UNIVERSITI TEKNOLOGI MARA

MAGNETIC NANOPARTICLE (MNPS) FOR REMOVAL OF DYES IN AQUEOUS SOLUTION

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In the name of Allah, The Most Gracious, The Most Merciful.

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TABLE OF CONTENT

ABSTRACT

Methylene blue solution is a thiazine dye that is commonly used in medicine, textile, paper and other industries. When methylene blue is irresponsibly deposited in water bodies, the dye can act as a contaminant as small concentrations are able to cause surface water to be cloudy, decreasing ability of aquatic plants to photosynthesize due to limited sunlight. This will eventually affect the entire aquatic ecosystem from disruption of producers in the food chain. For humans, contamination of methylene blue stems from its carcinogenic properties but can also cause in cyanosis, shock, gastritis, jaundice, methemoglobinemia, tissue necrosis, elevated heart rate, premature cell death in tissues, and irritation of the skin and eyes. Thus, functionalized magnetic nanoparticle with thymol (MNP@thymol) and menthol (MNP@menthol), was synthesised to filter methylene blue solution via co-precipitation method. Research also aimed to characterized MNPs, conduct batch adsorption study for three factors and tested for two adsorption isotherms. Results showed synthesised MNPs that were characterized by Fourier Transform Infrared Spectroscopy (FTIR). exhibited presence of hydroxyl group detected at 3350 cm^{-1} to prove functionalization of MNP to thymol and bands at 3510 cm^{-1} to prove functionalization of MNP to menthol. Then, batch adsorption study was carried out for pH, contact time and dosage. Optimum conditions for MNP@thymol were dosage of (0.5g), pH5 and contact time of 60 minutes while MNP@menthols' were dosage (0.5g), pH8 and contact time of 60 minutes. Functionalized MNPs both suited the Langmuir adsorption isotherm.

Keywords: *methylene blue, magnetic nanoparticle, batch adsorption study, menthol, thymol*

CHAPTER 1

INTRODUCTION

1.1 Background of study

Magnetic elements such as nickel, cobalt, iron and some alloys such as ferrite can be used to synthesise magnetic nanoparticles (MNPs). Magnetic nanoparticles have garnered considerable attention due to their small molecular size and their broad application in many industrial and biomedical processes in their normal or bare-naked form or in coated surfactants of functional groups for specialised applications. The most studied magnetic nanoparticles are ferrite nanoparticles, which can be considerably enhanced by clustering a number of individual superparamagnetic nanoparticles to form magnetic beads.

Magnetic nanoparticles can selectively form bonds to functional molecules, allowing them to be transported to a specific area using an electromagnet or permanent magnet. Surface coating may be necessary to prevent particle agglomeration and decrease particle contact with the system environment. This inherent selective property of MNPs is also the reason why they have become preferred in biomedical fields where they are classified under therapeutic and analytical applications. Examples are MNPs can be used to transfer drugs to cells in cancer therapy, provide detection of pathogenic bacteria to kill and become contrasted agents in biomedical imaging (Mirza et al., 2020). Surfactants, silica, silicones, and phosphoric acid derivatives are frequently used to modify the surface of ferrite nanoparticles to improve their stability in solution. Coated magnetic nanoparticles have a long history of usage in medicine, including cell isolation, immunoassay, diagnostic testing, and medication delivery.