CHAPTER I

INTRODUCTION

1.1 Research rationale

Nitrobenzene ($C_6H_5NO_2$) is a solvent intermediate in the preparation of aniline. Aniline ($C_6H_5NH_2$) is a compound used as synthetic products, dyes and as a chemical intermediate for rubber processing, corrosion inhibitors, accelerators, resins, pesticides. Many researches individually report the oxidation of aniline (Kirk et al., 1985; Brillas et al., 1995, 1998; Gheewala and Shabbir, 1997; Sanchez et al., 1997; Wenhua et al., 2000; Sauleda et al., 2001) and nitrobenzene (Lee and Park, 1996; Piccinini et al., 1997; Contreras et al., 2001; Rodriguez et al., 2002), however no explanation of their mechanism of competitive degradation has been reported. According to the functional group in benzene ring of both substances, aniline has the function group as NH_2 but nitrobenzene has the functional group as NO_2, Figure 1, oxidation reaction of both substances would be different.

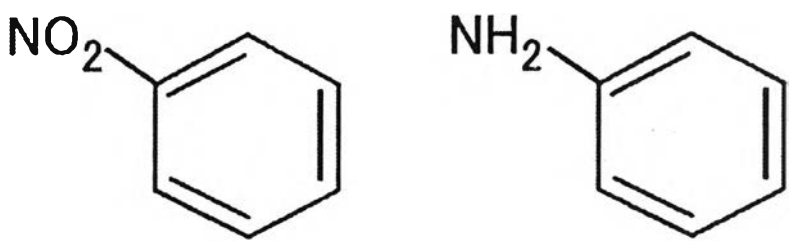

Figure 1 Chemical structure of nitrobenzene and aniline

For the industrial process, the mixture of nitrobenzene and aniline would be discharged in the same wastewater. Major industry release those two substances are chemical industry such as rubber processing, resins and pesticide. The concentrations of both substances are varied in the wide range depending on type of industry. The biological treatment process is used to treat these contaminants from the water (Gheewala and Shabbir, 1997). Thus, the competitive degradation behavior between aniline and nitrobenzene by oxidation pathway draws an attention for this research

investigation. The aim of this work was to investigate the competitive decomposition between these two benzene ring compounds by oxidation method.

Advanced oxidation processes (AOPs) have been used to degrade pollutants which have an unfavourable effect on biological treatment. This process has recently emerged and demonstrated a high efficiency in chemical degradation treatment (Glaze et al., 1987). Advanced oxidation processes are considered an effective method for treating wastewater due to generation of hydroxyl radical ($^{\bullet}OH$), a powerful and non-selective oxidant. This process has also been attempted to annihilate aniline and nitrobenzene. For example, electrochemical oxidation is the most studied method (Kirk et al., 1985; Comninellis and Plattner, 1988; Brillas et al., 1995). Some of research reported that aniline and most of its derivatives are difficult to biodegrade (Gheewala et al., 1997). The photocatalytic catalyzed with titanium dioxide was reported as an effective treatment method in the destruction of both aniline and nitrobenzene (Piccinini et al., 1997; Sanchez et al., 1997; Wenhua et al., 2000). The ozonation was also reported as high efficiency for treating aniline (Sauleda et al., 2001). Nevertheless, photocatalytic and ozonation process required high energy. Therefore, those methods may difficult to arise in the applied use in wastewater treatment process (Laura et al., 1997).

Regarding the conventional Fenton process, a combination of hydrogen peroxide and ferrous ions, is frequently used because of the high potential in organic compounds destruction, low cost and easy operation. Many previous researches (Solozhenko et al., 1995; Walter et al., 1997; Sheng, 1999; Lu, 1999) reported that Fenton process is effective in decolorizing and destruction of trihalomethanes, surfactant wastewater and insecticide. In addition, Fenton process has also been found to be effective in treating different types of industrial wastewater. In this study, Fenton process, the focused technique for aniline and nitrobenzene decomposition, was performed in order to carry out the competitive degradation of both substances, which were in the mixture solution

1.2 Objectives

The main objective of this study was to investigate the competitive degradation behavior between aniline and nitrobenzene in the conventional Fenton process. The specific objectives are:

1. To investigate effect of initial conditions including initial pH, initial concentrations of H_2O_2 and Fe^{2+}on the degradation of aniline and nitrobenzene.
2. To evaluate the competitive behavior between aniline and nitrobenzene.
3. To investigate the mineralization of aniline and nitrobenzene in the conventional Fenton process.

1.3 Hypotheses

1. Efficiency of the conventional Fenton process on degradation of aniline and nitrobenzene depends on an initial pH and the amounts of H_2O_2, Fe^{2+}.
2. Aniline and Nitrobenzene may compete to consume hydroxyl radicals.
3. Mineralization of aniline and nitrobenzene could be achieved by the conventional Fenton process.

1.4 Scopes of work

1. Aniline and nitrobenzene were mixed together in the solution as the synthetic wastewater.
2. The temperature was controlled at 30°C in all experiments.
3. The degradation of aniline and nitrobenzene was studied by conventional Fenton process

1.5 Advantages of this work

Results obtained from this research could be beneficial for treatment of wastewater containing benzene compounds. Moreover, the results could be used for other mixture compounds which have a similar chemical structure in industrial wastewater.