APPLICATION OF COPPERAS AND SAGO STARCH IN DOMESTIC WASTEWATER TREATMENT BY COAGULATION FLOCCULATION PROCESS

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by

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LIST OF ABBREVIATIONS

WHO	World Health Organisation
APHA	American Public Health Association
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
SEM-EDX	Scanning Electron Microscopy and Energy Dispersive X-ray
FTIR	Fourier Transform Infrared
IEP	Isoelectro Static Point
pH	pondus Hidrogen
RPM	Rotation Per Minute
TKN	Total Kjehdahl Nitrogen
TOC	Total Organic Carbon
CPP	Copperas
AFS	Analytical Ferrous Sulfate
SG	Sago starch

APLIKASI KOPERAS DAN KANJI SAGU DALAM OLAHAN AIR SISA DOMESTIK SECARA PROSES PENGGUMPALAN DAN PENGGELOMPOKAN

ABSTRAK

Olahan air sisa domestik secara konvensional melibatkan pelbagai proses seperti proses secara fizikal, kimia dan biologi. Penggumpalan dan pengelompokan adalah salah satu kaedah yang biasanya digunakan dalam olahan air dan air sisa. Koperas (CPP) dan kanji sagu (SG) sebagai bahan penggumpal dikaji dalam penyelidikan ini. CPP yang digunakan merupakan bahan sampingan yang terhasil dari salah sebuah kilang pemprosesan ilmenite di Malaysia. Sebelum ini ia hanya dibuang di tapak pelupusan tanpa olahan. Ciri-ciri serta potensi CPP diuji dalam olahan air sisa domestik dan keputusannya dibandingkan dengan ferum sulfat analitikal (AFS). SG adalah kanji komersial yang sering digunakan dalam industri pembuatan makanan, bioteknologi dan kosmetik. Kegunaannya dalam olahan air sisa domestik belum pernah lagi diuji setakat ini. Air sisa domestik yang digunakan dalam kajian ini diperoleh daripada Loji Olahan Air sisa Berpusat (JRSTP) yang terletak di Juru, Pulau Pinang, Malaysia. Proses pesampelan dilakukan selama setahun iaitu dari April 2014 hingga April 2015. Sampel air sisa didapati mengandungi kandungan keperluan oksigen kimia (COD), kekeruhan, pepejal terampai, ammonia dan warna yang agak tinggi. Dalam kajian ini, kedua-dua bahan penggumpal (CPP dan SG) telah diuji menggunakan kaedah ujian jar standard. Keadaan optimum bagi eksperimen melibatkan CPP adalah pada pH 9, kepekatan 150 mg/L dengan aplikasi 1 min untuk pengadukan laju (100 rpm), 20 min pengadukan perlahan (60 rpm) dan 18 min untuk masa enapan. Untuk ujian menggunakan SG, keadaan optimum berlaku pada pH 7, kepekatan 2000 mg/L dengan aplikasi 1 min pengadukan laju (100 rpm),

30 min untuk pengadukan perlahan (20 rpm) dan 18 min masa enapan. Hasil kajian menunjukkan bahawa koperas berjaya mengurangkan 88% kekeruhan, 79% warna, 92% pepejal terampai, 83% keperluan oksigen kimia, 98% fosforus, 24% ammonia serta 44% Kjeldahl Nitrogen Jumlah. Manakala untuk AFS, 83% kekeruhan, 82% warna, 95% pepejal terampai, 79% keperluan oksigen kimia, 99% fosforus, 16% ammonia dan 12% jumlah Kjehdahl Nitrogen Jumlah. Olahan menggunakan SG pula mencatatkan penyingkiran 82% kekeruhan, 71% warna, 82% pepejal terampai, 73% keperluan oksigen kimia, 57% fosforus, 38% jumlah Kjeldahl Nitrogen Jumlah dan 6% ammonia. Dapat disimpulkan melalui kajian ini bahawa CPP, AFS serta SG mempunyai potensi besar dalam mengolah air sisa domestik.

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ABSTRACT

Conventional treatment of domestic wastewater involves various processes which include physical, chemical and biological method. Coagulation and flocculation is one of the methods normally applied for water and wastewater treatment. In this study, copperas (CPP) and sago starch (SG) were used as coagulant. CPP used is a by-product of one of an ilmenite processing factories in Malaysia. Previously, it has been dumped in the landfill, untreated. The characteristics and its potential in treating domestic wastewater were investigated and the performances were compared with analytical ferrous sulfate (AFS). SG is a common starch commercially available. It has been used in food, biotechnology and cosmetic industries. Its usage as coagulant in domestic wastewater treatment has not been investigated to date. The domestic wastewater used in this research was collected from Juru Regional Sewage Treatment Plant (JRSTP) at Juru, Penang, Malaysia. Sampling process was conducted for one year (April 2014 to April 2015). The raw sample contains high concentration of COD, turbidity, suspended solids, ammoniacal nitrogen and colour. In this study, both coagulants (CPP and SG) were examined in standard jar test method. The optimum experimental conditions for CPP was pH 9, 150 mg/L of dosage with 1 min of rapid mixing (100 rpm), 20 mins of slow mixing (60 rpm) and 18 mins of settling. For test using SG, the optimum conditions occurred at pH 7, 2000 mg/L of dosage with 1 min of rapid mixing (100 rpm), 30 mins of slow mixing (20 rpm) and 18 mins of settling. It was found that, CPP removed 88% of turbidity, 79% of colour, 92% of suspended solids, 83% of COD, 98% of phosphorus, 24% of

ammonia and 44% of TKN. On the other hand, AFS removed 83% of turbidity, 82% of colour, 95% of suspended solids, 79% of COD, 99% of phosphorus, 16% of ammonia and 12% of TKN. Besides that, the treatment using SG obtained the removal of 82% of turbidity, 71% of colour, 82% of suspended solids, 73% of COD, 57% of phosphorus, 38% of TKN and 6% of ammonia. As a conclusion, CPP, AFS and SG have good potential to be used as coagulant in domestic wastewater treatment.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Uncontrolled discharge of domestic and industrial wastewaters into the environment causes severe pollution problems such as eutrophication or oxygen depletion in receiving water bodies and toxicity to aquatic organisms which makes wastewater treatment mandatory (Cai et. al., 2013; Moharram et al., 2015). Almost 2.5 billion people stay in developing countries have lacked access to a basic sanitation system nowadays. Hence, more than 40% population in the world dumps their wastewater improperly in watercourses (WHO, 2012). This improper dumping generates environmental problems that directly affect public health and increases the cost water treatment for public supply (Von Sperling, 2005; Wang et al., 2007). Domestic wastewater consists of nutrients, organic matter and other chemicals such as PAHs and phthalates (Huang et al, 2010). Thus, the untreated wastewater can lead to spreading of disease in the form of several types of endemic and epidemic illnesses (Ahmad et al., 2008).

Currently, there are many types of wastewater treatment which can be applied ranging from modest, low priced and less efficient processes to very advanced, highly efficient and pricey operations. The factors influence the selection of the treatment applied are the local area circumstances, such as climate and the weather, social attributes, economy, availability of enforceable standards, availability of land and power, demanded operation skills and its availability, monitoring actions,