



**24TH ANNUAL CONGRESS OF THE
CHEMICAL SOCIETY OF ETHIOPIA (CSE)**

**ABSTRACTS AND
CONGRESS PROGRAM**

**"Chemistry in the New Millennium: for
Eradicating Poverty & Combating Climate
Change"**

**Venue: Science Faculty, Addis Ababa
University**

**February 22 -24, 2008
Addis Ababa, Ethiopia**

Special Event



The 25th Foundation Anniversary of the CSE

Feb. 18-24, 2008

**THE 25TH FOUNDATION ANNIVERSARY OF
THE CHEMICAL SOCIETY OF ETHIOPIA (CSE)
(FEBRUARY 18-24) AND THE 24TH ANNUAL
CONGRESS OF THE CSE (FEBRUARY 22-24)**

The Chemical Society of Ethiopia (CSE) was founded in 1983. The CSE has been actively involved and is still working hard for the growth of chemical sciences in Ethiopia and in Africa at large. As a result the Society enjoyed its excellent relationship with national and international sister Societies for the last two decades.

In 2006, together with sisterly associations of other African countries, the Society took the initiative to establish the Federation of African Societies of Chemistry (FASC). FASC was then established here in Ethiopia on Thursday 23rd February, 2006 along with the Society's 22nd Annual Congress. The headquarters FASC was decided to be in Addis Ababa, Ethiopia by the founding members.

Recently, the Bulletin of the Chemical Society of Ethiopia celebrated its 20th Anniversary by organising a three days international workshop in Addis Ababa in 2007. The year 2008 is the 25th Foundation Anniversary of the Chemical Society of Ethiopia. Accordingly, on behalf of the Society and myself, I am pleased to announce that the CSE has planned to celebrate colourfully the 25th Foundation Anniversary of the Society during 18-24 February 2008 in Addis Ababa, Ethiopia and welcome all of you to Addis Ababa, the capital city of Ethiopia in the new Ethiopian millennium. The Anniversary will be accompanied by:

- ✓ The 6th Chemistry Open Day Competition among University and Secondary School Students;
- ✓ The Green Chemistry Workshop;
- ✓ An Industry Bazaar;
- ✓ The CSE Awards Ceremony and the 24th Annual Congress of the CSE.

The application of the Society for full membership in the International Union of Pure and Applied Chemistry (IUPAC) as a "National Adhering Organisation, (NAO)" was accepted at the 44th IUPAC assembly meeting held on 11-12 August 2007 in Torino, Italy. This is a milestone for the international recognition of the Society.

Since the 25th birthday of our Society coincide with the celebration of the Ethiopian millennium it is time to make a concerted effort to tackle the very alarming national and international environmental issues. Therefore, the theme of the upcoming Congress is **"Chemistry in the New Ethiopian Millennium: for Combating Climate Change and Poverty Reduction"**.

To this end, on behalf of the Society, I would like to thank all those committed active members, partner organisations, the Executive and Organising Committee Members and our sponsors over the years, the CSE office and all others who were involved in one way or the other in the activities of the Society.

Mulat Abegaz, PhD, President of the Chemical Society of Ethiopia

Congress Organisation

The event is organised by the Chemical Society of Ethiopia, CSE. This is facilitated by an Organising Committee (OC) for the event that was established by the Executive Committee (EC) of the Society. The Congress consists of oral and poster presentations. The official language of the conference will be English.

Executive Officers of the Chemical Society of Ethiopia since Feb. 2007

President:	Dr. Mulat Abegaz, QITC PLC
Vice President:	Dr. Mesfin Redi, Department of Chemistry, Faculty of Science, AAU
Secretary:	Mr. Negussie Negash, Department of Chemistry Education, Faculty of Education, AAU
Finance Head:	Mr Yebegashet Tafesse, Chora Gas and Chemicals Factory
Treasurer:	Dr Ahmed Mustefa, Department of Chemistry, Faculty of Science, AAU
Editor-in-Chief:	Prof. B.S. Chandravanshi, Department of Chemistry, Faculty of Science, AAU
Editor:	Dr. Feleke Zewge, Department of Chemistry, Faculty of Science, AAU
Member:	Ato Tolosa Mergo, Akaki Secondary School

Organizing Committee for the event

- ✓ Dr. Mesfin Redi, Chairman;
- ✓ Dr. Ahmed Mustefa, member;

- ✓ Dr. Feleke Zewge, member;
- ✓ Mr. Negussie Negash, member;
- ✓ Mr. Tolosa Mergo, member;
- ✓ Mr. Yebegashet Tafesse, member and
- ✓ Mr. Tesfalidet Balcha, member

The Venue

The venue of the congress is at the faculty of science of the Addis Ababa University Hall. Computers and LCD for Power Point Presentations will be made available.

Tentative Programme

An Industry Bazaar - February 18-23, 2008

Opening of Bazaar and Symposium- Monday February 18, 2008

A Chemistry Open Day Competition- Feb. 19-20, 2008

- ✓ Among University Students – Tuesday Feb. 19, 2008
- ✓ Among High School Students- Wednesday Feb. 20, 2008

Green Chemistry Workshop –Thursday- Feb 21, 2008

24th CSE Annual Conference- Friday and Saturday Feb. 22-23, 2008

CSE Awards- February 22 during Opening of the Congress

- ✓ Scientific Achievement Awards
- ✓ Industrial Achievement Awards
- ✓ Chemical Education Awards

Excursion- Sunday February 24, 2008

Local Transport

A bus will be arranged for guests to shuttle between the hotel and the congress hall in the mornings and evenings. Weather conditions are expected to be fine, around 24 °C during day time.

Registration for the Congress

Official registration to attend the Congress will be made at the gate of the Congress Hall on Friday 22 of February at 8:30 am from the morning. Other than invited guests and representatives, all participants shall pay their annual membership fees during registration or at the Societies Head Office ahead of the Congress. Participants will get conference documents at the time of registration.

Lectures

Lectures will have duration of 15 Minutes plus 5 minutes for discussion. Thirty minutes are allowed for plenary lectures to be followed by 10 minutes discussion. Time will be strictly respected.

Posters

Posters will be displayed throughout the Congress. Stands, pins, tapes, necessary to set up the posters, will be made available at the Registration Desk. Owners of posters are expected to remove them after the display.

Lunch and coffee breaks during the Congress

Coffee breaks will be served for participants by the Society close to the Congress Centre.

Special Dinner

Cultural Dinner Party will be arranged on Friday February 22 at 18:30 for invited international participants.

Reception Party

Reception party will be arranged on Saturday 23th February at 18:30 close to the Congress Centre.

Visa Requirements

Visas are required to enter Ethiopia except for nationals of Djibouti and Kenya. Participants from other than these countries are advised to have valid visas before arrival at the Bole International Airport. If you do not have valid visas upon arrival, you should have the letter of invitation to the conference, as this document will be needed for facilitating Visa formalities upon arrival. We will assign some one to help you in this regard. Ethiopian Visa will cost between USD 20-50 per person depending on nationality and is valid for one month.

Health and Medication

Malaria is reported in the field excursion areas, and hence those of you who will be participating in the field trip are advised to take the necessary medication in time. It is also necessary to have a valid inoculation certificate for yellow fever prior to arrival.

Currency/Banks

There is no limit to the amount of money you can take into the country. Ethiopian Currency is in "Birr" and "santim". 1 Birr = 100 santim. The exchange rate to other currencies varies but the current rate is 1 EUR = 13 Birr. Payment in credit card or visa is in general limited to a few hotels and restaurants in Ethiopia. It is, therefore, advisable to bring with you money in Cash or Traveller Cheques. There are a number of Banks where you can convert your money to local currency.

We acknowledge support from the following sponsors:

International

- ✓ International Science Programme (ISP)
- ✓ Royal Society of Chemistry (RSC)
- ✓ United Nations Educational and Scientific and Cultural Organisation (UNESCO)

Local

- Addis Ababa University (AAU)
- Ethiopian Science and Technology Agency (ESTA)
- Muger Cement Enterprise
- Bekas Chemicals PLC
- Department of Chemistry, AAU
- Diredawa Food Complex Sh. Co.
- Chora Gas and Chemical Products Factory
- National Alcohol Liquor Factory
- FAFA Foods Sh.Co.
- QITC PLC
- Abyssinia Spring water
- Harar Brewery
- Berhanena Selam Printing Enterprise
- Jimma University
- Haramaya University
- Debre Markos University
- Madawalabu University
- Yitbarek Alemu Starch, Chemical and Adhesives Industry



ESTA



United Nations
Educational, Scientific and
Cultural Organization



Qitc

Quality, Inspection,
Testing & Certification
Services PLC

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The University of
Nottingham

Yitbarek Alemu
Starch, Chemical
and Adhesives
Industry



DelPHE, DFID

PROGRAMME

FRIDAY, FEBRUARY 22, 2008

OPENING SESSION

8:00 – 8:45	REGISTRATION
8:45 - 8:55	PROGRAM INTRODUCTION
8:55 – 9:15	WELCOMING ADDRESS <i>President, CSE</i>
9:15– 9:30	OPENING REMARK <i>Guest of Honor</i>
9:30 – 10:00	AWARDING CEREMONY
10:00 – 10:15	COFFEE AND TEA BREAK

SCIENTIFIC SESSION

SESSION I *BASIC RESEARCH*

Chairpersons: Prof. Theodros Solomon & Dr Ashebir Fisseha, Department of Chemistry, AAU, A.A., Ethiopia.

10:20 - 10:45	REWRITABLE IMAGING ON THE SURFACE OF A FROZEN IONIC LIQUID; <i>Peter Licence, School of</i>
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*Chemistry, the University of
Nottingham, Nottingham, NG7 2RD,
UK, Email:
peter.licence@nottingham.ac.uk.*

10:45 – 11:10 PHOTOELECTROCHEMICAL,
ELECTROCHEMICAL AND
THERMODYNAMIC PROPERTIES
OF PHENYL-SUBSTITUTED
POLYTHIOPHENES, *Shimelis
Admassie, Department of Chemistry,
Addis Ababa University, P. O. Box.
1176, Addis Ababa, Ethiopia.*

11:10 - 11:35 QUANTUM CHEMICAL STUDIES
ON THE INHIBITION EFFICIENCIES
OF SOME SULPHONAMIDES FOR
THE CORROSION OF MILD STEEL
IN ACIDIC MEDIUM; *E. E. Ebenso
Department of Chemistry and
Chemical Technology, National
University of Lesotho, P.O. Roma
180, Lesotho, Southern Africa.*

11:35 - 12:00 COMPARATIVE STUDY OF
SPECIFIC ACID CATALYSIS ON
DIELS-ALDER REACTIONS IN
AQUEOUS MEDIA; *E. B. Mubofu,
Chemistry Department, University
of Dar es Salaam, P.O. Box 35061, Dar
es Salaam, Tanzania.*

12:00 - 1:30 LUNCH BREAK

*Chairpersons: Prof. Negussie Retta & Prof. V. J. T. Raju,
Department of Chemistry, AAU, A.A.,
Ethiopia.*

1:30 - 1:55 SYNTHESIS AND COORDINATION
COMPOUNDS OF N
PYRAZOLYLPROPANAMIDE - A
VERSATILE ACRYLAMIDE-DERIVED
LIGAND; *Kibatu B. Girma,*
Department of chemistry, Bahir Dar
University, Bahir Dar, Ethiopia.

1:55 - 2:20 SECOND DERIVATIVE
SPECTROPHOTOMETRY FOR THE
SIMULTANEOUS DETERMINATION
OF IRON (II) AND COPPER (II);
COPPER (II) AND VANADIUM (V)
USING 2-KETO BUTYRIC ACID
THIOSEMICARBAZONE; *L. E. At,*
Department of Applied Chemistry,
Jimma University, Ambo College, P
O Box 19, Ethiopia.

2:20 - 2:45 LONG-TERM PHOSPHORUS
DESORPTION USING DIALYSIS
MEMBRANE TUBES FILLED WITH
IRON HYDROXIDE AND ITS
EFFECT ON PHOSPHORUS
POOLS; *Taddesse, A.M.,*
Department of Plant Production and
Soil Science University of Pretoria,
Hatfield 0002.

2:45 - 3:15 COFFEE AND TEA BREAK

SESSION II

CHEMISTRY IN THE FOOD & AGRICULTURAL SECTOR

*Chairpersons: Dr Gulilat Dessie, Department of Food Science
& Dr Shimeles Admasu, Department of
Chemical Engineering, AAU, A.A., Ethiopia*

3:15 - 3:40

DETERMINING WATER
DIFFUSIVITY, SEED CONSTANT,
CRITICAL TIME FOR
GERMINATION AND ITS
APPLICATION FOR IMPROVING
GERMINATION OF SOME WHEAT
AND MAIZE GENOTYPES, *M.L.
Sood, Department of Chemistry,
Haramaya University, Ethiopia,
Email: mlsood28@yahoo.co.in.*

3:40 - 4:05

LEVELS OF SOME NUTRIENTS
AND NON-ESSENTIAL METALS IN
COW'S WHOLE FROM ADDIS
ABABA, ETHIOPIA; *Engdawork
Admasu, Department of Chemistry,
Bair Dar University, Bahir Dar,
Ethiopia.*

4:05 - 4:30

ISOLATION AND STRUCTURAL
ELUCIDATION OF SECONDARY
METABOLITES FROM PLANTS;
Hailemichael Tesso, *Haramaya
University, Department of
Chemistry, Haramaya, Ethiopia, e-
mail: michaeltesso@yahoo.com.*

SATURDAY, FEBRUARY 23, 2008

SESSION V PAPERS ON
ENVIRONMENTAL/ GREEN
CHEMISTRY

*Chairperson: Dr Feleke Zewge, Department of Chemistry,
AAU, A.A., Ethiopia*

8:30 - 8:55 REMOVAL OF COLOR AND TOXIC
METALS FROM INDUSTRIAL
WASTEWATER BY INDIGENOUS
BIOMATERIALS: *Malairajan
Singanan' Department of Applied
Chemistry, Ambo College – Jimma
University, Ambo Town, Email:
Msinganan@yahoo.com.*

8:55 - 9:20 DEVELOPMENT IN LIQUID
MEMBRANE EXTRACTION FOR
CONTINUOUS SAMPLING AND
TRACE ENRICHMENT OF
PESTICIDE POLLUTANTS IN
ENVIRONMENTAL WATERS;
*Negussie Megersa, Department of
Chemistry, Addis Ababa University;
P. O. Box 1176, Addis Ababa,
Ethiopia.*

9:20 – 9:45 POTASSIUM STATUS IN THE
SOILS OF THE HIGHLANDS
OF ETHIOPIA AND THE NEED
FOR POTASH FERTILIZERS;
Fassil Kebede, Department of Land

Resource Management and Environmental Protection, Mekelle University; Mekelle, Ethiopia; E-mail: fassil@ethionet.et.

9:45 - 10:05 **COFFEE AND TEA BREAK**

Chairpersons: Dr Yonas Chebude, Department of Chemistry, AAU, A.A., Ethiopia.

10:05 - 10:30 ANTIOXIDANT PROPERTIES OF HERBAL DRUGS IN HEAVY METAL INDUCED TOXICITY IN COMMON CARP (CYPRINUS CARPIO L.); *Vinodhini Singanan, Department of Applied Biology, Ambo College – Jimma University, Ambo Town, Western Shoa, Ethiopia. Email: swethasivani@yahoo.co.in.*

10:30 - 10:55 ANALYSIS OF HEXAVALENT CHROMIUM FROM SHEBA TANNERY EFFLUENTS, WUKRO, TIGRAY, ETHIOPIA; *Abraha G.kidan¹, Department of Chemistry, Mekelle University, PO Box 231, Mekelle, Ethiopia.*

10:55 - 11:20 DOWNSTREAM POLLUTION PROFILES ALONG HULUKA RIVER OF AMBO, ETHIOPIA; *P.C. Prabu, Department of Biology, Ambo College, Ambo, Ethiopia.*

11:20 - 11:45 SWEDISH CHEMICALS POLICY – AN EXAMPLE FRAMEWORK FOR GREENER CHEMISTRY? *Peter Sundin, International Science Programme (ISP), Uppsala University, P.O.Box 549, Uppsala, Sweden; phone: +46 70 167 9118; email: peter.sundin@isp.uu.se.*

11:45 - 12:05 *PHYLANTHUS AMARUS* EXTRACTS AS ECO-FRIENDLY CORROSION INHIBITOR FOR MILD STEEL IN ACIDIC MEDIA; *E. E. Ebenso Department of Chemistry and Chemical Technology, National University of Lesotho, P.O. Roma 180, Lesotho, Southern Africa.*

12:05 - 1:30 LUNCH BREAK

SESSION III PAPERS ON CHEMICAL EDUCATION

Chairpersons: Dr Dejene Ayele, Dean of Faculty of Education, P. O. Box No. 378, Jimma University, Jimma, & Ato Negussie Negash, Department of Chemistry Education, Faculty of Education, AAU, A.A., Ethiopia.

1:30 – 1:55 *PERCEPTIONS OF CHEMISTRY STUDENTS ON THE RELEVANCE OF MATHEMATICS COURSES TO THEIR FIELD OF STUDY: THE*

*CASE OF AMBO COLLEGE;
Andualem Tamiru, Jimma University
Ambo College, P.O. Box 19, Ambo,
Ethiopia, E-Mail:
Andualemtam@yahoo.com.*

1:55 - 2:25

*THE EFFECTS OF CONCEPT
MAPPING AND PROBLEM
SOLVING ON STUDENTS'
ATTITUDES AND
ACHIEVEMENT IN
CHEMISTRY; Dr. Kehinde
Olugbenga Aluko Department of
Applied Chemistry, Jimma
University Ambo College, Ethiopia.
E-mail: dralukokehinde@yahoo.com.*

SESSION IV

CHEMISTRY IN INDUSTRY

Chairpersons:

*Dr Gizachew Alemayehu,
Department of Chemistry, AAU &
Ato Yebegashet Tafesse, Chora Gas
& Chemical Products Factory, A.A.,
Ethiopia.*

2:25 - 2:50

*INHIBITION OF MILD STEEL
CORROSION IN ACIDIC MEDIUM
USING SYNTHETIC AND
NATURALLY OCCURRING
POLYMERS AND SYNERGISTIC
HALIDE ADDITIVES; E. E. Ebenso,
Department of Chemistry and
Chemical Technology, National
University of Lesotho, P.O. Roma
180, Lesotho, Southern Africa.*

2:50 - 3:10

COFFEE AND TEA BREAK

3:10 - 3:40

CLEAN CHEMICAL PROCESSES AND THE USE OF LIFE CYCLE ANALYSIS TO EVALUATE THEIR "GREENNESS", *Endalkachew Sahle-Demessie, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, Ohio, E-mail: sahle-emessie.endalkachew@epa.gov*

3:40 - 4:10

APPROPRIATE TECHNOLOGY: BREEDING A BETTER STOVE; *Mike Clifford, School M3, the University of Nottingham University Park, Nottingham, NG7 2RD, UK.*

4:10 - 4:40

SYNERGISTIC INHIBITION BETWEEN NATURALLY OCCURRING EXUDATE GUM AND HALIDE IONS ON THE CORROSION OF MILD STEEL IN ACIDIC MEDIUM; *E. E. Ebenso Department of Chemistry and Chemical Technology, National University of Lesotho, P.O. Roma 180, Lesotho, Southern Africa.*

4:40 - 5:30

BUSINESS SESSION

5:30 - 5:40

CLOSING REMARK

Dr Mulat Abegaz, CSE President.

6:30-8:30

RECEPTION

SUNDAY, FEBRUARY 24, 2008

6:00 AM - 6:30 PM

EXCURSION

ABSTRACTS

REWRITABLE IMAGING ON THE SURFACE OF A FROZEN IONIC LIQUID

Frank J. M. Rutter¹, Haregewine Tadesse² and Peter Licence^{2}*

*¹The Lennard-Jones Laboratories, Keele University, Keele, ST5 5BG,
UK*

*²School of Chemistry, the University of Nottingham, Nottingham,
NG7 2RD, UK, e-mail: peter.licence@nottingham.ac.uk*

Room temperature ionic liquids have been a source of fascination to chemists, finding application both as reaction media and catalyst support. Because they are composed entirely of ions, ionic liquids have an ***almost zero vapour pressure*** and consequently do not normally evaporate even under vacuum. We have recognized that this lack of volatility allows ionic liquids to be used in a whole range of analytical instruments that require high vacuum (UHV) for their operation. UHV spectroscopies including X-ray Photoelectron Spectroscopy (XPS) Auger Electron Spectroscopy (AES) and Secondary Ion Mass Spectrometry (SIMS) are established techniques that have, until now, been employed almost exclusively in the study and characterization of surfaces and solid samples. Over the past few years we have employed these techniques in the investigation of a range of ionic liquids and solutions thereof.

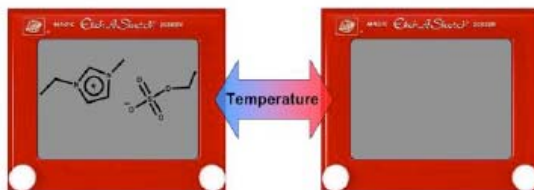


Fig 1: Cartoon depicting the rewritable nature of images laid down on the surface of frozen ionic liquids.

During our studies, using both XPS and SIMS [1], we noted that the “clarity” of spectroscopic data was slightly perturbed as the sample was cooled through its melting point, i.e. cooled to form a solid. This observation opened up a rather unusual series of experiments that allowed us to probe the insulator - conductor transition that accompanies this change of state.

This lecture will give an overview of a number of background experiments conducted by our group that led to the serendipitous discovery of a novel re-writable method for generating image type data on the surface of a frozen ionic liquid. At this time, charged images of moderate resolution (line widths of the order $10\text{ }\mu\text{m}$) may be generated using the focused Ga ion beam that is employed as the primary ion source in a commercial ToF SIMS instrument.[2] We believe that this process can be further optimized using highly focused ion beam (FIB) techniques and could potentially offer opportunities in data storage, intelligent materials and application as a high resolution mask for application in microlithography. Image erasure is facilitated by either softening/melting the frozen surface of by simply

neutralizing the image using a low energy electron source, i.e. charge compensation filament or flood gun.

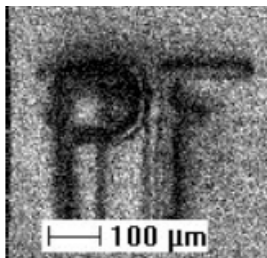


Fig 2: Typical image formed on the surface of the frozen ionic liquid [EMIM][EtSO₄], T = -85 °C.

REFERENCES

- [1] E. Smith, F.J.M. Rutten, I.J. Villar-Garcia, D. Briggs, P. Licence, *Langmuir*, 22, 9386-9392 (2006).
- [2] F.J.M. Rutten, Haregewine Tadesse, P. Licence, *Angew. Chemie. Int. Ed.*, 46, 4163-4167 (2007).

PHOTOELECTROCHEMICAL, ELECTROCHEMICAL AND THERMODYNAMIC PROPERTIES OF PHENYL- SUBSTITUTED POLY THIOPHENES

*Shimelis Admassie**

*Department of Chemistry, Addis Ababa University, P. O. Box 1176,
Addis Ababa, Ethiopia*

In this study, the effect of side chains on the photoelectrochemical properties of phenyl substituted polythiophenes electro-synthesized from their monomers was investigated. The effect of side chains on the

electronic and thermodynamic properties of the monomers and dimers were also investigated using the Hatree-Fock (HF) and Density Functional Theory (DFT) to understand the photoelectrochemical and electrochemical properties. A structure-property relation was observed which was explained using the experimental and theoretical quantum chemical data.

QUANTUM CHEMICAL STUDIES ON THE INHIBITION EFFICIENCIES OF SOME SULPHONAMIDES FOR THE CORROSION OF MILD STEEL IN ACIDIC MEDIUM

Fatma Kandemirli¹, Taner Arslan², E. E. Ebenso^{3}, I. Love³ and H.M. Alemu³*

¹Department of Chemistry, Kocaeli University, 41380, Izmit, Turkey

²Department of Chemistry, Osmangazi University, 41380, Eskişehir, Turkey

³Department of Chemistry and Chemical Technology, National University of Lesotho, P.O. Roma 180, Lesotho, Southern Africa

Quantum chemical calculations using ab-initio density functional theory (DFT) and semi-empirical methods were performed on four sulphonamides (e.g. sulfaguanidine, sulfamethazine, sulfamethoxazole and sulfadiazine) used as corrosion inhibitors for mild steel in acidic medium to determine the relationship between molecular structure and their inhibition efficiencies. The highest occupied molecular orbital energy (E_{HOMO}), lowest unoccupied molecular orbital energy (E_{LUMO}), the Mulliken charges on the C, O, N, S atoms, hardness, the polarizabilities, the coefficients of the atomic orbitals (AO) have been calculated. The results of the quantum

mechanical calculations and experimental efficiencies of the inhibitors were subjected to QSAR correlation analysis. The phenyl ring plays an important role in bonding of the sulphonamides with metal atom in corrosion process according to the calculations.

KEYWORDS: Corrosion inhibitor; Quantum chemical studies; Ab-initio density functional theory (DFT); Semi-empirical; Sulphonamides

COMPARATIVE STUDY OF SPECIFIC ACID CATALYSIS ON DIELS-ALDER REACTIONS IN AQUEOUS MEDIA

E.B. Mubofu

Chemistry Department, University of Dar es Salaam, P.O. Box 35061, Dar es Salaam, Tanzania

A comparative study of Brønsted acid catalysis on Diels-Alder reactions between dienophiles (**1**, **4**) and cyclopentadiene (**2**) in water at 32 °C is reported. Copper (II) nitrate was used as Lewis acid catalyst and hydrochloric acid was employed for Brønsted acid catalysis. The presence of a chromophore in the dienophiles was used to monitor the reaction by UV-VIS technique at between 310 nm and 330 nm wavelength. The disappearance of the dienophile at different diene concentrations gave the reaction rate constants using a pseudo-first order model. At equimolar amounts of copper and HCl (0.01 M), the reaction rate for **1a** and **2** is about 40 times faster for copper catalysis than for the Brønsted catalysis. At 32 °C and 0.01 M HCl, the

reaction of **1a** and **2** is about 21-fold faster compared to pure water at the same reaction conditions. By using deuterium oxide, we observed a solvent kinetic isotope effect with $k_H/k_D < 1$ which suggesting that the reaction undergoes specific Brønsted acid catalysis. Relative to the uncatalysed reaction of **1a** and **2** in acetonitrile at 25 °C, ($k_2 = 1.4 \times 10^{-5} \text{ M}^{-1}\text{s}^{-1}$) catalysis by 0.01 M HCl in water is ($k_2 = 0.07 \text{ M}^{-1}\text{s}^{-1}$), which is about 5000 times faster.

SYNTHESIS AND COORDINATION COMPOUNDS OF *N*-PYRAZOLYLPROPANAMIDE - A VERSATILE ACRYLAMIDE-DERIVED LIGAND

Kibatu B. Girma¹, Volker Lorenz², Steffen Blaurock² and Frank T. Edelmann^{2}*

¹*Department of chemistry, Bahir Dar University, Bahir Dar, Ethiopia*

²*Chemisches Institut der Otto-von-Guericke-Universität, Magdeburg, Germany*

** Prof. Dr. F. T. Edelmann. Tel.: +49-391-6718327; fax +49-391-6712933; e-mail: frank.edelmann@ovgu.de
Universitätsplatz 2, D-39106 Magdeburg, Germany*

The syntheses, spectroscopy and single crystal X-ray structures of the multifunctional acrylamide-derived ligand *N*-pyrazolylpropanamide (= L) (**1**), and its complexes L_2CuCl_2 (**2**) and $\text{L}_4\text{Co}_3\text{Cl}_6$ (**3**) with copper(II) and cobalt(II) chlorides, respectively, are described. The ligand **1** is easily obtained in one step by the reaction of pyrazole with acrylamide in a 1:1 molar ratio in the presence of trimethylbenzylammonium hydroxide as a basic catalyst. The reaction of $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ with **1** in a 1:2 metal salt:ligand molar ratio in ethanol/-

triethylorthoformate solution gave coordination compound **2**. The crystal structure of **2** contains two seven-membered chelate rings formed by two nitrogen atoms of the pyrazolyl groups and two weakly coordinated carbonyl oxygen atoms of the substituted amide moieties. Two chloride ions in the axial positions complete a distorted octahedral coordination environment around the Cu(II) center. The reaction of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ with **1** in a 1:2 metal salt:ligand molar ratio afforded the unusual zwitterionic complex **3**. The crystal structure of **3** contains a central cobalt atom in an octahedral coordination geometry surrounded by four ligands in which two of them act as chelate ligands and the other two, coordinated *via* the carbonyl oxygen atoms of the amide moieties to this metal center, act as bridging ligands bonded to two CoCl_3^- units.

SECOND DERIVATIVE SPECTROPHOTOMETRY FOR THE SIMULTANEOUS DETERMINATION OF IRON (II) AND COPPER (II); COPPER (II) AND VANADIUM (V) USING 2-KETO BUTYRIC ACID THIOSEMICARBAZONE

L. E. Attah

*Department of Applied Chemistry, Jimma University, Ambo College,
P. O. Box 19, Ethiopia*

A new chromophoric reagent, 2- ketobutyric acid thiosemicarbazone (KBAT) has been used for the simultaneous determination of iron(II) and copper(II); copper(II) and vanadium(V). KBAT forms yellowish-green and blue complexes with iron(II) and copper(II) respectively at pH 6.5 and a yellow complex with vanadium(V) at pH 5.5. Calibration graphs for the

individual determinations and second derivative determinations and also for the simultaneous determination by second derivative spectrophotometry were obtained. The derivative amplitudes obey Beer's law at 387.2 nm for copper(II), 410 nm for iron(II) and 400nm for vanadium(V). Zero crossing methods using the second derivative spectrophotometry at 387.2 nm or 365 nm for copper (II), 410 and 400 nm, respectively for iron(II) and vanadium(V) were used for the simultaneous determinations. The accuracy and reproducibility of the determination methods for the various known amounts of iron(II) and copper(II) and copper(II) and vanadium(V) in their binary mixtures were tested. A large number of diverse ions except Fe(II), Cu(II), Ni(II), Co(II) and EDTA do not interfere in the studies. The recommended procedure was applied to the analysis of ferro-vanadium alloy, phosphor bronze 7A and rice.

LONG-TERM PHOSPHORUS DESORPTION USING DIALYSIS MEMBRANE TUBES FILLED WITH IRON HYDROXIDE AND ITS EFFECT ON PHOSPHORUS POOLS

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Many agricultural fields that have received long-term applications of P often contain levels of P exceeding those required for optimal crop production. Knowledge of the effect of the P remaining in the soil (residual effect) is of great importance for fertilization

management. Plant P availability of residual P in soils is usually estimated using successive cropping experiments carried out in field or green house studies. This approach, however, takes many years to realize which makes it very expensive and time consuming. Therefore more rapid soil test methods that can approximate this biological measure have been required. The objective of this paper was to use a different approach to evaluate P availability (desorption) over a long period of time instead of the classical means of extraction. Thus, a modified sequential P extraction procedure using dialysis membrane tube filled with ferric hydrate solution (DMT-HFO) was used on the long-term P fertilized soils of South Africa that received differential P treatments (PoLo, P1L1 and P2L1) to determine the changes in the different P pools and to relate these P fractions with maize yield. In this study the contribution of both the labile and non-labile P_i fractions in replenishing the solution P_i was significant where as the organic fractions appeared to have limited contributions in replenishing the solution P. Highly significant correlations were observed between dry matter yield and the P pools extracted by HFO- P_i (0.997**), HCO_3^- - P_i ($r = 0.994$ **), OH- P_i ($r = 0.969$ **), OH-Po ($r = 0.944$ **), D/HCl- P_i (0.991**) and C/HCl- P_i ($r = 0.997$ **). Strongly significant correlations were also observed between the different P fractions and plant P uptake. Significant correlations were observed between Bray1P and dry matter yield ($r=0.965$ **) and plant P uptake ($r=0.982$ **). The correlation between the different P fractions and Bray1P was also very strong and significant for all fractions except C/HCl-Po, C/ H_2SO_4 and total P. The C/HCl- P_i is the fraction that decreased most especially for the high P treatments indicating that this

fraction contributed significantly to the P extracted by DMT-HFO. This suggests that this fraction may be a buffer to more labile P fractions. The combined method employed here could act as an analytical tool to approximate successive cropping experiments carried out under green house condition. But data from a wider range of soils is also needed to evaluate the universality of this method. Besides assessment of this method at field level should also be carried out to evaluate the applicability of this method.

KEY WORDS: Dialysis membrane tubes; Phosphorus; Phosphorus dynamics; Phosphorus fractionation Soil test methods; Successive desorption of P

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DETERMINING WATER DIFFUSIVITY, SEED CONSTANT, CRITICAL TIME FOR GERMINATION AND ITS APPLICATION FOR IMPROVING GERMINATION OF SOME WHEAT AND MAIZE GENOTYPES

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In the present studies applicability of the recently developed new theory of water diffusivity in this laboratory has been further extended and seed constant, water diffusivities, critical time for germination experimentally determined for wheat viz. HAR-1781,

HAR-3116, HAR-3354, Simba and Bobicho and maize viz. DTP-I and AL-COMP genotypes at 25 °C. The critical time for germination obtained for the wheat varieties were 49 h, 41 h, 41.5 h, 45 h, 41 h for HAR-781, HAR-3116, HAR-3354, Simba and Bobicho whereas it was 70h and 53h for the DTP-I and AL-COMP genotypes and the amount of water absorbed at the above critical time for germination was 0.0237 g, 0.0233 g, 0.0261 g, 0.0281 g, 0.0264 g and 0.1335 g and 0.1362 g, respectively. From the laboratory germination studies that were carried out by using the bulk seeds of each genotypes and after performing water diffusion experiments for the above critical time for germination the percent germination obtained clearly showed an increase of 10 % (Simba), 6 % (HAR-1781), 14 % (HAR-3354), 19 % (HAR-3116) and 7 % (Bobico) and 16 % and 4 % for AL-COMP and DTP-1 in comparison with that of control (un-soaked seeds). It is concluded that the diffusion technology developed on the basis of the theory of water diffusivity can now be extended not only to other varieties of wheat and maize crops but to other crops as well.

KEY WORDS: Water; Diffusivity; Germination; Wheat; Maize; Seed

LEVELS OF SOME NUTRIENTS AND NON- ESSENTIAL METALS IN COW'S WHOLE MILK FROM ADDIS ABABA, ETHIOPIA

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Bulk milk samples representative of 309 cows were collected in two periods (December and February) from four different farms which supply milk to Addis Ababa, Ethiopia. In each sampling period, one bulk milk sample was collected from each farm. Sizes of the four farms involved in the research were of 78 Jersey, 125 Holstein, 59 Holstein and 47 Crossbreeds cows. Milk samples were analysed for various essential (Ca, Mg, Fe and Zn) and non essential (Cd, Ni, Pb, and Tl) nutrients, fat and protein levels. Known weights of freeze dried cow's whole milk samples were digested with 3.5 mL HNO₃ and 2.0 mL HClO₄ on a hot plate for 4.5 h. The contents of nutrients in the digests were then analyzed employing standard methods. The following mean levels were recorded (mg/L): Ca 1600, Mg 65, Fe 1.5, Zn 4.9, Cd 0.06, Ni 1.4, Pb 2.6, Tl 2.2, and (% m/m): fat 3.8, protein 3.2. The mineral concentrations in cow's whole milk were found within normal intervals described in the literature. However, the non-essential elements were significantly higher than literature data. Results further indicated positive correlations between animals' feeding habits and milk moisture content and milk yield and protein level. An important contribution to the daily intake of calcium for Addis Ababa population due to the consumption of cow's whole milk was observed. The accuracy of results was checked by analyzing the NIST reference material SRM 8435 (whole milk powder) and good agreement was achieved with certified values.

KEY WORDS: Milk; Nutrients; Non-essential elements; Atomic absorption spectroscopy; Fat; Protein; Ethiopia

ISOLATION AND STRUCTURAL ELUCIDATION OF SECONDARY METABOLITES FROM PLANTS

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Plant materials obtained from different geographical locations including Africa, Asia and Europe were investigated for their secondary metabolites using *the-state-of-the-art* separation and structural elucidation techniques comprising analytical and preparative Gas Chromatography (GC), GC-Mass Spectrometry (MS), one-dimensional (1D) and two-dimensional (2D) Nuclear Magnetic Resonance (NMR) techniques. Many volatile compounds, mainly mono- and sesquiterpenes and their derivatives could be identified. In addition, a number of hitherto unknown compounds could be isolated and their structures elucidated by extensive spectral analysis. These include, a prenyl bisabolane type diterpene (+)-axinyssene, and two furanolabdanediterpenes, preotostegindiol and otostegindiol from *Otostegia integrifolia* collected in Ethiopia, two guaiane sesquiterpenes, guaia-1(10),11-diene, and guaia-9,11-diene from *Peucedanum tauricum* collected in Poland, four sesquiterpenoids: chloranthalactone A, isogermafurenolide, eudesma-4(15),7(11),9-trien-12-olide, and 7 α -hydroxyeudsm-4-en-6-one from *Chlorantus spicatus* flower oil from Vietnam, a phthalide named isoligustilide from *Meum athamanticum* from Germany, two viscidane diterpenes

and four bisabolane sesquiterpenes (1-6) from *Radula perrottetii* of Japanese origin and a sesquiterpene hydrocarbon with novel skeleton, melanene, from *Melanoselinum decipiens* grown in Hamburg, Germany.

REMOVAL OF COLOR AND TOXIC METALS FROM INDUSTRIAL WASTEWATER BY INDIGENOUS BIOMATERIALS

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In the field of wastewater treatment, bioadsorption and biodegradation technologies plays a very important role in modern industries especially in the recovery of chemicals and biochemical pollutants. In the present research studies, chemically modified activated carbon (CMAC) and raw biomaterials (RBM) of the indigenous plant materials were used to the removal of color and toxic metals from the simulated wastewater. The simulated wastewater contains basic dyes and toxic metals such as Cd(II), Pb(II), Cr(VI) and Hg(II) ions. The results indicate that, the percent removal of Cd(II), Pb(II), Cr(VI) and Hg(II) was 98.5, 96.0, 93.0 and 94.0, respectively. The optimum adsorbent dose was 1.5 g and the contact time was 180 min. The removal of toxic metals was mainly controlled by pH and temperature of the experimental solution. The temperature of the batch experiments was 25 ± 2 °C. The pH of the solution was 3.2 to 4.0. The particle size of the CMCA was also influences the adsorption of the toxic metals. The rate

of color removal was 100 percent with CMCA and 86 percent with RBM. The color removal efficiency of the CMCA was very much high when compared with RBM. The color removal was mainly due to bioadsorption mechanism of the CMCA. Particularly the RBM was very effective in the conversion of Cr(VI) to Cr(III). The bioadsorption data were fitted with the Langmuir and Fredundlich isotherms at 30 °C. Present results highlight the relevance of utilizing the indigenous biomaterials for the treatment of industrial effluents containing toxic metals and color.

DEVELOPMENT IN LIQUID MEMBRANE EXTRACTION FOR CONTINUOUS SAMPLING AND TRACE ENRICHMENT OF PESTICIDE POLLUTANTS IN ENVIRONMENTAL WATERS

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A portable and time-integrating field sampler was developed based on supported liquid membrane extraction technique to carry out automatic and unattended sampling of residues of ionizable pesticides and their metabolites in the water system of a lake environment.

The supported liquid membrane (SLM) field sampler is built in a plastic box and consisted the membrane holder, two syringe pumps and one valve among the other parts necessary to run the sampler. The two

syringe pumps were used to control the flow rates of the donor and acceptor channels of the liquid membrane independently. The valve helps to distribute extracted samples from the acceptor phase to the extraction vials. Performance of each unit is controlled and synchronized by programs pre-hand written and saved in the memories of the devices. Power is supplied to the extraction system using a serially connected 12 V batteries, which was continuously charging by the solar cell panels. No electrical energy, which was actually absent around the studied site, was required for the 24 h continuous and unattended extraction in the field.

Performance of the developed field sampler was then tested by carrying out extraction of the residues of four triazine pesticides along with six of their major degradation products in Awassa Lake; found in agricultural region of the Southern Rift Valley of Ethiopia. The pollutants, in question, were selectively extracted during the 24 h continuous extraction under the optimized membrane conditions. Results of the chromatographic analysis revealed that, in all the extractions done during varied seasons, the metabolites were found in higher concentrations than the parent compounds showing that this class of compounds degrade in the lake environment.

POTASSIUM STATUS IN THE SOILS OF THE HIGHLANDS OF ETHIOPIA AND THE NEED FOR POTASH FERTILIZERS

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Potassium is absorbed by plants in larger amounts than any other mineral element except nitrogen and, in some cases, calcium because it helps in the building of protein, photosynthesis, fruit quality and reduction of diseases. In contrast more nitrogen and potassium than phosphorus get depleted from soils. This disparity necessitates for using optimum potash fertilizer to boost crop production. In the history of Ethiopian agriculture the role of potassium/ potash fertilizer in crop production is overlooked for various *raison d'être*s. Hence, this study was conducted to assess the potassium status of Vertisols thereby to prove whether potash fertilizers should be an immediate requisite in our farming systems. The exchangeable K reflects fairly well the availability of the nutrient, which increases with increase in soil water. Consequently, thirty eight soil samples were collected from the Vertisol zones of Tigray and the analysis for exchangeable K was made in the Laboratory of National Soil Research Centre, Addis Abeba. This study reveals that only 20 % of the soils have sufficient exchangeable K whereas 80 % of the soils are deficient in exchangeable K. Thus, it is high time to consider potash fertilizer for substantially increasing crop production.

KEY WORDS: Soil potassium; Increased crop production; Potash fertilizer; Vertisols

ANTIOXIDANT PROPERTIES OF HERBAL DRUGS IN HEAVY METAL INDUCED TOXICITY IN COMMON CARP (CYPRINUS CARPIO L)

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In all aquatic species, fishes are particularly sensitive to waterborne contamination, and are recognized as bioindicators for water quality monitoring. The objective of the present study was to evaluate the antioxidant effect of herbal drugs *Nelumbo nucifera* Geartn (Nymphaeaceae) and *Aegle marmelos* (Rutaceae) using standard reference drug Silymarin a flavolignan component of *silybum marianum* (Compositae) in heavy metal induced toxicity in common carp (*Cyprinus carpio* L.) exposed to the heavy metal contaminated aquatic system. The fish was exposed to the sub lethal concentration (5ppm) of the combined heavy metal solutions ($1/10^{\text{th}}$ of LC_{50} / 48 h) such as cadmium, lead, nickel and chromium for a period of 32 days. Thereafter, the species was treated with the herbal drugs for 30 days. The analytical result indicates that, heavy metal toxicity in fish organs gradually increases during the exposure period and slightly decreases at 32nd day. The activity of antioxidant enzymes superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione – S – transferase (GST) in fish was

significantly increased during the heavy metal exposure. The biochemical results were statistically significant at $P < 0.001$. However, treatment with herbal drugs counteracts the adverse effects and deleted the immunosuppressive effect of heavy metal toxicity. The antioxidant effect of *Nelumbo nucifera* Geartn and *Aegle marmelos* was found to be equivalent to the standard drug Silymarin. The results of our experiments suggest that treatment with *Nelumbo nucifera* and *Aegle marmelos* can be used as potential herbal drugs for the detoxification of heavy metals in contaminated aquatic environment.

KEYWORDS: Antioxidant Enzymes; *Cyprinus carpio* L.; Common carp; Heavy metals

ANALYSIS OF HEXAVALENT CHROMIUM FROM SHEBA TANNERY EFFLUENTS, WUKRO, TIGRAY, ETHIOPIA

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The levels of hexavalent chromium from different sample sites taken from Sheba tannery and nearby areas was determined using by Model 752 UV-VIS Grating spectrometer using the s-diphenyl carbazide method at 540 nm and without the s-diphenyl carbazide at 440 nm for the purpose of comparison. Six replicates were taken for each sample. Three samples were taken directly from the tannery effluents (S_1 = General

effluent, S_2 = Sedimentation pond or partially treated, S_3 = Chromium oxidation pond), which pass through different oxidation pools and partial treatments. Two samples for controlling purpose (S_6 = above the tannery and S_7 = aside to the tannery) were taken from at about 5 Km and 3 Km distance respectively far sampling sites from the tannery. The remaining two (S_4 = River down the tannery and S_5 = stream near to the river) was from areas, which are near to the Sheba tannery but believed to be contaminated due the slope or geographical location with respect to the tannery. To minimize the possible interferences, all the samples were taken at an appropriate time with great care using a relatively very specific and selective method. The observed level of hexavalent chromium was in the order of the sites proximity to the factory, geological make up and level of treatment and source of the tannery effluents. These were also inline with what is expected in the hypothesis. The mean amounts of hexavalent chromium in S_1 , S_2 , S_3 , S_4 , S_5 , S_6 and S_7 are 10.524, 0.9096, 0.780, 0.581, 0.5407, 0.0147, 0.0012 ppm by s-diphenyl carbazide and 10.1996, 0.88871, 0.78120, 0.56011, 0.52854, 0.03769, 0.0012 ppm with the absence of s-diphenyl carbazide, respectively. According to World Health Organization (WHO) international standards for drinking water the mandatory limit for hexavalent chromium is 0.05 ppm and hence the effluents of the tannery pollute the water bodies near this Sheba tannery. Therefore the Sheba tannery should take some measures to protect this series environmental pollution.

DOWNSTREAM POLLUTION PROFILES ALONG HULUKA RIVER OF AMBO, ETHIOPIA

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Our present study aims to assess the downstream pollution profiles of Huluka river due to sewage water pollution and to provide data on physico-chemical and nutrient content of Huluka river, Ethiopia. The temperature, pH, electrical conductivity, CO₂ content, total dissolved solids, hardness, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), Ca, Mg, Cl, nitrate, phosphate and sulphate have been determined to assess the pollution profiles along the river due to sewage water addition at various levels. Increasing concentration of these parameters in downstream of the river indicates the introduction of pollution load from domestic sewage and agricultural activities. The downstream samples had eight to ten times more of BOD and COD than the upstream samples. The mean Ca, Mg, chloride, nitrate, phosphate, and sulphate content exceeded their most common natural concentrations (MCNC) in world rivers. The water quality of the river shows pattern of behavior linked to human pressure associated with domestic, municipal sewage wastewater and agricultural activities. Almost all the measured ions showed increasing trend from upstream to downstream and the declining quality of Huluka river.

KEYWORDS: Huluka river; Sewage water pollution;
Ethiopia

SWEDISH CHEMICALS POLICY – AN EXAMPLE FRAMEWORK FOR GREENER CHEMISTRY?

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"A non-toxic environment" is one of 16 environmental quality objectives decided by the Swedish Parliament.¹ It means that the environment should be free from chemicals released by human activities and that represent a threat to human health or biological diversity.

The outcome within a generation for this environmental quality objective should include the following:

- The concentrations of substances that naturally occur in the environment are close to the background concentrations.
- The levels of foreign substances in the environment are close to zero.
- Overall exposure in the working environment, the natural environment and the indoor environment to particularly dangerous substances is close to zero and, as regards other chemical substances, to levels that are not harmful to human health.

¹ <http://miljomal.nu/english/english.php>

Originally, six interim targets were linked to the environmental quality objective. Four of these concern information about properties or safe handling based on that information:

- 1) About the need for data on health and environmental properties of chemical substances on the market.
- 2) About the need for information of any dangerous chemicals in products.
- 3) About the need to phase out from use of chemicals with particularly dangerous properties.
- 4) About the need for reduction of risks to health and the environment due to manufacture and use of chemical substances.

The Swedish Chemicals Agency² (KemI) is responsible for the follow-up and evaluation of the development with regard to "A non-toxic environment". To guide concerned actors to reach the environmental quality objective, KemI has issued a web-based tool, PRIO,³ (available in English) intended to be used to preventively reduce risks to human health and the environment from chemicals.

The implications of this environmental quality objective will be discussed, as well as its use as a policy instrument.

² <http://www.kemi.se>

³

http://www.kemi.se/templates/PRIOEngframes____4144.aspx

PHYLANTHUS AMARUS EXTRACTS AS ECO-FRIENDLY CORROSION INHIBITOR FOR MILD STEEL IN ACIDIC MEDIA

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The inhibitive action of leaves (LV), seeds (SD) and a combination of leaves and seeds (LVSD) extracts of *Phyllanthus amarus* on mild steel corrosion in HCl and H₂SO₄ solutions was studied using weight loss and gasometric techniques. The results indicate that the extracts functioned as a good inhibitor in both environments and inhibition efficiency increased with extracts concentration. Temperature studies revealed an increase in inhibition efficiency with rise in temperature and corrosion activation energies decreased in the presence of the extract. A mechanism of chemical adsorption of the plants components on the surface of the metal is proposed for the inhibition behaviour. The adsorption characteristics of the inhibitor were approximated by Temkin isotherm.

KEYWORDS: Mild steel; Corrosion inhibition; *Phyllanthus amarus*; Adsorption isotherm

PERCEPTIONS OF CHEMISTRY STUDENTS ON THE RELEVANCE OF MATHEMATICS COURSES TO THEIR FIELD OF STUDY: THE CASE OF AMBO COLLEGE

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The perception of students towards a lesson is an important determinant that can affect their motivation. Students are motivated to learn a lesson which they perceive is important to their requirements. Students tend to ask why they learn a lesson or a course. This study investigates the perceptions of chemistry students towards the relevance of mathematics courses, which they learn, to their field of study. I used the qualitative research methodology and case study design, and employed in-depth interview, observation and document analysis of curriculum of the program to collect data. I used the purposive sampling technique to select the participants. The key informants were selected based on their level of achievements: high, medium and low achievers. I analyzed the data based on direct interpretation of data and using categories for recurring ideas. I found out that the participants perceive that most of the topics in the mathematics courses they learn were irrelevant to chemistry. The implication is that the chemistry students are not well informed of the application or relevance of mathematics courses to their field of study, and the curriculum of the program lacks detail information.

THE EFFECTS OF CONCEPT MAPPING AND PROBLEM SOLVING ON STUDENTS' ATTITUDES AND ACHIEVEMENT IN CHEMISTRY

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The study investigated the effects of using concept mapping and problem solving on students' attitudes and achievement in Chemistry. The study made use of a $3 \times 2 \times 2$ quasi-experimental design, non-randomized factorial design. The study sample comprised of two hundred and fifty (250) senior secondary two (SS II) chemistry students, randomly selected from six secondary schools in Ibadan North Local Government Area of Oyo State, Nigeria. The subjects comprised of 148 males and 102 females. Six null hypotheses were raised and tested at 0.05 level of significance. The instruments used to collect data were: "Chemistry Achievement Test (CAT)" $r=0.756$, "Chemistry Attitude Questionnaire (CAQ)" $r=0.756$, Teacher's Instructional Guide on Concept Mapping in Chemistry, Teacher's Instructional Guide on Problem Solving in Chemistry, Teacher Instructional Guide on Conventional Method (Modified Lecture Method) in Chemistry. The data collected were analysed using inferential statistics of Analysis of Covariance (ANCOVA), and Scheffe post hoc analysis.

The results showed that students exposed to problem solving instructional strategy had the highest mean score of 11.920 followed by those of concept mapping instructional strategy with mean score of 10.690 while those of conventional strategy obtained 7.290. There

was a significant main effect of treatment on students' academic achievement in Chemistry [$F(1,237) = 120.372$; $P < 0.05$] and also a significant main effect of treatment on students' attitude to Chemistry [$F(1,237) = 16.387$; $P < 0.05$]. The results also showed that there was a significant main effect of gender on students' achievement in Chemistry [$F(1,237) = 22.497$; $P < 0.05$] but no significant main effect of gender on students' attitude towards Chemistry [$F(1,237) = 1.368$; $P > 0.05$]. There was a significant interaction effect of treatment and gender on students' achievement in Chemistry [$F(1,237) = 11.690$; $P < 0.05$] but no significant interaction effect of treatment and gender on students' attitude towards Chemistry [$F(1,237) = 2.141$; $P > 0.05$].

Based on these findings, it was recommended that Problem Solving and Concept Mapping Instructional strategies should be adopted by teachers of Chemistry in teaching the subject.

INHIBITION OF MILD STEEL CORROSION IN ACIDIC MEDIUM USING SYNTHETIC AND NATURALLY OCCURRING POLYMERS AND SYNERGISTIC HALIDE ADDITIVES

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The corrosion inhibition of mild steel in H_2SO_4 in the presence of gum arabic (GA) (naturally occurring polymer) and polyethylene glycol(PEG) (synthetic polymer) was studied using weight loss, hydrogen evolution and thermometric methods at 30-60 °C. The effect of addition of halides (KCl, KBr and KI) was also studied. Results obtained showed that inhibition efficiency (% I) increased with increase in GA and PEG concentration, addition of halides and with increase in temperature. GA and PEG alone and in combination with halides were found to obey Temkin adsorption isotherm. Phenomenon of chemical adsorption is proposed from the trend of inhibition efficiency with temperature and values ΔG_{ads}^0 obtained. Increase in inhibition efficiency (% I) and degree of surface coverage (θ) was found to follow the trend $\text{Cl}^- < \text{Br}^- < \text{I}^-$ which indicates that the radii and electronegativity of the halide ions play a significant role in the adsorption process. The synergism parameter, S_1 evaluated is found to be greater than unity indicating that the enhanced inhibition efficiency caused by the addition of halides is only due to synergism.

KEY WORDS: Mild Steel; Polymers; Corrosion inhibition; synergism; Halides

CLEAN CHEMICAL PROCESSES AND THE USE OF LIFE CYCLE ANALYSIS TO EVALUATE THEIR "GREENNESS"

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The chemical industry faces many challenges to reduce its environmental footprints and improve the safety of its products and operations. There is a pressing need in reducing the large volume of hazardous and non-hazardous waste generated from the chemical manufacturing industry annually. Regulations are getting tighter, and the public has become more eco-conscious. Improving industrial housekeeping and pollution-prevention techniques can minimize many of these releases and chemists are working in process optimization, waste reduction and pollution prevention. These in turn are the basis of cleaner industrial development and are key elements in an overall philosophy of industrial pollution prevention.

However, it is clear that the long-term solution for the sustainability the chemical process industry lies in the development of new, cleaner and environmentally friendly production processes. This seminar presents the activities of the Green Chemistry and Engineering Research Group at US EPA, NRMRL, in introducing new scientific approaches to a persistent technological problem that is synthesis and commercial application of important chemicals without depleting or damaging the environment. Examples will be presented from current

research activities in the area of use of cleaner reaction technologies, the use of non-toxic solvents, nanoparticle catalysts that can help in reducing air pollution from various chemical processes.

Most new developments in green chemistry are not evaluated for their "greenness" via a systematic analysis of their environmental impact during their life cycle. Consequently, it is likely that many techniques that are claimed to be green may not really have a smaller environmental impact over their life cycle. This seminar also presents how thermodynamics based life cycle analysis can be used to compare green versus traditional chemistries.

KEY WORDS: Curriculum; Document; Motivation; Mathematics; Perception; Relevance

APPROPRIATE TECHNOLOGY: BREEDING A BETTER STOVE

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Half the world cooks using wood, often on open fires or on inefficient stoves. Collecting firewood is often left to women and children. As well as reducing the time available for education and other activities. The aim of this research is to produce optimised wood stoves, reducing the amount of wood required, hence reducing carbon emissions, and improving the quality of life, particularly for women and children.

Our approach is to use computational fluid dynamics and genetic algorithms to improve the combustion conditions in wood-burning cook-stoves. In the initial experimental phase, open wood fires were characterised in terms of burn-rate, and gas temperature and velocity. Several stove designs were also assessed, including the three-stone fire (3-5 % efficient), the Eritrean mogogo (5-10 % efficient) and the rocket elbow (20-30 % efficient).

The experimental results were replicated in a computer simulation which was validated for a range of fires. This model was embedded in a CFD package which correctly predicted the flame height, velocity and temperature.

The validated CFD model is being used with a genetic algorithm to optimise the stove design: each stove is defined by a genome describing its dimensions; the various designs are allowed to "mate", each one vying for the attention of the "fittest" or most efficient stove; the offspring inherit a mixture of their parents' features, until an optimum design emerges. Finally the optimised design is to be built and physically tested before being modified to make it suitable for field trials and dissemination to rural communities.

In conclusion, this research aims to improve the quality of life for women and children by developing an improved cook-stove using computer-aided design tools. Novel aspects of the work are the application of CFD to wood combustion in stoves and the use of genetic algorithms to improve combustion chamber design.

SYNERGISTIC INHIBITION BETWEEN NATURALLY OCCURRING EXUDATE GUM AND HALIDE IONS ON THE CORROSION OF MILD STEEL IN ACIDIC MEDIUM

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The effect of naturally occurring exudates gum from *Raphia hookeri* (RH) on the corrosion of mild steel in H₂SO₄ in the temperature range 30-60 °C was studied by weight loss and hydrogen evolution techniques. Results obtained reveal that the exudates gum reduces the corrosion rate. The inhibition efficiency increased with an increase in exudates gum content up to 5g/l to reach 70 % at 30 °C while it decreases with increase in temperature. Results obtained by weight loss and hydrogen evolution technique are in good agreement. The adsorption of exudates gum from *Raphia hookeri* on the mild steel follows Langmuir adsorption isotherm. The addition of halide ions (0.06 M KCl, KBr, and KI) to the exudates gum enhanced the inhibition efficiency to a maximum value of 75.2 % (0.06 M KI + RH exudates gum) due to synergistic effect. Mechanism of physical adsorption is proposed from the apparent activation energy (E_a) and the thermodynamic parameters obtained. The adsorption of the exudates gum on the mild steel surface is spontaneous.

Keywords: *Raphia hookeri*; Mild steel; Halide ions; Corrosion inhibition; Synergism