uniform asymptotic stability of the zero solutions (that is when

$p(t, x, y, z) = 0$ ) and uniform ultimate boundedness of solutions of the third order, non-linear, non-autonomous differential equations:

$$\dot{x} + f(t, x, x')x + q(t)g(x') + r(t)h(x) = p(t, x, x', x') \quad (1)$$

On setting  $x' = y$ ,  $x'' = z$  Eq. 1 is equivalent to the system of differential equation:

$$\begin{aligned} \dot{x} &= y, \quad \dot{y} = z, \\ \dot{z} &= p(t, x, y, z) - f(t, x, y)z - q(t)g(y) - r(t)h(x) \end{aligned} \quad (2)$$

In which:

$$\begin{aligned} p: \mathbb{R}^+ \times \mathbb{R}^3 &\rightarrow \mathbb{R}; f: \mathbb{R}^+ \times \mathbb{R}^2 \rightarrow \mathbb{R}; g, h: \mathbb{R} \rightarrow \mathbb{R}; q, r: \mathbb{R}^+ \rightarrow \mathbb{R}; \\ \mathbb{R} &= (-\infty, \infty); \mathbb{R}^+ = [0, \infty); \end{aligned}$$

$p, f, g, h, q$  and  $r$  depend only on the arguments displayed explicitly and

$$\frac{\partial}{\partial t} f(t, x, y) = f_t(t, x, y), \quad \frac{\partial}{\partial x} f(t, x, y) = f_x(t, x, y), \quad \frac{d}{dx} h(x) = h'(x)$$

$$\frac{d}{dt} q(t) = q'(t) \quad \text{and} \quad \frac{d}{dt} r(t) = r'(t) \quad \text{exist and are}$$

continuous for all  $t, x$ , and  $y$ . The dots here as elsewhere, stand for differentiation with respect to the independent variable  $t$ . Moreover, the existence and uniqueness of solutions of (1) will be assumed. Stability analysis and ultimate boundedness of solutions of nonlinear systems are important area of current research and many concept of stability boundedness of solutions have in the past and also recently been studied, see for

instance<sup>[14]</sup>, a survey book, Rouche *et al.*<sup>[15]</sup> and Yoshizawa<sup>[21, 22]</sup> are background books. The studies of qualitative behaviour of solutions have been discussed by many authors in a series of research study. See for instance<sup>[1-13, 16-20]</sup> and references therein. These study were done with the aid of Lyapunov functions except in<sup>[2, 3]</sup> where frequency domain approaches were used. With respect to our observation in the relevant

literature, these authors considered stability, asymptotic behaviour, boundedness of solutions of Eq. 1, 2 in the case  $f(t, x, x')$  equal any of  $f(x, x, x'), f(x, x'), f(x)$  and a where  $a$  is positive constant and  $q(t) = r(t) = 1$ .

In<sup>[17]</sup> Swick discussed conditions for uniform boundedness of Eq. 1 when  $p(t, x, x', x'') = 0$  using an incomplete Lyapunov functions.

## Characterization of Chain as a Regular Semi Group

<sup>1</sup>Suresh Babu and <sup>2</sup>MahaRani

Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract: Problem Statement:** There are some special classes of semi group namely: regular and eventually regular, abundant, orthodox, quasi-adequate. The objective of this study were to: (i) Define a new class of semi group on a Poset and give related examples (ii) Study and establish conditions that characterized Chain as a regular semi group. **Approach:** Tests of some of characteristics of semi group like associativity, commutativity, and regular semi group were carried out on this new class. **Results:** Conditions were obtained that showed it is associative and regular. **Conclusion:** Hence the results suggest that since Chain is regular, there are many other things we can still do this with class of semi group such as: (i) Whether one can characterize all the Green's equivalences and their starred analogues (ii) Whether one can characterize all the congruencies of the given semi group (iii) Whether one characterize all the subsemigroups of the given semi group.

**Key words:** Chain, binary operation, omega, partially ordered, regular semi group, total order, bicyclic

### INTRODUCTION

In<sup>[2,3]</sup>, Semi group was established as a non-empty set  $S$  with binary operation  $*$  such that  $S$  is associative on  $*$  that is, for all  $a, b, c \in S$ ,  $a*(b*c) = (a*b)*c$ . If there exist an element  $1$  of  $S$  such that for every  $a \in S$ ,  $a*1 = 1*a = a$ . We say that  $1$  is an identity element of  $S$  and that  $S$  is a semi group with identity. If  $(S, *)$  has an additional property that  $(\forall a, b \in S) ab = ba$ , we say that, it is a commutative semi group.

In<sup>[6]</sup>, Dilworth discussed a partially ordered set (Poset) as a set with binary relation  $\leq$  such that:

- $a \leq a \quad \forall a \in S$   
(reflexivity)
- If  $a \leq b$  and  $b \leq c$  then  $a \leq c \quad \forall a, b, c \in S$   
(transitivity)
- If  $a \leq b$  and  $b \leq a$  then  $a = b \quad \forall a, b \in S$  (ant symmetry)

If for any  $a$  and  $b$  in  $S$ , either  $a \leq b$  or  $b \leq a$ , then the partial order is called a total order or a linear order.

Therefore if a subset of  $S$  is totally ordered, it is called a Chain i.e., a partially ordered set in which any two elements are comparable.

If  $S$  is a semi group, the element  $a \in S$  is said to be regular if there exist  $b \in S$  such that  $aba = a$ <sup>[5]</sup>.

**Bicyclic semi group:** A semi group  $B = N \times N$  where  $N$  is the set of non-negative integers and  $(m, n)(p, q) = (m-n+t, q-p+t)$  where  $\{t = \max(n, p)\}$  is a Bicyclic semi group.  $E(B)$  = the set of idempotent of  $B$  defined as  $E(S) = \{(m, m) \in B : m \in N\}$ . These have played a very important role in the study of Chain as a semi group. See for example<sup>[4,7]</sup>.

Here we know that  $(1,1) > (2,2) > (3,3) > (4,4) > (5,5) > \dots$  is an omega semi group as in<sup>[4]</sup> because the set of idempotent elements is totally ordered, that is a Chain.

**Sequences:** The sequences  $(\pm 2, \pm 4, \pm 8, \pm 16, \pm 32, \pm 64, \pm \dots)$  and  $(\pm 5, \pm 10, \pm 20, \pm 40, \pm 80, \pm 160, \pm \dots)$  under  $(E, /)$ , is another example of a Chain<sup>[1]</sup>.

### MATERIALS AND METHODS

In this study, with the above related examples, we carry out some tests by studying the nature of this semi group. Conditions were established under which Chain is a regular semi group. We later generalized a formula based on the condition.

**Corresponding Author:** R. Kehinde, Department of Mathematics and Statistics, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria

**Generalization of Differential Operator**  
<sup>1</sup>Janaki and <sup>2</sup>Siddesh Babu  
 Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** The main objective of this study was to generalize a differential operator. The generalized differential operator reduced to many known operators studied by various authors. New classes containing this generalized operator were studied and characterization of these classes was obtained. Further, subordination and superordination results involving this operator were studied and obtained the sandwich theorem.

**Key words:** Differential operator, subordination, superordination

**INTRODUCTION**

Let  $H$  be the class of functions analytic in  $U$  and  $H[a, n]$  be the subclass of  $H$  consisting of functions of the form:

$$f(z) = a + a_n z^n + a_{n+1} z^{n+1} + \dots$$

Let  $A$  be the subclass of  $H$  consisting of functions of the form:

$$f(z) = z + \sum_{n=2}^{\infty} a_n z^n, \quad z \in U \quad (1)$$

Now we introduce a differential operator defines as follows:  $D_{\lambda, \delta}^k : A \rightarrow A$  by:

$$D_{\lambda, \delta}^k f(z) = z + \sum_{n=2}^{\infty} [1 + (n-1)\lambda]^k C(\delta, n) a_n z^n, \quad (2)$$

$k \in \mathbb{N}_0, \lambda \geq 0, \delta \geq 0$

Where:

$$C(\delta, n) = \frac{(n+\delta-1)!}{\delta! (n-1)!} = \frac{\Gamma(n+\delta)}{\Gamma(\delta) \Gamma(n)}$$

Some of relations for the differential operator (2) are discussed in the next lemma.

**Lemma 1:** Let  $f \in A$ . Then:

- $D_{1,0}^0 f(z) = f(z)$
- $D_{1,0}^1 f(z) = z f'(z)$

In the following definitions, new classes of analytic

functions containing the differential operator (2) are introduced:

**Definition 1:** Let  $f(z) \in A$ .

Then  $f(z) \in S_{\lambda, \delta}^{k, \mu}$  if and only if:

$$\Re \left\{ \frac{z [D_{\lambda, \delta}^k f(z)]'}{D_{\lambda, \delta}^k f(z)} \right\} > \mu, \quad 0 \leq \mu < 1, \quad z \in U$$

**Definition 2:** Let  $f(z) \in A$

Then  $f(z) \in C_{\lambda, \delta}^k(\mu)$  if and only if:

$$\Re \left\{ \frac{[z (D_{\lambda, \delta}^k f(z))']}{(D_{\lambda, \delta}^k f(z))} \right\} > \mu, \quad 0 \leq \mu < 1, \quad z \in U$$

**Remark 1:** When  $\lambda = 1, \delta = 0$  we get Sălăgean differential operator<sup>[8]</sup>,  $k = 0$  gives Ruscheweyh operator<sup>[7]</sup>,  $\delta = 0$

## Numerical Treatment of the Mathematical Models for Water Pollution

<sup>1</sup>Narasimha Reddy and <sup>2</sup> Siddesh Babu  
Department of Humanities and Sciences  
G.Pullaiah College of Engineering And Technology,  
Nandikotkur Road, Kurnool

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**Abstract:** To evaluate the environmental impact of pollution, mathematical models play a major role in predicting the pollution level in the regions under consideration. This paper examines the various mathematical models involving water pollutant. We also give the implicit central difference scheme in space, and a forward difference method in time for the evaluation of the generalized transport equation.

**Key words:** water pollution, dissolved oxygen, biological oxygen demand, Contaminant transport

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### INTRODUCTION

"Pure water is the best of gifts that man to man can bring" -Spectator, July 30, 1920

Water, comprising over 70% of the earth's surface, is undoubtedly the most precious natural resource that exists on our planet. Without the seemingly invaluable compound comprised of hydrogen and oxygen, life on earth would be non-existent. It is essential for everything on our planet to grow and prosper David<sup>[9]</sup>.

It is easy to dispose of waste by dumping it into a river or lake. In large or small amounts, dumped intentionally or accidentally, it may be carried away by the current, but will never disappear. It will reappear downstream, sometimes in changed form, or just diluted. Freshwater bodies have a great ability to break down some waste materials, but not in the quantities discarded by today's society. This overload that results, called pollution, eventually puts the ecosystem out of balance<sup>[24]</sup>.

Sometimes nature itself can produce these imbalances. In some cases, the natural composition of the water makes it unfit for certain uses: e.g., water flowing in the highly saline terrain of the prairies or gushing from highly mineralized springs in some parts of the country cannot sustain fish populations.

But most often our waterways are being polluted by municipal, agricultural and industrial wastes, including many toxic synthetic chemicals which cannot be broken down at all by natural processes. Even in tiny amounts, some of these substances can cause serious harm.

Many causes of pollution including sewage and fertilizers contain nutrients such as nitrates and

phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms consequently clogs our waterways, use up dissolved oxygen as they decompose, and block light to deeper waters. This, in turn, proves very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside in water.

Pollution is also caused when silt and other suspended solids, such as soil, washoff plowed fields, construction and logging sites, urban areas, eroded river banks when it rains. Under natural conditions, lakes, rivers, and other water bodies undergo Eutrophication, an aging process that slowly fills in the water body with sediment and organic matter. When these sediments enter various bodies of water, fish respiration becomes impaired, plant productivity and water depth become reduced, and aquatic organisms and their environments become suffocated. Pollution in the form of organic material enters waterways in many different forms as sewage, leaves and grass clippings, or as runoff from livestock feedlots and pastures. When natural bacteria and protozoan in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many types of fish and bottom-dwelling animals cannot survive when levels of dissolved oxygen drop below two to five parts per million. When this occurs, it kills aquatic organisms in large numbers which leads to disruptions in the food chain.

Pathogens are another type of pollution that prove very harmful. They can cause many illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. Pathogens include such organisms as bacteria, viruses, and protozoan. These pollutants enter

## Numerical Treatment of the Mathematical Models for Water Pollution

V Narshimha Reddy and <sup>2</sup>Rama Krishna  
 Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

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**Abstract:** This work addresses the issue of ruin of an insurer whose portfolio is exposed to insurance risk arising from the classical surplus process. Availability of a positive interest rate in the financial world forces the insurer to invest into a risk free asset. We derive a linear Volterra integral equation of the second kind and apply an order four Block-by-block method in conjunction with the Simpson rule to solve the Volterra equation for ultimate ruin. This probability is arrived at by taking a linear combination of some two solutions to the Volterra integral equation. The several numerical examples given show that our results are excellent and reliable.

**Key words:** Risk theory, ruin probability, volterra integral equation, block-by-block method

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### INTRODUCTION

The problem of finding the probability of ultimate ruin was first considered by Lundberg<sup>[1]</sup>. Since then, the problem has received much attention up to present day. In his thesis, Lundberg considered a surplus model of the type:

Surplus = Initial reserve + Income - outflow. Among the earlier authors who gave a rigorous mathematical basis of Lundberg's work was Cramér<sup>[2,3]</sup>. His contributions were presented in his monograph 'Collective Risk Theory'. Lundberg's model, expounded by Cramér, is termed the Cramér-Lundberg model or the surplus model.

In this model, at time  $t$ , the surplus  $Y_t$  of an insurance company is given by

$$Y_t = y + pt - \sum_{i=1}^{N_t} S_i \quad (1)$$

where,  $y = Y_0 \geq 0$  is the initial reserve,  $p > 0$  is the premium rate,  $\{N_t\}_{t \in \mathcal{R}^+}$  is a Poisson process with intensity  $\lambda$ , modelling the number of claims in  $(0, t]$  and  $\{S_i\}_{i \in \mathcal{N}}$  is an independent and identically distributed sequence of positive random variables (with

distribution  $F$ ) independent of  $N$ , modelling the claim sizes. The distribution  $F$  has finite expectation and

finite variance  $\sigma^2$ . In the literature, the process  $Y$  in equation (1) is commonly known as the classical risk model.

A critical look at the process in (1) raises a couple

term. It does not mean that the company is bankrupt. However, if ruin occurs, it is interpreted as meaning that the company has to take action in order to make the business profitable.

The Cramér-Lundberg model serves as a skeleton for more realistic models that have been studied in the insurance literature. This standard model for nonlife insurance is simple enough to calculate probabilities of interest, but too simple to be realistic. For example, it does not include interest earned on the invested surplus. There are several papers treating this model in many directions and forms, all with a view of finding the probability of ruin. By far the majority of these papers are concentrated on the analytical aspects of the

problem but there is also a quite considerable number that deal with numerical methods to calculate this probability. More on the history of this problem can be traced from Segerdahl<sup>[4,5]</sup>, Andersen<sup>[6]</sup>, Davidson<sup>[7]</sup>,

Thorin<sup>[8]</sup>, Wikstad<sup>[9]</sup>, Gerber<sup>[10]</sup>, Harrison<sup>[11]</sup>, De Vylder<sup>[12]</sup>. For a general background to ruin theory, we

refer to Bühlmann<sup>[13]</sup>. In this study, we shall be concerned with ruin under interest force and our emphasis will be on numerical methods.

### THE MODEL AND THEORETICAL RESULTS

All processes and random variables are assumed to

be defined on the stochastic basis  $(\Omega, \mathcal{F}, \{f_t\}_{t \in \mathcal{R}^+}, P)$

satisfying the usual conditions, i.e.  $f_t$  is right continuous and  $P$ -complete. Here,  $\Omega$  is an abstract sample space whose elements are denoted as  $\omega$ ;  $\mathcal{F}$  is a  $\sigma$ -algebra on  $\Omega$ ;  $P$  is a probability measure and



## On Characteristic Functions of First Order Theta Function

<sup>1</sup>Narasimha Reddy and <sup>2</sup>Janaki

Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** In this study, a relation on the coefficients periods of first order theta function according to the period pair using the theta characteristic values is established.

**Key words:** First-theta function, characteristic, period pair

### INTRODUCTION

**Definition1:** For  $u \in \mathbb{C}$ ,  $\text{Im}\tau > 0$  and characteristic

$(\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix})$ , the function defined as

$$\theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u, \tau) = \sum_{n=-\infty}^{\infty} \exp\left\{ \left( n + \frac{\varepsilon}{2} \right) \pi i \tau + 2\pi i \left( n + \frac{\varepsilon}{2} \right) \left( u + \frac{\varepsilon'}{2} \right) \right\} \quad (1)$$

$$\theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u, \tau) = \sum_{n=-\infty}^{\infty} \exp\left\{ \left( n + \frac{\varepsilon}{2} \right) \pi i \tau + 2\pi i \left( n + \frac{\varepsilon}{2} \right) \left( u + \frac{\varepsilon'}{2} \right) \right\}$$

is called the first order theta function<sup>[1]</sup>.

**Definition 2:** A half-period is half of a period (in particular a complex vector), written

$$\begin{pmatrix} \mu \\ \mu' \end{pmatrix} = \frac{1}{2} \begin{pmatrix} \mu \\ \mu' \end{pmatrix} = \frac{\mu'}{2} + \frac{\mu\tau}{2}$$

A reduced half-period is half of a period in which  $\mu$  and  $\mu'$  where  $\mu$  and  $\mu'$  are integers.

In the present paper, whenever the integers  $\mu$  and  $\mu'$  will be as  $\mu = 1$  and  $\mu' = 1$ , unless otherwise

stated.

In this study,

$$\begin{pmatrix} \varepsilon \\ \varepsilon' \end{pmatrix} \equiv \begin{pmatrix} 1 \\ 1 \end{pmatrix} \pmod{2}$$

$$\begin{pmatrix} \varepsilon \\ \varepsilon' \end{pmatrix} \equiv \begin{pmatrix} 1 \\ 1 \end{pmatrix} \pmod{2}$$

$$\begin{pmatrix} \varepsilon \\ \varepsilon' \end{pmatrix} \equiv \begin{pmatrix} 1 \\ 1 \end{pmatrix} \pmod{2}$$

values of characteristic are  $(\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix})$  used. When the

$$\begin{pmatrix} \varepsilon \\ \varepsilon' \end{pmatrix}$$

$$\theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u + \tau, \tau) = \sum_{n=-\infty}^{\infty} \exp\left\{ \left( n + \frac{\varepsilon}{2} \right)^2 \pi i \tau + 2\pi i \left( n + \frac{\varepsilon}{2} \right) \left( u + \tau + \frac{\varepsilon'}{2} \right) \right\}$$

$$= (-1)^\tau \exp\left\{ -\pi i \tau - 2\pi i u \right\} \theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u, \tau)$$

If we choose  $\mu_2 = (-1)^\tau \exp\left\{ -\pi i \tau - 2\pi i u \right\}$  then we

obtain the following equality

$$\theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u + \tau, \tau) = \mu_2 \theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u, \tau)$$

Hence

$$\theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u + 1 + \tau, \tau) = \sum_{n=-\infty}^{\infty} \exp\left\{ \left( n + \frac{\varepsilon}{2} \right)^2 \pi i \tau + 2\pi i \left( n + \frac{\varepsilon}{2} \right) \left( u + 1 + \tau + \frac{\varepsilon'}{2} \right) \right\}$$

$$= \sum_{n=-\infty}^{\infty} \exp\left\{ \left( n + \frac{\varepsilon}{2} \right) \pi i \tau + 2\pi i \left( n + \frac{\varepsilon}{2} \right) \left( u + \frac{\varepsilon'}{2} \right) + n 2\pi i \tau + \pi i \tau \varepsilon \right\}$$

$$= (-1)^\tau \exp\left\{ -\pi i \tau - 2\pi i u - \pi i \varepsilon' \right\} \theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u, \tau)$$

By using

$$\mu_3 = (-1)^\tau \exp\left\{ -\pi i \tau - 2\pi i u - \pi i \varepsilon' \right\}$$

we obtain

$$\theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u + 1 + \tau, \tau) = \mu \theta_{\begin{smallmatrix} \varepsilon \\ \varepsilon' \end{smallmatrix}}(u, \tau)$$

## The Extended Laplace Transform

<sup>1</sup>HarshaVardhan and <sup>2</sup> MahaRani

Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** The space of new generalized functions has been constructed. The operation of associative multiplication has been defined on this space. The Extended Laplace Transform has been defined.

**Key words:** New generalized functions, extended Laplace Transform, associative multiplication, semi norms, topology. 44A10,46F12

### INTRODUCTION

If  $f(t)$  is defined for  $t \geq 0$ , then the improper

integral  $\int_0^\infty K(s,t) f(t) dt$  has many important

applications. The choice  $K(s,t) = e^{-st}$  gives us an especially important integral transform said to be Laplace transform of  $f$ , provided the integral converges.

In the linear mathematical model for a physical system such as a spring /mass system or a series electrical circuit, the right-hand member of the differential equation

$$m \frac{d^2x}{dt^2} + \beta \frac{dx}{dt} + kx = f(t) \text{ or}$$

$$L \frac{d^2q}{dt^2} + R \frac{dq}{dt} + \frac{1}{C} q = E(t)$$

is a driving function and represents either an external force  $f(t)$  or an impressed voltage  $E(t)$ . Solving these differential equations in general is difficult but not impossible. The Laplace transform is an invaluable tool in solving problems such as these. Moreover the Laplace transform can be used for solving

In (1) we defined the space  $\xi(E)$  as a factor space  $T^*(E)/I^*(E)$  [5] and we proved many Important results for this space. Also we have defined the extended

Fourier Transform  $F : \xi(S(\mathbb{R})) \rightarrow \xi(S(\mathbb{R}))$ .

Also in algebras  $\xi(E)$  constructed in(1-5) all the operations of multiplication convolution, differentiation are defined.

There arises a natural question : How is to define the Laplace transform in those algebras ?

In (6) the spaces  $\Pi(R)$ , and the space of New Generalized functions  $\xi(\Pi(R))$  were constructed so that

$\Pi'(R) \subset S'(R) \subset \xi(S(R)) \subset \xi(\Pi(R))$ , where  $\xi(S(R))$  - the space of New Generalized

functions constructed in (1);  $S(R)$  - the space of test

functions of rapid decay;  $S'(R)$  - the space of tempered distributions.

We also use the definitions ,and some results in(6) .Lat us repeat some of them which are used throughout this paper .

Define the space  $\Pi(R) = \Pi_1(R) \cup \Pi_3(R)$  where  $\Pi = \left\{ \eta(t) \in C^\infty(R) : \lim_{t \rightarrow \infty} t^k \eta(t) = 0, \forall n, k \in \mathbb{Z} \right\}$

## Study of Families of Curves in the Euclidian Plan

<sup>1</sup>HarshaVadhan and <sup>2</sup> Janaki

Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** Non-standard analysis techniques are more considered in approaching complex mathematical domains. By using some concepts of non-standard analysis methods such as regionalization method, we deal with a family of curves in an Euclidian plan. The solutions of the algebraic equations representing these curves in a plan have an hyperbolic forms.

**Key words:** Non-standard analysis, regionalization, unlimited number, infinitesimal, appreciable

### INTRODUCTION

Our recent work deals with a family of curves in the Euclidian plan by using some concepts of non-standard analysis given by Robinson, A<sup>[1]</sup> and axiomatized by Nelson, E.<sup>[2]</sup> More precisely, under

some conditions concerning domains we show that the solutions of the algebraic curves have geometrical forms (hyperbolic).

we start our study with the algebraic curve

$E(m, n, a)$  defined in  $\mathfrak{R}_{+2}$  by the set

$$E(m, n, a) = \left\{ (x, y) \in \mathfrak{R}_+^2 \mid \left( \frac{1}{x} \right)^{2m} + \left( \frac{1}{y} \right)^{2n} = a, m \geq n > 0, a > 0 \right\}$$

where  $(x, y)$  verify the following

equation  $x^{2m} y^{2n} a = y^{2n} + x^{2m}, a > 0, \text{ real } x > 0, y > 0$

by using the regionalization method<sup>[3]</sup>.

This curve allows us to define two

sets  $Q \left( a^{-\frac{1}{2m}}, a^{-\frac{1}{2n}} \right)$  and  $Q \left( a^{-\frac{1}{2m}}, a^{-\frac{1}{2n}} \right)$  such that

$Q \left( a^{-\frac{1}{2m}}, a^{-\frac{1}{2n}} \right)$  the quadrant defined by

$x \geq a^{-\frac{1}{2m}}$  and  $y \geq a^{-\frac{1}{2n}}$  and the vertex  $\left( a^{-\frac{1}{2m}}, a^{-\frac{1}{2n}} \right)$

$\left( \left( \frac{1}{a} \right)^{\frac{1}{2m}}, \left( \frac{1}{a} \right)^{\frac{1}{2n}} \right)$ ; which allow us to cover the curve  $E(m, n, a)$ .

From the equation  $\left( \frac{1}{x} \right)^{2m} + \left( \frac{1}{y} \right)^{2n} = a$  which defines the

$$x \left( \frac{1}{y} \right)$$

curve  $E(m, n, a)$  and we can write the function

$f_{m,n,a}$  defined from  $\left[ a^{-\frac{1}{2m}}, +\infty \right[$  into  $\mathfrak{R}$ , such that

$$f_{m,n,a}(x) = \frac{x^{-\frac{n}{m}}}{\left( a x^{\frac{2m}{m} - 1} - 1 \right)^{\frac{1}{2n}}}$$

**Proposition 1:** The function  $f_{m,n,a}$  has the following properties:

1°  $f_{m,n,a}(x)$  is strictly decreasing on  $\left[ a^{-\frac{1}{2m}}, +\infty \right[$ .

2°  $f_{m,n,a}(x)$  has  $y = a^{-\frac{1}{2n}}$  as horizontal asymptote

3°  $f_{m,n,a}(x)$  has  $x = a^{-\frac{1}{2m}}$  as vertical asymptote

## Abstract Fixed Points of Set-valued Mappings

<sup>1</sup>Chandrika and <sup>2</sup>Rama Krishna

Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** We defined new concept of complete sequences of equivalence relations on a given abstract set on which no topology is considered, the concept of contraction mappings with respect to these sequences, proved the existence of a fixed point of a multivalued and in particular single valued mappings T on the given abstract set.

**Key words:** Abstract fixed points, set-valued mappings, topology

### INTRODUCTION

Let X be a metric space with metric d. Denote by CB(X) the class of all nonempty closed bounded subsets of X and define the Hausdorff metric H by

$$H(A, B) := \max \left\{ \sup_{a \in A} \inf_{b \in B} d(a, b), \sup_{b \in B} \inf_{a \in A} d(a, b) \right\} \text{ for } A, B \in CB(X).$$

A mapping T of a metric space (X, d) into itself is  $\alpha$ -contraction for some  $\alpha \in (0, 1)$  if and only if  $d(T(x), T(y)) \leq \alpha d(x, y)$  for all  $x, y \in X$ .

A mapping T of a metric space (X, d) into CB(X) is  $\alpha$ -contractive for some  $\alpha \in (0, 1)$  if and only if

$$H(T(x), T(y)) \leq \alpha d(x, y) \text{ for all } x, y \in X.$$

The Banach contraction principle stated that if (X, d) is a complete metric space and let T be a contraction mapping from X into itself. Then T has a unique element  $x \in X$  such that  $T(x) = x$ . Moreover the sequence  $\{T^n(y)\}_{n \in \mathbb{N}}$  is converging strongly to x for every  $y \in X$ .

Nadler<sup>[1]</sup> generalized this principle as follows: Let (X, d) be a complete metric space and T be  $\alpha$ -contractive mapping from X into CB(X). Then there exists  $y \in X$  with  $y \in T(y)$ . For other results<sup>[2-4]</sup>.

In this paper we introduce the concept of complete sequences of equivalence relations on a given abstract set on which no topology is considered, the concept of

contraction mappings with respect to these sequences, proved the existence of a fixed point of a multivalued and in particular single valued mappings T on such a given abstract set. we also showed that the existence of

of equivalence relation and its contractive condition with respect to the corresponding metric are equivalent in that case the sequence of iterates  $T^n(y)$  is Mosco's convergent to the set of fixed points of T for every  $y$  in X. We supported our work with some examples, showed the validation of Nadler's fixed point theorem for multivalued mappings.

A sequence of subsets  $\{A_n\}_{n=0}^\infty$  in a metric space (X, D) is said to be Mosco's convergent to a subset A if and only if for every  $x \in A$  there exists a sequence  $\{x_n\}_{n=1}^\infty$ ,  $x_n \in A_n \forall n \in \mathbb{N}$  such that  $\{x_n\}_{n=1}^\infty$  is strongly

convergent to the point  $x$ <sup>[5]</sup>.

A metric d on a set X is call non-Archimedean if and only if for all  $x, y, z \in X$ ,  $d(x, y) \leq \max \{d(x, z), d(z, y)\}$ , then, in fact  $d(x, y) = \max \{d(x, z), d(z, y)\}$ .

If  $d(x, z) \neq d(z, y)$  and therefore, each non-Archimedean metric space has the geometric property that each three points of it are vertices of an isosceles triangle<sup>[6]</sup>.

We introduce the following definitions.

### Definitions

1. Let X be an abstract set. Then the sequence of equivalence relations  $\{R_n\}_{n=0}^\infty$  on X is said to be

complete if and only if  $\{R_n\}_{n=0}^\infty$  fulfills the following conditions.

- i.  $X \times X = R_0 \supseteq R_1 \supseteq R_2 \dots$  ;

## Generalized Cauchy's Models and Generalized Integrals

<sup>1</sup>Chandrika and <sup>2</sup>MahaRani  
 Department of Humanities and Sciences  
 G.Pullaiah College of Engineering And Technology,  
 Nandikotkur Road, Kurnool

**Abstract:** The space of generalized complex numbers  $C^*$  has been constructed. The Cauchy's model in the space of new generalized functions is well defined. The generalized integral of new generalized function over the compact  $K$  has been defined.

**Key words:** Cauchy's models, generalized complex numbers, generalized integral, ideal, algebra, topology

### INTRODUCTION

Antonevich and Radyno<sup>[1]</sup> gave the following general method of constructing algebras of new

generalized functions:

Let  $E$ - be some generalized function space and there is a some algebra  $A$  of infinitely many differentiable functions such that  $A \subset E$ .

The multiplication of generalized functions  $\eta, \mu \in E$  will be defined by constructing a new algebra  $\zeta$  and embedding (linear and injective mapping  $j: E \rightarrow \zeta$ , such that  $j(uv)=j(u)j(v)$  for each  $u, v \in A$ ).

If we have the following objects:

1.  $E$ - separated topological vector space;
2. Topological algebra  $A \subset E$ ;
3. Some method of regularization define by a set of linear operators  $R_{\psi, \varepsilon}: E \rightarrow A, \psi \in \phi, \varepsilon \in \zeta$

(where  $\phi$ - fixed set,  $\zeta$ - set with filter) so that  $\forall \psi \in \phi, u \in E$

$R_{\psi, \varepsilon}(u) \rightarrow u$  in since of topology of  $E$ .

Define  $G(\phi, A) = \{f: \phi \times \zeta \rightarrow A\}$  and  $R_u$  the embedding of  $E$  into  $G(\phi, A)$ :

$E \ni u \rightarrow R_u(\phi, A), R_u(\psi, \varepsilon) \equiv R_{\psi, \varepsilon}(u)$

The elements  $f_1, f_2 \in G(\phi, A)$  are called weakly equivalent if  $\forall \psi \in \phi, f(\psi, \varepsilon) - f(\psi, \varepsilon) \rightarrow 0$  in since

of the topology of  $E$ .

**Theorem 1:** Let the sub algebra  $G^*$  and the ideal  $N$  satisfy the following conditions:

1.  $\forall u \in E, R_u \in G^*$ ;
2. The elements of  $N$  are weakly equivalent of zero;
3.  $R_{u, v} - R_u \cdot R_v \in N, \forall u, v \in A$ .

Then  $E$  included in algebra  $\zeta$  as a vector sub space and  $A$  included in  $\zeta$  as a sub algebra and if the operator of differentiation  $D$  defined in  $A$  so that  $D(G^*) \subset G^*$  and  $D(N) \subset N$  then the operator  $D$  is well defined on  $\zeta$  and  $A$  embedded in  $\zeta$  with the operator  $D$ .

**Theorem 2:** If there is an algebra  $\zeta$  and embedding  $j: E \rightarrow \zeta$ , such that  $A$  included in  $\zeta$  as a sub algebra. Then for each  $R_{\psi, \varepsilon}, \psi \in \phi, \varepsilon \in \zeta$ , there are a sub algebras  $G^*$  and  $N$  that satisfy the conditions of

Theorem 1 and  $\zeta = G^* / N$  isometric of the smallest sub algebra containing  $E$ .

**Generalized complex numbers:** Following the Antonevich -Radyno general method of constructing algebras of new generalized functions in<sup>[2-7]</sup> were constructed many algebras of new generalized functions

as:  $\zeta(\zeta(R)), \zeta(D(R)), \zeta(Z(R)), \zeta(S(R)), \zeta(\Pi(R))$ .

where the elements of the algebra  $\zeta(M)$  are ebra  $G(\phi, A)$  define a sub algebra

# A Review on Emerging Contaminants in Sludge Waste Treatment and its Methodology

Dr. Syeda Jeelani Basri<sup>1</sup>, Nagaraja Setty K<sup>2</sup>, Sreenubabu A<sup>3</sup>, Ravi M<sup>4</sup>

<sup>1</sup>Associate Professor, Department of Chemistry, G. Pullaiah College of Engineering & Technology, Kurnool,

<sup>2,3</sup>Lecturer in Chemistry, SML Govt. Degree College, Yemmiganur

<sup>4</sup>Assistant Professor, Department of Chemistry, G. Pullaiah College of Engineering & Technology, Kurnool

**Abstract:** The wastewater discussed is predominantly of domestic origin. Varying amounts of industrial and laboratory wastewaters can be collected and treated with the sanitary sewage. The primary purpose of the treatment of sewage is to prevent the pollution of the receiving waters. Many techniques have been devised to accomplish this aim for both small and large quantities of sewage. Biological Wastewater Treatment System integrates biological reactors with Degremont clarifiers and sludge thickeners to treat effluent from a physical/chemical wastewater treatment system for the removal of nitrates, heavy metals, ammonia, and biochemically oxidizable organics measured as the Biochemical Oxygen Demand (BOD).

**Key words:** domestic origin, industrial wastewaters, laboratory wastewaters, pollution, biological reactors, Degremont, , heavy metals, Biochemical Oxygen Demand (BOD).

## I. INTRODUCTION

Industrial sludge treatment chemicals are extensively used in order to purify water before it can be reused or released into the atmosphere. Industrial sludge contains a combination of compounds of agricultural value (nitrogen, organic matter, phosphorous etc) and pollutants (metals, pathogens, organic pollutants). The market for these chemicals is expected to grow significantly over the next few years due to the expected growth in volume of sludge owing to the growing level of industrialization. Industries such as food and beverage, personal care, automotive and paper and pulp are the key consumers for these chemicals due to the large production of sludge in these units. Industrial sludge treatment chemicals are categorized based on the function they perform into dewatering and drying chemicals, conditioning and stabilizing chemicals, thickening chemicals and digestion chemicals among others. Conditioning and stabilizing chemicals are the highest used chemicals globally. The market for these chemicals is expected to witness significant growth over the new few years owing to the increases industrial activities and the growing regulatory requirements for industrial sludge treatment. The product category for these chemicals consists of coagulants and flocculants, corrosion inhibitors, de-foamers, disinfectants and biocides among others. Flocculants are used in order to support the functioning of coagulants in dewatering and thickening process. These chemicals are cost effective as compared to other methods of sludge treatment and are increasingly being preferred in major emerging economies. However, the growing demand supply gap coupled with the high cost of production and raw material for these chemicals is expected to curtail the growth of the market over the next couple of years.

## II. LITERATURE SURVEY

The Auckland region has two sewage treatment plants: one in Albany and one in Mangere. The process described below is that used by the Mangere treatment plant, which was built in 1960 and currently serves Auckland, Manukau and Waitakere Cities and the Papakura District. It is the largest such treatment plant in New Zealand, but its methods are similar to those used throughout the country. Pepples and Mancl (1998) did document diluting raw wastewater to obtain wastewater with residential strength characteristics, but development of HSW is more complicated than adding water and nitrogen. Dog food was the major contributor to TSS in the synthetic mixture. The sludge was the There is only one published paper available documenting the creation of synthetic HSW (Matejcek et al., 2000). The authors generated synthetic HSW starting with tap water that was allowed to dechlorinate over 4 days. Then SPAM®, Crisco® Vegetable Oil, Purina® Brand Dog Food and dextrose were added along with sludge from a wastewater treatment plant. SPAM® was the primary source for BOD<sub>5</sub> and O&G with dextrose added for minor adjustment to the BOD<sub>5</sub> source for natural bacteria. Batches were mixed from low strength to high strength as described previously.

India is a developing country with 16 per cent of the world population and two percent of the total land area. The exponential increase in industrialization is not only consuming large areas of agricultural land but simultaneously causing serious environmental

# Chemicals – Cancer & You

Nagaraja Setty K<sup>1</sup> Dr. Syeda Jeelani Basri T<sup>2</sup> Sreenubabu A<sup>3</sup> Ravi M<sup>4</sup>

<sup>1</sup>Lecturer in Chemistry, SML Govt. Degree College, kns1196@gmail.com, Yemmiganur

<sup>2</sup>Associate professor, G.Pullaiah College of Engg. & Tech. Dept. of Chemistry, Kurnool

<sup>3</sup>Lecturer in Chemistry, SML Govt. Degree College, sreenubaburoyal@gmail.com, Yemmiganur

<sup>4</sup>Assistant professor, G.Pullaiah Engineering College, Dept. of Chemistry, Kurnool

## ABSTRACT:

Substances known to cause cancer are called carcinogens. Coming into contact with a carcinogen does not mean you will get cancer. It depends on what you were exposed to, how often you were exposed, and how much you were exposed to, among other things.

An early link between cancer and a chemical was found in the late 1700s. An English physician noted that a large number of chimney sweeps had cancer of the scrotum due to exposure to soot, which contains chemicals known as polycyclic aromatic hydrocarbons. Since then, many more chemicals have been identified as known or suspected causes of cancer. Today, much of what we know about chemicals causing cancer in humans we have learned from workers exposed at their jobs.

Examples of some known human cancers are asbestors, benzene ,berellium,arsenic, vinyl chloride,DDT,chloroform.

## I. INTRODUCTION:

### What Is Cancer?

The cell is the basic building block of all living things. All cells normally grow and divide (multiply) to replace old cells to keep the body healthy. A cell becomes cancerous when it grows quickly and uncontrollably. In most cancers, this process leads to the growth of tumors. A tumor is an abnormal growth of tissue resulting from uncontrolled cell growth. Tumors are either benign or malignant[1]. Benign tumors are not cancer. Cells from benign tumors do not spread to other parts of the body. Benign tumors are not usually life threatening. Malignant tumors are cancer.

Cancer cells can spread to other tissues and organs near the tumor. They can also spread to other sites in the body through the bloodstream or lymphatic system. This spreading is called metastasis. People of all ages get cancer, but it is most common in people older than 55. One of every three people will get cancer at some point in his/her life. Though we know more about some cancers than others, in most cases we don't know why or how a normal cell changes into a cancer cell. We do know that changes occur in a series of steps, which usually takes a long time. The time from the first cell change to the time the cancer is detected is called the latency period[2].

## Synthesis and biological studies of new quinazolines with ether functions in position 2

M. Ravi\*, A. Uma Ravi Sankar, A. B. V. Kiran Kumar, C. Raghavendra Reddy

*Department of Humanities and Science, G. Pullaiah College of Engineering and Technology, Kurnool, Andhra Pradesh, India,*

Email: [drraviqpcet@gmail.com](mailto:drraviqpcet@gmail.com)

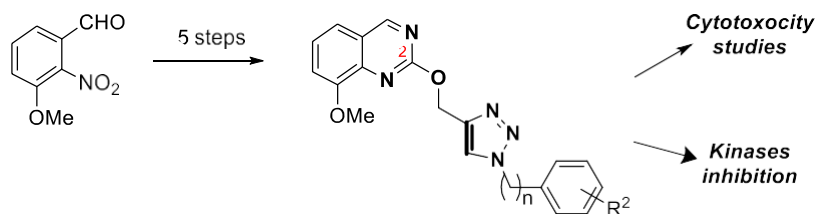
Received 12-21-2018

Accepted 02-12-2019

Published on line 02-28-2019

### Abstract

A series of new quinazolines linked to triazoles through an ether chain in position 2 has been designed and synthesized through a flexible route. Cytotoxicity assays on selected cancer cell lines and inhibition studies toward a panel of representative mammalian kinases have been performed on these molecules.



**Keywords:** Quinazolines, triazoles, cytotoxicity, kinases



## Fluorine substituted non-symmetric phenazines: a new synthetic protocol from polyfluorinated azobenzenes

M Ravi\* and A Uma Ravi Shankar

Department of Chemistry, G.Pullaiah college of Engineering & Technology, Nandikotkur road, Kurnool-518452.

E-mail: [ravim5148@gmail.com](mailto:ravim5148@gmail.com)

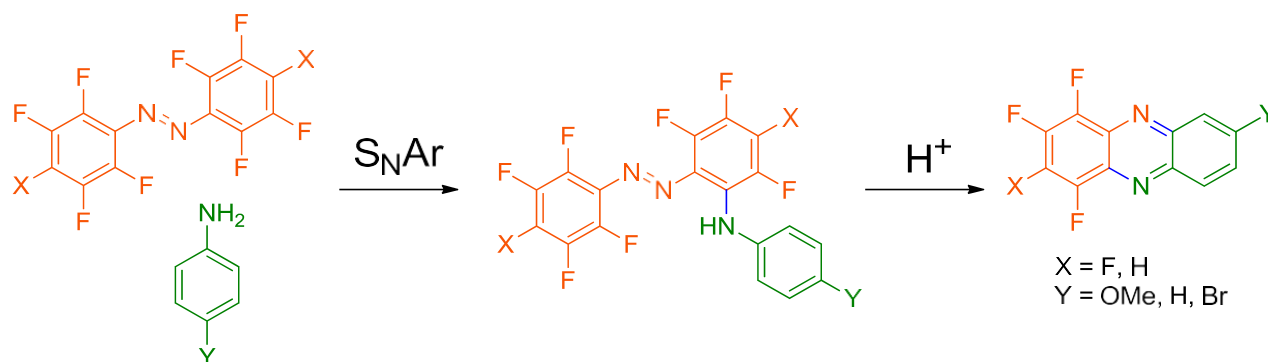
Received 03-27-2019

Accepted 06-04-2019

Published on line 07-03-2019

### Abstract

A high ortho regioselectivity in nucleophilic aromatic substitution in low polar solvents is reported in the reaction of polyfluorinated azobenzenes with anilines. *o*-Anilino substituted derivatives could be easily transformed into non-symmetric phenazines by acid catalyzed electrocyclization. Phenazines are interesting compounds for their important properties as bioactive molecules. In addition, these fluorinated phenazines manifest interesting spectroscopic and electronic properties that make them candidates for n-type organic semiconductor. Furthermore, the prepared phenazines show reversible reduction with the LUMO and HOMO energy level controlled by the electronic nature of the substituent on the non-fluorinated ring of the system.



**Keywords:** Polyfluorinated compounds, azobenzenes, phenazines, aromatic nucleophilic substitution, nitrogen-containing heterocycles

# Performance of Mn<sup>2+</sup>-modified Bentonite Clay for the Removal of Fluoride from Aqueous Solution

E. Swarna Gowri <sup>a\*</sup>, Y. B. Kiran<sup>b</sup>, V. Madhu Mohan<sup>b</sup>, A.B.V. Kiran Kumar<sup>b</sup>

<sup>a</sup>Department of Humanities and Science, G. Pullaiah College of Engineering & Technology, Nandikotkur Rod, Kurnool, India 518 452.

<sup>b</sup>Centre for Applied Sciences, Department of Basic Science and Humanities, Mohan Babu University, A. Rangampet, Sree Sainath Nagar, Tirupati, India 517502.

Received 14 March 2017, revised 12 December 2017, accepted 13 December 2017.

## ABSTRACT

A low-cost adsorbent produced from Mn<sup>2+</sup>-modified bentonite clay was evaluated for groundwater defluoridation. Batch experiments were used to evaluate the effect of contact time at various adsorbent dosages, adsorption isotherms and the effect of pH on fluoride removal. The results showed that the optimum F<sup>-</sup> uptake occurred within the first 30 min contact time and the percentage removal increased with increasing adsorbent dosage. The data fitted better to pseudo-second-order reaction indicating that F<sup>-</sup> adsorption occurred *via* chemisorption. The Weber-Morris model of intra-particle diffusion revealed that both surface and intra-particle diffusion processes were involved during the F<sup>-</sup> adsorption process. Furthermore, the batch results showed that pH of the solution governed the percentage of fluoride removal with the optimum of 75.2 % fluoride removal achieved at pH 4. The adsorbent chemical stability assessment showed that chemical species were leached at trace concentrations which are within the South African National Standards (SANS) limits. Electrostatic attraction and ion-exchange were established as the major mechanisms responsible for fluoride adsorption at acidic pH and at moderate to alkaline pH levels, respectively. The study demonstrated that Mn<sup>2+</sup> intercalated bentonite clay has potential for application in defluoridation of groundwater.

## KEYWORDS

Adsorption, defluoridation, ion exchange, ligand exchange, intra-particle diffusion.

## 1. Introduction

The presence of fluoride in water has both beneficial and detrimental implications on human health depending on concentrations. At concentrations below 1 mg L<sup>-1</sup> fluoride helps in prevention of dental caries and development of bones particularly for children below the age of 10.<sup>1,2</sup> Conversely, at concentrations above the World Health Organization (WHO) permissible limit of 1.5 mg L<sup>-1</sup> fluoride is linked to dental and skeletal fluorosis.<sup>3</sup> Fluorosis is an incurable disease and it is now regarded as a global health problem with countries such as India, China, Mexico, Pakistan, Ethiopia and Egypt largely affected.<sup>4,5</sup>

Defluoridation is the viable option for areas that have groundwater containing fluoride concentration greater than World Health Organization standard of 1.5 mg L<sup>-1</sup>.<sup>3</sup> Several authors have identified adsorption as suitable method for defluoridation in rural areas because it uses materials that are available at little or no cost and it is easy to operate.<sup>6,7</sup> Furthermore, adsorption has proved to be the sustainable method since it uses materials that can be regenerated. Some authors have also identified number of promising adsorbent including acid-activated kaolinite clay soils,<sup>8</sup> La<sup>3+</sup>-modified bentonite,<sup>9</sup> organosmectite,<sup>10</sup> smectite-rich clay soils,<sup>11</sup> Al/Fe oxide-coated diatomaceous earth,<sup>12</sup> mixed Mukondeni clay soils,<sup>13</sup> and MnO<sub>2</sub>-coated bentonite clay.<sup>14</sup>

Clay minerals are promising materials for defluoridation of groundwater due to their abundance and cost-effectiveness. Nonetheless, clays have good adsorptive properties such as: larger chemically active surface area, higher cation exchange

capacity as well as chemical and mechanical stability. Bentonite clay belongs to the class of aluminosilicates. It has a permanent negative charge caused by the isomorphous substitution of Al<sup>3+</sup> for Si<sup>4+</sup> in the tetrahedral layer and Mg<sup>2+</sup> for Al<sup>3+</sup> in the octahedral layer.<sup>15</sup> The negatively charged surface allows bentonite to weakly adsorb anionic pollutants. This is due to repulsion forces between the anions and the permanent negative charge on the edge of the bentonite sheet. The clay can be modified to improve its binding capacity for the anions. Bentonite clay modified with Mg<sup>2+</sup>, Fe<sup>3+</sup> and Al<sup>3+</sup> have been observed to provide improved fluoride adsorption capacity.<sup>16–18</sup> Mn<sup>2+</sup> is a high charge density polycation that is stable at extreme pH levels and its use in defluoridation has not been exploited. This study aimed at evaluating the applicability of Mn<sup>2+</sup>-modified bentonite clay in defluoridation of groundwater. Physicochemical properties of the raw and modified bentonite clay were also evaluated. The adsorption data were modelled through the pseudo-reaction kinetics models, intra-particle diffusion model and Langmuir adsorption isotherm model. The chemical stability of the adsorbent was also evaluated.

## 2. Experimental

### 2.1. Sample Preparation

Raw bentonite clay with a chemical composition of: SiO<sub>2</sub> (65.2 %), Al<sub>2</sub>O<sub>3</sub> (15.30 %), CaO (1.50 %), Fe<sub>2</sub>O<sub>3</sub> (3.41 %), K<sub>2</sub>O (0.98 %), MgO (3.20 %), MnO (0.1 %) and Na<sub>2</sub>O (2.12 %) was collected from ECCA Pty. (Ltd.) in Cape Town, South Africa. All reagents and Total Ionic Solution Buffer (TISAB-III) were

\* To whom correspondence should be addressed. E-mail: [mugera.gitari@univen.ac.za](mailto:mugera.gitari@univen.ac.za)

