

SULPHIDE REMOVAL USING PHYTOREMEDIATION PROCESS

KOH RUI SHUAN

**BACHELOR OF CHEMICAL ENGINEERING
UNIVERSITI MALAYSIA PAHANG**

SULPHIDE REMOVAL USING PHYTOREMEDIATION PROCESS

KOH RUI SHUAN

Thesis submitted in partial fulfilment of the requirements
for the award of the degree of
Bachelor of Chemical Engineering

**Faculty of Chemical & Natural Resources Engineering
UNIVERSITI MALAYSIA PAHANG**

DECEMBER 2016

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor in Chemical Engineering.

SIGNATURE :

SUPERVISOR'S NAME : DR. SYARIFAH BT RAHIM

POSITION : SENIOR LECTURER

DATE : DECEMBER 2016

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own doing except for quotations and summaries which has been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award for other degree.

SIGNATURE :

NAME : KOH RUI SHUAN

ID NUMBER : KC13046

DATE : DECEMBER 2016

DEDICATION

To my parent: Without you none of my success would be possible. Thank you makes me someone who I am.

To my supervisor: You are not just my lecturer, you are my guide, my friend, my mentor, I will always thank to you because of your patience and support. Thank you, Dr. Syarifah.

ACKNOWLEDGEMENT

An accomplishment of such a feat is not possible if not for the help of those around me. First, I would like to extend my eternal appreciation to my supervisor Dr. Syarifah Binti Rahim for his guidance through an effective well-arranged weekly meeting. Besides, I would like to express my gratefulness to all faculty lecturers and lab assistants for their direct and indirect help.

I also would like to express my deepest love to our family members and friends for their love and support. Besides that, appreciations are delivered to all seniors who help by giving advices in completing this thesis. Lastly, many thank and appreciation to my friends that spend your times for me. Your ideas, support, motivation and many things, I'll appreciate and remember this wonderful life and moment as a university student.

Thanks very much.

TABLE OF CONTENTS

	Page
SUPERVISOR'S DECLARATION	iv
STUDENT'S DECLARATION	v
ACKNOWLEDGEMENT	vi
ABSTRACT	viii
ABSTRAK	ix
TABLE OF CONTENTS	x
LIST OF TABLES	xii
LIST OF FIGURES	xiii
CHAPTER 1 INTRODUCTION	1
1.1 Background of the Study	1
1.2 Problem Statement and Motivation	2
1.3 Research Objective	3
1.4 Scope of Research	3
CHAPTER 2 LITERATURE REVIEW	4
2.1 Spent Sulfidic Caustic (SSC)	4
2.2 Existing treatment of spent sulphide caustic	4
2.2.1 Neutralization	5
2.2.2 Wet Air Oxidation	6
2.2.3 Chemical Oxidation	7
2.3 Phytoremediation	8
2.3.1 Phytoextraction	8
2.3.2 Phytovolatilization	10
2.3.3 Phytostabilisation	11
2.3.4 Rhizofiltration	11
2.3.5 Phytodegradation	12
2.3.6 Rhizodegradation	12

2.4	Plant species	13
2.4.1	<i>Water hyacinth</i>	14
2.4.2	<i>Indian mustard</i>	14
2.4.3	<i>Poplars tree</i>	14
2.4.4	<i>Scirpus grossus</i>	15
2.5	Semi-batch process.	16
CHAPTER 3 METHODOLOGY		17
3.1	Materials	17
3.2	Initial growth of <i>Scirpus grossus</i> .	17
3.3	Synthetic SSC preparation.	18
3.4	The phytotoxicity test by phytoremediation process	19
3.5	Semi-batch phytoremediation process	20
3.6	Batch phytoremediation process	21
3.7	Characterization	22
3.7.1	Chemical oxygen demand (COD)	22
3.7.2	pH	23
3.7.3	Sulphide content	24
CHAPTER 4 RESULTS AND DISCUSSION		25
4.1	Initial Growth of <i>Scirpus grossus</i>	25
4.2	The phytotoxicity test for sulphide removal by using phytoremediation process	28
4.3	The synthetic SSC preparation throughout the semi-batch process.	31
4.4	The sulphide concentration, COD and pH analysis for during semi-batch process	32
4.5	The response of withered leaves for semi-batch process.	36
4.6	The effect of synthetic SSC on <i>Scirpus grossus</i> plants for batch process.	38
CHAPTER 5 CONCLUSION AND RECOMMENDATION		40
REFERENCES		41
APPENDIX		45

LIST OF TABLES

Table No.	Title	Page
Table 1:	The contaminants present in the refinery caustic	4
Table 2:	Different technique for phytoremediation	13
Table 3:	The growth of <i>Scirpus</i> plants	25
Table 4:	The percentage of withered leaves after 2 days exposure	28
Table 5:	The characterization value for the synthetic SSC added to the <i>scirpus grossus</i> plants for the semi batch process.	31
Table 6:	The characterization value on the three different concentration of sodium sulphide by semi batch process from day 0 to day 7	33
Table 7:	The response of sulphide removal during the semi batch process.	35
Table 8:	The response of withered leaves during the semi batch process.	36
Table 9:	The characterization value on the three different concentration of sodium sulphide by batch process.	38

LIST OF FIGURES

Figure No.	Title	Page
Figure 1:	The block diagram for chemical oxidation flow diagram.	6
Figure 2:	The block flow diagram of WAO system	7
Figure 3:	The process involved in the phytoextraction of contaminants from soil.	9
Figure 4:	The process involved in the phytovolatilization of contaminants from groundwater.	10
Figure 5:	<i>Scirpus grossus</i> plant	15
Figure 6:	The summary of the initial growth observation of <i>Scirpus grossus</i> .	17
Figure 7:	The summary of synthetic SSC preparation	18
Figure 8:	The steps for the SSC phytotoxicity test.	19
Figure 9:	The steps for the semi-batch phytoremediation process.	20
Figure 10:	The steps for batch phytoremediation process.	21
Figure 11:	The summary of COD analysis.	22
Figure 12:	The summary of pH analysis.	23
Figure 13:	The summary of sulphide content analysis.	23
Figure 14:	The healthy <i>Scirpus grossus</i> plants planted in the container.	27
Figure 15:	The physical appearance of <i>Scirpus grossus</i> after 1 day exposed in the synthetic SSC.	29
Figure 16:	The physical appearance of <i>Scirpus grossus</i> after 2 days exposed in the synthetic SSC	30
Figure 17:	The response of sulphide removal during the semi batch process.	35
Figure 18:	The percentage of withered leaves during the semi batch process.	37
Figure 19:	The <i>Scirpus grossus</i> plants for different concentration on day 0.	45
Figure 20:	The <i>Scirpus grossus</i> plants for different concentration on day 1.	45
Figure 21:	The <i>Scirpus grossus</i> plants for different concentration on day 2.	46
Figure 22:	The <i>Scirpus grossus</i> plants for different concentration on day 3.	46
Figure 23:	The <i>Scirpus grossus</i> plants for different concentration on day 4.	47
Figure 24:	The <i>Scirpus grossus</i> plants for different concentration on day 5.	47
Figure 25:	The <i>Scirpus grossus</i> plants for different concentration on day 6.	48

Figure 26: The <i>Scirpus grossus</i> plants for different concentration on day 7.	48
Figure 27: The <i>Scirpus grossus</i> plants for different concentration on day 12.	49
Figure 28: The <i>Scirpus grossus</i> plants for different concentration on day 19.	49