CHAPTER I

INTRODUCTION

1.1 Research Background and Motivation

Biodegradable dissolved organic carbon (BDOC) analysis measures the portion of organic carbon that can be metabolized by heterotrophic microorganisms within a few days to a few month (Servais *et* al., 1989; Huck, 1990) or the portion of dissolved organic carbon (DOC) that is biodegradable (Khan *et al.*, 1998a). BDOC, which is widely used as a parameter for quantifying the amount of biodegradable organic matter (BOM) in drinking water, provides the potentials in indicating the efficiency of water treatment processes and quality of raw and treated water (Khan *et al.*, 1999) and characterizing secondary treated wastewater (Wanaratna, 2002). All BDOC procedures, which rely on the reduction of DOC after the sample is exposed to microorganisms, have benefits over biological oxygen demand (BOD) and chemical oxygen demand (COD) analyses. BOD and COD analyses lack precision and accuracy at low organic concentrations, which are increasingly becoming more important (Khan *et al.*, 1998a) because of the high removal efficiency of wastewater treatment systems. Furthermore, bacterial growth may occur in the water distribution systems even at low BOM concentration (Ribas *et al.*, 1997). Khan *et al.* (1998a) modified a BDOC batch procedure (Servais *et al.*, 1987) used in the drinking water industry for determining BDOC in waters with moderate DOC (4-15 mg/L), for instance, reclaimed and secondary treated wastewater.

Another parameter, which indicates a relative concentration of organic compounds that are aromatic in structure or that have conjugated double bonds absorbing light in the ultraviolet (UV) wavelength region, is UV absorbance at 254 nm (UV_{254}). Some organic compounds commonly found in water and wastewater strongly absorb UV. It has been shown that the concentration of DOC for some waters is proportional linearly to UV_{254} (Edzwald *et al.*, 1985). The relative level of aquatic humics in water sample can be determined by comparing specific UV absorbance (SUVA). SUVA, the ratio of UV absorption to dissolved organic carbon (UV_{254}/DOC, expressed in m^{-1}/mg/L), has been used to characterize natural organic matter (APHA *et al.*, 1998). SUVA is a useful surrogate measure of selected organic compounds in fresh waters, salt waters, and wastewater. It has been used to monitor industrial wastewater

effluents and evaluate organic removal by coagulation, carbon absorption, and other water treatment processes (Edzwald *et al.*, 1985). In the drinking water field, SUVA has been used to characterize the DOC of raw waters, as cited in Khan *et al.* (1998b). Wanaratna (2002) suggested that UV_{254} might be used as an indicator of the wastewater quality.

In this study, three bench scale biological wastewater treatment processes, which are activated sludge (AS), trickling filter (TF) and rotating biological contactor (RBC), will be used to determine the capabilities of BDOC and UV_{254} as wastewater quality parameters and treatment efficiency indicators. These three biological wastewater treatment processes have their advantages. AS requires small volume of wastewater and provides high suspended solids and BOD removal. Another commonly used process is RBC, which has a high capacity to handle shock load with fast recovery and is less energy intensive. The last one is TF process, a towered fixed film reactor that is suitable for small communities because of the ease of operation. Mean cell residence time (MCRT) or solids retention time (SRT), and organic loading rate (OLR) or hydraulic loading rate (HLR) are specific control parameters that affect the performances of the AS, and RBC and TF systems, respectively. The effect of these specific control parameters on effluent BDOC and UV_{254} and their removal efficiencies provided by AS, TF and RBC processes will be investigated.

1.2 Problem Statement

As mentioned above, BDOC is a more precise parameter and more sensitive in detecting biodegradable organic compounds than BOD, and UV_{254} can be easily measured compared to other water quality parameters. Thus, investigating BDOC and UV_{254} will be very useful for the wastewater quality and treatment field. However, the modified BDOC batch method (Khan *et al.*, 1998a) requires a 28-day incubation period which is its major drawback. Since the use of 5-day BOD (BOD_5) is acceptable, it is likely that 5-day BDOC ($BDOC_5$) is sensitive enough to indicate wastewater quality. $BDOC_5$ and UV_{254} have not been applied to determine the performances of bench scale AS, TF or RBC. This study intends to show the potential of $BDOC_5$ and UV_{254} as wastewater quality parameters and treatment efficiency indicators using three bench-scale biological wastewater treatment processes.

1.3 Objectives

The main objective of this study is to investigate the uses of $BDOC_5$ and UV_{254} for characterizing secondary treated wastewater quality and treatment efficiency. The specific objectives are as follows:

1. To determine the effect of HLR of TF and RBC processes on $BDOC_5$ and UV_{254} removal efficiencies and concentrations in the effluents.
2. To determine the effect of SRT in AS process on $BDOC_5$ and UV_{254} removal efficiencies and concentrations in the effluent.
3. To investigate the relationships among $BDOC_5$, UV_{254} and traditional water quality parameters such as soluble BOD_5 ($SBOD_5$) and soluble COD (SCOD).