

UNIVERSITI TEKNOLOGI MARA

**CHEMICAL AND BIOLOGICAL METHODS FOR
COLOR REMOVAL FROM WASTEWATER OF
CARTON PRINTING-INK INDUSTRY**

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ABSTRACT

Water-based and solvent-based ink wastewaters from carton-printing industry are generated from the cleaning of printing machines when the color of the printing ink is changed. Generally, the wastewater is intense in color and high in composition of organic compounds. Colors are recalcitrant compounds and solvents are toxic to microorganism; they often cause the conventional treatment plant to become ineffective. In this study the removal of color and COD was attained by using individual chemical and biological first, and subsequently two combined chemical and biological methods (I & II) for water-based and solvent-based printing ink wastewaters. The chemical methods include coagulation and flocculation, Fenton and Fenton-like reagent. The biological method was carried out with two white rot fungi, namely *Coriolus versicolor* and *D-UiTM*. Biological treatment using *C. versicolor* in the growth medium M1 shows higher removal of color and COD compared to growth medium M2. For water-based printing ink wastewater, it is found that combined method I of Fenton reagent followed by biological method is as with M1 effective as combined method II, both being able to reduce the color and COD to below the standard discharge limits of DOE. However, combined method I is more efficient than combined method II in term of hydraulic retention time being one day as compared to 4 days for method II. For solvent-based printing ink wastewater both combined methods are equally efficient to archive more than 90% removal of color and COD with the same hydraulic retention time. But, combined method I resulted in lower values of color and COD in the final treated water. The results obtained indicate that the effectiveness of individual chemical and biological methods is less than that the combined methods.

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TABLE OF CONTENTS

TITLE PAGE	i
CANDIDATE’S DECLARATION	
ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xx
CHAPTER 1: INTRODUCTION	
1.1 Background	1
1.2 Objectives of the Research	2
CHAPTER 2: LITERATURE REVIEW	
2.1 Introduction	3
2.2 Printing Inks, Printing and Dyes	5
2.2.1 <i>Printing Process</i>	6
2.2.2 <i>Printing Ink</i>	10
a) <i>Solvent-based Ink</i>	10
b) <i>Water-based Ink</i>	10
2.2.3 <i>Types of Dyes</i>	11
2.2.4 <i>Toxicity of Dyes</i>	15

CHAPTER 1

INTRODUCTION

1.1 Background

Color compounds and dyes are important materials in food, pharmaceutical, paper and printing, leather and cosmetic industries. There is a continual demand to develop longer lasting and more applicable dyes that satisfies the trends dictated by changing social ideas and styles. Increasing production of dyes has also become a major environmental concern. Many of these dyes find their way into the environment via wastewater facilities. Because these compounds retain their color and structural integrity under exposure to sunlight, soil, bacteria and sweat, they also exhibit a high resistance to microbial degradation in wastewater treatment systems (Ganseh, 1992). Most of the dyes are non-toxic, but a higher percentage of their intermediates have been identified as carcinogens (Brown and DeVito, 1993). Because of the toxic potential of many aromatic amines, further degradation of the dye compound is necessary if toxicity is to be eliminated or reduced (Levine and Walter, 1991; Brown and DeVito, 1993).

Globally, the printing ink industry is facing stringent requirements to produce new and better-performing and environmentally friendly printing inks (Metes et al. 2004). Over 90% of some 4000 dyes tested in Ecological and Toxicological Association of Dyestuffs Manufacturing Industry (ETAD) survey had LD₅₀ values greater than 2×10^3 mg/kg and the highest rates of toxicity were found amongst basic and diazo direct dyes (Walthall and Stark et al., 1996; Tsuda et al., 2001; Novotný et al., 2006)

Carton printing ink wastewater is usually difficult to treat biologically but the possibility of utilizing bacteria to degrade printing ink in wastewater was proposed (Guojun et al., 2004). Since flocculation was shown to be a simple and efficient method for removing