



PROCEEDING

14th Asian Chemical Congress 2011

CONTEMPORARY CHEMISTRY FOR SUSTAINABILITY AND ECONOMIC SUFFICIENCY

THE LARGEST CHEMICAL CONGRESS IN ASIA

5 – 8 September 2011

Bangkok, Thailand

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Dear Colleagues,

On behalf of the 14th Asian Chemical Congress (14ACC) Organizing Committee and The Chemical Society of Thailand (CST) under the patronage of Professor Dr. HRH Princess Chulabhorn, it is my great pleasure to extend a warm invitation to you to participate in 14ACC on 5-8 September, 2011 in Bangkok, Thailand, under the auspices of the Federation of Asian Chemical Societies (FACS).

Over the past 26 years, ACC has grown to be one of the major international conferences in chemistry. The 14ACC continues the Asian Chemical Congress (ACC) tradition of high-quality, broad international participation in all areas of Pure and Applied chemistry. Fortunately, the year 2011 has been announced to be the "International Year of Chemistry" by International Union of Pure and Applied Chemistry (IUPAC) and United Nations Educational, Scientific and Cultural Organization (UNESCO) aiming to place importance on and promote the chemical scientific works. In this occasion, the 14ACC is event more special than before, as to celebrate the "International Year of Chemistry".

The 14ACC provides unprecedented opportunities for participants to expand their scientific horizons. The theme of 14ACC, "Contemporary Chemistry for Sustainability and Economic Sufficiency", is particularly appropriate as chemistry and the chemical sciences are increasingly being turned to address global environmental, health, and energy challenges. The scientific program will include all traditional areas of chemistry and also offers outstanding content uniquely characterized by 6 leading universities in Thailand. Bringing together participants from across region and around the world, this landmark congress will provide a superb opportunity for conversation, collaboration, and networking. In addition to the wide variety of technical presentations, the congress exhibition will provide insights into the latest products and developments from number of companies and organizations.

Aside from the opportunities afforded by the congress sessions, you will also have the chance to experience a myriad of Thailand's tourist and cultural attractions that are exceptional and exotic. From classic sights to fabulous temples and palaces, to natural wonders as diverse as forested mountains and beautiful beaches and islands, from delicious culinary discoveries to fabulous shopping bargains, there is plenty that will leave you with fond memories of the Kingdom of Thailand and its warm and welcoming people.

We are looking forward to meeting you, your family, and colleagues at 14ACC in Bangkok. We hope that you will find the congress both enjoyable and valuable. We thank you in advance for participating and contributing to the success of the event.

With best wishes

A handwritten signature in black ink, appearing to read "Supawan Tantayanon", written over a light-colored background.

Assoc. Prof. Dr. Supawan Tantayanon
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PREPARATION, CHARACTERIZATION OF Ni-PVC COMPOSITE ELECTRODE AND APPLICATION TO ELECTRODEGRADATION OF METHYL BLUE IN SODIUM CHLORIDE SOLUTION

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Abstract

Preparation, characterization of Ni-PVC composite electrode and application to electrodegradation of methylen blue in sodium chloride solution has been done. Ni-PVC composite electrodes were prepared by mixing together 95% of Ni metal powder with 5% PVC. PVC was used as a binder and tetrahydrofuran (THF) was used as a solvent in composite material preparation. The surface characterizations of the Ni-PVC using SEM and Cyclic voltammetry experiments for Electrochemical Tests were performed in a three electrodes system using Ni-PVC pellets as a working electrode (anode), saturated calomel electrode (SCE) as reference electrode and platinum wire as the counter electrode. Electrodegradation of 20 ppm of methylen blue in 0.1 M NaCl (50 mL) were carried out using potential 7 Volt for 15 minute with continuous stirring. Electrodegradation result obtained was analyzed using Spectrophotometer UV-Vis at wavelength 200-800 nm. The characterization result shows that the Ni-PVC composition electrode have surface was very rough, irregular and having porous characteristic and higher current density. Ni-PVC composite electrode very good material for electrodegradation of methylen blue in sodium chloride solution.

Keywords: Composite electrode, electrodegradation, methylen blue, sodium chloride.

INTRODUCTION

Most dyes used in the pigmentation of batik, textiles, paper, leather, ceramics, cosmetics, inks and food-processing products are derived from azo dyes, which are characterised by the presence of one or more azo groups ($-N=N-$) in their structure. Approximately 15% of the dyes produced worldwide are lost within waste water during synthesis and processing. This waste represents a great hazard to human and environmental health due to the toxicity of azo dyes. Rapid progress in industrial activities during recent years has led to the discharge of unprecedented amount of wastewater containing synthetic dyes, which pollutes the rivers and consequently causes harm to human and other living organism. These dyes or their breakdown products are toxic to living organisms. Furthermore, dyes in wastewater are difficult to remove because they are stable to light, heat and oxidizing agents. In short, they are not easily degradable.

Color is one of the most obvious indicators of water pollution and the discharge of highly colored effluents containing dyes can be damaging to the receiving bodies. Of these, textile effluents typically have strong color due to unfixed dyes, as well as they are biorecalcitrant due to the presence of various auxiliary chemicals such as surfactants, fixation agents, bleaching agents, etc. The degree of dye fixation to fabrics depends on the fiber, depth of shade and mode of application and, depending on the dye, 2–50% of unfixed dye can enter the waste stream [1]. Reactive dyes are usually found at relatively high concentrations in wastewaters due to their low fixation especially to fibers such as cotton and viscose. Dye molecules often receive the largest attention due to their color, as well as the toxicity of some of the raw materials used to synthesize dyes (e.g. certain aromatic amines), although dyes are often not the largest contributor to the textile wastewater. Dyes concentration in effluents is usually lower than any other chemical found in these wastewaters, but due to their strong color they are visible even at very low concentrations, thus causing serious aesthetic problems in wastewater disposal. Colored wastewater caused serious environmental problems in various locations [1,2,3,4,5,6].

Textile industries consume large volumes of water and chemicals in wet processing of textiles. The chemical products used are very diverse in composition, from inorganic compounds to polymers and other organic products. In general, the final textile waste effluent can be broadly categorized into three types of wastewater according to their COD content [2].

The presence of dyes in textile effluents is also common and highly visible. Depending on the type of dyestuff used, the color of the wastewater can change from day to day, or even several times a day because the dyestuff used in the dyeing process changes frequently due to customer's requirements. The large pH swing in the textile wastewater (can change from 2 to over 12) is another strong negative point. This variation is primarily caused by different kinds of dyestuff used in the dyeing process. As most dyes usually occur at low concentrations, it may be presumed that removing it from wastewater is not particularly difficult. However, due to their chemical structure, such as acidic, basic, disperse, azo, diazo, anthraquinone based, dyes are resistant to fading on exposure to light, water or chemical compounds action. Anthraquinone based dyes are most resistant to degradation due to the fused aromatic ring structure [2].

Textile dye processes are among the major industrial water users; in many areas, this industry has the wastes most difficult to treat satisfactorily. Textile dye wastewater is well known to contain strong color, high pH, temperature and COD and low biodegradability especially the effluent from the dyeing stages of the dyeing and finishing process. The removal of dyes (color) is therefore a challenge to both the textile industry and the wastewater-treatment facilities that must treat it [3].

Therefore, methods for decolorization of textile effluents have received considerable attention in recent years. Chemical precipitation, adsorption on activated carbon and natural adsorbents, as well as several advanced oxidation processes have been employed for the treatment of textile effluents. Of the latter, ozonation, photocatalytic oxidation, Fenton and photo-Fenton oxidation, ultraviolet (UV) irradiation and electrochemical oxidation have been reported in the literature as effective means for the treatment of synthetic and actual textile effluents [1,3,6].

Different methods are commonly used to remove colour from textile wastewater: chemical, physical and biological. Because of the large variability of the composition of textile wastewaters, most of these traditional methods are becoming inadequate. It has been shown to be quite effective in decolorizing textile wastewater; however, the cost of ozonation for such purposes needs to be further ascertained to insure the competitiveness of this method [3,6]. Biological methods are generally cheap and simple to apply and have been applied to remove organics and colour of textile wastewater. But the refractory pollutants caused by textiles industries cannot easily be degraded by traditional biological process and remain in the effluent. Conventional aerobic biological process cannot readily treat textile wastewater because most commercial dyes are toxic to the organisms used. So, a physical/chemical method must be used [2].

Electrochemical oxidation is a relatively new technique, developed in the 90's. It's an effective method for colour removal; there is little or no consumption of chemicals, no sludge production and degradation of recalcitrant pollutants can be achieved, including polyaromatic organic compounds, like anthraquinone-based compounds. It is considered as one of the advanced oxidation processes, potentially a powerful method of pollution control, offering high removal efficiencies [2,5,7].

Electrochemical technologies such as electrooxidation, electrocoagulation and electroflotation have been widely used in water and wastewater treatment and several applications have been recently reviewed elsewhere. Electrooxidation over anodes made of graphite, Pt, TiO₂, IrO₂, PbO₂, several Ti-based alloys and, more recently, boron-doped diamond electrodes in the presence of a supporting electrolyte (typically NaCl) has been employed for the decontamination of various industrial effluents [1].

In recent years there has been increasing interest in the use of electrochemical methods for the treatment of wastewaters. The organic and toxic pollutants present in treated wastewaters such as dyes and phenols are usually destroyed by a direct anodic process or by an indirect anodic oxidation via the production of oxidants such as hydroxyl radicals, ozone, etc. Electrochemical methods have been successfully applied in the purification of several industrial wastewaters as well as landfill leachate [3].

Electrochemical methods represent the very method good to decolorization textile dyes wastewater. The oxide process or electrooxidation represent the appropriate

process, because organic compounds will be oxidized to become the gas of CO_2 and H_2O . Efficacy process the oxide electrochemical oxidation very determined by type of substance anode, stability, reactivity and electrocatalytics [4]. So that nowadays not yet there is study of use of bimetallic composite electrode for the anode of in course of decolorization textile dyes. Bimetallic composite electrodes have high porosity and the existence of the two metals will cause synergistic effect. Bimetallic composite electrode which exhibit better catalytic activity compared to monometallic composite electrode [8-10]. Researcher has success full in design electrode metallic composite electrode like Ni-PVC electrode [11-12]. Objective in this research is decolorization textile dyes wastewater by electrochemical oxidation using Ni-PVC composite electrode.

Electrocatalytic activity of these materials strongly depends on their morphology, surface area and structure, which in turn depend on the preparation methods. One of the techniques of making the porous electrode is by incorporating polymer material like polyvinyl chloride (PVC) with the powder of respected metals [13-17]. Cobalt and nickel, being transition elements, with their electronic layer d incomplete, have shown good electrocatalytic properties for the electrooxidation of ethanol in alkaline solution.

The objective of this research is to investigate the decolorization of batik and textile dyes wastewater by electrochemical oxidation technique using Ni-PVC composite electrodes. Metallic composite electrodes have high. Researcher has success full in design electrode metallic composite electrode like Ni-PVC electrode.

EXPERIMENTAL SECTION

Preparation of Ni-PVC composite electrodes

Ni-PVC electrode was prepared by mixing a weighed portion of Ni powder (< 2 micron in size and 99.9% purity, Aldrich Chemical Company), and PVC in 4 ml tetrahydrofuran (THF) solvent and swirled flatly to homogeneous followed by drying in an oven at 100°C for 3 hours. The mixture was placed in 1 cm diameter stainless steel mould and pressed at 10 ton/cm^2 . A typical pellet contained approximately different amount of Ni powder, and approximately 5% of PVC polymer. The total weighed of pellet obtained is approximately 1.5 g.

Characterization of electrode

Direct observations of the powder and microstructure of electrode were made by scanning electron microscopy (SEM). The aggregates sizes and the standard deviations were estimated by laser size distribution analyzer.

Electrochemical behaviors of electrode by cyclic voltammetry

Universal Pula Dynamic EIS, Voltammetry, Voltalab potentiostat (Model PGZ 402) was used for electrochemical behavior measurements, data acquisition was accomplished using the Voltamaster 4 software. Cyclic voltammetry experiments were performed in a three electrodes system using Ni-PVC as a working electrode

(anode), an SCE as reference electrode and platinum wire as the counter electrode. All potentials given are with respect to the SCE reference electrode.

Electrochemical oxidation of batik and textile dyes wastewater

The electrolysis process of MB was performed in a solution of NaCl at room temperature. The electrochemical studies by cyclic voltammetry (CV) and electrochemical oxidation of textile dyes wastewater by potentiostatic (chronocoulometry) method were performed in 25 mL capacity glass electrochemical cell.

Analysis product electrochemical oxidation

The qualitative analysis product electrochemical oxidation of MB using spectrophotometer UV-Vis. All experiments were carried out at room temperature. The 5 mM H_2SO_4 were used as mobile phase throughout.

RESULT AND DUSCUSSION

Optimizations of electrochemical oxidation variables

Optimizations of variables electrochemical oxidation like potential, time electrolysis, agitation and temperature. Fig. 1 shown schematic diagram reactor for electrochemical experimental waste water batik and textile.

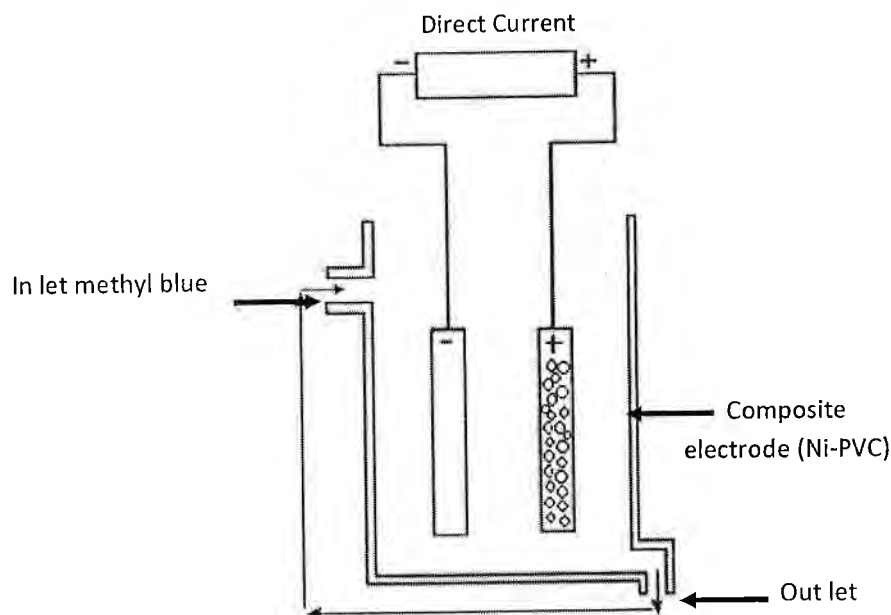


Figure 1. Schematic diagram reactor for electrochemical experimental waste water batik and textile

SEM micrograph at Fig. 2A and 2B shown in electrodes surface were very rough, irregular and having porous characteristic. It has been reported that electrode prepared using powdered metal-PVC yielded electrode have surface which is very rough, irregular, and formed a lamellar orientated particles. The picture shown in Fig. 2B and 2C indicates that the surface and cross section morphology is highly heterogeneous and composed of aggregates of nickel particles separated by gaps of PVC and voids between aggregate of nickel. Fig. 2C shows cyclic voltammogram using Ni composite electrode in 1.0 M KOH (Ni-PVC composite electrodes) in 1.0 M KOH. Ni-PVC composite electrode is good stability for electrochemical oxidation in KOH solution.

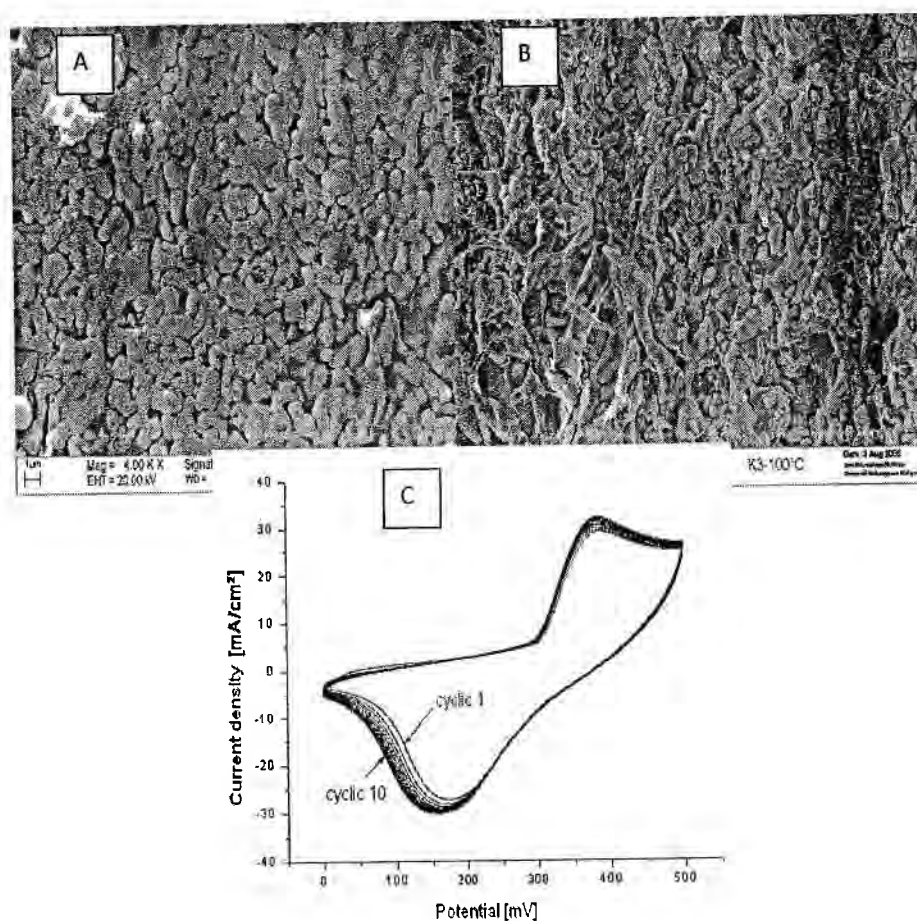


Figure 2. Physical characterization of Ni-PVC material used scanning electron microscopic images (magnification x4000) at (A) surface (B) cross section and (C) cyclic voltammograms in 1.0 M KOH, scan rate 10 mV/sec

Prior to the electrolysis on the actual waste batik done electrolysis of methyl blue (MB) as a comparison. MB degradation with electrolysis can be determined by comparing the spectra before and after electrolysis in the same condition. Fig 3 shown is results before and after electrolysis of MB.

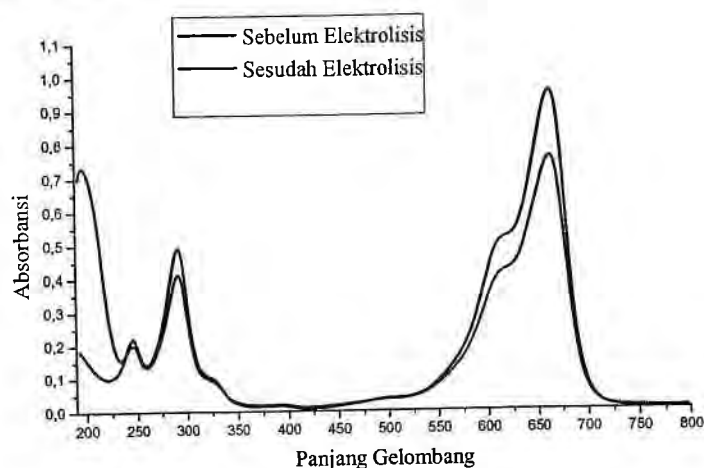


Figure 3. Spectral analysis of 10 ppm MB between before and after electrolysis for 2 hours at a potential of 2.0 V (without NaCl)

Fig. 4 shows the comparison of spectra of MB between before and after the electrolysis for 2 hours. From these images, it appears that there has been a decrease in absorbance of methylene blue compound after the electrolysis. It is seen in the figure that the compound methylene blue prior to electrolysis with a concentration of 10 ppm has absorbance 0.952 and after the electrolysis for 2 h with a voltage of 2 volts was dropped to 0.757 absorbance. From the absorbance values shown can be calculated per cent of the methylene blue compound that is 79.51% degraded.

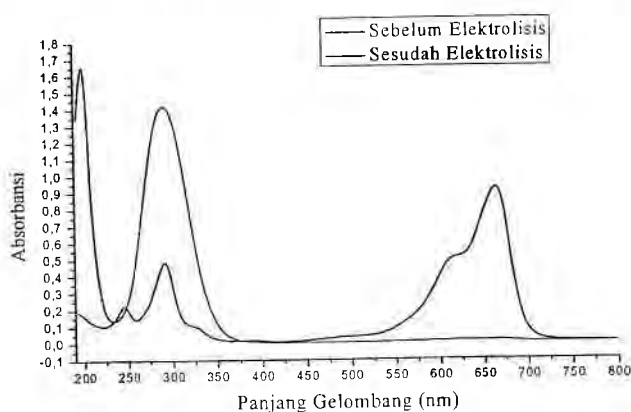


Figure 4. Spectral analysis of 10 ppm MB between before and after electrolysis for 15 minutes with the addition of 0.5 g of NaCl

Electrolysis is done by the addition of 0.5 g NaCl and 7.5 Volt voltage in order to determine the optimum concentration of NaCl was added to the solution. The time required for the electrolysis until the solution became clear that for 15 minutes and the results are shown in Figure 4.

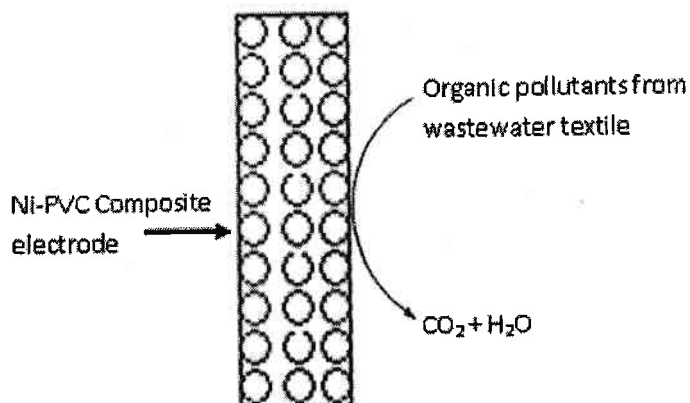


Figure. 5 Mechanism oxidation of organic pollutant on surface Ni-PVC composite electrode

On the Ni-PVC electrode, MB is oxidized to CO_2 and H_2O . Most of MB is oxidized to H_2O . The reaction of organic compounds with the nickel-PVC of higher valency is usually the rate-determining step [18-20]. The other mechanisms that have been suggested for the electrooxidation of MB on Ni electrode surface are as follows Fig. 5.

CONCLUSIONS

Ni-PVC composition electrode have surface was very rough, irregular and having porous characteristic and higher current density. Ni-PVC composite electrode is very good material for electrodegradation of methylen blue in sodium chloride solution.

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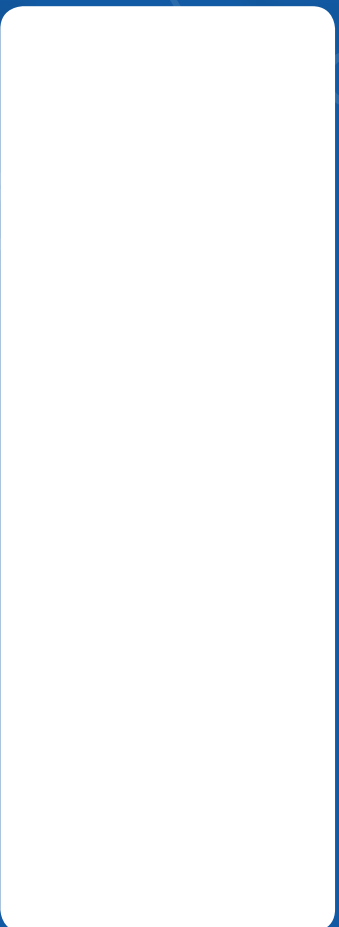
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