UNIVERSITI TEKNOLOGI MARA

STORMWATER PURIFICATION THROUGH PROGRESSIVE FREEZE CONCENTRATION: EFFECT OF COOLANT TEMPERATURE AND OPERATION TIME

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ABSTRACT

The scarcity of clean water due to industrialization, the growth of the population, urbanization and the climate changes was becoming a concern for the world. There are several methods that were usually used to purify water by the industries such as reverse osmosis (RO) and evaporation. However, these methods have several flaws and Progressive Freeze Concentration (PFC) was introduced as a better method. In previous researches, it stated that PFC has low energy consumption compared to evaporation method. It also has lower capital cost and maintenance fees compared to reverse osmosis. Therefore, PFC was introduced in this research as an alternative method to purify the stormwater The objectives of this research were to investigate the effect of operation time on K value and water recovery and to study the effect of coolant temperature on K value and water recovery. The experiment was conducted with simulated stormwater as raw material. Coolant bath, stirrer, motor and crystallizer were gathered to form the PFC system. The experiment was conducted by varying the studied operating condition such as coolant temperature and operation time while other operating conditions such as initial concentration and speed rotation were kept constant. The required data were measured, collected and calculated for evaluation of K value, water recovery and efficiency. As the result, it was found that the best operation time is at 20 minutes with K value, water recovery percentage and the efficiency percentage of 0.1329, 23.8% and 88.27%, respectively. Meanwhile, the best coolant temperature is -10°C with of K value, water recovery percentage and the efficiency percentage of 0.1829, 34.7% and 88.3% respectively.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

It's been 60 years since the Independence Day, Malaysia has becoming more and more developed to achieve improvement. In the process to achieve the advancement, Malaysia also faced lots of crisis including the water crisis. Water scarcity is one of hot issues occurs in Malaysia. According to Chan (2009), more than 95% of the population were served by the water for 24 hours. However, the improvement is still needed in some areas. On February 2012, the resident of Rompin, Pahang experienced the shortage of clean water supply due to the flash flood and the clean water appeal was ignored ("Air Tercemar Punca Derita ,2012"). The residents had to use river water as their water supply but the river water was already polluted by the flash flood. As a result, some residents were infected by scabies.

Although Malaysia is one of the countries that has high rainfall rates, it still faced the scarcity of clean water due to the population growth, industrialization, urbanization and climate changes ("Quest to Solve Water Scarcity", n.d.). Some areas in Malaysia has high tendency to be hit by natural disaster every year and due to the disaster, the areas high probably will face water disruption. The disruption of water will cause the residents to lose clean water supply and urge the residents to use any source of water for daily uses. The water used may be contaminated by bacteria, viruses and chemical waste which later could risk the health of the residents.

Department of Irrigation and Drainage Malaysia prepared the Urban Stormwater Management Manual for Malaysia to manage the stormwater in a more environmentally approach instead of just draining it away(Zakaria et al., 2004). This manual proposed the purification, infiltration and utilizes retention/detention of stormwater. This manual also considers the stormwater that was collected from river pollution, hill development, flash flood, and soil erosion. The stormwater management is needed in Malaysia to avoid the increases of flash flood incidence due to the poor drainage system. The usual technologies