Effect of Methyl Cellulose Admixture on Durability Properties of Rice Husk Ash Polymer Modified Concrete (A new approach)

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Abstract: This paper investigates and addresses the effect of Methyl Cellulose on durability properties of Rice Husk Ash Polymer Modified Concrete. Concrete mixes were prepared, i.e. Control Mix (CM), Rice Husk Ash blended Concrete (10% cement replacement with rice husk ash) and Rice Husk Ash Polymer Modified Concrete (RHAPMC) prepared by replacing 10% cement with the extracted rice husk ash and the addition of 2.5% re-dispersible polymer powder (RPP) by the weight of cement. To investigate the effect of Methyl Cellulose (MC) in RHAPMC, the addition of MC from 0.1 to 1.1 % by the weight of cement was used. MC has a significant impact on unit weight as well as in permeability of RHAPMC. The modified concrete became light weight with the addition of MC. A significant improvement in impermeability of RHAPMC at 0.1% dosage of MC has been observed.

Keywords: *Methyl Cellulose, Rice Husk Ash, Re-dispersible Polymer Powder, Permeability*

1. Introduction

Researchers are trying to alter the fundamental properties of concrete to make a strong and long lasting concrete. An entirely new composite of concrete, i.e. rice husk ash polymer modified concrete prepared by [1]. Authors [2] investigated the effect of Methyl Cellulose (MC) in rice husk ash polymer modified concrete and concluded that it has favourable effects in tensile strength but has adverse effect in compressive strength of the concrete. Dry-mix mortars water retention additives play a collective and effective role in state of art building products [3]. Their job is to avert abandoned water loss into porous substrates such as brick, lime stone, and aerated concrete. Cellulose ethers control industrial market due to their suitable cost usefulness and their good environmental compatibility [4].

The first report on the preparation of methyl cellulose and its derivate originate from Lilienfeld [5] and Dreyfus [4].Main existing applications of cellulose ethers comprise wall renders and plasters, joint compounds for gypsum board paneling, cementitious tile adhesives , floor screeds, self-leveling under-layments and water-proofing membranes [5].When mortars are dried state, cellulose ethers assist to offer water holding and viscosity. Some types retard Portland cement hydration severely[6, 7]. The effect depends on the specific composition (e.g. degree and type of substitution) of the cellulose ether. Application dosages possibly will range between 0.1 and 1.5% by weight of binder, subject to the anticipated properties. Methyl hydroxyethyl cellulose (MHEC also called as HEMC) has been used successfully due to their various advantages and methyl hydroxypropyl cellulose (MHPC) [8-10]. The main application of MHEC is an auto-leveling flooring and cementitious tile adhesives.

This paper encompasses the new approach of addition of Methyl Cellulose (MC) in rice husk ash polymer modified concrete and to investigate its effect in terms of permeability.

2. Materials and Methods

2.1. Materials

OPC confirming to ASTM C 150 type I was used in this experimental work. For preparation of concrete, fine and coarse aggregate having maximum size of 4.75 mm and 19 mm respectively, has been used respectively. The extracted rice husk ash meeting the ATSM 618-03 requirement for a supplementary cementing material has been used in this study. The physical, chemical properties and the amorphous nature of RHA are shown in Table 1 and Fig. 1 [2], respectively. GinShicel MH256-ALX3, which is a high viscosity grade of Hydroxy Propyl Methyl Cellulose also known as HPMC/MHPC, is used throughout in this research work. The Chemical and Physical characteristics of the HPMC are summarized in Table 2.

Water re-dispersible EVA powder (VINNAPAS 5044 N) is manufactured by Wacker has been used as a cement

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modifier and for maintaining the fluidity of the concrete Sulfonated Melamine Formaldehyde (SMF 10) used as a plasticizer.

2.2 Mix proportions of concrete specimens

All concrete mixes, i.e. Control Mix (CM), RHA blended concrete (10% cement replacement) and RHAPMC (10% cement replacement with RHA and addition of 2% RPP) were prepared as per mix design as shown in Table 3. To examine the influence of HPMC of on density and water penetration properties of RHAPMC, the concrete specimens prepared by adding varying proportion of HPMC dosages in RHAPMC. The details are shown in Table 3.

2.2.1 Preparation of specimens

Total 27 cubical specimens of size 150 x 150 x 150 mm were cast for permeability test. The moulds were demoulded after 24 hours. CM and RHA blended concrete samples were kept 28 days for curing and the specimens prepared from RHAPMC having varying proportion of HPMC were kept in alternative 7 days wet and 21 air dry curing.

2.2.2 Permeability determination

Permeability of all types of concrete was determined after 28-days cured age as stipulated by Torrent Permeability Tester).

Table. 1. Characteristics of an extracted RHA [2]

Material	**Physical Properties**	**Chemical**							
	Spe: Gravity	**Blaine (cm^2/g)**	**SiO_2**	**Al_2O_2**	**Fe_2O_3**	**CaO**	**MgO**	**K_2O**	**LOI**
RHA	2.05	2251	70.38	1.59	0.86	3.19	3.32	2.88	4

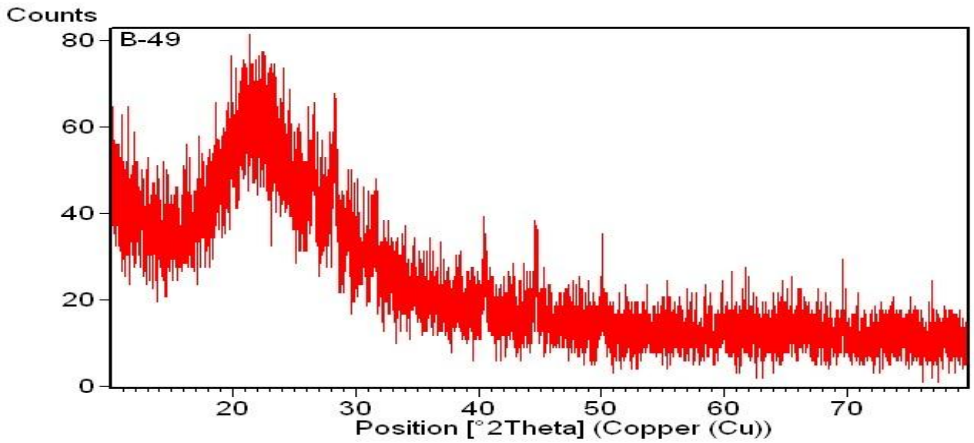

Figure.1. X-ray diffraction pattern of RHA [2]

Table. 2. General specification of methyl cellulose

Specifications	
Powder	
Appearance	Whitish Powder Or Granules
Particle Size	99%<250µm
Water Content Max	5
Ash Content Max	3
Hydroxypropyl Content	4-12%
Methoxyl Content	19-24%
Packing	25kgs

Table. 3. Concrete mix proportions

Concrete Mix	(Kg/m^3)					MC %age	MC (Kg /m^3)	W/C	(Kg/m^3)		
	Cement	RHA	RPP	T. Binder	Plasticizer				Water	F.A	C.A
CM	346	0	0	0	0	0	0	0.55	206	623	1038
RHA Concrete	311	35	0	0	0	0	0	0.55	206	623	1038
RHAPMC	311	35	8	346	2.8	0	0	0.55	206	623	1038
RHAPMC M1	311	35	8	354	2.8	0.1	0.31	0.55	206	623	1038
RHAPMC M2	311	35	8	354	2.8	0.3	0.93	0.55	206	623	1038
RHAPMC M3	311	35	8	354	2.8	0.5	1.55	0.55	206	623	1038
RHAPMC M4	311	35	8	354	2.8	0.7	2.18	0.55	206	623	1038
RHAPMC M5	311	35	8	354	2.8	0.9	2.80	0.55	206	623	1038
RHAPMC M6	311	35	8	354	2.8	1.1	3.42	0.55	206	623	1038

3. Results and Discussion

3.1. Permeability

The mean permeability of CM, RHA blended concrete and Rice Husk Ash Polymer Modified Concrete (RHAPMC) mix cast with replacement of cement with 10% of RHA, addition of 2.5% re-dispersible polymer and addition of HPMC with dosage from 0.1- 15 % were tested are shown in Table 4 and Fig.2. Table 4 & Fig. 2 show the permeability of the all mixes. When cement is replaced with rice husk ash the impermeability of rice husk ash blended concretes lightly decreases due to un-controlled burning of the rice husk. Furthermore, the addition of the re-dispersible polymer powder causes a considerable decrease in the impermeability of rice husk ash polymer modified concrete due to air entrapping in the concrete. Addition of methyl cellulose has both negative and positive effect on permeability of the mixes. It can be seen that at 0.1% addition of MC dosage in RHAPMC causes a significant increase in the impermeability of RHAPMC and on further addition the impartiality of concrete decreases.

Table. 4. Permeability of concrete mixes

S.No	Concrete Mix	Admixture %			Coefficient of air permeability (KT) 10^{-16}
		RHA	SMF	RPP	
1	CM	0	0	0	0.023
2	RHA Concrete	10	0	0	0.0345
3	RHAPMC	10	0	2.5	0.207
4	RHPMC0.1	10	0.8	2.5	0.0265
5	RHPMC0.3	10	0.8	2.5	0.261
6	RHPMC0.5	10	0.8	2.5	0.3225
7	RHPMC0.7	10	0.8	2.5	0.38
8	RHPMC0.9	10	0.8	2.5	0.4775
9	RHPMC1.1	10	0.8	2.5	2.365

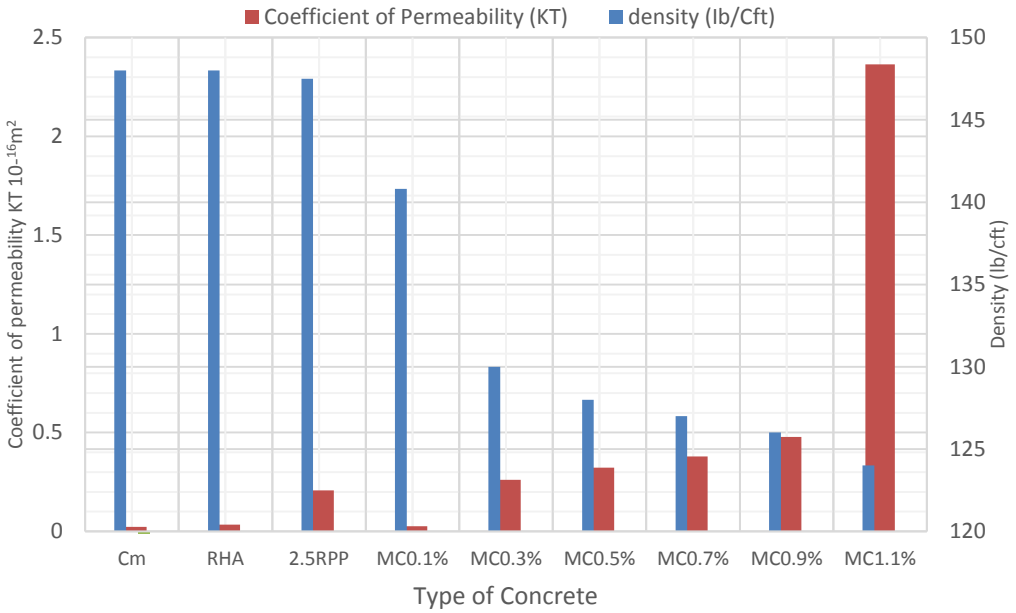

Figure.2 Coefficient of permeability and density of concrete mix

3.1. Density

The Fig.2 shows that there is a continuous decrease in density of the concrete. The mixes concrete became light weight with the addition of Methyl Cellulose dosages. The loss in weight of concrete is solely due air entrapping effect of the concrete.

4. Conclusion

- At 0.1 % addition of the HPMC by the weight of cement a significant improvement in the impermeability of RHAPMC has been observed but at the further addition of methyl cellulose causes decrease in the impermeability.
- A decreasing trend in loss of weight in concrete has been found.

Acknowledgment

The authors express their thanks to Civil Engineering Department QUEST Nawabshah for necessary support.

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