UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

MODELLING OF CHLORINE RESIDUAL FOR DRINKING WATER USING PARALLEL FIRST ORDER MODEL

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ABSTRACT

Setting the right amount of initial chlorine is important because if it is too low, the bacteria in the water will regrowth but if it too high it can increase the carcinogenic effect. So, the water treatment company need to follow the World Health Organization(WHO) guideline to avoid this problem. In this study, the rate of chlorine decay, time taken for the chlorine to achieve minimum level and predictive chlorine residual are determined using the parallel first order model. The parallel first order decay model is model was first develop from first order decay model which consist of two different reaction rate (Haas & Karra, 1984). The data used in this project is the secondary data collected from Sungai Dua Treatment Plant Outlet, Penang. Chlorine residual data that was taken every day from five monitoring points. The reaction rate was obtained where the rate for fast reaction and slow reaction are 0.0108 and 0.0082 respectively. The predictive chlorine concentration formula for parallel first order is $C(t) = 1.86e^{-0.0108t}(0.692) + 1.86e^{-0.0082t}(0.308)$. Time taken for the chlorine to reach minimum level was obtained and the value is 227 hours. Thus, from the result obtain, it shows that mathematical modelling can be used to help in predicting and forecasting the chlorine concentration to ensure the quality of water distributed that compliance the guideline by WHO.

1 INTRODUCTION

1.1 Introduction

Good quality of drinking water is essential to public health. Untreated water may contain bacteria and microorganisms that can be risky to people's health. Thus, in order to prevent water-borne epidemics, the usage of the hygienic process in the treatment process is important (Kim et al., 2014).

World Health Organization, WHO (2008) stated that every year, there are millions of people suffered as a result of water-borne disease. It is estimated that around 4000 children in Africa and Asia die each day as a result of that disease by consuming unsafe drinking water.

It is important to study the quality of water in water distribution system to ensure a good quality of water is being delivered to the consumer (Munavalli & Kumar, 2005). As the water moves in the distribution system, the water quality tends to decline (Kim et al., 2014). To ensure the drinking water is safe for public use, the drinking water company need to disinfect the drinking water. Disinfection is the water treatments process that being carried out to kill these microorganism and other harmful bacteria.

According to Castro & Neves (2003), there are three types of disinfection methods which are UV radiation, ozonation and by chlorination. Chlorination is one of the most widely used method for disinfection. In Malaysia, chlorine has been used as water disinfectant since 1915 and it is still being used until now. It is because chlorine is cheap, easy to use and monitor and effective in killing bacteria (Gibbs et al., 2006). Besides that, chlorine disinfection also has the benefit to stays in the distribution system for quite long time (Hua et al., 1999). Compared to disinfection by UV radiation and ozonation, even though both techniques are also efficient in disinfecting, but they do not long-lasting and more expensive.

According to Al-Jasser (2007), as the chlorine travels through the distribution system, the chlorine concentration will decrease due to reaction with substances in water, non-organic ma-