شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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HANAA ALY

PREPARATION OF GEOPOLYMER BRICKS USING FINE GRANITE WASTE

By

Amal Magdy Mohammed El Sayed Abu El Seoud

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Chemical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Prof. Shakinaz Ali El Sherbiny

………………………………..

Professor
Chemical Engineering Department
Faculty of Engineering
Cairo University

Prof. Shereen Kamel Amin Kamel

………………………………..

Research Professor
Chemical Engineering and Pilot Plant Department
Engineering Research Division
National Research Centre (NRC)

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Approved by the
Examining Committee

____

Prof. Shakinaz Ali El Sherbiny, **Thesis Main Advisor**

____

Prof. Dr. Magdi Fouad Abadir, **Internal Examiner**

____

Prof. Dr. Salwa Ismail Hawash, **External Examiner**

- Emeritus professor in National Research Centre (NRC)

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Engineer's Name: Amal Magdy Mohammed El Sayed Abu El Seoud
Date of Birth: 28/12/1993
Nationality: Egyptian
E-mail: Amal.magdy2393@gmail.com
Phone: 01094278587
Address: 12 alferdos buildings, El taqa st.- Nasr city – Cairo

Registration Date: 1/10/2017
Awarding Date: …./…./……..
Degree: Master of Science
Department: Chemical Engineering Department

Supervisors:

Prof. Shakinaz Ali El Sherbiny
Prof. Shereen Kamel Amin Kamel
Research Professor – Chemical Engineering and Pilot Plant Department – Engineering Research Division – National Research Centre (NRC)

Examiners:

Prof. Shakinaz Ali El Sherbiny (Thesis main advisor)
Prof. Magdi Fouad Abadir (Internal examiner)
Prof. Salwa Ismail Hawash (External examiner)
Emeritus professor in National Research Centre (NRC)

Title of Thesis:

Preparation of Geopolymer Bricks Using Fine Granite Waste

Key Words:

Geopolymer bricks; Granite waste; Recycling; Solid waste management

Summary:

Among the main challenges nowadays are energy crisis, lack of resources and high waste generation rate that are mainly resulted from stone sector and building bricks industry. In this research; recycling technique was implied to produce green geopolymer bricks using waste fired clay bricks, fine granite waste, $Ca(OH)_2$, and NaOH. Raw materials were characterized physically, chemically, and thermally, also the product was tested according to the American Society for Testing and Materials standards. Finally; a preliminary economic study was performed to compare between the prices of product and the fired clay bricks.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Amal Magdy Mohammed Date: … /.../…

Signature:

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Nomenclature

Abbreviation	Full name
AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society for Testing and Materials
BWA	Boiling water absorption
CDW	Construction and demolition waste
CFA	Coal fly ash
CMRDI	Central Metallurgical Research and Development Institute
CWA	Cold water absorption
DTA	Differential thermal analysis
DTG	Derivative Thermogravimetry
FGW	Fine Granite Waste
HBRC	Housing and Building National Research Center
L.O.I	Loss On Ignition
MW	Moderate Weathering
NW	Normal Weathering
PM	Particulate Matter
STCE	Scientific & Technology Center of Excellence
SW	Severe Weathering
TGA	Thermogravimetric Analysis
TS	Turkish Standard Institution
UNE	Asociación Española de Normalización (The Spanish Association for Standardization)
VOC	Volatile Organic Compounds
WFCB	Waste Fired Clay Bricks
XRD	X-ray Diffraction
XRF	X-ray Fluorescence

Abstract

Among the main challenges nowadays are energy crisis, lack of resources and high waste generation rate that has a negative impact on the environment. Both stone sector (mainly granite and marble industries) and clay building bricks industry are considered two of the major sources of non-biodegradable solid wastes. By 2025; the global production of stones is estimated to be 450 million ton from which more than 30% of their volume is considered as a waste besides the waste generated form the quarrying step. Waste management techniques such as reduce, reuse, recycle, and recover must be used to mitigate their negative impact on the environment.

In this research; recycling methodology was implied using both granite waste and waste fired clay bricks (WFCB) to produce green geopolymer bricks. The characteristics of both granite waste and WFCB were obtained through screen analysis, true density determination, XRD, XRF, TGA and DTG analyses. Geopolymer blocks were prepared using different granite waste percentages in which portion of WFCB is replaced by several percentages of granite waste (0 to 35%), then activation is performed by adding $Ca(OH)_2$ and NaOH with percentages 8 and 0.5% respectively. These blocks were cured at room temperature for 3, 7, 14 and 28 days then their bulk density, cold and boiling water absorption, saturation coefficient, apparent porosity and compressive strength were determined. The optimum granite percentage was determined according to the American Society for Testing and Materials (ASTM) standards.