

STUDY ON IRON AND MANGANESE REMOVAL IN RIVER WATER FOR  
TEXTILES INDUSTRY USAGE

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**STUDY ON IRON AND MANGANESE REMOVAL IN RIVER WATER  
FOR TEXTILES INDUSTRY USAGE**

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Especially dedicated to my beloved mother, brothers, sisters, my wife “YATI” and  
my daughter “Aisyah Nabila”  
For all the love, encouragement and faith....

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## ABSTRAK

Industri tekstil merupakan salah satu industri yang penting di Malaysia. Dalam industri tekstil terdapat berbagai aktiviti di mana aktiviti pencelupan merupakan proses yang menggunakan air paling banyak di dalam sektor ini. Oleh itu kualiti air yang digunakan memainkan peranan yang penting bagi menghasilkan produk yang bermutu.

Kajian rawatan air yang digunakan di Ramatex Textiles Industrial Sdn Bhd. dilakukan untuk melihat tahap keberkesanan penyingkiran Ferum dan Mangan. Kehadiran Ferum dan Mangan pada kepekatan yang tinggi akan menyebabkan kerosakkan pada fabrik yang dicelup seperti lekatan kotaran dan sebagainya. Bagi Ramatex kepekatan yang dibenarkan bagi Ferum dan Mangan ialah 0.3 mg/L dan 0.05 mg/L.

Kajian ini menjurus kepada tiga kaedah penyingkiran Ferum dan Mangan iaitu, pengoksidaan dengan potassium permanganate, teknik penyerapan udara dan kombinasi kedua-duanya. Kualiti air sungai yang dirawat mempunyai kepekatan Ferum di antara 0 mg/L sehingga 6.5 mg/L, manakala untuk Mangan antara 0 mg/L sehingga 2.6 mg/L.

Dari kajian didapati kecekapan penyingkiran Ferum dengan menggunakan kaedah pengoksidaan potassium permanganat ialah 22% sehingga 100%. Kaedah teknik penyerapan udara dari 94% sehingga 100% dan kombinasi keduanya ialah antara 70% sehingga 100%. Kecekapan penyingkiran Mangan dengan menggunakan kaedah pengoksidaan potassium permanganat ialah dari 8% sehingga 64.5%. Kaedah teknik penyerapan udara dari 0% sehingga 13 % dan kombinasi keduanya ialah antara 0% sehingga 100%.

Selain daripada itu dengan kombinasi dua kaedah ini, penggunaan bahan kimia dapat diturunkan sebanyak 55% bagi potassium permanganate tanpa menurunkan kualiti air yang dirawat.

## ABSTRACT

Textile Industry is one of main industry in Malaysia. There are a lot of activities in textiles industry such as dyeing process where a lot of water is required. Quality of water is main issue in this process to produce quality product or fabric.

A study was done at Ramatex Textiles Industrial Sdn. Bhd. raw water treatment plant to see efficiency of ferum and manganese removal. Water supply, which contains high concentration of ferum and manganese, will affect the fabric quality such as yellowish stain. For Ramatex permeable limit for Ferum and Manganese concentration are 0.3 mg/L and 0.5 mg/L.

This study was concentrate at three methods to removed Ferum and manganese by using potassium permanganate, aeration and combination of potassium permanganate and aeration method. Quality of river has concentration of Ferum between 0 mg/L to 6.5 mg/L, and for manganese between 0 mg/L to 2.6 mg/L which are excess with Ramatex quality limit.

From the study, it show that efficiency of Ferum removal by potassium permanganate is between 22 % to 100%. Aeration method has efficiency from 94 % to 100% and combination of two methods between 70 % to 100%. Efficiency of Manganese removal by potassium permanganate is between 8 % to 64.5%. Aeration method has efficiency from 0 % to 13% and combination of two methods between 0 % to 100%.

Chemical consumptions also reduce about 55% for potassium permanganate by using combination of two method without reduce water quality for production usage.

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**LIST OF ABBREVIATIONS**

<b>Abbreviations</b>	<b>Full Name</b>
DO	Dissolved Oxygen
ORP	Oxidation Redox Potential
PAC	Poly Aluminium Chloride
TDS	Total Dissolved Oxygen

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of Study

Water is one of the most important elements in human life. Water is essentials for human daily activities such as for drinking, washing, cooking and others. In Malaysia as climate country source of water supply is mainly from surface water such as streams, rivers, ponds, lakes and reservoirs.

The quality and quantity of surface water depends on combination of climatic and geological factors. Water is needed to treat for drinking purpose or other usage such as for industrial or production usage. Textiles Industry is one of the biggest consumers of water supply especially for dyeing activities.

Ramatex Textiles Industrial Sdn. Bhd. is an integrated textiles manufacturer located at Sri Gading Industrial Estate, Batu Pahat Johor. The main activities in this plant are spinning, knitting, dyeing, printing and finishing. All the activities were need water in their activities such as spinning and knitting for cooling system which is important to maintain the quality of product during manufacturing process. Washing activities and preparation of the pigment at printing mill. The largest consumer of water in this plant is dyeing mill were about 80% of water supply are use in this mill. Water demand for dyeing mill at Ramatex was about 210 cubic meters per hour.

Currently Ramatex in the process of establish its own standard of water quality for the purpose of dyeing process. Table 1.1 shows standard of water quality for Ramatex and other for textiles industry. Excess contaminant in the water such as hardness, iron, manganese and turbidity affect the quality of fabric during dyeing process. Management are more concern with iron and manganese in the water. Iron and manganese affect the quality of fabric if excess in the water supply although in small amount.

Table 1.1: Standard water quality for textile industry (Cheong, 1996).

No	Parameter	A	B	C	D
1.	pH	6.5 – 7.4	5.5 – 9.0	-	5.5 – 6.0
2.	Alkalinity	-	-	-	< 15
3.	Turbidity	-	-	-	< 0.5 FTU
4.	Hardness	-	-	-	< 30
5.	Chloride	9 – 25	< 300	-	-
6.	Total Dissolved solid	130 – 170	< 1000	-	< 150
7.	Calcium	-	-	-	< 5.0
8.	Magnesium	-	-	-	< 5.0
9.	Iron	0 – 0.1	< 0.3	0.01 – 0.1	< 0.3
10.	Manganese	-	-	0.02	< 0.05
11.	Silica	5 – 30	< 50	15 – 20	< 10.0

Unit in mg/l except for pH

Note:

A: Standard of Japan Textiles Finishers Association (JTFA)

B: Standard for Cotton and PE/COT Fabric

C: Calise, Textile Chemicals and Auxiliaries

D: Ramatex Textiles Industrial Sdn. Bhd.

Since year 1990, Ramatex was using municipal water for dyeing process. But after water crisis on year 1997, Ramatex with their own afford was build their own water treatment system for their usage. This plant is using chemical treatment i.e. coagulant and flocculants process for primary treatment before further treated by using membrane filtration in secondary treatment. Water resource are taken from Sungai Simpang Kanan , tributary of Sungai Batu Pahat.

Base on water analysis from Water Department of Ramatex, concentration of iron and manganese in the river water fluctuated and the highest concentration of iron is about 15 ppm. From data analyses it also shown that iron concentration in the river water are high for several month i.e. in mid of the year. That may be due to drought season or excavating activities by Drainage and Irrigating Department (DID) for maintenance purpose. Figure 1.1 shows iron concentration in Sungai Simpang Kanan water at catchments area.

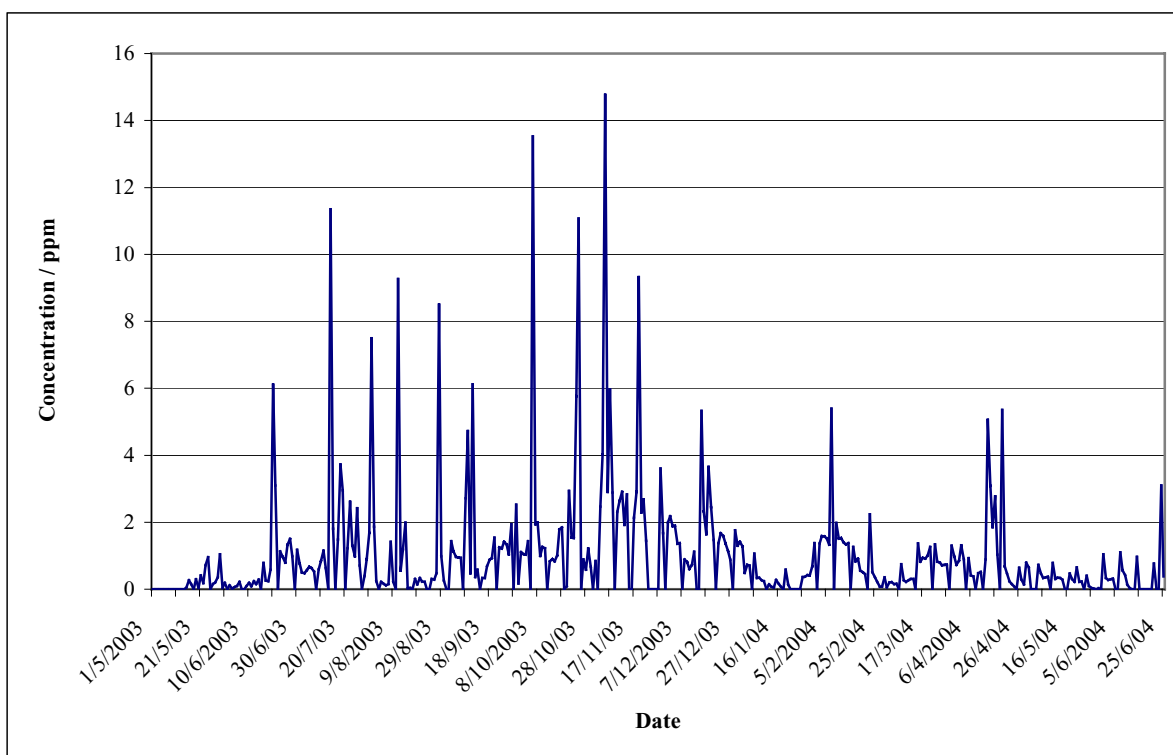


Figure 1.1: Concentration of Iron and Manganese in Sungai Simpang Kanan from May 2003 until June 2004



Excess of iron and manganese content in water supply for production was create a problem to the quality of dyed and yarn fabric. Red stain was occurring at white or light colour of fabric after dyeing process. The worse problem are facing by yarn dyeing part were yarn was act as filter during dyeing process by trap suspended iron and manganese at their yarn fibre. This will cause about 20-30% of yarn will be remove and thrown away as reject product.

To solve this problem, management was agree to put potassium permanganate to remove iron and manganese from river water. This method will increase operation cost. This study was conducted to see efficiency of aeration as alternative method to remove iron and manganese and to reduce the operation cost of water treatment.

## **1.2 Objective of Study**

Iron and Manganese are two elements that always occur in river water. High concentration of two elements in water will cause problem for further usage. There are many methods to remove iron and manganese in water such as oxidation by chemical or aeration method. The objective of this study is to compare the effectiveness of iron and manganese removal by:

1. Chemical oxidation by using potassium permanganate.
2. Oxidation by aeration method, and
3. Combination of potassium permanganate and aeration method.

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