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## RESEARCH ARTICLE

# EXPERIMENTAL STUDY ON FRESH CONCRETE USING METAKAOLIN AND FLY ASH AS PARTIAL REPLACEMENT OF CEMENT

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### ABSTRACT

Concrete is most widely used construction material because of ease of construction and its properties like compressive strength and durability. It is difficult to point out another material of construction which is versatile as concrete. It is well known that plain concrete is very good in resisting compressive strength but possesses low specific modulus, limited ductility and little resistance to cracking. Internal micro cracks inherently present in the concrete and its poor tensile strength is due to propagation of such micro cracks eventually leading to brittle failure of concrete.

To ensure its high filling ability, flow without blockage and to maintain homogeneity, SCC requires a reduction in coarse aggregate content and hence a high cement content which can increase cost and also cause temperature rise during hydration as well as possibly affect other properties such as creep and shrinkage. Therefore significant quantities of additions are often incorporated to replace some of the cement, to enhance the fresh properties and reduce heat generation.

Several admixtures have been developed to improve the strength and workability properties of concrete. Of all admixtures used in concrete, Metakaolin occupies a special position for quite a few reasons. The improvement of durability, resistance to chloride, sulphate, freezing and thawing, alkali silica reaction, frost attack, increase in compressive strength, reduces the permeability and bleeding. Metakaolin effectively improve the structure of interface eliminates the weakness of the interfacial zone.

The present experiment is carried out to investigate the fresh and hardened properties concrete with 10% of Metakaolin and 30% of fly ash by weight of cement as partial replacement of cement. Compressive strength of Fresh concrete is measured by testing standard cubes (150mmx150mmx150mm) at the age of 7 and 28 days

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## INTRODUCTION

The importance of concrete in modern society cannot be underestimated. There is no escaping from the impact of concrete on everyday life. Concrete is a composite material which is made of filler and a binder. Typical concrete is a mixture of fine aggregate (sand), coarse aggregate (rock), cement, and water. Nowadays the usage of concrete is increasing from time to time due to the rapid development of construction industry. The usage of concrete is not only in building construction but also in other areas such as road construction, bridges, harbor and many more. Thus technology in concrete has been developing in many ways to enhance the quality and properties of concrete.

The elimination of vibrating equipment improves the environment on and near construction and precast sites where

concrete is being placed, reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health and safety benefits. Increased fines contents can be achieved by increasing the content of cementitious materials or by incorporating mineral fines. Admixtures that affect the viscosity of the mixture are especially helpful when grading of available aggregate sources cannot be optimized for cohesive mixtures or with large source variations. This research was implemented to develop and to determine the properties of Concrete by using flyash and metakaolin as cement replacement

## MATERIALS

The materials used in this experimental study are Cement, Fine aggregate, Coarse aggregate, Water, Fly ash, Metakaolin.

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**Experimental Programme**

Testing of the properties of fresh concrete by the following Tests.

- Slump Cone Test
- V-funnel test
- L-box test

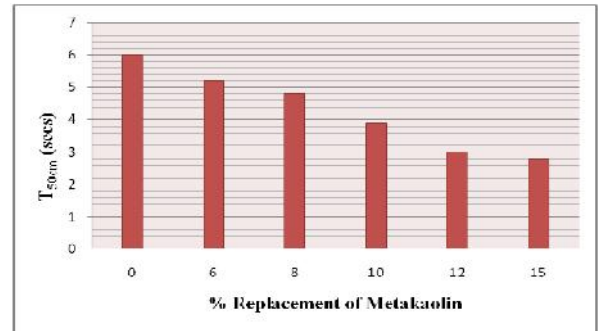
**Compression Testing**



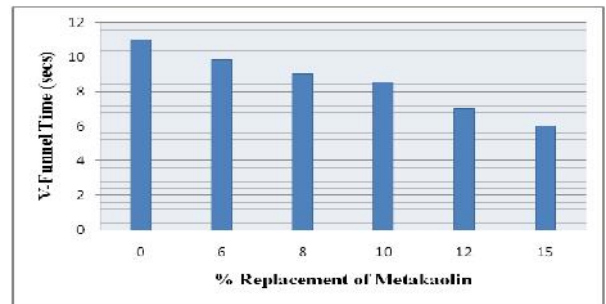
**DISCUSSION OF TEST RESULTS**

Fresh Concrete properties with varying % replacement of metakaolin

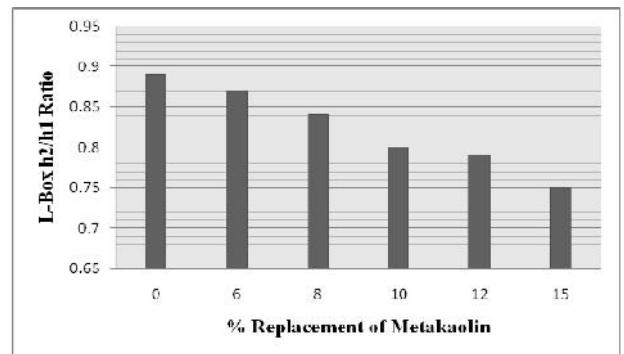
S.	TESTS	RANGE		MIX ID					
		MIN	MAX	F0	F30	F30	F30	F30	F30
N									
O				MK0	MK6	MK8	MK10	MK12	MK15
1	SLUMP FLOW (mm)	650	800	645	655	663	675	680	690
2	T50CM (seconds)	2	5	6	5.2	4.8	3.9	3.0	2.8
3	V-FUNNEL (seconds)	6	12	11	9.8	9	8.5	7	6
4	L-BOX (H2/H1)	0.8	1	0.89	0.87	0.84	0.8	0.79	0.75



T<sub>50cm</sub> Time Vs % Replacement of Metakaolin



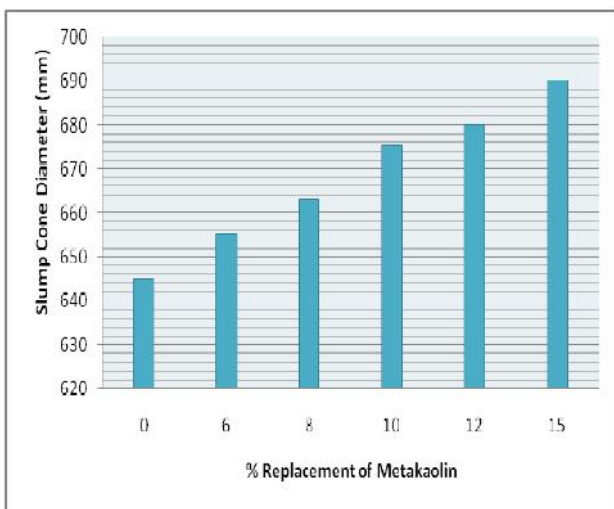
V-Funnel Time Vs % Replacement of Metakaolin



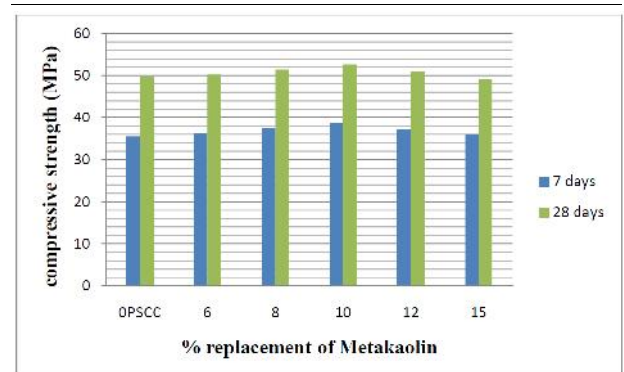
L-Box h<sub>2</sub>/h<sub>1</sub> Ratio Vs % Replacement of Metakaolin

**Compressive Strength of Various Concrete Mixtures with Constant flyash and Different Percentage of metakaolin at 7 and 28 days curing**

S.No.	Mix ID	Compressive Strength (MPa)	
		7 days	28 days
1	F30MK0	35.5	49.81
2	F30MK6	36.2	50.2
3	F30MK8	37.5	51.4
4	F30MK10	38.7	52.6
5	F30MK12	37.1	50.9
6	F30MK15	35.9	49.1



Slump Cone Diameter Vs % Replacement of Metakaolin



## TEST RESULTS

There is a considerable improvement in the properties of fresh Concrete with replacement of cement by Metakaolin, because of the high reactive nature and fineness of the Metakaolin though there was increase in water demand.

There is a considerable improvement in the compressive strength of SCC with replacement of cement by 30% replacement of Flyash and 10% replacement of Metakaolin, because of the high Pozzolanic nature of the condense Metakaolin, Fly ash and its void filling ability. The test results indicate that with 30% Flyash and 6 to 12% Metakolin as replacement of cement gives better strength.

## CONCLUSIONS

Optimum percentage of Concrete mix containing Metakaolin and Fly ash as partial replacement of cement was found to be 10% and 30% respectively. The use of Metakaolin along with Flyash as partial replacement of cement enhances the properties of fresh and hardened Concrete.

## Acknowledgement

While bringing out this thesis to its final form, I came across a number of people whose contributions in various ways helped my field of research and they deserve special thanks. It is a pleasure to convey my gratitude to all of them.

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He is a great person and one of the best mentors, I always is thankful to him.

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