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From the Editor's Desk

We have the privilege to introduce the fourth issue of the Amity Journal of Engineering and Technology (**AJET**), a peer-reviewed multidisciplinary scientific journal that focuses on emerging trends in various domains of engineering and technology. AJET aims to provide a platform to researchers to share their ideas and emerging trends, across varied themes related to the disciplines of engineering, technology, and allied areas.

The current issue of the journal is a compilation of six papers, wherein authors have discussed ideas ranging from catalytic membranes, membrane separation technologies and their applications. This particular issue also includes a study that proposes a priority-destination-based rerouting protocol for vehicles that are approaching to the area of accident. There is an interesting case study presenting vegetable oil as an alternate fuel in diesel engines. Fifth paper presents a novel blind steganalysis scheme that can reliably detect hidden data in JPEG images. Then, there is a paper to study the stressor-related pain among outdoor manual workers.

We would like to extend our sincere gratitude to the authors of the papers, from different countries, without whose dedication to research, this journal would not have been possible. We would also like to thank the reviewers for their valuable comments to the authors and the editorial committee, for extending support in bringing out this journal in its present form. All published issues of AJET bear testimony to the zeal and commitment of the founding editors of the journal in providing a common forum to researchers to share their ideas and build upon them, adding to the process of knowledge creation.

We hope that academics, researchers, and industry experts will find AJET useful, as they set out to explore the fascinating world of advanced engineering, emerging technologies, and inspiring architectures. We will continue to publish interesting articles with more focus on applications of engineering, science & technology, and architecture.

Prof. Dr. Piyush Maheshwari
Editor in Chief

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Catalytic Membranes for Hydrogen Production

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Abstract - Hydrogen is the lightest element, yet it has the highest energy when combusted. The gas is mainly produced by steam-methane reforming (SMR) but the process is energy-intensive and limited by the chemical equilibrium. Alternatively, ceramic membranes can produce high-purity hydrogen by partial-oxidation of methane (POM). The membranes can do separation and reaction at the same time and this can reduce energy consumption by 30%. This paper gives an overview about catalytic membranes; their materials and transport mechanism. It also discusses the current challenges for applying this technology in industry.

Keywords: Hydrogen, steam-methane reforming, partial-oxidation of methane, catalytic membranes, mixed conductors.

1.0 Introduction

Hydrogen is considered is a source of green energy because it only emits water when combusted. The gas is extensively used in ammonia synthesis for making fertilizers. It is also heavily consumed in refineries for hydrotreating (to remove sulfur from fuels) and hydrocracking (to break down large molecules into useful products) processes. Furthermore, due to the high thermal conductivity, hydrogen is used as a coolant in many pilot plants.

Most of the hydrogen is produced by steam-methane reforming (SMR) where methane reacts with water to form synthesis gas, a mixture of hydrogen and carbon monoxide. The process is energy-intensive because of the endothermic reaction. The reaction is also limited by the chemical equilibrium. Partial-oxidation of methane (POM) provides another route for hydrogen production by the reaction of oxygen with methane. Unlike SMR, the reaction of POM is exothermic and it is not controlled by the chemical equilibrium. However, the addition of high-purity oxygen by cryogenic distillation greatly affect the process economy [1]. Ceramic membranes made of mixed conductors can produce oxygen with 100% purity and compared to cryogenic distillation, the membranes can save energy by 35% [2]. In addition, the membrane surface can provide the active sites for POM to generate hydrogen [3].

2.0 Mixed Conductor Membranes

Mixed ionic-electronic conducting (MIEC) membranes were discovered in 1980s by Teraoka et al [4]. They prepared non-porous, dense membranes and they noticed that the materials permeate oxygen. These membranes have a perovskite structure of ABO_3 where A stands for an alkali earth metal (e.g., barium) and B for a transition metal (e.g., cobalt). At high temperature of 800°C, oxygen atoms leaves the perovskite structure and this creates vacancies that provide the path for oxygen transport [5].

3.0 Transport Mechanism in MIEC Membranes

Oxygen flux (J_{O_2}) through MIEC membrane can be approximated using Fick's law:

$$J_{O_2} = -D\frac{\partial \emptyset}{\partial x} = D_v\frac{(C_2 - C_1)}{\Delta l} \quad (1)$$

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Preparation of Zeolite Composite Membrane for Pervaporation Application

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Abstract **-** Currently, there is a high demand for membrane separation technologies, and many researchers have become interested in this technology. In the past few decades, petrochemical-related industries have expended a lot of time and resources in efforts to replace many conventional separation methods with more economical methods that consume less energy (Li and Yang, 2008). Zeolites have proven to be beneficial in this effort due to their uniform microstructure and molecular sieving properties. Many studies have reported that zeolites can withstand the extreme operating conditions associated with some separation technologies, e.g., membrane reactors and gas separation units that operate at high temperatures. In this study, ethanol dehydration was performed using a pervaporation (PV) system with LTA/carbon composite membranes. Glucose was used as a carbon precursor for fabricating the LTA membrane under pyrolysis conditions. The effects of the post-treatment methods on the permeability and selectivity of the membranes were investigated.

Keywords: Zeolite membranes, Ethanol, Carbon, Pervaporation.

1.0 Introduction

Zeolite industries are improving their products and opening new horizons in many applications, i.e., the petrochemical and refining industries, the manufacture of adsorbents, the manufacture of detergents, and agricultural uses (Dyer, 1988). A zeolite is defined as a three-dimensional framework structure of an aluminosilicate crystalline structure that forms uniformly-sized pores of molecular dimensions (Dyer, 1988). The structural design of zeolites at the molecular level has attracted the interest of many scientists during the last few decades (Dyer, 1988). Zeolites act as molecular sieves due to their microporous structure, which is controlled by the dimensions of the channels.

The term 'molecular sieves' expresses the ability of the zeolitic material to adsorb molecules that are small enough to fit inside the pores, while rejecting other molecules that are too large to fit. The type of framework that makes up a given zeolitic material defines the structure and properties of the material and has a significant effect on the material's ability to adsorb various molecules. Therefore, scientists noticed very early that determining the structural frameworks of various zeolites was fundamentally important in developing an understanding of their physical and chemical characteristics. A zeolite's framework is defined on the basis of the connectivity of its tetrahedral framework using cages and subunits, such as α-cavity, β-cage, and pentasil units.

Thus, the structure of the pores, the channel system, the volumes of the cages, and the arrangement of the cages can all be defined if the structural framework is known (Feng et al., 1997). This means that the main properties of zeolites, such as ion exchange potential, catalytic activity, and sorption capacity, can be determined from their structural frameworks. Many studies have reported that there are over 130 confirmed types of frameworks in zeolites, and the International Zeolite Association (IZA) has assigned three-letter abbreviations to designate the different structures, e.g., LTA is the abbreviation for Linde Type A, FAU represents faujasite zeolite, and ZSM-5 represents Zeolite Socony Mobil.

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Priority-Destination-based Rerouting of Vehicles in time of Accident

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Abstract **—**This paper proposes a priority-destination-based rerouting protocol for vehicles that are approaching to the area of accident. Vehicles that are having same route where the accident happened must be rerouted to prevent congestion. We propose a priority-destination-based rerouting which considers high priority for the vehicles having destination as hospital, school, etc. These high priority vehicles are rerouted with least possible delay.

Keywords: VANET, Rerouting, Priority destination, Vehicular Network.

1.0 Introduction

Vehicular Ad Hoc Networks (VANET) is known for the purpose of communication in vehicular network such as communication between Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I) and Infrastructure-to-Vehicle (I2V). VANET has a vast number of applications such as traffic congestion control, traffic safety and infotainment. To provide these services vehicles are equipped with sensors, cameras, global positioning system (GPS), and so on [1].

Vehicles are getting smarter with time, an autonomous vehicle today can move from one point to another without human intervention. These autonomous vehicles can help in preventing road accidents and congestion that are mostly caused by human errors such as, perceptual error, distraction error, response error [2], etc.

In our previous paper, we worked on the effectiveness of data processing and data dissemination in cluster-based autonomous vehicles. We used three processing positions, such as cluster head (CH), Road-Side Unit (RSU), and vehicular cloud and the most effective one was selected to process the data and then disseminates it to the destination [3]. In this paper, we propose a rerouting scheme for the vehicles which are going to pass through the accident area.

Congestion control and rerouting of vehicles is the most important concern after an accident occurs. Most of the navigators are using the Dijkstra shortest path algorithm [4, 5], SAINT [6] uses a self-adaptive interactive navigation approach to prevent the congestion in light traffic road.

The smart vehicles can share information about traffic statistics with each other and also with road side unit (RSU) to prevent congestion and make the traffic flow smoother. Information from vehicles about their trajectories, current positions are periodically sent to traffic control center (TCC). Vehicle that encounters any accident also sends the information to the TCC where it is processed and sent to the vehicles approaching the same route.

Vehicles that are supposed to use the accident road in the near future should be rerouted to prevent congestion. In this case the goal of this paper is to prioritize the vehicles according to their destination and then reroute them.

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Vegetables Oil as Alternate Fuels in Diesel Engines – A Case Study

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Abstract **-** The indiscriminate extraction and consumption of fossil fuels have led to a reduction in petroleum reserves. Petroleum based fuels are obtained from limited reserves. These finite reserves are highly concentrated in certain region of the world. Therefore, those countries not having these resources are facing a foreign exchange crisis, mainly due to the import of crude petroleum oil. Hence it is necessary to look for alternative fuels, which can be produced from materials available within the country. Although vegetative oils can be fuel for diesel engines, but their high viscosities, low volatilities and poor cold flow properties have led to the investigation of its various derivatives. Among the different possible sources, fatty acid methyl esters, known as Biodiesel fuel derived from triglycerides (vegetable oil and animal fates) by trans esterification with methanol, present the promising alternative substitute to diesel fuels and have received the most attention now a day. It does not contribute to a rise in the level of carbon dioxide in the atmosphere and consequently to the greenhouse effect.

Keywords: Trans esterification, Vegetable oil, Petrol, Biodiesel, Diesel engines.

1.0 Introduction

It is known that the remaining global oil resources appear to be sufficient to meet demand up to 2030 as projected in the 2006– 2007 world energy outlook by the International Energy Information Administration (Kjarstad et al 2009). There is, therefore, a demand to develop alternative fuels motivated by the reduction of the dependency on fossil fuel due to the limited resources. In this respect biodiesel have been proposed as alternate solution for increasing of energy demand and environmental awareness. Vegetable oil is not a new fuel for CI engine hundred years ago Mr. Rudolf Diesel tested vegetable oil for his engine. (Chen Hu et al 2010). Diesel demonstrated his engine at the Paris Exposition of 1900 using peanut oil as fuel. In 1911 he stated "The Diesel engine can be fed with vegetable oils and would help considerably in the development of Agriculture of the countries which use it". In 1912, Mr. Rudolf Diesel said, "The use of vegetable of oils for engine fuels may seem insignificant today. But such oils may become in course of time as important as petroleum and the coal tar products of the present time" (Babu et al 2003). With the advantages of the cheap petroleum, appropriate crude oil fractions were refined to be used as fuel and Diesel engine were evolved together. In the 1930s and 1940s vegetable oils used as diesel fuels from time to time, but usually only in emergency situations. Recently, because of rise in crude oil prices, limited resources of fossil fuel, environmental concerns, there has been a renewed focus on vegetable oils to make bio diesel fuels (Hak-Joo Kim et al 2004). Diesel engines are usually classified into two categories; these are direct and indirect injection engines. Direct injection means the fuel is directly injected into the combustion chamber. The fuel is injected under high pressure through a nozzle with single or multiple tiny orifices. This results in a fuel spray with very fine droplets thus making it easier for the fuel to evaporate and burn. But in the indirect injection engines, the fuel is injected into an auxiliary chamber that is adjacent and connected to the main combustion chamber. Most combustion start sooner in this chamber and burning gases exit the chamber with high velocities giving a greater ability for mixing of fuel and air. These types of engines are not very sensitive on the ignition ability of the fuels.

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Steganalysis of various image steganography schemes based on Discrete Cosine Transform

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Abstract - Steganalysis is a method of finding covert information transmitted over a communication medium. In this paper, we present a novel blind steganalysis scheme that can reliably detect hidden data in JPEG images. This would enhance the reliability rate of steganalysis by identifying data in transform domain. This scheme is feature based for the matter that features that are reactive to any changes in embedding are being employed as an input for steganalysis. The features are extracted in DCT domain. DCT domain features have extended DCT features and Markovian features. The blind steganalysis technique has a wide range of evaluating different embedding techniques. The feature set is scrutinized by using two steganographic schemes F5 and PVD. These features are used to train the Support Vector Machine (SVM) classifier.

Keywords: *DCT Features, Markovian, Support Vector Machine.*

1.0 Introduction

The aim of steganalysis is to isolate suspected packages, decide whether a payload is embedded in them, and if possible, recover that payload. Steganalysis can be generally classified into Blind Steganalysis and Targeted Steganalysis. Targeted Steganalysis is considered for a specific steganographic algorithm. This technique is more robust since it has a better accuracy to detect when they used against a specific steganographic technique. Blind Steganalysis are schemes that are free of any specific embedding technique.

They can relieve the dearth of targeted analyzers by removing their dependency on the behavior of individual embedding techniques [2] [7]. These statistics, taken from both cover and stego images are used to train a classifier. This is subsequently used to distinguish between cover and stego images from a given set of test images [13] [14] [15]. In targeted schemes, the feature set is not a complete descriptor of covers. Its purpose is to merely detect specific embedding changes. The targeted scheme often uses a single feature. Blind steganalysis has two important components. These are feature extraction and feature classification. In feature extraction, a set of relevant statistics are extracted from a data set of images.

There is no preset rules to retrieve the statistics, but they are obtained by checking general image features that show potent disparity when there is an embedding [16].Feature classification operates in two modes. After feature extraction, the features are used to train a classifier. The trained classifier is then used to classify an input image as either a clean image or carrying a hidden message. This paper discuss on a feature based steganalytic technique that is used in the DCT domain to extract the basic 23 functional and classify the dataset according to these functional [17]. The feature set can be enlarged to about 274 features by merging both DCT and Markovian features. The paper is organized as follows. Steganalysis based on DCT features is discussed in Section 2. Section 3 provides the performance and experimental results. Finally, the discussion with conclusions is provided in Section 4.

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Stressor-related Pain among Outdoor Manual Workers: Assessment of Causal Factors with Decision Tree

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Abstract **-** Stressor is physical, psychological or social force that puts real or perceived demands on the body, emotions, mind, or spirit of an individual. A worker may suffer from Stressor Related Pain (SDP) when exposed to stressful events. This study used decision tree-based modelling technique to identify common work-attributes' influencing factors that can lead to SDP in outdoor tasks. Data was collected from 135 unskilled workers in 10 building construction sites located in Abeokuta, the Southwest Nigeria through questionnaire. Variables considered that played key roles in SDP were measured. All variables having association significantly ($p \leq 0.05$) to the reported SDP were noted with Chi-Square. The decision tree model, implemented in SPSS package, used CHAID method. The decision tree system predicted more than 74.3% cases correctly. With the risk estimate of 0.257 (Std. Error = 0.036), the prediction was only wrong for 25.7%. 'Lack of work control' was the best predictor identified. This was followed by 'poor provision of shade' and 'wrong method of working'. The author recommended a regular time away from work areas, integration of sun safety practices and ergonomics training on proper work-methods. These measures among others will reduce costs resulting from employees absenteeism and promote workers' productivity.

Keywords**: *Stress; unskilled workers; construction; decision; tree; model.***

1.0 Introduction

Work-related Stress is stress caused or made worse by work. Stress occurs when an individual perceives an imbalance between the demands placed on them to accomplish a task at a set time and their ability to cope. It is an adverse reaction by people to excessive pressure or other types of demand placed on them (Health and Safety Executive (2001). Stressor Related Pain (SDP) is one of the most common types of workplace health problems and its risk may be present in any workplace. According to Workplace Health & Safety QLD (2004), some common work elements that may increase stress include: working too hard or too fast and difficult targets, work that is monotonous and dull or does not utilise a worker's range of skills, working long hours or overtime, working through breaks, work that affect amount and quality of sleep, or make it difficult to balance work and family life.

Stress itself is not a disease. Infrequent exposures to low-level stressors are not likely to lead to harm. However when stressful situations go unresolved, the body is kept in a constant state of stimulation. This can result in physiological and/or psychological changes and illness. Continuous stress can cause physical illness (headaches, indigestion, tiredness, slow reactions, and shortness of breath), mental disorder (difficulty in decision-making, forgetfulness), emotional trouble (irritability, excess worrying, anxiety, anger), behavioural ailment (diminished performance, withdrawal behaviours, increase in alcohol). Common longer-term health issues linked to stress include cardiovascular disease, immune deficiency disorders, gastrointestinal disorders, psychiatric/psychological illness and musculoskeletal disorders (Workplace Health and Safety, 2017). Michie (2002) mentioned some factors in workplace that can increase SDP. These include lack of clear definition of role at work, over design of work beyond worker's ability, leadership problem at work, lack of control, lack of proper training, high work demands.

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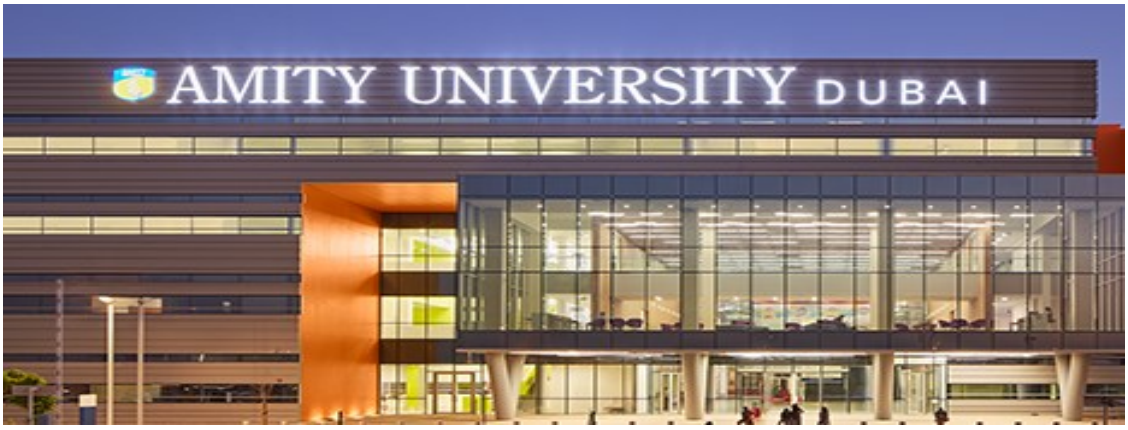

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