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RECYCLING OF SOME INDUSTRIAL BY-PRODUCTS IN THE PREPARATION OF BLENDED CEMENT

BY

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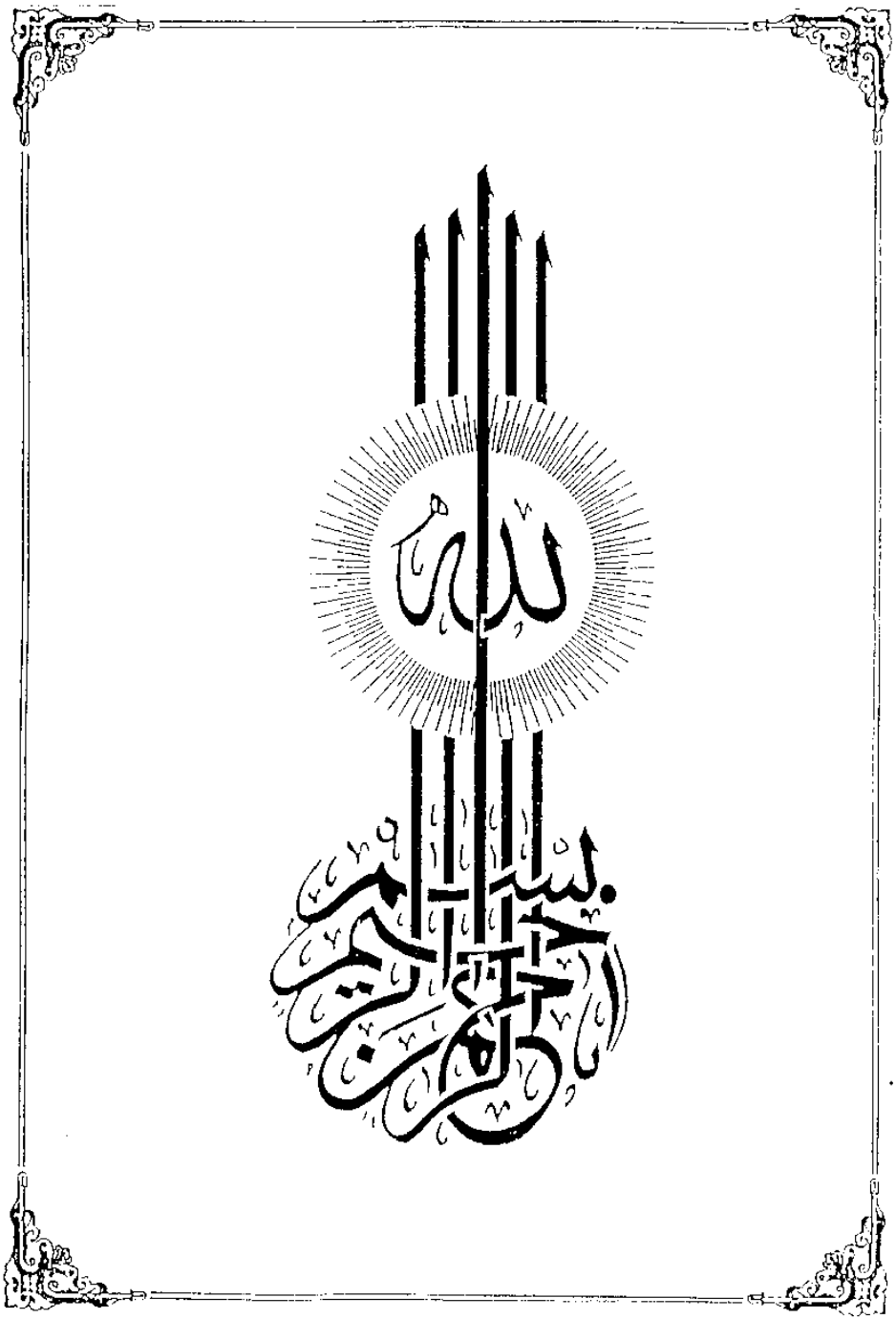

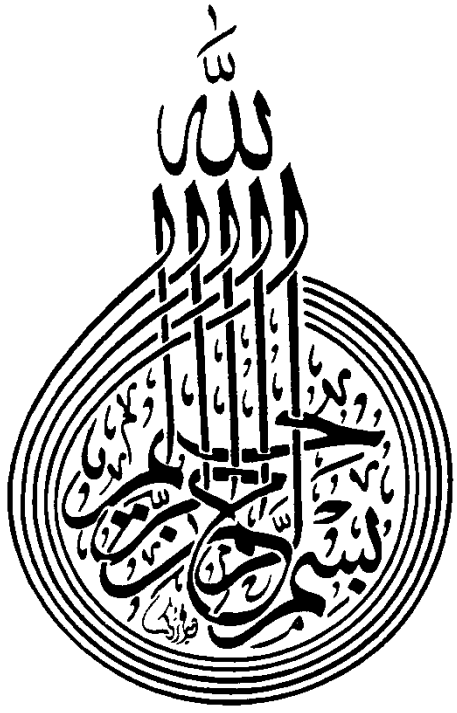

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ABSTRACT

RECYCLING OF SOME INDUSTRIAL BY-PRODUCTS IN THE PREPARATION OF BLENDED CEMENT (M.Sc. THESIS), Submitted by Chemist: **Tarek Moustafa El-Sokkary**, B.Sc.(1984), Mansoura University, Geology/Chemistry Department, Chemist in Soil Mechanics and Foundation Department .at **Housing and Building Research Center, Dokki - Cairo**.

The materials used in this work were cement kiln dust from the dry process, condensed silica fume (Kom-Ombo), Ordinary Portland, slag as well as Karnak cements provided from Helwan Cement Company. The effect of leaching and firing of dry cement dust on the sublimitation and removal of the alkali oxides Na_2O, K_2O as well as Cl^- and SO_3 was studied . Blended cements were prepared from each type of cement with various prportions from fired as well as wet cement dust and silica fume. The Kinetics of hydration of the cement pastes such as the liberated free lime and combined water contents were determined as a function of curing time up to 90 days. Also, the water of consistency, initial and final setting times, as well as bulk density and compressive strength of hardened cement pastes were measured. It can be concluded that the washed and fired dry cement dust at 1350 ^oC can be used in the presence of silica fume for the activation of slag cement . Also, the raw wet cement dust can be used up to 5% in the preparation of blended cements from ordinary Portland , slag and Karnak cement . The liberated $Ca(OH)_2$ was consumed by the condensed silica fume whereas the addition of washed and fired as well as raw wet cement dust tends to increase the liberated $Ca(OH)_2$ which increases with the amount of added cement dust . The fired cement dust incraesas the mechanical properties of slag cement and decreases that of ordinary as well as Karnak cements .

***Key Words :** **O.P.C : Ordinary Portland Cement**
SL.C : Slag Cement
K.C : Karnak Cement

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1.1. Introductory Remarks

The word "cement" denotes any kind of binding agent. This definition includes a wide variety of substances having little in common with one another but adhesiveness. However, materials most commonly associated with this word are hydraulic cements of which Portland cement is the most familiar. The use of cement is very old.The ancient Egyptians used calcined impure gypsum. The Greeks and Romans used calcinated limestone and late learned to add to lime and water, sand and crushed stone or bricks.

Portland cement is manufactured by intimately mixing a calcareous (lime-containing) and argillaceous (clay-containing) materials which can be done either in water (wet process) or in dry (dry process). After mixing and grinding of the raw mixture it is burned at a clinkering temperature, up to 1450 ^{o}C. The product of the rotary kiln is called cement clinker, which is cooled,mixed with a few percent of gypsum and ground to a very fine powder.

The main constituents exist in the cement clinker are : -

Tricalcium silicate	3 CaO. SiO_2, (C_3S)	"Alite"
β-Dicalcium silicate	β-2CaO.SiO_2 (C_2S)	"Belite"
Tricalcium aluminate	3 CaO.Al_2O_3, (C_3A)	
Tetracalcium aluminoferrite	4 CaO.Al_2O_3.Fe_2O_3	(C_4AF)

These four compounds occur together to the extent of about (90%) of the cement by weight with some free CaO, MgO, Na_2O, K_2O. SO_3 and few other trace elements [(Lee,1970), (Taylor,1964)].

Several types of Portland cement are manufactured having different characteristics.The most important standard types of Portland cement are (Neville,1981) :-

* ***Normal or Ordinary Portland Cement*** : This is a general purpose cement, suitable for all uses when the special properties of other types are not required. The cooled clinker typically contains four compounds in the approximate proportions (Neville,1981).

Tricalcium silicate , (C_3S)	= 55%
β-Dicalcium silicate, β-(C_2S)	= 20%
Tricalcium aluminate, (C_3A)	= 10%
Tetracalcium aluminate ferrite(C_4AF)	= 10%

* ***High-Early Strength Portland Cement*** : This cement is used when early strength is required. It is ground to a higher fineness than ordinary Portland cement which is usually ground to a specific surface area of 2500 to 3000 cm^2/g compared with at least 3300 to 4000 cm^2/g for this type.

* ***Low Heat Portland Cement*** : This is a special cement for use where the amount and rate of heat generation must be kept very low. It is used in the construction of massive structures such as dams. This type of cement has a strict composition where the maximum C_3A is limited to 7 % whereas the β-C_2S should not be less than 40 % (Neville,1981).

* ***Sulphate - Resisting Portland Cement*** : This cement is used only in structures exposed to severe sulphate action. It is manufactured in the same way as Portland cement, except that the iron content is increased to reduce the percentage of tricalcium aluminate to below the 3.0% and the SO_3 content to 2.5%