

# Laboratory Investigation of Portland Pozzolona Cement (PPC) with Hot Mix Plant Filler Material (HMPFM)

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## ABSTRACT

Hot Mix Plant Filler material (HMPFM) is the unexploited product of asphalt plant having very fine size of particles. There is immense problem of disposal of this material. This HMPFM is also causes pollution problem as well as health problem to the workers of the plant. In current research work the HMPFM is replaced with Pozzolona Portland cement (PPC) and its mechanical properties were tested. During this research work it was found that the initial setting time of PPC with HMPFM is reduces by 16.67% than PPC without HMPFM, final setting time of PPC is reduces up to 57.86% than PPC without HMPFM. The soundness also reduces by 30% & compressive strength of PPC is increases by 15.22% than cement without HMPFM. HMPFM help to increases the early strength development of PPC

**Keywords :** *Hot Mix Plant Filler Material, asphalt, PPC, soundness, Compressive test, Nano particle.*

## 1. INTRODUCTION

Pozzolona Portland Cement (PPC) regeneration as supplementary cementing materials like fly ash in Portland cements and may replace part of the clinker in order to modify the performance of the hydrated cement. When Cement clinker is produced there is important amount of CO<sub>2</sub> emitted from the Chemical reaction of the limestone. [1]. In order to reduce the emission of CO<sub>2</sub>, reduction of the cement amount in concrete production and usage of pozzolans like fly ash is an advantage [2]. There was problem in strength gaining in early stages of hydration process of PPC. Along with this the Initial Setting Time (IST) and Final Setting Time (FST) is also large as compare to Portland cement [3-4]. The hot mix asphalt (HMA) industry has been pressured in recent years to incorporate a wide variety of waste materials into HMA pavements. This has raised the following legitimate concerns: (a) engineering concerns such as effect on the engineering properties (for example, strength and durability), impact on production, and future recyclability; (b) environmental concerns such as emissions, fumes, odor, leaching, and handling and processing procedures; and (c) economic concerns such as life cycle costs, salvage value, and lack of monetary incentives. [6-7]

HMPFM is a raw material from the asphalt industry. This material is available in form of powder which having size in very fine. There is major problem of disposal of this HMPFM. Due to small size particles it creates environmental

pollution. It also causes ill effect on health of workers like asthma, breathing problem. There is big challenge to use this type of material as construction material. On the other hand, it has great potential to use as construction materials. This material is having resemblance properties with fly material. The hot mix plant filler material is unused materials which is waste product of hot mix plant. For plant management disposal of HMPFM really a large problem. In this research work the properties of Portland Pozzolona Cement (PPC) were investigated with HMPFM. The finding of this work is having some novelty as it increases the initial strength gaining of PPC.

We are using waste HMPFM which partially replaces cement as 5%, 10%, and 15% of weight of cement. This partial replacement of cement with waste HMPFM improves the properties of cement in various ways. In this research our main objective is to study the influence of partial replacement of cement with HMPFM, and to compare it with the property of PPC without HMPFM. We are also trying to find the percentage of HMPFM replaced in cement that gives the optimum properties of PPC. Now-a-days HMPFM has become a pollutant. So, partially replacing cement with HMPFM, we are proposing a method that can be of great use in reducing pollution to a great extent and try to diminish the limitations PPC and improve the performance of PPC over the boundary conditions

## 2. Materials and Methods

**2.1 Cement:** Confirming to IS 1489 part 1-1991[10].

**2.2 Sand:** Confirming to IS 383-1970 is used for this experimental work [11].

**2.2 Hot Mix Plant Filler Material:** HMPFM is the product obtained from the whole process of bitumen plant. It is raw material of the HMPFM in the form of fine particle. This is the very fine particles. The aggregates are used in the bitumen for the construction of roads, and the finest particles which are not used called as HMPFM. This is not used anywhere or in any construction purpose. HMPFM is black in color which is very fine of powdered form. This Material does not have the binding property.



Fig 1 Hot Mix Plant Filler Material Particles (HMPFM)

**2.4 Methodology:**

In this research work physical testing of HMPFM and PPC is performed. The percentage of replacement of PPC by HMPFM is varies as 0%, 5%, 10% and 15%. The test perform are Fineness, Soundness, Consistency test, Initial Setting Time (IST), Final Setting Time (FST) as per IS 4031 and Compressive Strength test as per IS 516. The results are compare with the normal cement test.

### 3. Result and Discussion

The replacement of PPC by using HMPFM as various percentages from 0%, 5%, 10%, 15% is done. The results of mechanical properties of PPC are compared. This comparison is tabulated and the graphs showing the comparison are plotted. Normally the PPC take more setting time to set. It has low initial strength. PPC having adequate soundness, consistency. The compressive strength of PPC is good in harden stage after 28 days curing. The incorporation of HMPF does not causes large difference in fineness and consistency. The other properties like IST, FST, and Soundness & Compressive Strength are changes considerably.

Table 1 Comparison of Test Conducted

Sr no	Test Replacement	Fineness (%)	Consistency (%)	IST (min)	FST (min)	Soundness (mm)	Compressive Test(N/mm <sup>2</sup> )		
							3 days	7days	28 days
1.	0% Replacement	7	32	40	262	7.4	16.5	23.6	33.4
2.	5% Replacement	6	32	35	150	6.2	16.9	24.5	35.23
3.	10 %Replacement	4.7	33	37	110	5.7	17	26.9	39.4
4.	15% Replacement	10.1	33	30	95	7.39	16.56	26.7	33.36
5.	Limitations	<10	<33	≥60	<600	<10	16	22	33

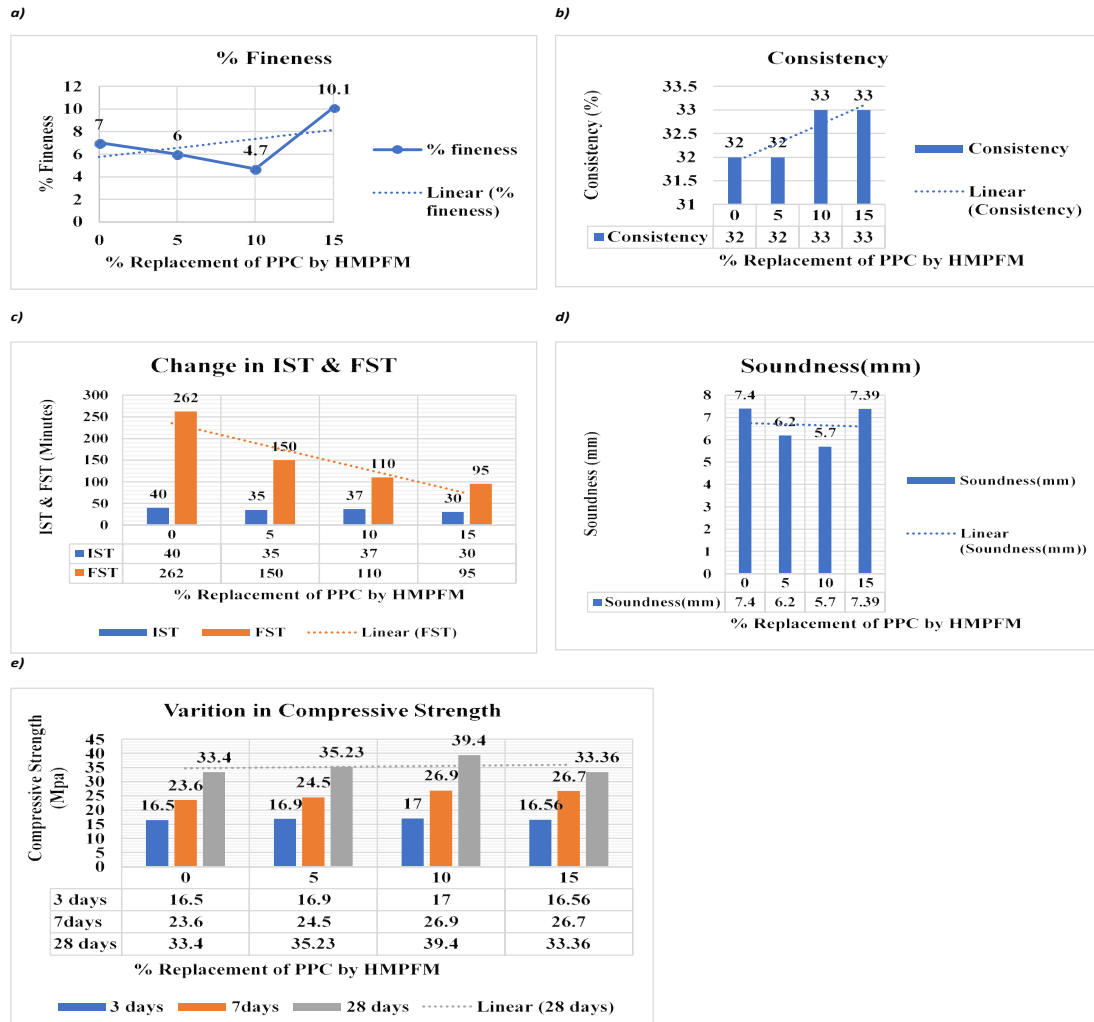


Fig. 2. (a) % Fineness Vs % Replacement, (b) Consistency Vs % Replacement, (c) Change in IST & FST (Minutes), (d) Change in Soundness, (e) Variation in compressive Strength

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From Fig. 2(a) the fineness percentage of PPC is increase as addition of bitumen particles added in the PPC. From Fig.2(b) the consistency of normal PPC is slightly change as percentage of HMPFM is increases.Fig.2(d) shows the soundness of the PPC is decreases as percentage of HMPFM is increases for 15 % of replacement the soundness again decreases. A Fig.2. (c) Show that IST& FST of PPC is change as percentage of replacement of cement by HMPFM is increase. Fig.2(e) shows that the compressive strength of PPC increase by replacing PPC with HMPFM upto 10% only.

## 4. Conclusion

Initial strength gaining capacity is increases due incorporation HMPFM. As per this research work the major finding about PPC is the change in IST & FST. Generally PPC has very high initial & final setting time but due to addition of very fine size particles of HMPFM the initial and final setting time of PPC is reduces . Specifically the final setting time is reduces up to 63.7 % because of HMPFM help early strength development. The fineness of PPC is increase up to 48.93% on addition of HMPFM upto 10% only, beyond 10% fineness of cement get decreases. Replacement of HMPFM increases the water requirement of PPC so it reduces consistency upto 3.03%. Soundness of PPC is increases upto 29.82 % the HMPFM particles help to develop early strength of PPC. For addition of HMPFM up to 10%, the compressive strength of PPC is increases upto 15.22%, beyond 10% strength of PPC is reduces. PPC with HMPFM can be use at the high strength gaining work.

### Future scope

In brick industry, cement block, in various works of construction we can check feasibility of HMPFM. The use and effect of HMPFM in concrete may study.

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