International Journal on
Advanced Science
Engineering
Information Technology

HOME   ARCHIVES

International Journal on Advanced Science, Engineering and Information Technology

International Journal on Advanced Science, Engineering and Information Technology (IJASEIT) is an international peer-reviewed journal dedicated to interchange for the results of high quality research in all aspect of science, engineering and information technology. The journal publishes state-of-art papers in fundamental theory, experiments and simulation, as well as applications, with a systematic proposed method, sufficient review on previous works, expanded discussion and concise conclusion. As our commitment to the advancement of science and technology, the IJASEIT follows the open access policy that allows the published articles freely available online without any subscription.

Scope

The journal scopes include (but not limited to) the followings:

Science: Bioscience & Biotechnology, Agriculture, Chemistry & Food Technology, Environmental, Health Science, Mathematics & Statistics, Applied Physics.

Engineering: Architecture, Chemical & Process, Civil & structural, Electrical, Electronic & Systems, Geological & Mining Engineering, Mechanical & Materials.

Information Science, Artificial Intelligence, Computer Science, E-Learning & Education Learning, Multimedia, Knowledge Technology, Information System, Internet & Mobile Computing, Machine Learning.

Frequency: 6 issues per year

DOI: 10.18517/ijaseit

ISSN: 2088-5334

IJASEIT

About

Editorial Board

Guide for Authors
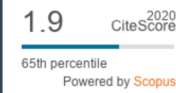
Journal Contact

Online Submission

Peer Review Policy

Publication Ethics

Browse Authors

NEW Update : IJASEIT in Scopus

NEW Update : IJASEIT in Scimago JR

Scopus CiteScore

1.9   CiteScore 2020

65th percentile
Powered by Scopus

Scimago Journal Rank

International Journal on Advanced Science,...

Q3   Agricultural and Biological Sciences (miscellaneous)
best quartile

SJR 2022
0.21

powered by scimagojr.com

Template of Journal IJASEIT

Support Contact
WAG : +62-82171-822448
E-mail : ijaseit@insightsociety.org

The Map Authors

Keywords Cloud

International Journal on
Advanced Science
Engineering
Information Technology

HOME   ARCHIVES

Editorial Team

Editor in Chief :

Rahmat Hidayat, (Scopus ID: 57191265401) Politeknik Negeri Padang, INDONESIA

Associate Editors :

Taufik, (Scopus ID: 23670809800), California Polytechnic State University, USA
Haitham Alali, (Scopus ID: 49963007000), Amman Arab University, JORDAN
Wan Mohtar Wan Yusoff, (Scopus ID: 15019967700), Univ. Kebangsaan Malaysia, MALAYSIA
Halimah Badioze Zaman, (Scopus ID: 25825801600), Univ. Kebangsaan Malaysia, MALAYSIA
Son Radu, (Scopus ID: 7005251005), Universiti Putra Malaysia, Malaysia, MALAYSIA
Mohd Razi Ismail, (Scopus ID: 25957691400), Universiti Putra Malaysia, MALAYSIA
Takashi Oku, (Scopus ID: 56275094900), Prefectural University of Hiroshima, JAPAN
Kohei Nakano, (Scopus ID: 7402011766), Gifu University, JAPAN
Nurul Huda, (Scopus ID: 6701695514), Universiti Malaysia Sabah, MALAYSIA
Yandra Arkeman, (Scopus ID: 55946558300), Bogor Agriculture University, INDONESIA
Sate Sampattagul, (Scopus ID: 7801640861), Chiangmai University, THAILAND
Peeyush Soni, (Scopus ID: 9248907800), Asian Institute of Technology, THAILAND
Yolanda Lechon Perez, (Scopus ID: 6602826000), Ciemat, Madrid, SPAIN
Gabriele Arcidiacono (Scopus ID: 56656284600), G. Marconi University, ITALY
Alessandra Pieroni (Scopus ID: 25929524500), Marconi International University, Florida - USA
Alessandro Simonetta (Scopus ID: 55344403700), University of Rome Tor Vergata, ITALY
Rita Muhamad Awang, (Scopus ID: 55957782400), Universiti Putra Malaysia, MALAYSIA
Anton S Prabuwono, (Scopus ID: 18134309800), King Abdulaziz Univ, SAUDI ARABIA
P Mangala C S De Silva, (Scopus ID: 7006461145), University of Ruhuna, SRI LANKA
Bich Huy Nguyen, (Scopus ID: 36191086100), Nong Lam University, VIETNAM
Paul Kristiansen, (Scopus ID: 23097563600), University of New England, AUSTRALIA
Amitava Basu, (Scopus ID: 21833738300), Bidhan Chandra Krishi Vidyalaya, INDIA
Shahrul Azman Mohd Noah, (Scopus ID: 35087633200), Universiti Kebangsaan Malaysia, MALAYSIA
Luca Di Nunzio (Scopus ID:57195199010), University of Rome Tor Vergata, ITALY
Rocco Fazzolari (Scopus ID:36469997900), University of Rome Tor Vergata, ITALY
Ruben Paul Borg (Scopus ID:55246483600), L-Università ta' Malta, Msida, Malta
Van Viet Pham (Scopus ID:57200413784), Ho Chi Minh City University of Transport, VIETNAM

Editors :

Novizar Nazir, (Scopus ID: 35503777500), Universitas Andalas, INDONESIA
Rahadian Zainul, (Scopus ID: 56737195700), Universitas Negeri Padang, INDONESIA
Ario Betha Juansilfero, (Scopus ID: 57189369470), Kobe University, JAPAN
Zairi Ismael Rizman, (Scopus ID: 36959761800), Universiti Teknologi MARA (UiTM) (Terengganu) MALAYSIA
Shahreen Kasim, (Scopus ID: 36155431900), Universiti Tun Hussein Onn - MALAYSIA
Chi-Hua Chen, (Scopus ID: 35799698800), National Chiao Tung University, TAIWAN

International Journal on Advanced Science Engineering Information Technology

HOME   ARCHIVES

Vol. 7 (2017) No. 2

Articles

Panoramic Image Communication for Mobile Application using Content-Aware Image Resizing Method

Jaejoon Kim
pages: 338-344   `Full text`   DOI:10.18517/ijaseit.7.2.1751

Pseudo-Elliptic Bandpass Filters Using Closed-Loop Resonator

Norfishah Ab. Wahab, I. Pasya, M. F. Abdul Khalid, I. M. Yassin, S. H. Herman, Z. Awang
pages: 345-351   `Full text`   DOI:10.18517/ijaseit.7.2.1362

Development of Electronic Nose with High Stable Sample Heater to Classify Quality Levels of Local Black Tea

Danang Lelono, Kuwat Triyana, Sri Hartati, Jazi Eko Istiyanto
pages: 352-358   `Full text`   DOI:10.18517/ijaseit.7.2.1659

Modelling Effect of Aggregate Gradation and Bitumen Content on Marshall Properties of Asphalt Concrete

Arief Setiawan, Latif Budi Suparma, Agus Taufik Mulyono
pages: 359-365   `Full text`   DOI:10.18517/ijaseit.7.2.2084

IoT and Public Weather Data Based Monitoring & Control Software Development for Variable Color Temperature LED Street Lights

Gandeva Bayu Satrya, Haftu Tasew Reda, Kim Jin Woo, Philip Tobianto Daely, Soo Young Shin, Seog Chae
pages: 366-372   `Full text`   DOI:10.18517/ijaseit.7.2.1578

The Performance of Binary Artificial Bee Colony (BABC) in Structure Selection of Polynomial NARX and NARMAX Models

Azlee Zabidi, Nooritawati Md Tahir, Ihsan Mohd Yassin, Zairi Ismael Rizman
pages: 373-379   `Full text`   DOI:10.18517/ijaseit.7.2.1387

Evaluation of the Pre-Cracked RC Beams Repaired with Sealant Injection Method

- Zaidir, Rendy Thamrin, Erick Dalmantias
pages: 380-386   `Full text`   DOI:10.18517/ijaseit.7.2.2085

A Survey on Building Safety after Completing the Construction Process in Malaysia Using Statistical Approach

Nurnadiah Zamri, Fadhilah Ahmad, Amira Husni Talib, Mohamad Shafiq Mohd Ibrahim
pages: 387-398   `Full text`   DOI:10.18517/ijaseit.7.2.1450

Role of Corridor in Territorial Meaning Formation in "Owned Low-cost Apartments" ('Rusunami') Bidara Cina, Jakarta, Indonesia

Fermanto Lianto, Lilianny Sigit Arifin, Y. Basuki Dwisusanto
pages: 399-405   `Full text`   DOI:10.18517/ijaseit.7.2.2095

The Function of Religious Language in the Media: A Comparative Analysis of the Japanese, German and American Newspaper Coverage about the 2011 Great East Japan Earthquake and Tsunami

Yukiko Sato, Ikumi Waragai
pages: 406-417   `Full text`   DOI:10.18517/ijaseit.7.2.2172

The Investigation of 1997 and 2015 El Nino Events in West Sumatera, Indonesia

Revalin Herdianto, Elvi Roza Syofyan, Suhendrik Hanwar, Bambang Istijono, - Dalrino
pages: 418-423   `Full text`   DOI:10.18517/ijaseit.7.2.1594

Splitting Tensile Strength of Lightweight Foamed Concrete with Polypropylene Fiber

Freccy Raupit, Anis Saggaff, Cher Siang Tan, Yee Ling Lee, Mahmood Md Tahir
pages: 424-430   `Full text`   DOI:10.18517/ijaseit.7.2.2096

Sample Biochemical Methane Potential from the Digestion of Domestic Mixed Sewage Sludge in Batch Tests

Roslinda Seswoya, Ahmad Tarmizi Abdul Karim
pages: 431-437   `Full text`   DOI:10.18517/ijaseit.7.2.2094

Improving the Performance Of Single Cells In The Design Of Proton Exchange Membrane Fuel Cell (PEMFC) When Using Hydrogen

- Mulyazmi, Maria Ulfah, Silvi Octavia
pages: 438-445   `Full text`   DOI:10.18517/ijaseit.7.2.1256

Risk Management Framework in Oil Field Development Project by Enclosing Fishbone Analysis

Abdul Hamid, Ishak Baba, Winardi Sani
pages: 446-452   `Full text`   DOI:10.18517/ijaseit.7.2.1499

The Evaluation of Heavy Metals Concentrations in Cempaka Lake, Bangi, Selangor, Malaysia

Muhd. Barzani Gasim, Mohd. Ekhwan Toriman, Amal Barggig, Soaad Mutfah, Norsyuhada Hairoma, Azizah Endut
pages: 453-459   `Full text`   DOI:10.18517/ijaseit.7.2.1004

White-box Implementation to Advantage DRM

Scopus CiteScore

1.9   CiteScore 2020

65th percentile
Powered by Scopus
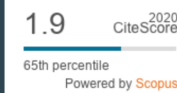
Scimago Journal Rank

International Journal on Advanced Science,...

Q3   Agricultural and Biological Sciences (miscellaneous)
best quartile

SJR 2022
0.21

powered by scimagojr.com

Template of Journal IJASEIT

Support Contact
WAG : +62-82171-822448
E-mail : ijaseit@insightsociety.org

The Map Authors

Keywords Cloud

Antonius Cahya Prihandoko, Hossein Ghodosi, Bruce Litow
pages: 460-467　Full text　DOI:10.18517/ijaseit.7.2.1445

Speed Effect to a Quarter Car ARX Model Based on System Identification

Dirman Hanafi, Mohd Syafiq Suid, Mohamed Najib Ribuan, Rosli Omar Omar, M Nor M. Than, M. Fua'ad Rahmat
pages: 468-474　Full text　DOI:10.18517/ijaseit.7.2.1500

Speaker Independent Speech Recognition of Isolated Words in Room Environment

M. Tabassum, M. A. Aziz Jahan, M. M. Rahman, S. B. Mohamed, M. A. Rashid
pages: 475-481　Full text　DOI:10.18517/ijaseit.7.2.1465

Validation on an Enhanced Dendrite Cell Algorithm using Statistical Analysis

Mohamad Farhan Mohamad Mohsin, Abdul Razak Hamdan, Azuraliza Abu Bakar, Mohd Helmy Abd Wahab
pages: 482-488　Full text　DOI:10.18517/ijaseit.7.2.1743

Rapid Simulation Model Building in Cellular Manufacturing using Cladistics Technique

Zainal Rasyid Mahayuddin, Nur Afiqah Khairuddin
pages: 489-495　Full text　DOI:10.18517/ijaseit.7.2.2136

An Efficient Cloud based Image Target Recognition SDK for Mobile Applications

Haslina Arshad, Meng Chun Lam, Waqas Khalid Obeidy, Siok Yee Tan
pages: 496-502　Full text　DOI:10.18517/ijaseit.7.2.1744

Assessing the Determinants of Cloud Computing Services for Utilizing Health Information Systems: A Case Study

Ahmed Meri Kadhum, Mohamad Khatim Hasan
pages: 503-510　Full text　DOI:10.18517/ijaseit.7.2.1814

A Comparative Review of Machine Learning for Arabic Named Entity Recognition

Ramzi Esmail Salah, Lailatul Qadri binti Zakaria
pages: 511-518　Full text　DOI:10.18517/ijaseit.7.2.1810

Interaction in Online System is A Favor Key for Learners' Success

Imane Kamsa, Rachid Elouahbi, Fatima El Khoukhi
pages: 519-525　Full text　DOI:10.18517/ijaseit.7.2.1475

Key Factors for Selecting an Agile Method: A Systematic Literature Review

Mashal Kasem Alqudah, Rozilawati Razali
pages: 526-537　Full text　DOI:10.18517/ijaseit.7.2.1830

Factors Affecting The Success of Incubators and The Moderating Role of Information and Communication Technologies

Qadri Kamal Alzaghal, Muriati Mukhtar
pages: 538-545　Full text　DOI:10.18517/ijaseit.7.2.1678

An Automatic Updating Process to Control The E-learning Courseware

Fatiha Elghibari, Rachid Elouahbi, Fatima El Khoukhi
pages: 546-551　Full text　DOI:10.18517/ijaseit.7.2.1871

Finding an Optimum Period of Oxidative Heat Treatment on SS 316 Catalyst for Nanocarbon Production from LDPE Plastic Waste

Praswasti P.D.K. Wulan, Satrio Bimo Wijardono
pages: 552-558　Full text　DOI:10.18517/ijaseit.7.2.2097

Identification of Nutrient Contents in Six Potential Green Biomasses for Developing Liquid Organic Fertilizer in Closed Agricultural Production System

- Fahrurrozi, Yenny Sariasih, Zainal Muktamar, Nanik Setyowati, Mohammad Chozin, Sigit Sudjatmiko
pages: 559-565　Full text　DOI:10.18517/ijaseit.7.2.1889

Treatment of Wastewater Containing Hexavalent Chromium Using Zeolite Ceramic Adsorbent in Adsorption Column

Tuty Emilia Agustina, Tine Aprianti, Siti Miskah
pages: 566-572　Full text　DOI:10.18517/ijaseit.7.2.2035

Identification of Plant Morphology of Taro as a Potential Source of Carbohydrates

Zulfadly Syarif, Nasrez Akhir, Benni Satria
pages: 573-579　Full text　DOI:10.18517/ijaseit.7.2.1323

Mixed Cooked Rice with Purple Sweet Potato is Potentially to be The Low Glycemic Index Food

Evawany Aritonang, Albiner Siagian, Fannisa Izzati
pages: 580-586　Full text　DOI:10.18517/ijaseit.7.2.1033

A Review of Minimum Quantity Lubrication Technique with Nanofluids Application in Metal Cutting Operations

Safian Sharif, Ibrahim Ogu Sadiq, Noordin Mohd Yusof, Amrifan Saladin Mohruni
pages: 587-593　Full text　DOI:10.18517/ijaseit.7.2.2141

### Susceptible Phase of Chili Pepper Due to Yellow Leaf Curl Begomovirus Infection

Dwi Wahyuni Ganefianti, Sri Hendrastuti Hidayat, Muhamad Syukur
pages: 594-601　Full text　DOI:10.18517/ijaseit.7.2.1872

Sweet Corn Performance and its Major Nutrient Uptake Following Application of Vermicompost Supplemented with Liquid Organic Fertilizer

Zainal Muktamar, Sigit Sudjatmiko, Mohammad Chozin, Nanik Setyowati, - Fahrurrozi
pages: 602-608　Full text　DOI:10.18517/ijaseit.7.2.1112

Secure Data Sensor In Environmental Monitoring System Using Attribute-Based Encryption With Revocation

- Munsyi, Amang Sudarsono, M. Udin Harun Al Rasyid
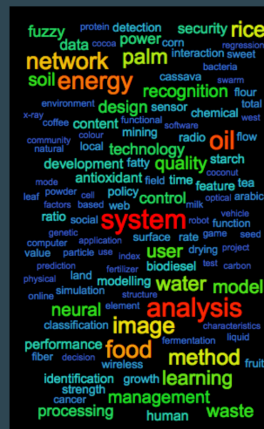
pages: 609-624 | Full text | DOI:10.18517/ijaseit.7.2.2175

A Novel Method to Detect Segmentation points of Arabic Words using Peaks and Neural Network

Jabril Ramdan, Khairuldin Omar, Mohammad Faidzul
pages: 625-631 | Full text | DOI:10.18517/ijaseit.7.2.1824

Investigation of Home Agent Load Balancing, Failure Detection and Recovery in IPv6 Network-based Mobility

Anshu Khatri, Mathi Senthilkumar
pages: 632-641 | Full text | DOI:10.18517/ijaseit.7.2.1787

Feature Selection for Multi-label Document Based on Wrapper Approach through Class Association Rules

Roiss Alhutaish, Nazlia Omar
pages: 642-649 | Full text | DOI:10.18517/ijaseit.7.2.1040

Local Color Voxel and Spatial Pattern for 3D Textured Recognition

Hero Yudo Martono
pages: 650-661 | Full text | DOI:10.18517/ijaseit.7.2.2173

Molecularly Imprinted Polymers (MIP) Based Electrochemical Sensor for Detection of Endosulfan Pesticide

Yohandri Bow, Edy Sutriyono, Subriyer Nasir, Iskhaq Iskandar
pages: 662-668 | Full text | DOI:10.18517/ijaseit.7.2.1064

Water Flow-Like Algorithm with Simulated Annealing for Travelling Salesman Problems

Zulaiha Ali Othman, Nasser Hamed Al-Dhwai, Ayman Srour, Wudi Yi
pages: 669-675 | Full text | DOI:10.18517/ijaseit.7.2.1837

An Automatic Feature Extraction Method of Satellite Multispectral Images for Interpreting Deforestation Effects in Soil Degradation

Irene Erlyn Wina Rachmawan, Yasushi Kiyoki, Shiori Sasaki
pages: 676-687 | Full text | DOI:10.18517/ijaseit.7.2.2174

Influence of Partial Solar Eclipse on the Radio Signal during 9 March 2016

Nur Zulaikha Mohd Afandi, Roslan Umar, Zainol Abidin Ibrahim, Nor Hazmin Sabri, Marhamah Mohd Shafie
pages: 688-694 | Full text | DOI:10.18517/ijaseit.7.2.1154

Dual-Band Bandpass Filter with Dumbbell Shaped Defective Ground Structure

M. F. Abdul Khalid, Z. Ismail Khan, Z. Awang, I. Pasya, N. Ab Wahab, I. M. Yassin
pages: 695-701 | Full text | DOI:10.18517/ijaseit.7.2.1342

Acrylic Acid Neutralization for Enhancing the Production of Grafted Chitosan Superabsorbent Hydrogel

Dhena Ria Barleany, Retno Sulistyo Dhamar Lestari, Meri Yulvianti, Taufik Rachman Susanto, - Shalina, - Erizal
pages: 702-708 | Full text | DOI:10.18517/ijaseit.7.2.2340

Physicochemical and Fatty Acid Profile of Fish Oil from Head of Tuna (Thunnus albacares) Extracted from Various Extraction Method

Novizar Nazir, Ayu Diana, Kesuma Sayuti
pages: 709-715 | Full text | DOI:10.18517/ijaseit.7.2.2339

Structural Behaviour of Steel Building with Diagonal and Chevron Braced CBF (Concentrically Braced Frames) by Pushover Analysis

- Saloma, Yakni Idris, - Hanafiah, Nico Octavianus
pages: 716-722 | Full text | DOI:10.18517/ijaseit.7.2.2341

Cost and Performance-Based Resource Selection Scheme for Asynchronous Replicated System in Utility-Based Computing Environment

Wan Nor Shuhadah Wan Nik, Bing Bing Zhou, Jemal H. Abawajy, Albert Y. Zomaya
pages: 723-735 | Full text | DOI:10.18517/ijaseit.7.2.1460

Molecularly Imprinted Polymers (MIP) Based Electrochemical Sensors for Detection of Endosulfan Pesticide

Yohandri Bow[#], Edy Sutriyono[*], Subriyer Nasir[$], Iskhaq Iskandar[&]

[#]*Chemical Engineering Department, State Polytechnic of Sriwijaya, Palembang, 30139, Indonesia*
& Environmental Science, Sriwijaya University, Indonesia
E-mail: yohandribow@gmail.com

[*]*Geology Study Program, Sriwijaya University, Palembang, 30139, Indonesia*

[$]*Chemical Engineering Department, Sriwijaya University, Palembang, 30139, Indonesia*

[&]*Physics Department, Mathematics and Natural Science Faculty, Sriwijaya University, Palembang, 30139, Indonesia*

Abstract— **The use of endosulfan pesticides in agriculture can cause environmental problems, such as pollution in aquatic environments that can lead to the destruction of fishery resources and drinking water. So, it has become imperative to detect and separate the hazardous pesticide endosulfan from contaminated water. In this work, molecularly imprinted membrane has been fabricated for the specific recognition by using methacrylic acid (MAA) as functional monomer and ethylene glycol dimethyl acrylate (EGDMA) as cross-linker. Scanning Electron Microscopy (SEM) confirmed the molecular imprinting of endosulfan on membrane matrix. Sensing of the endosulfan by voltammetry followed this. The electrochemical potential is additional information enhancing the selectivity of the sensor. It can be concluded that MIP-based voltammetric sensors are very promising analytical tool for the development of highly selective analytical sensor. The test results of electrode performance indicated that MIP endosulfan-based aluminum-carbon sensor had a detection limit of 0.02 mM, sensitive in the concentration range from 0.02 to 0.12 mM with Nernst factor > 0.059 V/decade and had good stability.**

Keywords— **endosulfan pesticide; molecularly imprinted polymer; electrochemical sensor**

I. INTRODUCTION

Environmental contamination with pesticides is an undesired consequence of agricultural activities. Direct discharge of pesticide-containing wastewater into soil or natural water sources constitutes a major problem of point-source contamination. Inappropriate handling of pesticides during agriculture use results in a risk of contamination in tasks such as the spraying of pesticides on the field, their dilution and pouring in spraying tanks, the discharge of residues and cleaning of those tanks after application, and utilization in postharvest treatment [1], [2].

In recent years, farmers are using a higher percentage of chemical fertilizers and pesticides to enhance the yield of crops to fulfil growing demands of food crops. If pesticides are not used, crop yield has been reported to reduce by about 10%. It is well known that several pesticides used for agriculture purposes are associated with surface and groundwater contamination. Extravagant and enormous usage of endosulfan pesticide not only will leave a traceful damage for the environment but also to the human living in it. This condition leads to the concern for people living in certain places such as children, pregnant women, farmers, farm workers and the elderly undergo negative health effects and can also cause acute poisoning, cancer, neurological damage, birth defects and reproductive as well as development harms. The excessive and uncontrolled uses of endosulfan pesticide in crops have raised and alarm for its toxicity not only in crops but also in drinking water. So, it has become imperative to detect and separate the hazardous pesticide endosulfan from contaminated water [3].

Persistent Organic Pollutants (POPs) are a set of chemicals that are toxic; persist in the environment for long periods of time, and biomagnify as they move up through the food chain. POPs have been linked to adverse effects on human health and animals. Because they circulate globally via the atmosphere, oceans, and other pathways, POPs released in one part of the world can travel to regions far from their source of origin [4].

Endosulfan is a man-made insecticide. It is used for control of a number of insects on such food crops as grains, tea, fruits, and vegetables and on such non-food crops like tobacco and cotton. It is also used as a wood preservative.

Endosulfan is sold as a mixture of two different forms of the same chemical (referred to as alpha- and beta-endosulfan). It is a cream-to-brown colour solid that may appear crystalline or be in flakes. It has a distinct odour similar to turpentine. Endosulfan does not burn. Its chemical name is 1,4,5,6,7,7-hexachloro-8,9,10-trinoborn-5-en-2,3-ylenebismethylene sulfite or 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathie-pen 3–oxide. The empirical, structural formula and molecular mass are given as Fig. 1 below.
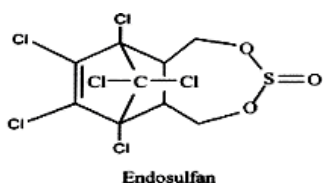
C9H6Cl6O3S
406,9

Fig. 1 Structure formula endosulfan

Endosulfan is an organochlorine insecticide and acaricide, and act as a contact poison in a wide variety of insects and mites [5]. It is easily absorbed by the stomach, lungs and through the skin, which meaning that all routes of exposure can pose a hazard. It enhances the effect of estrogens can pose a hazard. It enhances the effect of estrogens and acts as an endocrine disruptor, causing reproductive and development damage in animals and humans as well as cause cancer [6].

Endosulfan is a neurotoxic organochlorine insecticide of the cyclodiene family of pesticides. It is highly toxic and an endocrine disruptor and it is banned in the European Union, Philippine, and several countries. Due to extreme toxic of bioaccumulation and pollution in the environment, a worldwide ban for usage and production of endosulfan is applied as regulated by the Stockholm Convention [7].

Endosulfan is a broad-spectrum organochlorine insecticide and comes in α and ß isomers, both of which are found in commercial formulations. It is practically insoluble in water but is soluble in organic solvents. In the biological tissues and the environment, it is known to degrade into various metabolites, which include endosulfan sulphate, endosulfan alcohol, endosulfan ether and endosulfan lactone [8]. Consequently, it becomes the foremost important act to get the early detection and separation of this pesticide from the polluted water. Recent researches are reported developing methods in sensing and separating the pesticide from the environment. Biosensors and sensors are excellent tools for detecting the pesticides. Molecularly Imprinted Polymers (MIPs) are used for separating pesticides, which have created receptor structure artificially. There are many recent reports of molecularly imprinted polymer, which are used to develop detection systems for pharmaceuticals and environmental contaminants.

Molecular imprinting is a technology that is used to create specific cavities in the synthetic polymer with a memory for the molecules template. Until now molecularly imprinted polymers (MIPs) have earned a strong position in material science and technology, expanding the list of functional materials significantly.

Molecular imprinting technology is a promising technique for creating recognition elements for selected compounds and has been successfully applied for the synthesis of environmetal pollutants such as pesticides [9].

The molecular imprinting technique continues to be a fascinating field of analytical chemistry offering strategies for creating molecule-specific recognition matrices with recognition capabilities analogous to those of biological receptors [10]. The positions, shape, and size of the functional groups in the sites of recognition generated are complementary to its original analyte. Thus, molecularly imprinted polymers (MIPs) rebind their original analyte in preference to related molecules. MIPs have considerable potential for application in the areas of clinical analysis, medical diagnostic, environmental monitoring and drug delivery. Imprinted polymer materials possess several other virtues viz. physical and chemical stability, storage endurance and imprint memory, which is essential for the preparation of recognition membranes in a robust and reusable sensing device. Moreover, MIPs are usually cheaper and more accessible high-affinity recognition materials in contrast to many biological entities [11].

MIPs have been synthesized for large and small molecules, herbicides including atrazine [12] and 2,4,5 trichlorophenoxyacetic acid [13], environmental contaminants pentachlorophenol and organophosphorus such as paraoxon, dichlorovos [14]. Scheme for molecular imprinting is given as Fig. 2 [15].

MIPs are advantageous for sensors because they selectively bind the targeted compound while ignoring all others. Therefore, an MIP-based sensor should reduce the number of false positives that often plague other types of sensors (for example, pesticides often cause false alarms with nerve gas sensors) [16].

Potentiometric sensors, a subgroup of chemical sensors, are attractive for practical applications, as they are associated with small size, portability and low energy consumption and cost compared to another group of sensors [17], [18].

The development of MIP-based sensors with potentiometric transduction does not require the template or print molecule to be extracted from the membrane to create membrane potential and does not have to diffuse through the membrane so that there is no size restriction on the template molecule, the main Achilles heel of MIP's until recently. MIP-based potentiometric sensor for methylphosphonic acid, an ultimate degradation product of nerve agents by coupling surface imprinting technique with a nanoscale transduces indium tin oxide [19]. The literature reveals that the prepared imprinted polymer membranes can be effectively used for the detection of nerve agents by fabricating them into potentiometric sensors [20], [21].

The purpose of this study is to develop a molecularly imprinted polymer composite membrane to identify and recognize the contaminant (endosulfan) selectively in the water. The functions of selective matrix membrane are the identification and remove of selected analyte. In this research, MIPs composite membrane has been synthesized
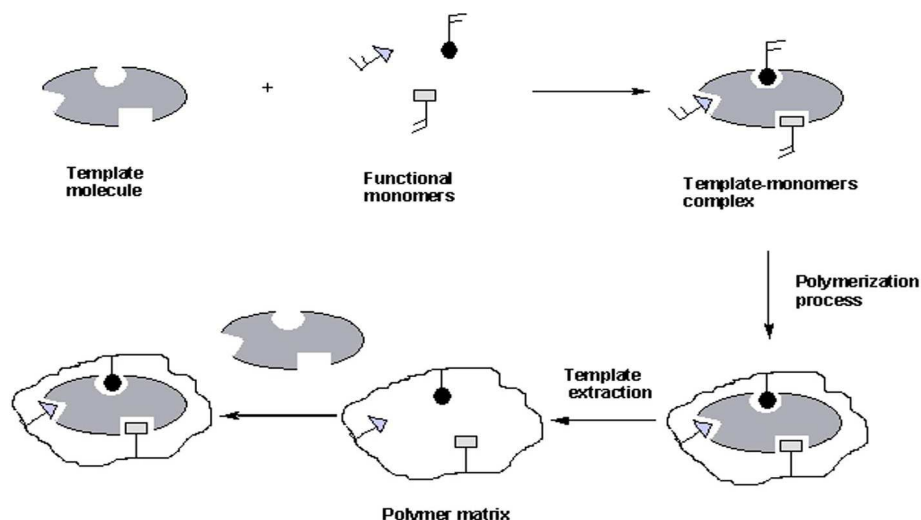
Fig. 2 Scheme of molecular imprinting

and used for sensing and separating the pesticide because of its exclusive stability and easy to adapt using an advanced instrumental technique like UV-Visible spectrophotometer and Scanning Electron Microscopy (SEM).

II. Material and Method

A. Preparation of Endosulfan Template

All the reagents were of analytical grade. The procedure for the synthesis of MIP and NIP polymers as following procedure: Briefly, a template of endosulfan was taken in 0.025 gr endosulfan and 2.1 ml chloroform solvent, 0.525 ml EDMA cross-linker, 0.059 ml MAA functional monomer and 0.05 gr BPO initiator were added to it. The entire components were thoroughly mixed for 15 minutes. Blank polymer without endosulfan was also prepared. After that, the reaction vial was kept at $-5^{o}C$ in the freezer for 1 hour and kept at $70\text{-}120^{o}C$ for 150 minutes for complete polymerization.

The polymer was transferred from the vial to mortal and ground. The polymers were collected through acetonitrile solvent filtered and washed using methanol and water (aqua-bidest) for 1 hour. Remaining residues filtrate was also collected for drying and future use.

A control sensor was prepared in every case following the same procedure but in the absence of template molecule. The control (or non-imprinted polymer-modified electrode) had the same treatment as the imprinted sensor, to ensure that the effect is observed only due to the imprinting features and not to the subsequent treatments undergone by the sensor.

B. Removal of Template and Confirmation by UV-Visible Spectrophotometer

Specific binding is confirmed by UV-Visible spectrophotometer. The MIPs were washed three times with methanol and also water to remove the print molecules. The imprinted template was eluted with methanol. The removal of the template was also confirmed by using a UV-Visible spectrophotometer.

C. Characterization of MIP Composite Membrane by Scanning Electron Microscopy (SEM)

Prepared molecular imprinted composite membranes with and without template were categorized by using scanning electron microscopy (SEM, Model: Pro-X) and the micrograph was recorded of all the different samples of the membrane including non-imprinted and MIP composite membranes.

D. Electrochemical Sensor Preparation

Electrochemical studies were performed using a potentiostat. The general procedure used to prepare the potentiometric sensor based MIP, using aluminium wire (1 mm diameter and 120 mm long) and carbon. The electrodes were polished with fine alumina slurries with a polishing cloth, sonicated in distilled water and dried in air. An unsaturated resin was glued to one end of the above aluminium wire. Endosulfan was dipped into the aluminium wire and added a solution of chloroform on the sensor surface that has been coated with endosulfan.

III. Results and Discussion

A. MIP Endosulfan Characterization

Scanning Electron Microscopy (SEM) study usually used for recognizing the morphology structure and MIP surface because it has an excellent and very high resolution. The morphology surface SEM images of the IP endosulfan template under the magnificent 500X - 1.99KX and 30 resolution are shown in Fig. 3-6. SEM micrograph of MIP at various magnifications which generally shows rough MIP surface with the irregular pores. The globular and porous MIP has higher adsorption capacity toward the target (in this case endosulfan) compared to a NIP, possibly due to the porosity and higher surface area. The specific binding sites created also contribute to the higher adsorption of MIP towards endosulfan.

SEM analysis described both the morphological characteristics of the shape and surface structure of the MIP.

This was important information for the synthesis and applications of MIP.

Fig. 3, 4, 5 and 6 show the SEM micrographs of the MIP composite membrane imprinted by endosulfan template, which was recorded at 500X, 1 KX, 1.5 KX and 1.99 KX magnifications and at a resolution of 30 µm. The surface texture clearly exhibits the cavities on the surfaces and within the pores, which is a clear indication of a change of porous behavior of MIP composite membrane after removal of the template. These things change in porous characteristic behavior in thermodynamical studies. Here were the results of SEM to the MIP obtained [22].
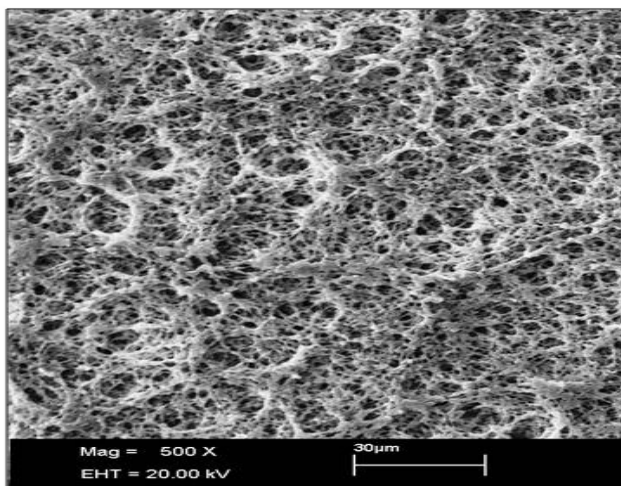
Fig. 3 SEM of the MIP endosulfan template at 500X magnification and 30 µm resolution
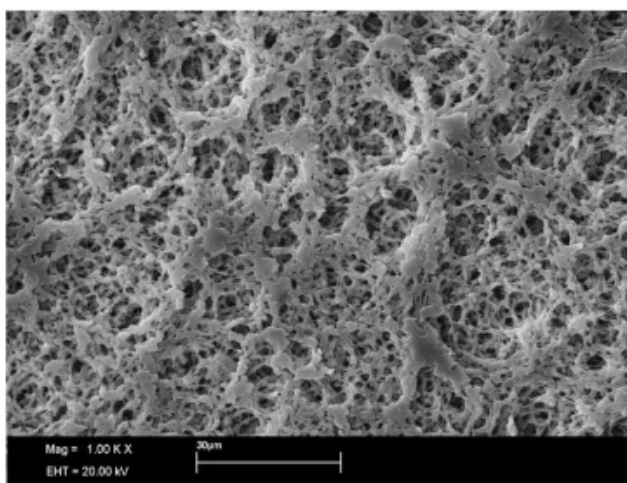
Fig. 4 SEM of the MIP endosulfan template at 1.0 KX magnification and 30 µm resolution

B. Specific Binding of Endosulfan

MIP has cavities that specific, which can be passed by template because every template has its sensitivity. Endosulfan MIP sensitivity can be measured using the UV-Visible Spectrophotometer and see the elution curve. From the curve, it can be known that MIP has a sensitivity to the template. Fig. 7 shows the graph of absorbance vs. wavelength of endosulfan concentration passed from MIP and non-imprinted polymer.
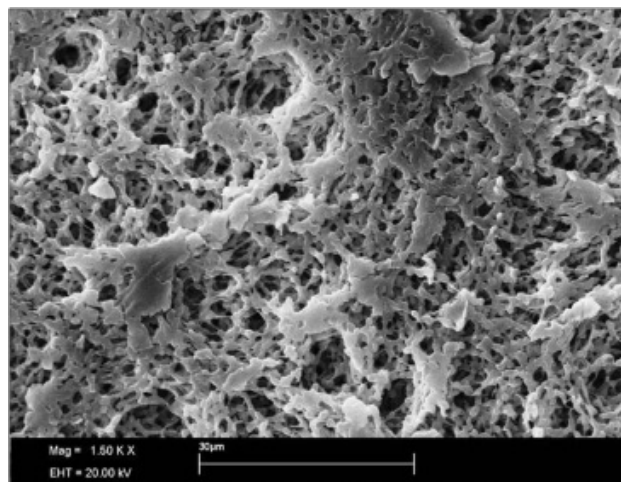

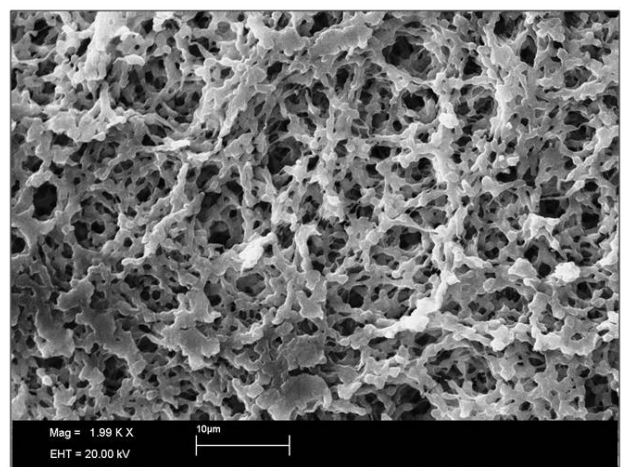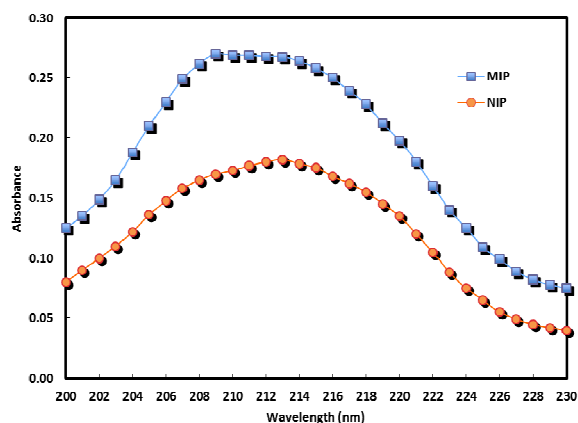Fig. 5 SEM of the MIP endosulfan template at 1.5KX magnification and 30 µm resolution

Fig. 6 SEM of the MIP endosulfan template at 1.99 KX magnification and 30 µm resolution

Fig. 7 Endosulfan concentration passed from MIP and NIP

C. The Concentration of Endosulfan Bound to the MIP

MIP endosulfan was fabricated with cooling - heating method for a variable heating time (90, 120, and 150 minutes), which includes the initial concentration (target), endosulfan concentrations of free and bound endosulfan concentrations of MIP. The relationship between the concentrations of endosulfan independent of the

665

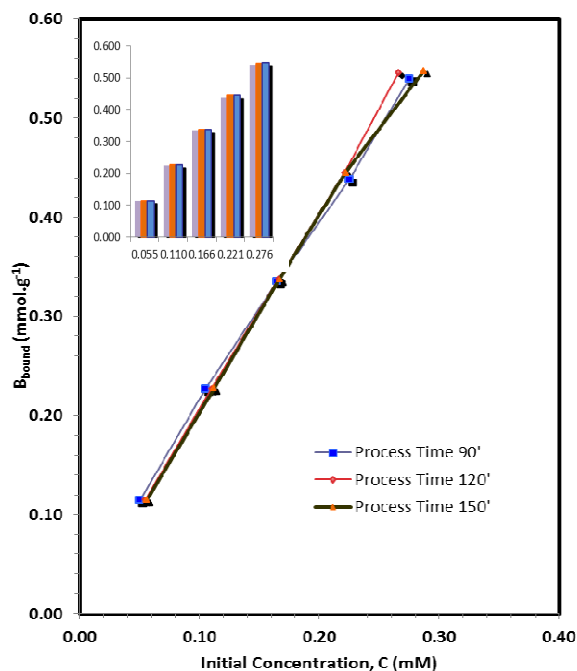concentration of endosulfan bound to the MIP can be seen in Fig. 8.

Fig. 8 The relationship between the concentrations of target bounds to the initial concentration of MIP

Furthermore, the concentration of endosulfan independent of the concentration of bound target can be seen in Fig. 8. It was explained that the polymer bound endosulfan concentrations increased with increasing concentrations of endosulfan free. Heating time of 150 minutes produces the least amount of free endosulfan than the heating time of 90 minutes and 120 minutes. This indicates that endosulfan bounds to the MIP are most numerous in the old polymer prepared by heating 150 minutes. This result corresponds to the available cavities, where these polymers are more porous than the other polymers.
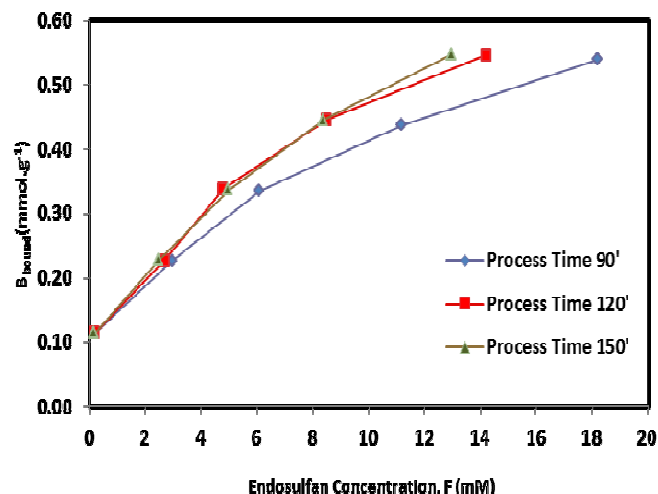

Fig. 9 The relationship between B_{bound} to the concentration of endosulfan free

From Scatchard Plots, it was found that the maximum amount of targets bounds to the MIPs was 10,03 mmol/gr for heating time 150 minutes, respectively. On the other hand,

the cavities of MIPs were 528 for heating time 150 minutes, as analyzed from the SEM images. These finding confirmed that the heating time of 150 minutes results in the endosulfan MIP with the best endosulfan sensing properties. The relationship between the concentrations of bounds to the initial concentration can be seen in Fig. 10.
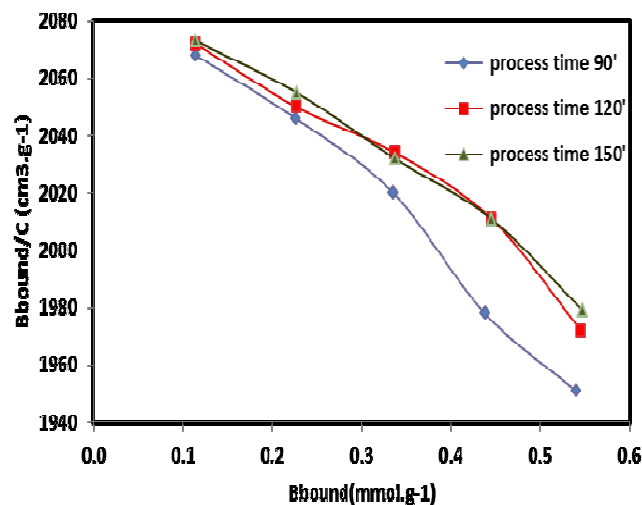

Fig. 10 Relationship B_{bound}/C to B_{bound}

D. Sensor Performance Test

After testing the performance of the sensor by measuring the voltage (volts) on a standard solution with varying concentrations, linearity equation and Nernst factor were obtained.
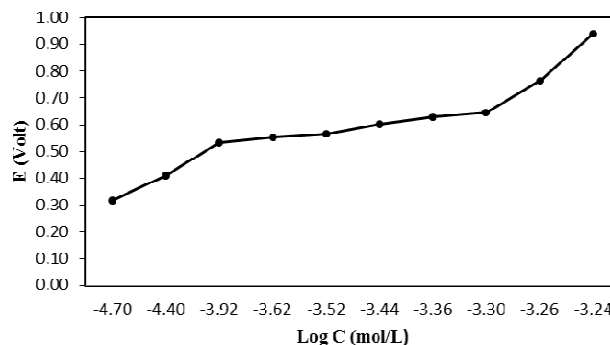

Fig. 11 Graph between MIP endosulfan potential to the target logarithm concentration on the aluminum-carbon sensor on the 1st day

Fig. 11 showed that the slope of the function E versus log concentration increased with increasing concentrations of the target value. Based on the graph, linear equation with three ranges of concentration was obtained. Based on the results of a linear regression on the graph of potential E (volts) to the logarithm concentration, the obtained parameter values were as in Table 1.

From the measurements performed in the concentration range from 0.02 to 0.58 mM obtained three N slopes with a value of 0.2682 in the concentration range from 0.02 to 0.12 mM, 0.3093 in the concentration range from 0.24 to 0.44 mM, and 4.2808 in the concentration range from 0.50 to 0.58 mM. These sensors had good sensitivity in the concentration range from 0.02 to 0.12 mM as indicated by the linearity value closed to 1, $R^2 = 0.9977$.

TABLE I
THE OBTAINED PARAMETERS OF POTENTIAL PLOT E (VOLT) TO
THE LOGARITHM CONCENTRATION AT 1ST DAY

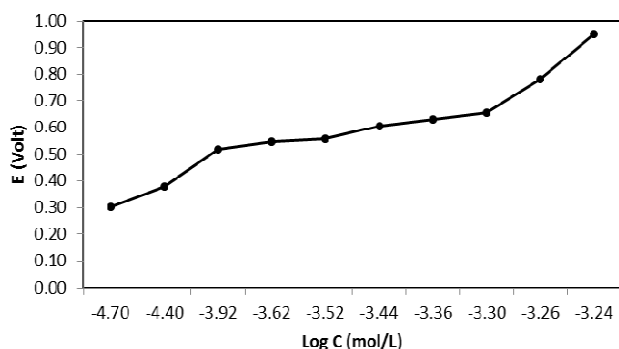| Concentration Range	E = K + N (slope) Log C	Z	R^2
0.02 – 0.12	1.5838 + 0,2682 log C	0.21626	0.9977
0.24 – 0.44	1.6656 + 0,3093 log C	0.18752	0.9841
0.50 – 0.58	14.763 + 4,2808 log C	0.01355	0.9120

Fig. 12 Graph of MIP potential of endosulfan to the target of logarithm concentration on the aluminum-carbon electrodes on at 20th day

Based on the results of a linear regression on a graph of potential E (volt) to the logarithm of the concentration, the obtained parameters were as Table 2.

TABEL II
OBTAINED PARAMETERS FROM E (VOLT) POTENTIAL PLOT TO
THE LOGARITHM OF THE CONCENTRATION AT THE 20TH DAY

Concentration Range	E = K + N (slope) Log C	Z	R^2
0,02 - 0,12	1,631 + 0,2837 log C	0,20444	0,9993
0,24 - 0,44	1,7386 + 0,3302 log C	0,17565	0,9213
0,5 - 0,58	14,87 + 4,3094 log C	0,01346	0,9330

From the measurements done on the 20th day in the concentration range from 0.02 to 0.58 mM N obtained three slopes with a value of 0.2837 in the concentration range from 0.02 to 0.12 mM, 0.3302 in the concentration range of 0.24 -0.44 mM, and 0.3094 in the concentration range 0.50 to 0.58 mM Measurement on the 20th day also showed sensors had good sensitivity in the concentration range from 0.02 to 0.12 mM with the linearity of 0.9993.
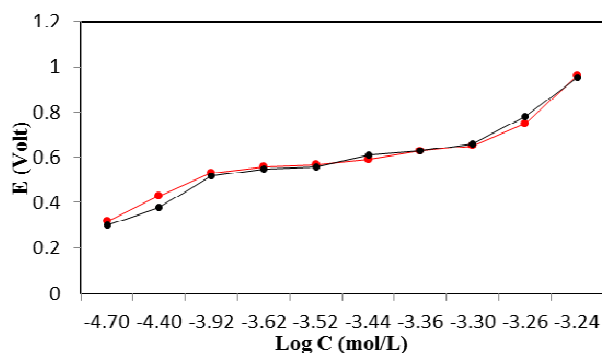

Fig. 13 Graph of stability of sensor the 1st and the 20th days

Based on Fig. 13, measurements of the 1st day and 4th were coincided, this indicated that this sensor had good stability.

The limit of detection indicated the lowest concentration of analyte ions addressed by the sensors the lowest measurement limit. Based on the experiment, the detection limit of the aluminum-carbon sensor was 0.02 mM Sensors responded well to a minimum level of 0.02 mM concentration of endosulfan.

IV. CONCLUSIONS

Molecularly imprinted polymers were successfully prepared for endosulfan using MAA as functional and EGDMA as cross-linking monomers. The method developed for the determination of residues of endosulfan. The molecularly imprinted polymer matrices specific to endosulfan pesticides were synthesized and used for the fabrication of MIP composite membranes. These MIP composite membranes were further characterized by using UV-Visible and SEM. In recent studies, for the specific recognition of endosulfan pesticide, the molecularly imprinted membrane is fabricated, widely used in controlling insects.

The test results of electrode performance indicated that MIP endosulfan-based aluminum-carbon sensor had a detection limit of 0.02 mM, sensitive in the concentration range from 0.02 to 0.12 mM with Nernst factor > 0.059 V/ decade and had good stability.

REFERENCES

[1] Carlos, *et al*. *On-farm Biopurification Systems: Role of White Rot Fungi in Depuration of Pesticide-containing Wastewater.* Minireview. FEMS Microbial Lett. 345. p. 1-12. 2013.

[2] Singh, *et al*. *Selective Recognition of Endosulfan Pesticide in Environmental Matrix with Molecularly Imprinted Polymer Membrane.* Research Journal of Chemical Science, Vol. 4(4), p. 63-70, 2014.

[3] Juan He, Lixin Song, Si Chen, Yuanyuan Li, Hongliang Wei, Dongxin Zhao, Keren Gu and Shunsheng Zhang. Novel Restricted Access Materials Combined to Molecularly Imprinted Polymers for Selective Solid-Phase Extraction of Organophosporous Pesticides from Honey. Food Chemistry, Elsevier. 187. p. 331-337. 2015.

[4] Kanchan Singh, Akmal Pasha, B.E. Amitha Rani. Preparation of Molecularly Imprinted Polymers for Heptachlor: An Organochlorine Pesticide. Chronicles of Young Scientists, Vol. 4(1). p. 46-50. 2013. doi: 10.4103/2229-5186.108806.

[5] Abdul Latif Ahmad, Nuur Fahanis Che Lah and Siew Chun Low. Molecular Imprinted Polymer for Atrazine Detection Sensor: Preliminary Study. Chemical Engineering Transactions. Vol. 45. p. 1483-1488. 2015. doi: 10.3303/CET1545248.

[6] Maricely Janette Uria Toro, Luiz Diego Marestoni and Maria Del Pilar Taboada Sotomayor. A New Biomimetic Sensor Based on Molecularly Imprinted Polymers for Highly Sensitive and Selective Determination of Hexazinone Herbicide. Sensors and Actuators B 208. p. 299-306. 2015.

[7] Jianshe Tang and Li Xiang. Development of a Probe Based on Quantum Dots Embedded with Molecularly Imprinted Polymers to Detect Parathion. Pol. J. Environ. Stud. Vol. 25, No. 2. p. 787-793. 2016. doi: 10.15244/pjoes/60888.

[8] Fabrizio Ruggieri, Luca Lozzi, Angelo Antonio and Sandro Santucci. Development of Molecularly Imprinted Polymeric Nanofibers by Electrospinning and Applications to Pesticide Adsorption: Sample Preparation. Journal Separation Science. February 2015. doi: 10.1002/jssc.201500033.

[9] Singh, *et al*. *Molecular Imprinting for Heptachlor.* Cronicles of Young Scientists. Vol. 4, Issue 1 Jan-Jun. p. 46-50. 2013.

[10] Vishnuvardhan, Varada, *et al. Imprinted Polymer Inclusion Membrane Based Potentiometric for Determination and Quantification of Diethyl Chlorophosphate in Natural Waters.* American Journal of Analytical Chemistry, 2, p. 376-382, 2011.

[11] Tehrani, M.S, *et al. Molecularly Imprinted Polymer Based PVC-Membrane-Coated Graphite Electrode for Determination of Metoprolol.* Int. J. Electrochem. Sci. 5. p. 88-104. 2010.

[12] Saliza Asman, Sharifah Mohamad and Norazilawati Muhamad Sarih. Exploiting ß-Cyclodextrin in Molecular Imprinting for Achieving Recognition of Benzylparaben in Aqueous Media. Int. J. Mol. Sci. 16. p. 3656-3676. 2015. doi: 10.3390/ijms16023656.

[13] Gabycarmen Navarrete-Rodriguez, Cesareo Landeros-Sanches and Alejandra Soto-Estrada. Endosulfan: Its Isomers and Metabolites in Commercials Aquatic Organisms from the Gulf of Mexico and the Caribbean. Journal of Agriculture Science, Vol. 8(1). p. 8-24. 2016. doi: 10.5539/jas.v8n1p8.

[14] U.S. Environmental Protection Agency, Manual of Analytical Methods for the Analysis of Pesticides in Human and Environmental Samples. 2012.

[15] Sha Yang, Yonghui Wang, Yingda Jiang, Shuang Li and Wei Liu. Molecularly Imprinted Polymers for the Identification and Separation of Chiral Drugs and Biomolecules. Polymer. 8. 2016. doi: 10.3390/polym8060216.

[16] Saxena, Ronika and Poonam Garg. Vitamin E Provides Protection against in vitro Oxidative Stress due to Pesticide (Chlorpyrifos and Endosulfan) in goat RBC. GERF Bulletin of Biosciences 1(1), p. 1-6, 2010.

[17] Rusdianasari, Bow, Y., Taqwa, A. Treatment of coal stockpile wastewater by electrocoagulation using aluminum electrode. J. Advanced Material Research. Vo. 896. p. 145-148. 2014.

[18] Rusdianasari, Meidinariasty, and Purnamasari, I. Level Decreasing Kinetics Model of Heavy Metal Contents in the Coal Stockpile Wastewater with Electrocoagulation. International Journal on Advanved Science, Engineering and Information Technology. Vol. 5(6). p. 387-391. 2015. doi:http://dx.doi.org/10.18517/ijaseit.5.6.593.

[19] Mercedes Roldan-Pijuan, Rafael Lucena, Soledad Cardenas, Miguel Valcarcel, Abuzar Kabir and Kenneth G. Furton. Stir Fabric Phase Sorptive Extraction for the Determination of Triazine Herbicides in Environmental Waters by Liquid Chromatography. Journal of Chromatography A. 2014.

[20] Mengchun Zhou, Nana Hu, Shaohua Shu and Mo Wang. Molecularly Imprinted Nanomicrospheres as Matrix Solid-Phase Dispersant Combined with Gas Chromatography for Determination of Four Phosphorothioate Pesticides in Carrot and Yacon. J. Anal. Methods Chem. 2015. Doi: 10.1155/2015/385167.

[21] Monireh Khadem, Farnoush Faridbud, and Parviz Nouzi. Biomimetic Electrochemical Sensor Based on Molecularly Imprinted Polymer for Dichloran Pesticeide Determination in Biological and Environmental Samples. J. Iran Chem. Soc. Vol. 13(11). 2016. Doi: 10.1007/s13738-016-0925-8.

[22] Singh K.P., Kumar Ajeet and Tyagi Shweta. Selective Recognition of Endosulfan Pesticide in Environmental Matrix with Molecularly Imprinted Polymer Membrane. Research Journal of Chemical Sciences. Vol.4(4). Pp. 63-70. 2014.