A STUDY OF SELF COMPACTING CEMENTITIOUS SYSTEMS USING WHEAT STRAW (TOORI) ASH AND CALCINED BENTONITE

A STUDY OF SELF COMPACTING CEMENTITIOUS SYSTEM USING TOORI ASH AND CALCINED BENTONITE

By

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ABSTRACT

Self Compacting Cementitious Systems (SCCS) is the modern technology of this decade. Secondary Raw Materials (SRM's) form the basic ingredients along with chemical admixtures in SCCS/HPC. Extensive successful research work has been carried out throughout the world on use of secondary raw materials in self compacting cementitious systems and now this practice is quite popular. However, in Pakistan, research is being carried out in phases on pozzolanic materials like Wheat Straw (Toori) Ash, Rice Husk Ash, Ground Granulated Blast Furnace Slag, Glass Powder, Metakaolin, and Bentonite. Accordingly, their usage in the self compacting cementitious systems will take place when the results on local SRM's would be known to practitioners. This study was made to evaluate the feasibility of using Bentonite (BN), a naturally occurring pozzolan and Wheat Straw (Toori) Ash, an artificial pozzolanic material, in single component self compacting paste system with ultimate aim to produce three components self compacting concrete with desired properties. The parameters studied include secondary raw material's particle characterization, flow behavior, strength development, resistance to water absorption and acid attack, x-ray diffraction (XRD) study and microstructural analysis by scanning electron microscopy (SEM) and Mercury Intrusion Porsimetry (MIP).

The results showed that particle characterization of secondary raw materials affects the water demand and super plasticizer demand of self compacting paste system. While the shape, size and surface texture of secondary raw materials along with their chemical and physical properties all have vital effects on the flow behavior, strength and durability. The rate of strength gain of self compacting cementitious system is also an important aspect besides the strength level at a specified age as it varies with the type of secondary raw material being used. Furthermore, the addition of secondary raw materials in replacement mode reduces the permeability of the hardened paste and thus enhances its resistance against sulfate attack. The results show that both secondary raw materials investigated, can be successfully used in self compacting cementitious systems as each contributes positively towards enhancement of certain properties of SCP and the use of SRM's blends can further optimize the response of self compacting concrete system.

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LIST OF NOTATIONS

AASHTO	American Association of State Highway and Transportation Officials
Afm	Aluminate Ferrite monosulfate or Alumina, Ferric oxide, mono-sulfate or Al_2O_3 – Fe_2O_3 – mono
Aft	Aluminate Ferrite Trisulfate or Alumina, Ferric oxide, tri-sulfate or Al_2O_3 – Fe_2O_3 – tri
ASTM	American Society for Testing and Materials
WSA	Wheat Straw Ash
BN	Bentonite
C_2S	Di – Calcium Silicate
C_3A	Tri – Calcium Aluminate
C_3S	Tri – Calcium Silicate
C_4AF	Tetra – Calcium Alumino Ferrite
CH	Calcium Hydroxide
CSH	Calcium Silicate Hydrate
EDAX	Energy Dispersive X – ray Analysis
FHWA	Federal Highway Administration
HPC	High Performance Concrete
ITZ	Interfacial Transition Zone
KPK	Khyber Pukhtoon Khwa
MIP	Mercury Intrusion Porosimetry
NVC	Normal Vibrated Concrete
OPC	Ordinary Portland Cement
PCE	Polycarboxylate ether
SCC	Self Compacting Concrete
SCCS	Self Compacting Cementitious Systems
SCM	Self Compacting Mortar
SCP	Self Compacting Paste
SP	Super Plasticizer
SRM	Secondary Raw Material
TA	Toori Ash

VMA	Viscosity Modifying Agent
w/c ratio	Water Cement Ratio
w/p ratio	Water Powder Ratio
XRD	X – Ray Diffraction

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