PURIFICATION OF RUTILE IN SRI LANKAN BEACH SAND FOR THE EXTRACTION OF TiO_2 BY REDUCING IRON CONTENT

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Degree of Master of Science

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August 2024

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Materials Science and Engineering

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DECLARATION

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The above candidate has carried out research for the Master's thesis under my supervision.

Signature of the supervisor: Date: 23.08.2024

Eng. S. P. Guluwita.

Signature of the supervisor: Date: 23.08.2024

Dr. L. P. S. Rohitha.

ACKNOWLEDGMENT

I would like to pay special thankfulness, warmth and appreciation to my research supervisor, Eng. S. P. Guluwita, Department of Materials Science and Engineering not only for his guidance throughout my research but also for the knowledge and tips he has shared with me. I thank him for his encouragement that made it possible to achieve the goal and also for playing a significant role in my career development by giving me guidance and support. Next, I would like to thank Dr. L. P. S. Rohitha, Department of Earth Resources Engineering for the supervision and support throughout the project. Also my sincere gratitude to Dr. (Mrs) N. M. V. K. Liyanage and Dr. (Mrs) A. S. Galhenage from the University of Moratuwa for their immense support and academic push throughout the evaluation procedure.

I would like to thank Mr. V. Sivahar, Head of the Department of Materials Science and Engineering and all the academic and non-academic staff of the Department of Materials Science and Engineering and Department of Earth Resources Engineering for supporting us with the knowledge and laboratory facilities.

Finally, I would like to thank all the research assistants who helped to succeed of this research. I would like to give my heartiest gratitude to all of them for being with me.

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ABSTRACT

The Pulmuddai region in Sri Lanka is characterized by key constituents: 55-60% ilmenite, 6-8% rutile, and 5-6% iron. Iron's presence emerges as a critical impurity necessitating pre-extraction removal for titanium dioxide extraction from rutile. Attaining a TiO_2 purity exceeding 99% within rutile is attainable through targeted iron elimination and meticulous optimization of the purification process. The methodological approach commences with the initial screening and separation of beach sand, utilizing the Humphrey spiral technique to selectively isolate high-density minerals enriched with rutile and ilmenite. Subsequent separation of rutile from ilmenite employs a magnetic separator. The conclusive step involves the strategic removal of iron from rutile via leaching with hydrochloric acid (HCl). Optimization of leaching parameters, including the solid-to-liquid ratio (S/L ratio), HCl concentration, and reaction time, maximizes iron removal from rutile. A comprehensive analysis of samples before and after leaching employs a UV-visible spectrophotometer and scanning electron microscopy utilizing Energy Dispersive X-Ray Spectroscopy on the samples. Results indicate 83.3% reduction in iron content within rutile from the initial raw mineral, achieved under optimized conditions of 1:3 S/L ratio, 80°C, 4-hour reaction time, and 4M HCl concentration.

Keywords: *Titanium dioxide, Pulmuddai, Rutile, Purification.*

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
TiO_2	Titanium Dioxide
TEFS	Titanium-Bearing Electric Furnace Slag
HCl	Hydrochloric acid
EDX	Energy-dispersive X-ray spectroscopy
S/L	Solid to Liquid
w/w	Weight in Weight
UV	Ultraviolet
LMS	Low-intensity Magnetic Separation