



شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



شبكة المعلومات الجامعية
@ ASUNET



شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم



شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of
15-25- c and relative humidity 20-40%

بعض الوثائق الأصلية تالفة

بالرسالة صفحات لم ترد بالاصل

546,391

**HYDROMETALLURGICAL COMPARATIVE STUDY BETWEEN
ION EXCHANGE AND SOLVENT EXTRACTION TECHNIQUES
ON BERYLLIUM COMPOUNDS**

21/10/06


A Thesis

**Submitted to the Chemistry Department
Faculty of Science, Cairo University**

By

**MOHAMMED DEMERDASH HASHEM MOHAMMED
NUCLEAR MATERIALS AUTHORITY**

**In Fulfilment for the Requirements of the Degree of M.Sc.
in Chemistry**

(2006)



APPROVAL SHEET FOR SUBMISSION

Title of (M.Sc) Thesis :

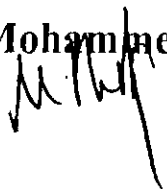
**HYDROMETALLURGICAL COMPARATIVE STUDY BETWEEN
ION EXCHANGE AND SOLVENT EXTRACTION TECHNIQUES
ON BERYLLIUM COMPOUNDS**

Name of the candidate : Mohammed Demerdash Hashem Mohamed

This thesis has been approved for submission by the supervisors :

1. Prof . Dr . Mohammed Mohammed Shokry

Signature :



2. Prof . Dr : Mohammed Shabban Atrass

Signature :



Prof . Dr



Chairman of Chemistry Department
Faculty of Science-Cairo University

Abstract

Name : Mohamed Demerdash Hashem

Title of thesis :

HYDROMETALLURGICAL COMPARATIVE STUDY BETWEEN ION EXCHANGE AND SOLVENT EXTRACTION TECHNIQUES ON BERYLLIUM COMPOUNDS

Degree .(M.Sc.) thesis, Faculty of Science ,Cairo University, 2006

This work has been carried out to investigate the process of separation of beryllium as beryllium oxide from beryl by ion exchange method using amberlite-IR-120 after precipitation of Aluminum sulphate as alum and complexing the interfering cations with EDTA at pH 3.5 . the separation process is firstly carried out over synthetic solution that results in the optimum condition that being used on the actual liquor samples

Supervisors :



Prof. Dr.

Chairman of Chemistry Department.
Faculty of Science, Cairo Univeristy.

بسم الله الرحمن الرحيم

فأما الزبد فيذهب جفاء و أما ما ينفع الناس فيمكث
فى الأرض

صدق الله العظيم

آية (١٧) ، سورة الرعد

TO MY FAMILY

MY FATHER

MY MOTHER

AND FINALLY

MY WIFE BASMA

TABLE OF CONTENTS

TABLE OF CONTENTS

	<u>Page</u>
TABLE OF CONTENTS.....	i
LIST OF TABLES.....	v
LIST OF FIGURES.....	ix
ACKNOWLEDGEMENT.....	xii
ABSTRACT.....	xiii
 <u>CHAPTER I : INTRODUCTION</u>	 1
I.1. HISTORY AND GENERAL PROPERTIES OF BERYLLIUM.....	1
I.2. BERYLLIUM BEARING MINERALS.....	2
I.3. USES OF BERYLLIUM.....	4
I.3.1. Nuclear Uses of Beryllium	4
I.4. HEALTH HAZARDS OF BERYLLIUM.....	5
I.5. MINEROLOGY AND CHEMICAL COMPOSITION OF BERYL.....	6
I.5.1. Crystal Structure of Beryllium Mineral	6
I.5.2. Identification of Beryl	6
I.5.3. Chemical Composition of Beryl.....	7
I.6. DISTRIBUTION OF BERYL IN THE WORLD AND EGYPT.....	9
I.7. AIM OF THE PRESENT WORK.....	12
 <u>CHAPTER II : CHEMICAL PROCESSING OF BERYL</u>	
<u>(THEORETICAL ASPECTS AND LITERATURE SURVEY)</u>	14
II.1. BREAKDOWN PROCEDURES FOR BERYL.....	14
II.1.1. The Sulphate Process.....	14
II.1.1.1. Heat Treatment of Beryl.....	15

II.1.1.2. Alkali Sintering.....	15
II.1.1.3. Preparation of the Sulphate Solution.....	17
II.1.1.4. The Brush Beryllium Company Process (Heat Treatment).....	18
II.1.1.5. The Degussa Process (Alkali Treatment).....	18
II.1.2. The Fluoride Process	19
II.1.2.1. The Silicofluoride Sintering Process.....	19
II.1.2.2. The Iron Cryolite Sintering Process.....	23
II.1.2.3. The Other Fluoride Processes.....	24
II.1.2.4. The Murex Process (Silicofluoride).....	25
II.1.2.5. The Beryllium Corp. of America Process(Mixed Silicofluoride/Cryolite).....	26
II.1.2.6. The SAPPI Process (Acid Fluoride).....	27
II.1.3. Other Breakdown Processes.....	28
II.2. RECOVERY PROCEDURES OF BERYLLIA CONCENTRATE.....	31
II.2.1. Recovery from the Sulphate Solution.....	31
II.2.1.1. Recovery of Beryllia at the Brush Beryllium Company.....	34
II.2.1.2. Recovery of Beryllia at Degussa.....	35
II.2.2. Recovery from the Fluoride Solution.....	35
II.2.2.1. Recovery of Beryllia at Murex.....	37
II.2.2.2. Recovery of Beryllia at the Beryllium Corp. of America.....	37
II.2.2.3. Recovery of Beryllia at SAPPI, Chivasso, Italy.....	38
II.3. RECOVERY PROCEDURES OF REFINED BERYLLIA	38
II.3.1. Solvent Extraction	39
II.3.1.1. Extraction by Organophosphorus Compounds.....	39
1) Mono and Dialkyl Phosphoric Acids.....	39
2) Tributylphosphate (TBP).....	40
II.3.1.2. Amines and Quaternary Ammonium Halides.....	41

II.3.2. Ion Exchange Resins.....	42
1) Cation Exchange Resins	42
2) Anion Exchange Resins.....	43
II.4. PREVIOUS WORKS ON EGYPTIAN BERYL.....	45
II.4.1. Breakdown Procedures of Um Debaa Beryl.....	45
II.4.2. Beryllium Refining by Organophosphorus Compounds.....	45
II.4.2.1. Beryllium Refining by DEHPA	45
II.4.2.2. Beryllium Refining by Neutral Compounds . (TBP and TOPO).....	48
II.4.3. Beryllium Refining by a Quaternary Ammonium Halide.....	50
<u>CHAPTER III : EXPERIMENTAL</u>	58
III.1. WORKING ORE MATERIAL.....	58
III.2. CHEMICALS AND REAGENTS.....	58
III.3. EXPERIMENTAL PROCEDURES.....	60
III.3.1. Breakdown Procedure.....	60
III.3.2. Recovery Procedure.....	61
III.3.2.1. Experiments on Synthetic Be/Al Solutions.....	61
III.3.2.2. Experiments on ZDB Beryllium Sulphate Solutions.....	61
III.4. ANALYTICAL PROCEDURES.....	62
III.4.1. Analysis of ZDB Beryl Concentrate.....	62
III.4.2. Control Analysis.....	62
III.4.3. Instrumentation.....	63
<u>CHAPTER IV : RESULTS AND DISCUSSION</u>	65
IV.1. CHEMICAL COMPOSITION OF ZDB ORE CONCENTRATE.....	65

IV.2. PREPARATION OF BERYLLIUM SULPHATE SOLUTION FROM ZDB BERYL CONCENTRATE.....	66
IV.2.1. Results of Caustic Breakdown of ZDB Beryl Concentrate.....	66
IV.2.1.1. Effect of Grain Size	67
IV.2.1.2. Effect of Soda to Beryl in Concentrate Weight Ratio	68
IV.2.1.3. Effect of Sintering Temperature.....	71
IV.2.1.4. Effect of Sintering Duration Time.....	73
IV.2.2. Acid Leaching of the Sintered Cake.....	75
IV.3. RESULTS OF ZDB BERYLLIUM REFINING BY ION EXCHANGE.....	79
IV.3.1. Determination of Resin Saturation Capacity.....	79
IV.3.2. Be/Al Separation by Amberlite IR-120 Resin.....	90
IV.3.2.1. Effect of pH	91
IV.3.2.2. Effect of Resin Grain Size.....	94
IV.3.2.3. Effects of Be/Al Concentration and Time (Unbuffered Influent).....	95
IV.3.2.4. Effects of Be/Al Concentration and Time (Buffered Influent).....	121
IV.3.3. IV.3.3. Optimum Condition of Be Adsorption.....	14
IV.3.3. Beryllium Refining from ZDB Beryl Concentrate.....	141
IV. 3.3.1 Results of Be Loading from ZDB Beryl Solution.....	141
IV. 3.3.2. Alum Formation Prior to Beryllium Loading from ZDB Beryl Solution.....	141
SUMMARY AND CONCLUSION.....	151
REFERENCES.....	161
ARABIC SUMMARY.....	161