UNIVERSITI TEKNOLOGI MARA

COAGULATION – FLOCCULATION MECHANISM OF *HYLOCEREUS UNDATUS* FOLIAGE IN WASTEWATER TREATMENT

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ABSTRACT

The floc particles formed during perikinetic and orthokinetic flocculation from molecular point of view was investigated and the effect of pH on zeta potential during coagulation flocculation process of wastewater using *hylocereus undatus* foliage was determined. Dragon fruit foliage is known to carry the characteristics of a natural coagulant. However, no previous study is carried out to unlock the fundamental theory behind the coagulation – flocculation mechanism in the application of *hylocereus undatus* foliage as a plant-based coagulant. Hence, this study was conducted without the addition of any synthetic coagulants and zeta potential was used as parameter in observing magnitude charges between particles. Jar test experiments were done using pharmaceutical wastewater and *hylocereus undatus* foliage as coagulant with different range of pH and analytical analysis was performed. Through FTIR spectroscopy, it was found that the functional groups of aliphatic primary amines, secondary amines and carboxylic acids, which are among protein-specific groups, were accountable for good coagulation activity. The zeta potential of dragon fruit foliage was found to be +0.433 mV indicating it to be a cationic coagulant. The mechanism of coagulation process is suggested to be charge neutralization and absorption since the zeta potential of wastewater was initially -7.72 mV but increased to -2.65 mV at optimum pH 3. Moreover, as the pH increases the zeta potential becomes more negative due to the dominant adsorption of OH^- in alkaline pH conditions.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Wastewater treatments have widely adopted the coagulation and flocculation methods, which are effectively proven in removing the colloidal particles that exist in wastewater (Ismail, Mahiddin, & Praveena, 2018). Coagulants that are commonly used in treating wastewater are inorganic or synthetically produced polymers. Its function is to remove chemical species that dissolved in wastewater and its turbidity (Idris, Som, Musa, Ku Hamid, Husen, & Mohd Rodhi, 2013; Som, Idris, & Hamid, 2007). Coagulants are also materials that act as advocates for aggregation of suspended particles in a solution that is followed by sedimentation (Nharingo, Zivurawa, & Guyo, 2015).

To date, most industries apply chemical-based coagulants in treating wastewater, for instance, aluminium sulphate, ferric chloride and poly-aluminium chloride (PAC). The most common chemical coagulant used in industries for wastewater treatment is aluminium sulphate that is usually called alum (Daud, Ghazi, & Ahamad, 2014). The application of alum in the treatment is wide because it is low cost compared to other chemical-based coagulants, high efficiency in water treatment, easily attainable and easy to handle (Idris, Rajab, Norshahid, & Lamin, 2013; Kopytko, Rueda, & Rincón, 2014).

However, previous research has found many disadvantages associated with the use of chemical-based coagulants in treating wastewater. Few of its disadvantages among others namely; ineffective in low temperature conditions, pH of treated water changes, large formation of chemical sludge in scheduled waste and high cost due to the acquisition of chemical-based coagulants. Moreover, inorganic coagulants can only operate within a limited range of pH in wastewater. The coagulants also sometimes form acidic salts that could eventually lead to pH recession in the wastewater stream. In addition, prolonged exposure and consumption of water with high content of residual aluminium may induce Alzheimer's (Md Som & Abd Wahab, 2018).