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Original Research Article

FLOW PROPERTIES STUDY OF MORTARS USING FLY ASH AND LIME

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ABSTRACT:

Due to developing in construction industrial, Energy-efficient, economical and durable building materials are essential for sustainable construction practices. Fly ash is being used in cement and building material industries. In the present investigation fly ash and lime is used with cement mortar to study various properties like flow on different proportion of mortars.

Keywords: flow properties, fly ash, lime, strength character of cement.

INTRODUCTION

The number of studies is made on flow and strength characteristics of cement and fly ash mortar but use of fly ash and lime with cement mortars and finding out the compressive strength ratio and stress strain characteristics of these mortar's are not made so far. R.C. Joshi and T.S. Nagaraj in (1990), they conducted experiment by optimizing the level of cement replacement by fly ash in cement fly ash mortar for flow table test. In this test, for any specific flow, a decrease in water content of the mix increase in number of drops. As the replacement of cement by fly ash is increased in any mix, there was progressive reduction in water requirement to cause some percentage flow. The slope of the flow lines gradually decreases with increasing fly ash content. And the generalized relationship for constant flow of 200% was w1/w25= 1.7216-0.5151 log N. The relative maximum shift in water content in relation to cement paste directly indicates the reduction in water content for cement replacement by fly ash. The experimental data suggest that the data obtained for pastes can be extended to mortars. Chindaprasirt, etal in 2004, they conducted experiment using class F fly ash with two fineness a original fly ash and a classified fly ash wit median particle size of

19.1 and 6.4µm respectively were used as partial replacement of Portland cement at 20% and 40% by weight. The water to binder ratio of 0.35 was used for all the blended cement paste.

MATERIAL PROPERTIES

Cement: Ordinary Portland cement 43 grade tested according to IS: 8112-1989 and the physical properties of the cement tested and results obtained were as follows: Specific surface area 343m^2 /kg, Normal consistency 33%, Initial setting time 202min and final setting time 480 min, Specific gravity 3.18 and Density of cement 3.10 gm/cc. The test done for 43 ordinary Portland cement tested for physical properties was confirmed to IS 8112-1989 for all the above tests and it was within limit. The initial setting time of cement was more than 80 minutes as specified in standards and the specific surface area and specific gravity obtained was higher.

Sand: The sand was sieved using 4.75mm and the fraction passing 4.75mm was used for all experiments. The physical properties were specific gravity and gradation of sand as per IS: 383-1970 tested. The sand belongs to zone -II as per IS: 383-1970.The specific gravity of sand is 2.8.

The particle size distribution graph shows that the sand contains more percentage of finer particles and less coarser particles. This indicates that the greater percentage of finer particle of sand has the ability to improve the mortar properties. The percentage fraction obtained from each sieve size was according to IS 383-1970 and there was no silt content in sand.

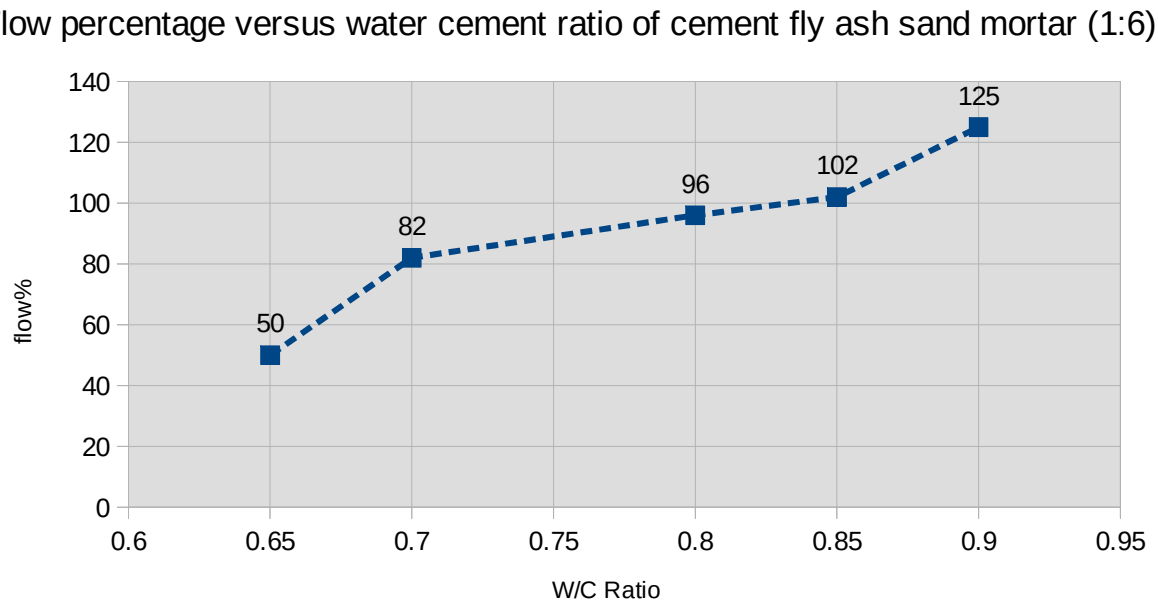
Lime: The raw lime was slaked fully into powder form. And allowed to cool for room temperature. Then it was kept in air tight bag to see that lime does not react with moisture in air and thus to avoid carbonation taking place. The slaked lime was sieved using 300micron and the fraction passing through it was used for all the experiment. The physical properties tested and results were specific surface area 591m^2 /kg, specific gravity 2.1 and density of lime 1.98gm/cc.As the lime has a greater specific surface area it shows that it has ability to bind the other particle and has capability to reduce the water content when mixed in mortar.

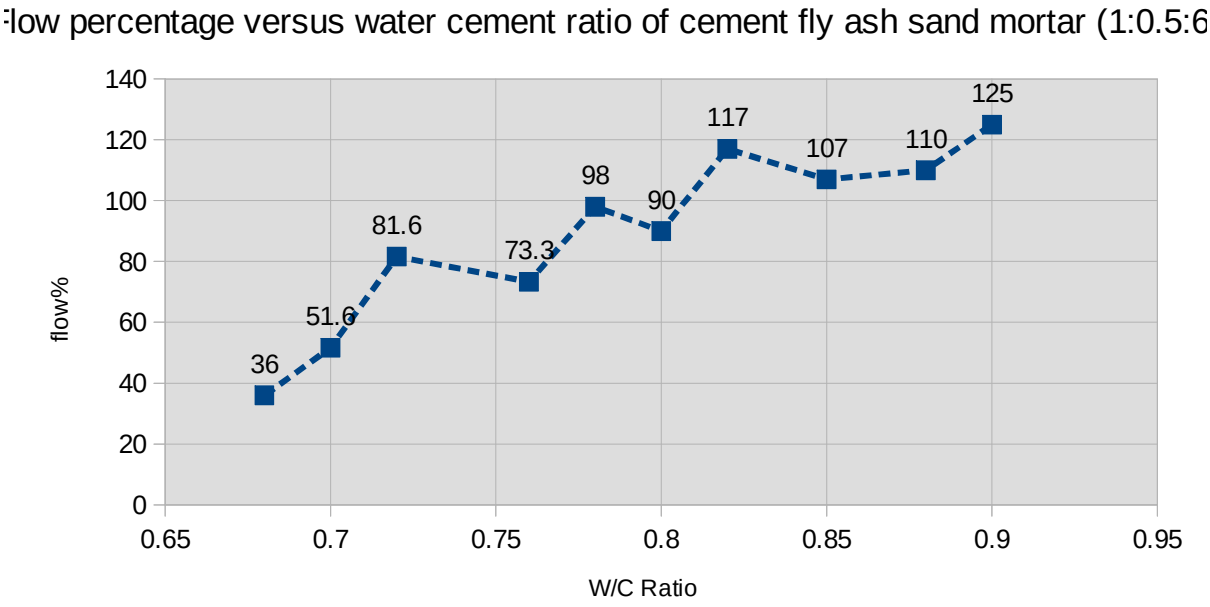
Fly Ash: Fly ash was procured from NTPC Seepat Bilaspur CG, was used in experiments and also used for casting of blocks. The physical properties tested and results obtained were lime reactivity 4.0 N/mm^2, specific surface area 452m^2/kg, specific gravity 2.2 and density 2.13 gm/cc. As per IS: 1727-1967, the reactivity of fly ash with lime was carried out and the result obtained was 4.0 N/mm^2 which was confirmed to IS 3812-1981. The specific gravity was 2.2 which confirms to IS 3812-1981.

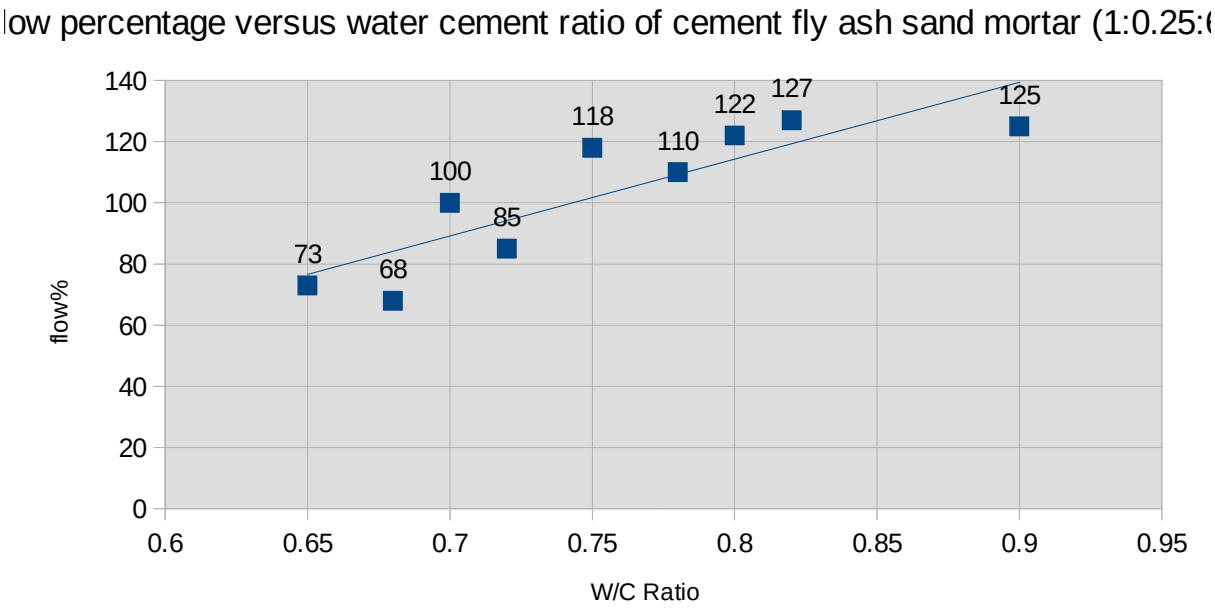
RESULTS : In this investigation four types of mortars were used. The ratio of cement sand was kept constant at 1:6 and other cementitious materials lime and fly ash were added to

cement mortar by varying their proportions. The composite mortars tried are cement fly ash mortar (1: 0.5: 6) and cement lime mortar (1: 0.25: 6 and 1: 1: 6). These mortars were tested for their flow consistency, strength and elastic properties.

Workability Test: Workability of fresh mortar mixes were determined by flow table test as per IS: 2250 – 1981. Water cement ratio for a flow of 75 percent was considered for casting of mortar in prisms, since literature review showed that 75 percent flow gives maximum bonding and hence maximum compressive strength. The graph of flow percentage versus water cement ratio was plotted:







Flow obtained for different mortars shows that some of the mortars has achieved greater flow with less water cement ratio. Due to addition of lime or fly ash to conventional cement mortar the specific surface area of these materials reduced the water content and making the mortar more workable within available water content and induces greater flow table spread. The flow percentage obtained for cement fly ash mortar was higher with less water cement ratio than the flow percentage obtained for cement sand mortar and cement lime mortar is higher with higher water cement ratio. **Flow characteristics of mortars:** As the flow % increased beyond 75% the compressive strength decreased at 7day, 14day and 28 day strengths. For cement fly ash sand mortar of 1: 0.5:6 ratio the compressive strength at 72% flow was 8.36Mpa and it decreased to 5.91MPa as the flow value increased to 104% which is a decrease of 37%. For Cement lime mortar of 1:1:6 ratio the compressive strength at 73% flow was 6.12MPaand it decreased to 4.08MPa as the flow was increased to 98 %. For Cement lime mortar of 1:0.25:6 the compressive strength measured for a flow of 73% was 6.63MPa and it decreased to 4.89MPa as the flow value increased to 100%. This is a decrease of 39%.

CONCLUSION

The workability of cement sand mortar (1:6) has achieved 75% flow with water cement ratio of 0.7 which is greater than the flow percentage achieved by cement fly ash mortar(1:0.5:6) and cement lime mortar(1:1:6 and 1:0.25:6) having water cement ratio around 0.65. The addition of fly ash 50% weight of the cement in cement sand mortar resulted in reduction of water cement ratio by 10% and the workability of mortar was improved by 23%.

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