UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

MODELLING OF CHLORINE DECAY RATES BASED ON INITIAL CHLORINE AND REACTANT CONCENTRATIONS IN THE WATER DISTRIBUTION SYSTEM

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

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ABSTRACT

Chlorination is one of the method that can be used to disinfect water. Chlorination is important to maintain the water quality in distribution system through a chlorine residual. Chlorine decay in bulk water need to be described clearly to understand the decay characteristics. Second order model for modelling reaction rate variation with respect to initial chlorine concentration was found to be one of the most suitable model for this purpose. This model is developed following a first order reaction. The model is used to determine the rate of variation bulk decay rates of chlorine residuals. In this project, an analytical solution for this model was developed by assuming that the initial phase using the second order decay equation to find decay constant C_o and the rate of reaction for the bulk decay of chlorine, k_d. From the data obtained we use Microsoft Excel to build the graph. By referring to the graph the constant value of C_o and k_d is obtained where C_o is the y-intercept of the graph and k_d is the gradient of the graph. The predictive chlorine concentration formula of second order model is

$$C(t) = 0.6131e^{-(0.0364)t}$$

where the value of C_o is fixed and was obtained by calculating the arithmetic mean. From the result obtained the optimum initial chlorine concentration is 40mg/L and the time taken for the chlorine to reach its minimum level is 9 days.

1 INTRODUCTION

1.1 Research Backgroud

Proper management of drinking water distribution system is crucial to make sure the drinking water being supplied to the customers are safe to drink. Drinking water supplies is disinfected to reduce the activity of microorganisms that give the bad effect to the human's health. Most countries all over the world chose chlorine as the most effective practice for water disinfection. there are numerous process involved before the drinking water being conveyed to the client's tap such as the water treatment, the process of disinfection and changes amid transport of treated water by means the distribution system. (Vuğă & Dumitran, n.d.-a).

Chlorine is the most suitable disinfectant compared to other halogens chemical such as bromine and fluorine because of its advantages. Chlorine is able to prevent the microbial re-growth and the most effective property to control varieties of pathogen spectrums. Chlorination has been used by many countries to avoid water borne disease and as a protection for the re-growth of algae. The side effects from the chlorine action process required regulation and standards to limit the amount of chlorine to the minimum level. Chlorine disinfectant has the benefit to stays in the distribution system for quite long time (Hua et al. (1999)), compared to the disinfection by UV radiation and ozonation.

World Health Organization, WHO (2008) has that set the free chlorine residual in drinking water for every 30 minutes contact time should be around 0.3-0.5 mg/l. If the dose of chlorine is lower, it will lead to the increase of bacterial growth and if the dose of chlorine is higher, it will lead to customers complain about the taste and odour. During the transport to the customer's tap the chlorine concentration added to the treated water does not remain. Chlorine concentration will decay and lead to the disappearance of the disinfectant due to the reaction on the water bulk and the wall interface of pipes and other chemicals .

Since a proper management of chlorine as disinfection is crucial, the mathematical model