

**A CONTRIBUTION TO
THE HYDROMETALLURGY OF EGYPTIAN ILMENITE
ORE FOR TITANIUM DIOXIDE PRODUCTION**

Thesis submitted



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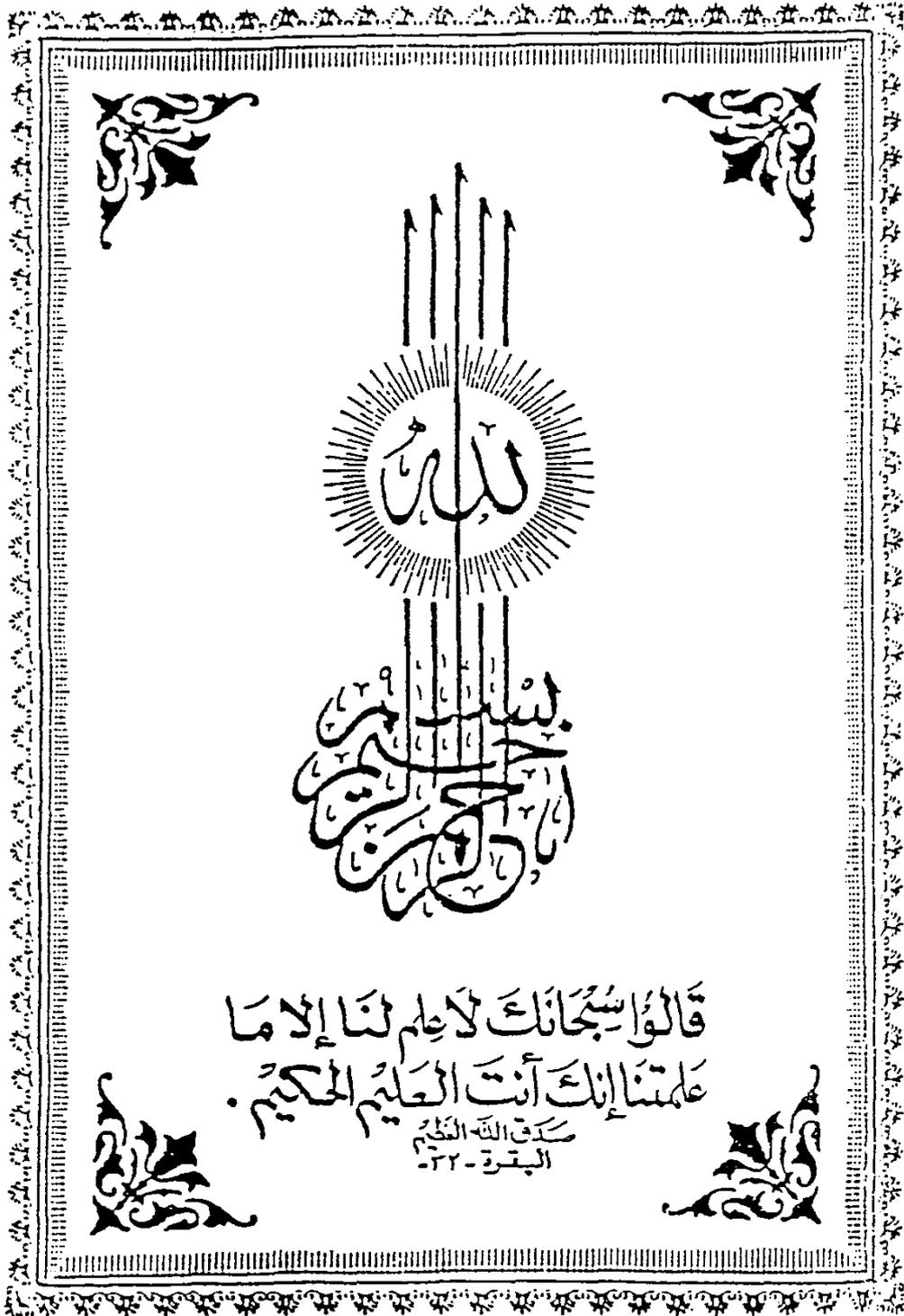
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قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا
عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ
سَدَقَ اللَّهُ الْقَلَمُ
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A Contribution To The Hydrometallurgy Of Egyptian Ilmenite Ore
For Titanium Dioxide Production

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ABBREVIATION

ASTM	:	The American Soceity for Testing Material.
min	:	Minute
g	:	gram
°C	:	degree celsius
h	:	hour
µm	:	micrometer
°C/ min	:	degree celsius per minute
I	:	ilmenite
H	:	hematite
R	:	rutile
A	:	anatase
DTA	:	Differential Thermial Analysis
TG	:	Thermogravimetric Analysis
g / ml	:	gram per milliliter

Aim of Work

In Egypt, huge reserves of ilmenite ore (≈ 50 million tons) are present at Abu Ghalaga mines of El-Nasr Phosphate Company - Eastern Desert. These reserves will secure continuous supply of raw material for the production of titanium dioxide from which the local market consumes $> 10,000$ tons annually, thus, saving hard currency paid for its import (40 million U.S. Dollar).

The present study aims at evaluation of Egyptian ilmenite ore from "Abu Ghalaga" mines for the production of titanium dioxide by sulfuric acid process.

ABSTRACT

Egyptian ilmenite ore from Abu Ghalaga, Eastern Desert was characterized and technologically evaluated for the production of titanium dioxide by sulfuric acid process.

It was found that the ore consists mainly of ferri-ilmenite together with some quantities of titanohematite.

The sulfuric acid process comprises eight stages, namely digestion, dissolution, reduction, clarification, chilling, concentration, hydrolysis and calcination. The optimum conditions of these stages were determined. About 82% of TiO_2 in the ore was converted into titanyl sulfate in the leaching stage at $152^\circ C$ using 70% H_2SO_4 for 2 hours retention time. Hydrolysis stage with 95.1% efficiency was performed at the boiling point using 0.75 liter concentrated liquor for one liter of water.

Rutile with 98.64% TiO_2 and 0.58% Fe_2O_3 was obtained after drying the hydrolysed product at $110^\circ C$ and calcination at $1100^\circ C$.

CHAPATER I
INTRODUCTION AND LITERATURE

CHAPTER I

INTRODUCTION AND LITERATURE

Titanium dioxide is an important intermediate in the manufacture of paints, pigments, welding rods coating, ceramics, papers, painting inks and in other areas of chemical industry. The main titanium-bearing minerals are rutile and ilmenite.

As the reserves of rutile are rather limited, special attention was given to ilmenite deposits which occur extensively in various parts of the world. The titanium dioxide industry accounts for 95% by weight of the world consumption of titanium bearing minerals, whilst the balance is used in making titanium metal, non titanium base alloys, carbides, fiber glass and chemicals.

In Egypt, huge reserves of ilmenite ore (≈ 50 million tons) are present at Abu Ghalaga mines of El-Nasr Phosphate Company - Eastern Desert. These reserves will secure continuous supply of raw material for the production of titanium dioxide from which the local market consumes $>10,000$ tons annually, thus, saving hard currency paid for its import (40 million U.S. Dollar).

The present study aims at evaluation of Egyptian ilmenite ore from " Abu Ghalaga " for the production of titanium dioxide by the sulfuric acid process. This process consists of eight stages, namely digestion, dissolution, reduction,

clarification, chilling, concentration, hydrolysis and calcination .

All the parameters affecting on the efficiency of each stage were separately studied and the optimum conditions were determined.

I.1. PRINCIPAL MINERALS OF TITANIUM

Titanium constitutes 0.61% of the earth crust. In nature it is mainly present as the dioxide or as salts of titanous acid. In its ores, titanium is present alone as the mineral rutile TiO_2 , together with ferrous oxide as ilmenite (iron metatitanate $FeTiO_3$), and together with calcium in the form of perovskite (calcium titanate $CaTiO_3$), and sphene or titanite (calcium titanosilicate $CaO \cdot TiO_2 \cdot SiO_2$).

Rutile is a mineral reddish in colour with a specific gravity of 4.18 to 4.28. The ore assays about 94-96% TiO_2 , the balance being iron oxides. Pure mineral contains as much as 99% of pure TiO_2 .

Ilmenite is the most common titanium mineral. It is brown mineral with metallic luster. Its specific gravity ranges between 4.56 and 5.21. Ilmenite deposits are found in black beach sands and in hard rock deposits usually associated with hematite or magnetite. These ores are classed as ilmenite-hematites and titaniferous magnetites. Pure mineral contains up to 59% TiO_2 .