UNIVERSITI TEKNOLOGI MARA

A BOMBASTIC APPROACH TO REMOVE 2,4,6-TRICHLOROPHENOL FROM SIMULATED WASTEWATER VIA PROGRESSIVE FREEZE CONCENTRATION: EFFECT OF OPERATING TIME AND OPTIMIZATION BY USING RESPONSE SURFACE METHODOLOGY

HARIZ ASYRAF BIN HAMIZLAN

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ABSTRACT

2,4,6-Trichlorophenol (TCP) is a type of chlorophenol compound widely used in various formulations as herbicides, fungicides and glue preservatives. Its chemical properties make it become toxic, hazardous and carcinogenic to human and environment. Nowadays their amount in industrial wastewater are increasing and the presence of low concentration of TCP also can be an obstacles to the usage of wastewater. Thus, researchers have been trying to find the best solution to overcome this issue. One of the potential technologies that can take into consideration of this wastewater treatment is progressive freeze concentration (PFC). PFC is a process in which only a big single ice crystal is generated in the process to remove TCP from simulated wastewater for this research. In this research, the objectives are to determine the relationship between effectiveness of operation time in separation of TCP from simulated wastewater on effective partition constant (K) and TCP reduction (%) and to study the relationship between operation time and optimum condition in separation of TCP by using Response Surface Methodology (RSM). Hence, the effect of operation time ranging from 10 minutes to 50 minutes was investigated. From the experimental work, it was found that higher efficiency results at higher operating of time based on lower value of K is achieved at 40 minutes where the value of K is 0.49. Apart from that, the TCP reduction (%) was also calculated in order to determine the performance of the PFC system where at 40 minutes the TCP reduction (%) is 64.85%. The optimization by using RSM also was successfully applied to obtain the optimum condition of operating time and initial concentration for concentrating the simulated wastewater of TCP. According to STATISTICA software, the best K value could achieve is 0.13 when operating time is 82.92 minutes and initial concentration at 93.21 ppm. For TCP reduction (%), the highest value could obtain is 76.53% when operating time is 60.49 minutes and 51.34 ppm for initial concentration.

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INTRODUCTION

1.1 Research Background

Water is a compound that is important in this world for all living things. According to the 'United States Geological Survey' about 71% of the Earth surface is covered by water and the ocean is about 97% of surface water, the glaciers hold 2.4%, while the other 0.6% of fresh water can be found at lakes, rivers and ponds. The river has contributed 97% total usage of water main source for domestic. Unfortunately, the clean and fresh water and its volume has decreased from time to time because of human's bad practices of habit. One of the main factors and reasons for this is because of the large volume production of wastewater discharged by domestic residences, commercial properties, industry and agriculture. Water shortage has become the serious issue and debatable particularly in developing countries. This may be due to increased demand, lack of river basin management, unparallel supply of water and rapidly growing population.

In these days, wastewaters which contain phenolic compounds are a serious issue as it is water soluble and can be detected in ponds, soil and river (J. Gao et al., 2008). This serious problem can be prevented by ensure that the wastewaters containing phenolic compound does not flow into open water before it undergoes a treatment. Its chemical properties make it become toxic and hazardous and nowadays their amount in industrial wastewaters are increase (Denizli et al., 2004). There are few sectors producing large volumes of wastewater that contain deadly toxic compound that can give a negative effect to the environment such as petrochemical, pesticidal, paper making and water disinfection industries. This phenolic compound also present in the wastewaters produced from pharmaceutical, paint, iron-steel and pulp industries (Denizli et al., 2004). The toxic compound named 2,4,6-trichlorophenol is generated through the process of producing by-products or chemical intermediates mainly in petrochemical industries (Anandan et al., 2007). Moreover, this toxic compound also one of the most vulnerable water pollutant, causing a severe damage to human vital organs that may cause headache, rapid fatigue and