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USE OF MEAT AND BONE MEAL ASH IN CEMENT BASED MATERIALS

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بسم الله الرحمن الرحيم

"إن الله لا يضيع أجر من أحسن عملا"

صدق الله العظيم

Thanks God,
My parents, my husband,
My sons and my sister

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ABSTRACT

Quantities of bone wastes have been on the rise in recent years after the bovine spongiform encephalopathy (BSE) crisis, which contracted cows and buffaloes all over the world specially Europe, and can no longer be used to feed cattle and must be safely disposal of or transformed. So, the best option became the incineration which produces huge amount of ash that should be managed by using in several applications as industry, agriculture, fuel, and in construction field, which is considered a suitable solution to manage these ashes and to protect the surrounding environment from the hazardous elements which leach by the conventional methods of disposal. Also, it is considered an economic solution because of saving the high tax of landfill.

This thesis studied the potential of using bone ash and meat and bone meal (MBM) bottom ash in construction field. The physical and chemical characteristics of bone ash and MBM bottom ash were presented. The experimental program was design to study the effect of using bone ash and MBM bottom ash in concrete as sand replacement with substitution levels from 0 to 100%, or as cement replacement with substitution levels from 0 to 30%. The effect of using the two types of ashes on the mechanical properties of concrete (compressive strength, splitting tensile strength and flexural strength) was investigated. The durability of

concrete incorporating ash was investigated for concrete specimens submersed in acid solution by concentration of 2% for 90 days after curing. The environmental impacts of the concrete incorporating MBM bottom ash were studied by carrying out leaching tests, to determinate the quantities of leachable elements.

The results of the compression tests indicated that the concrete mix incorporating 30% of MBM bottom ash in the dry state as sand replacement was the optimum mix. The result of the compressive strength of the optimum mix was approximately equal to that of the control mix which contained no ash. The result of the flexural strength of the optimum mix was 73.7% of that of the control mix, while the result of the splitting tensile strength of the optimum mix was 85.3% of that of the control mix.

The best results of the compressive strength for the four cases ; using MBM bottom ash as sand replacement in saturated state, the case of using bone ash as sand replacement in the dry and the saturated states, and the case of using MBM bottom ash in the saturated state as cement replacement were for the substitution level of 10%.

The results of the durability test indicated that the decrease in compressive strength of concrete specimens incorporating MBM bottom ash which were submersed in the acid solution for 90 days after hardening was approximately equal to that of the control mix under the same conditions.

The results of the leaching test indicated that when bone wastes (bone ash and MBM bottom ash) were used in concrete as sand replacement either

in the dry state or the saturated state, and as cement replacement in the saturated state, the quantities of leachable elements are considered either non-hazardous element or inert element which means that there is no harmful environmental impacts from using bone waste in concrete.

This thesis consists of five chapters as follow:

***Chapter 1*: "Introduction"**

***Chapter 2:* "Review of literature"**

***Chapter 3*: "Experimental Work"**

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***Chapter 4*: "Test Results"**

***Chapter 5*:" Conclusions and Recommendations"**

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