EXTRACTION STUDIES ON SOME ELEMENTS AND ACIDS

FROM AQUEOUS MIXED MEDIA BY ORGANIC SOLVENTS

Thesis

Submitted by

NADIA ABDOU TADROS

M.Sc.

Atomic Energy Establishment

To

The Faculty of Science

Ain Shams University

For

The Degree of Doctor of Philosophy

1985

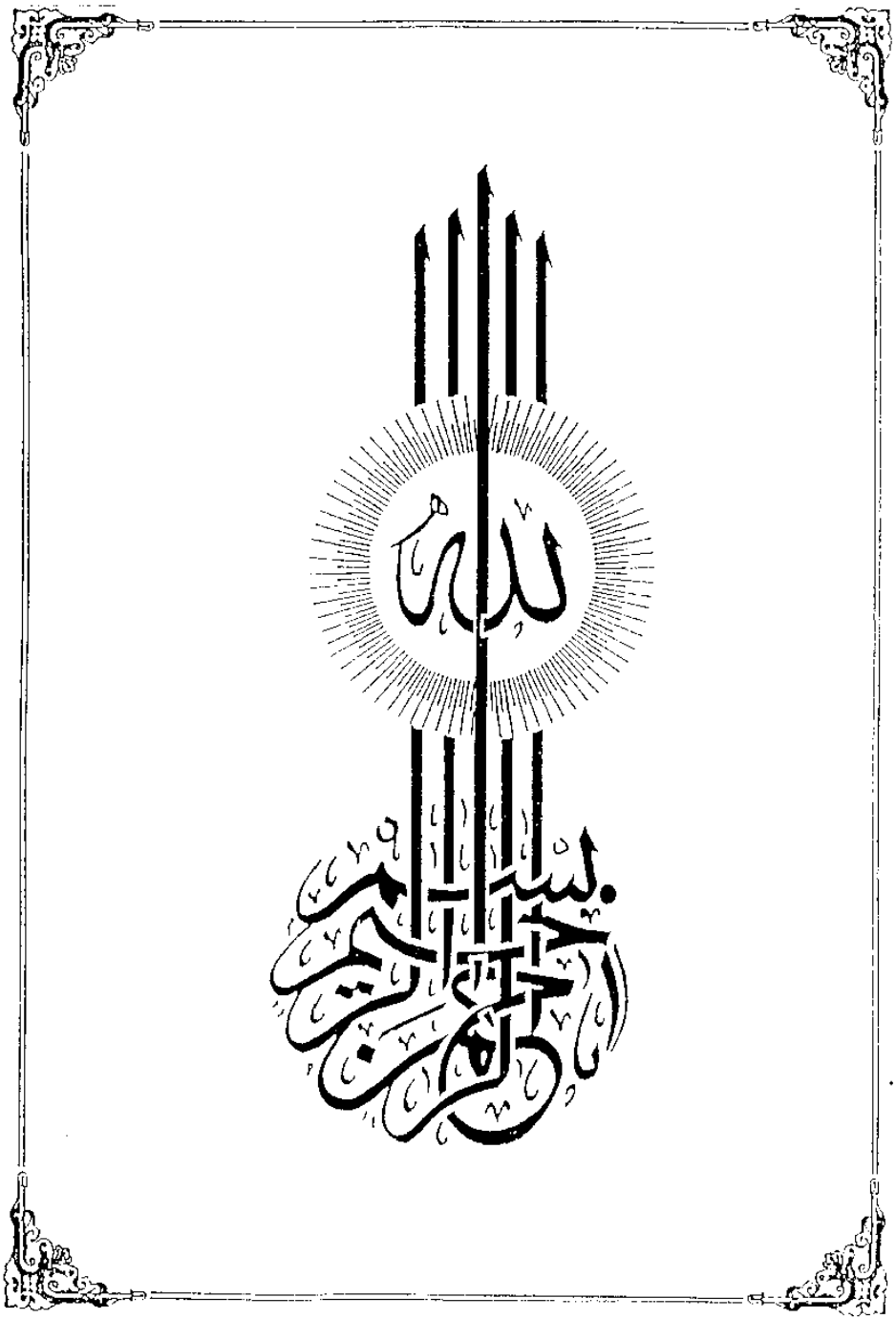
WORK

Dedicated to The LATE

Professor Dr. A. Haggag

Expressing our Feelings

of Sympathy and Compassion.



EXTRACTION STUDIES ON SOME ELEMENTS AND ACIDS

FROM AQUEOUS MIXED MEDIA BY ORGANIC SOLVENTS

Thesis Advisors

Prof. Dr. S. Tobia

Prof. Dr. M.A.El-Garhy

The Late, Ass. Prof. A. Haggag.

Thesis Approved

S. Tobia

M. El Garhy

Prof. Dr.

Head of Chemistry Department,

Nabila M. Guindi

ACKNOWLEDGEMENT

The author would like to thank Prof. Dr. S.Tobia, Professor of Inorganic and Radiochemistry, Faculty of Science, Ain Shams University for his valuable discussion, continuous encouragement, and sponsoring the work.

The author gives also her deep appreciation to Prof. Dr. M.A.El-Garhy, Professor of Radiochemistry, Nuclear Research Center, (N.R.C.) at Inshas, for continuous encouragement and valuable discussions.

I would like also to express my great indebtedness to the Late Dr. A.Haggag, Ass. Prof. at the (N.R.C.) for suggesting the subject of research, continuous supervision, careful guidance and critical reviewing of the entire manuscript.

I am deeply indebted to Dr. W.Sanad, Ass. Prof. at N.R.C. for her contribution and sincere guidance in developing this work.

Thanks also to Dr. R.Shabana, Ass. Prof. at N.R.C. for facilities provided.

I would like to give my appreciation to Prof. Dr. M.R.Zaki, Head of the Nuclear Chemistry Department, for his continuous encouragement.

My colleagues at the Nuclear Chemistry Department are all greatly thanked for their help and in particular Miss. H.Flex.

Papers Published

1. Formation of Extractable Species from Metal Sulphate and Amine Chlorides. Studies on Fe, In and Zn.

   A.Haggag, W.Sanad, N.Tadros.

   Journal of Radioanalytical Nuclear Chemistry, Article, 88/2, 193 (1985).

2. Effect of Hydrochloric Acid on Extractions from Sulphuric Acid by Amines.

   A.Haggag, W.Sanad, E.M.Mikhail and N.Tadros,

   Analyst, August , 107, 916 (1982).

3. Extraction of Uranyl Complexes from > 2M H_2SO_4 in Absence and Presence of HCl by LA_2, HDEHP and TBP.

   A.Haggag, W.Sanad and N.Tadros.

   Journal of Radioanalytical Chemistry (under publication).

4. Extraction and Separation of Uranium and Thorium from H_2SO_4-HCl Solutions by TBP.

   A.Haggag, W.Sanad and N.Tadros,

   Journal of Radioanalytical Chemistry(under publication).

5. Separation of Iron, Zinc, Cobalt and Manganese for Radiochemical Determination.

   A.Haggag, R.Shabana, W.Sanad, N.Tadros.

   Radiochem. Radioanal. Letters, 52/4, 225 (1982).

6. Neutron Activation Analysis of Uranium Concentration Loaded on Ion Exchange Resins.
A.Haggag, W.Sanad and N.Tadros,
Arab Journal of Nuclear Sciences and Applications,
Accepted for publication (1986).

7. A Simple Technetium Generator.
W.Sanad, N.Tadros, A.Haggag,
Journal of Radioanalytical Chemistry, Vol. 50,
No. 1-2, 153 (1979).

FORWARD

Solvent extraction is a well known technique in separation, purification and concentration of metal ions from trace as well as high level concentration. The technique is well applied in radioanalytical chemistry, fuel processing and reprocessing, purification and production of radioisotopes, as well as in the study of metal complexes and their stability constants. Tri-n-butyl phosphate, amines and bis(2-ethyl hexyl) phosphoric acid are among the most solvents used in this technique resembling neutral, anion and cation exchangers respectively.

Most of the research work published in the field of solvent extraction has applied the extraction of the metal salts from single acidic solutions. However, some work published by our laboratories involved the extraction from binary mixed acids-sulphuric and haloacids- for the purpose of separation. These reports did not give convenient picture about the reactions, complexes and mechanism appearing in the system. In some reports the complexes in 9M H_2SO_4 with 1M HCl (mixed acids) are mentioned as cationic species, while in others they are considered as chloride complexes neglecting the high stability constant of sulphate complexes.

The work in this thesis is aiming at introducing more details about the reactions taking place, complexes formed and the mechanism of extraction in the mixed acid systems. This study may lead to useful applications of the system studied in the field of nuclear and radiochemistry.

The complexes of Fe, Zn and In in the system are found as chloro-sulphate. This led us to separation of Fe, Zn, Co, Mn which is necessary before their determination due to the interference in their γ-energies. The reactions of UO_2^{2+}, SO_4^{2-}, HSO_4^- and Cl^- ions in the system and the anion exchange mechanism with amine showed that the extracted species is $(LA_2H)_4\ UO_2(SO_4)_3$. This study was extended to the neutral solvent tri-n-butyl phosphate (TBP) and the cation exchanger bis(di-ethyl hexyl) phosphoric acid. The effect of uranium concentration showed a great difference in complex formation. The high capacity of TBP for uranium in the system led to the study of thorium separation from uranium. ^{234}Th and ^{231}Th are obtained from the decay of ^{238}U and ^{235}U respectively, their separation is considered important to obtain thorium tracers that can be used in thorium chemistry and in some cases necessary for purification of

uranium from accumulated thorium and other elements.

The increase in production of uranium in industry has created a problem concerning natural water contamination. The described method for uranium determination in water is considered important, when the direct irradiation of uranium adsorbed on the resin is better than its analysis after elution.

Due to the importance of ^{99m}Tc, produced from the decay of radioactive ^{99}Mo in medical applications as clinical diagnosis, the development in the method of separation is important to obtain ^{99m}Tc of high purity. The study of separation showed that the method is simpler and the yield is higher and purer than that obtained by other methods.

CHAPTER I

INTRODUCTION

Cont.

CHAPTER II

EXPERIMENTAL

CHAPTER III

RESULTS AND DISCUSSION

Cont.

cont.