



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم



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شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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Studies on the Application of Eco-friendly Geopolymer as a Binder for Refractory Castables

Ph.D. Thesis

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**Chemistry Department – Faculty of Science-Ain Shams
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كلية العلوم – قسم الكيمياء

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قَالَ تَعَالَى: ﴿وَمَا تَكُونُ فِي شَأْنٍ وَمَا تَتْلُوا مِنْهُ مِنْ قُرْءَانٍ
وَلَا تَعْمَلُونَ مِنْ عَمَلٍ إِلَّا كُنَّا عَلَيْكُمْ شُهُودًا إِذْ
تُفِيضُونَ فِيهِ وَمَا يَعْزُبُ عَنْ رَبِّكَ مِنْ مِثْقَالِ ذَرَّةٍ فِي
الْأَرْضِ وَلَا فِي السَّمَاءِ وَلَا أَصْغَرَ مِنْ ذَلِكَ وَلَا أَكْبَرَ
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LIST OF ABBREVIATIONS

AP	: Apparent porosity
ASTM	: American Standard Testing material
Atm.	: Atmosphere
BD	: Bulk density
CA	: Calcium aluminate
CA ₂	: Di calcium aluminate
CAC	: Calcium aluminate cement
CCS	: Cold crushing strength
CTE	: Coefficient of thermal expansion
CVD	: Chemical vapor deposition
GGBFS	: Ground granulated blast furnace slag
HAC	: High alumina cement
L.E.	: Livre Egyptienne
LC	: Linear change
LTE	: Linear thermal expansion
PLC	: Permanent linear change
PSD	: Particle size distribution
RUL	: Refractoriness under load
SEM	: scanning electron microscopy
TE	: Thermal expansion
TGA	: Thermogravimetric analysis
TSR	: Thermal shock resistance
WA	: Water absorption
XRD	: X- ray diffraction
TDS	: Technical data sheet
EDX	: Electron dispersive spectroscopy

List of Abbreviations

XRF	: X-ray fluorescence
CPTF	: Cumulative percent finer than

Abstract

Abstract

This study aims to investigate the feasibility of using alkali-activated slag cement as a sole binder for refractory castables. Ground granulated blast furnace slag (GGBFS) and sodium carbonate were used as a precursor and as activator, respectively. A combination of silica fume and slaked lime was used as an accelerator to enhance the strength of alkali-activated slag cement. Phase change in refractory castables containing different percentage of dry powder alkali-activated slag (AAS) and high-alumina cement (HAC) at different firing temperatures and its effect on physico-mechanical properties were studied. Different percentage of one-part geopolymer slag replaced HAC in the mix design of refractory castables.

The prepared castable samples were subjected to different firing temperatures namely, 850, 1100 and 1300°C for 6 h after drying at 110°C for 24 hours. The mineralogical compositions of the fired castables were investigated using X-ray diffraction (XRD) analysis. The microstructure of some selected fired castable samples were examined using scanning electron microscope (SEM) attached with energy dispersive X-ray unit (EDX). Also, bulk density, porosity, water absorption, cold crushing strength, mechanical properties, thermal shock resistance, Refractoriness under load as well as permanent linear change (PLCs) were tested. The results revealed that no significant change in phase