# UNIVERSITI TEKNOLOGI MARA

# OPTIMIZATION OF STORMWATER PURIFICATION: COOLANT TEMPERATURE AND OPERATION TIME

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# ABSTRACT

Shortage and lack of sources of clean water is a big issue nowadays. This problem happens because of the increment of population. New sources of water need to be discovered. Therefore, the sources of water must be explored in order to get continuously supply of pure water. One of the ways to get pure water is by purifying the storm water. The method used to purify storm water in this research is by using progressive freeze concentration, PFC. This process produces ice crystal block that contain pure water through cooling process. This method has been chosen because it is a simple process that leads to low cost compared to other method. However, in order to obtain the high quality and quantity of pure water, it is important to determine the optimum condition for the system. Therefore, this research aims to investigate the optimum condition for coolant temperature and operation time. The objectives of this research are to investigate the optimum condition for coolant temperature and operation time for storm water purification through PFC system and to study interaction between coolant temperature and operation time. This research was conducted by using simulated stormwater. The simulated stormwater was performed by using zinc chloride and water. Besides that, the efficiency of the system was determined by using effective partition constant (K) and concentration efficiency (Eff). To run this experiment, the range of coolant temperature is between -6°C to -10°C while for operation time is between 10 minutes to 50 minutes. The optimization for this system was analysed by using research surface methodology (RSM) and the type of chemical composition that was investigated is composition of zinc. From this experiment, the result shows that the $R^2$ for generated model using Statistica Software is 0.97. This shows that the regression model is best fit to the data. For optimum condition, the result shows that at -8.9$^{o}$C for coolant temperature and 41 minutes for operation time is the best optimum condition in order to get the best quality of pure water. The best value of K and Eff resulting from this optimum condition are 0.1096 and 89.0235, respectively.

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Lastly, I really hope that this research can be useful in the future and make a better improvement in our environment. Alhamdulillah.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Research Background

The world population in 20th century are tripled but the water consumption is six times higher than amount of people. Most of the water is used for drinking, bathing, cooking, cleaning, and watering plants. Besides that, industrial usage is also very high such as for cooling process to produce electricity. Water is also use to sustain the environment and needed to produce food and fibre such as meats, fruits, cotton and many more. Its bring a lot of benefits to human when the water supply is enough such as thousand illness can be prevented because of the good sanitary and hygiene, the food production become more intense and people become more healthy (Coghlan et al., 2003).

World's water resources are having imbalanced distribution in time and space. The management will redistribute water to place where people need it and used it. However, there are many signals that warn the world that water supply is in critical condition. This problem might lead to damaging the ecosystem and people in urban area getting less water. These shortages of water usually happen because of the human itself. This is because water service is being subsidised by government which is done to care of people welfare. However, users do not grateful, not value water and keeps wasting it. Therefore, this kind of attitude needs to be change in order to save the world (Coghlan et al., 2003).

One of the ways to solve this problem is by finding other resources of water which is by purifying storm water. Other than storm water, sea water also can be used as water resources. But this storm water is rarely used as water resources. There are storm water management that control the flow of this water. Storm water management is very crucial because it can avoid damage to property and human from flooding, preserve the ecosystem and as our water resources. This water can be used as ground water recharge and flood protection (Taylor, 2014). When flood happen, people in that area will having shortages of clean water supply. By doing this purification process,