Strength Studies Of Natural Rubber Latex Modified High Performance Concrete.

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ABSTRACT

Nowadays the properties of the normal concrete can be improved regarding workability, strength characteristics and durability performance from reducing porosity by compaction, improved paste characteristics and aggregate matrix bond, thus resulting in high performance concrete. The improvements in strength characteristics of HPC can be made by inclusion of Natural rubber latex which is a polymer admixture in the concrete mix .This paper reveals the details of an experimental investigation to utilize Metakaoline in production of Rubber Latex modified High performance concrete [RLMKHPC].

Keywords: Latex-modified concrete, natural rubber latex, Metakaoline, high performance concrete, compaction factor, Vee-Bee seconds, compressive strength

.

1.0 INTRODUCTION

The source of natural rubber latex is the Para rubber tree [1] Hevea brasiliensis. Rubber exhibits unique physical and chemical properties. Rubber's Stress-Strain behavior exhibits Mullins [2] effect, the Payne [3] effect and is often referred hyper elastic. Latex is the polymer (cis1, 4-polyisoprene) with a molecular weight of 100,000 to 1,000,000.Rubber tree initially grew in South America and later in Kew Gardens, UK, then in Sri Lanka, Indonesia, and Singapore .In India first it was grown in Kerala. Rubber latex has found its applications in road construction which improves the quality of road pavement.

Latex modified concrete have good binding properties and good adhesion with aggregates. Natural rubber latex have long chain structure which helps in developing long range network structure of bonding. In contrast, cement materials provide short range structure of bonding. As a result polymer materials (rubber latex) usually provide superior compressive, tensile and flexural strength to the concrete compared to concrete without latex. The types of polymer-modified mortars and concretes are produced by using the polymers and monomers .Of these, latex modified mortars and concretes are by far the most used cement modifiers. Latex modification of

cement mortar and concrete is governed by both cement hydration and polymer film formation processes in their binder phase. The cement hydration process generally precedes the polymer formation process. In due course, co matrix phase is formed by both cement hydration and latex film formation.

1.1 Metakaoline is a mineral admixture which modifies the concrete characteristics. Metakaoline is a manufactured material that reacts rapidly with calcium hydroxide and produce calcium silicates. Thus a less permeable concrete is produced, with decrease in volume of pores. Hence this investigation aims in studying the properties of concrete using natural rubber latex and metakaoline blended high performance concrete.

Properties of materials used:

CEMENT

Table`1.

Type of cement-	Ordinary Portland cement confirming to IS: 12269-1987
Specific Gravity of Cement	3.1
Specific Surface Area	316 m^2/kg By Blaine's Air Permeability.
Compressive strength of cement	7 days-44 Mpa
	28 days-56 Mpa.

SAND

Table 2:

Specific Gravity of sand	2.67
Type of sand	River sand confirming to IS 2386-1963
Fineness Modulus	2.7
Sieve Analysis	confirming to zone –II

COARSE AGGREGATES

Table 3.

Specific gravity	2.7
Size of aggregates	Passing through 20mm sieve retained on 12.5mm-50%, 12.5 mm-10mm-50%.
Fineness modulus	7.5

WATER : Potable Water.

CHEMICAL ADMIXTURE

Super plasticizer Conplast SP-337 is used to achieve the homogeneity of the sample.

NATURAL RUBBER LATEX

Specific gravity=1.06

Chemical Composition: is a polymer consisting of repeating units of Isoprene, colloidal suspension 30-35 rubber, wide range of diameter from 0.01-5μm,0.1-2μm rubber phase,Frey-wyssling particles Serum.

MINERAL ADMIXTURE

METAKAOLIN

Table 4.-Properties of Metakaoline

Specific gravity	2.5
Residue 325 mesh	0.5
Bulk Density(gm/ltr)	300
Accelerated Pozzolanic Index,%	97
$Sio_2+Al_2O_3+Fe_2O_3$	96-98%
Loss on Ignition	<1%

TEST PROCEDURE:

To know the behavior of High performance concrete the tests on concrete both in green state as well as in hardened state has been performed. In green state the workability test like the Compaction factor test and Vee-Bee consistometer test were performed which are said to be the most appropriate methods. The workability of High performance concrete adopting different w/b ratios at various percentages of natural rubber latex and Metakaoline has been presented in Fig 1 & Fig 2. The behavior of high performance concrete in hardened state is observed by conducting the compressive strength tests and the total numbers of cubes casted are 360. The 28 days compressive strength results are also presented in Fig 3.One plain concrete mix of M_{20} has also been casted and tested in the laboratory as a reference mix. As there is no standard method for proportioning high performance concrete mixes; here in this investigation absolute volume method has been adopted for obtaining the mix proportions. The materials were weighed as

as per the weights obtained from the absolute volume method.

The various parameters adopted are:

Aggregate-Binder Ratio (A/B)=2.0

Water Binder Ratios (W/B) =0.3, 0.325, 0.35, 0.375, & 0.4.

Percentage weights of Natural Rubber Latex are= 0, 0.5, 1.0&1.5.

For determining 28 days compressive strength of the mix, keeping the percentage of Natural Rubber Latex constant and varying the percentages of Metakaoline as mentioned above for each mix, three cubes were casted in the mould of size 150mm*150mm and tested for the strength. The various compressive strengths of different percentages of natural rubber latex and Metakaoline are discussed from figures 3.1, 3.2, 3.3, &3.4.

4.0 RESULTS AND DISCUSSIONS

The workability tests like compaction factor test and Vee-Bee consistometer tests were conducted. The compaction factors ranging from 0.78-0.92 was obtained for different percentages of natural rubber latex and Metakaoline. Thus the workability of rubber latex modified high performance concrete [RLMKHPC] can be grouped from the experimental results as medium, low and very low workable concrete. Similarly the Vee-Bee time is obtained between the range 2-20 seconds and the workability curves are presented in the fig.1.1, 1.2, 1.3, &1.4. There is a improved consistency due to the ball bearing action of latex particles .The flow of latex modified concrete increases with increase in water cement ratio and polymer cement ratio. There is a decreased workability when metakaoline is replaced in the concrete in higher percentage. This is due to the absorption characteristics of the metakaoline in the paste.

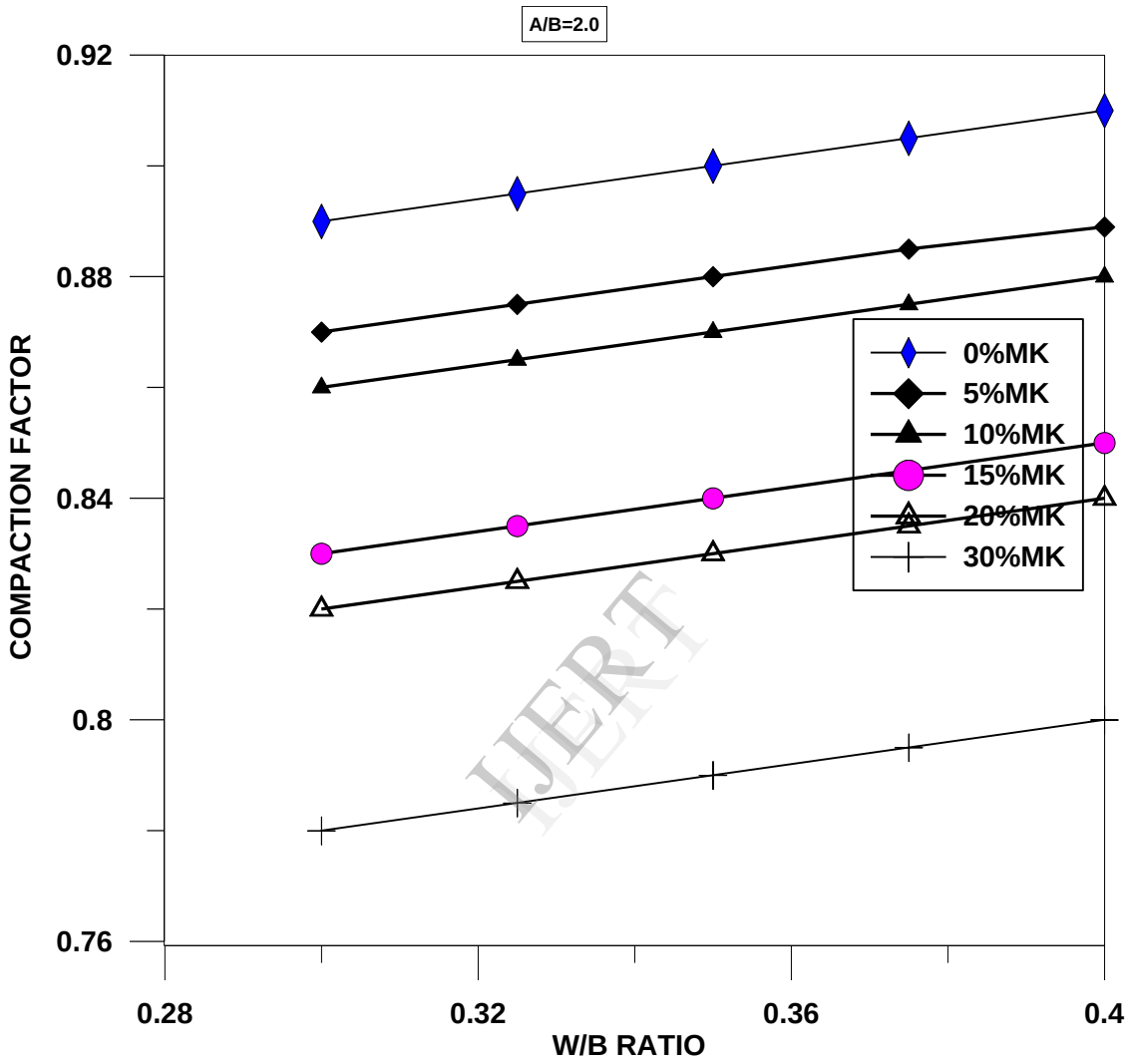

FIG 1.1 Workability Curves OF 0.5%RLMKHPC

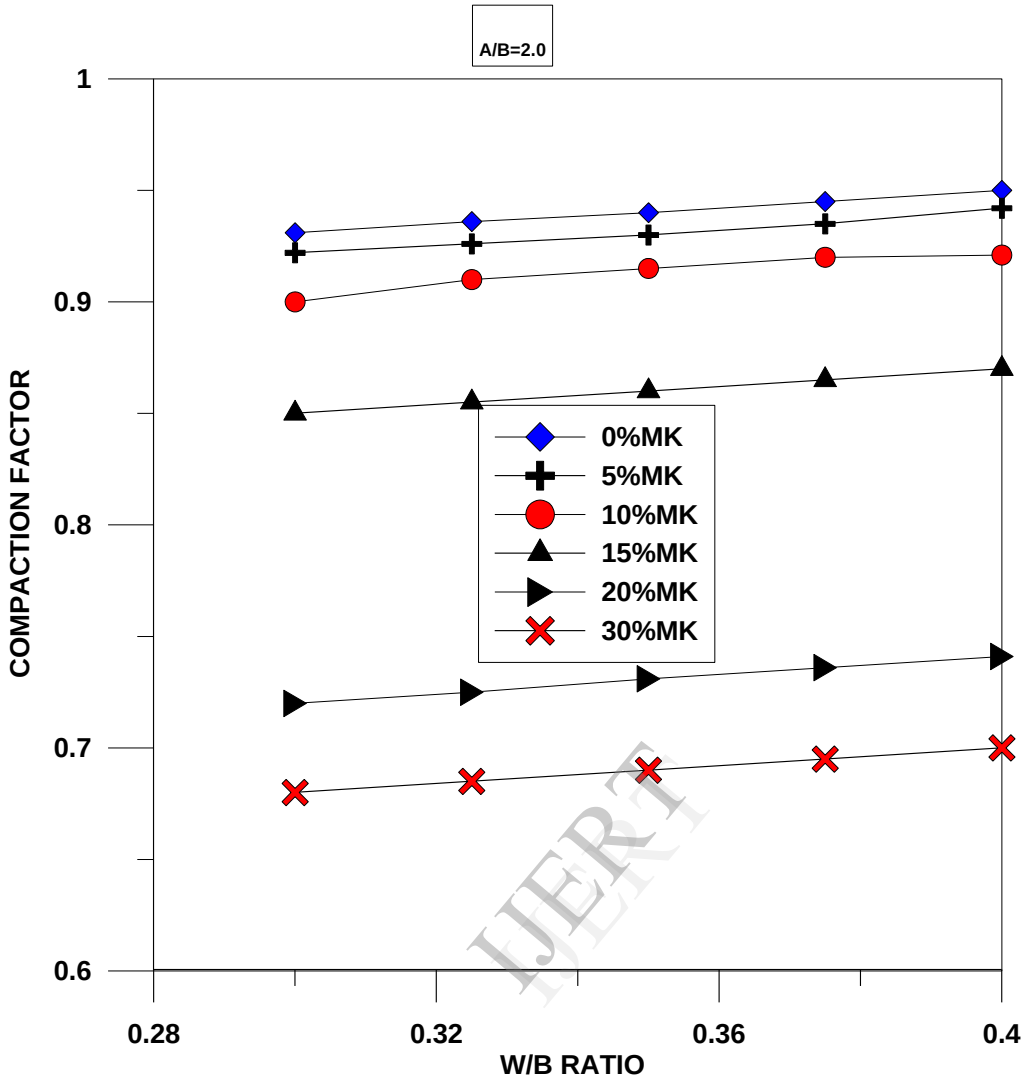

FIG-1.2 Workability Curves Of 1%RLMKHPC

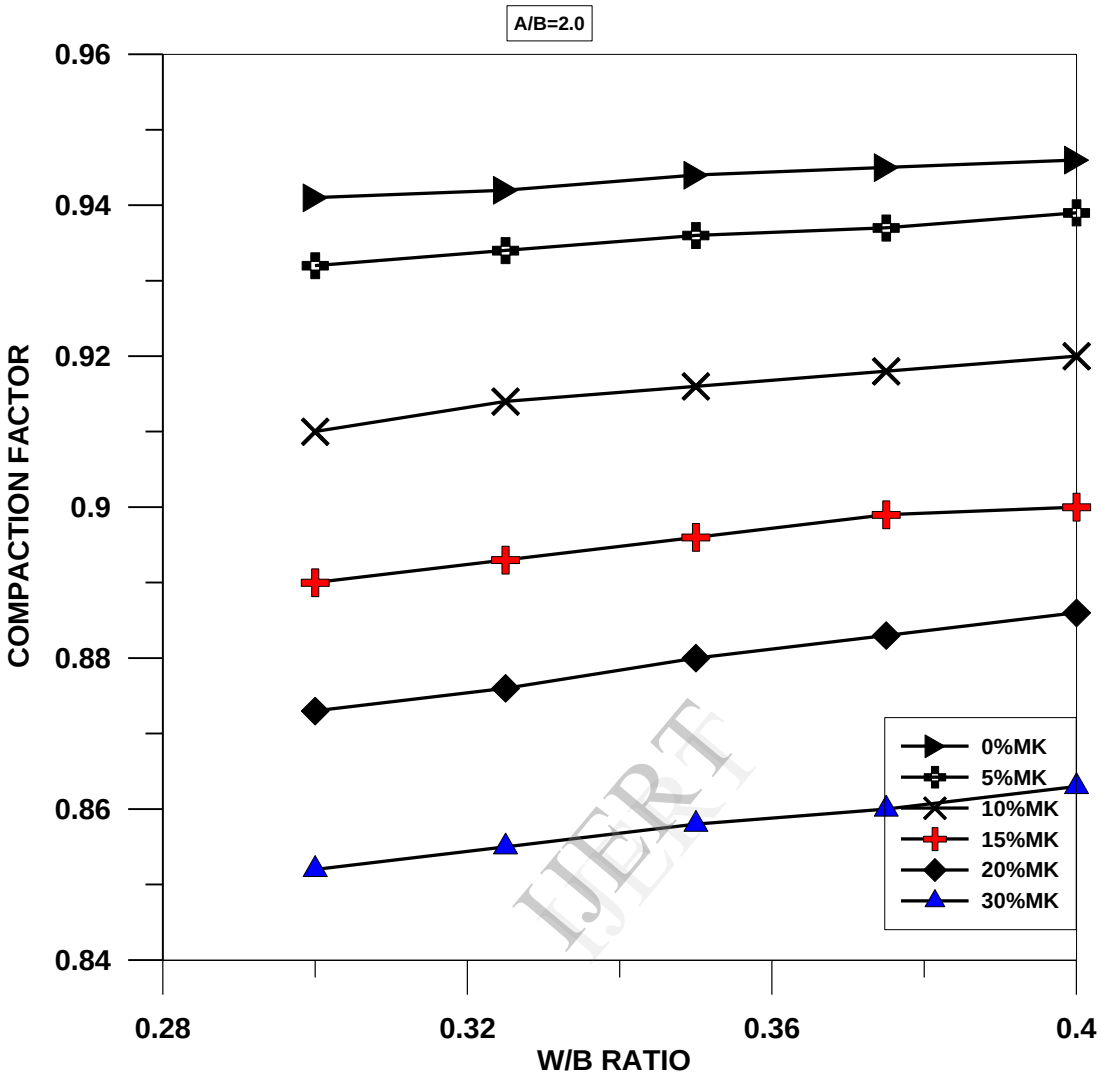

FIG 1.3 Workability Curves Of 1.5%RLMKHPC

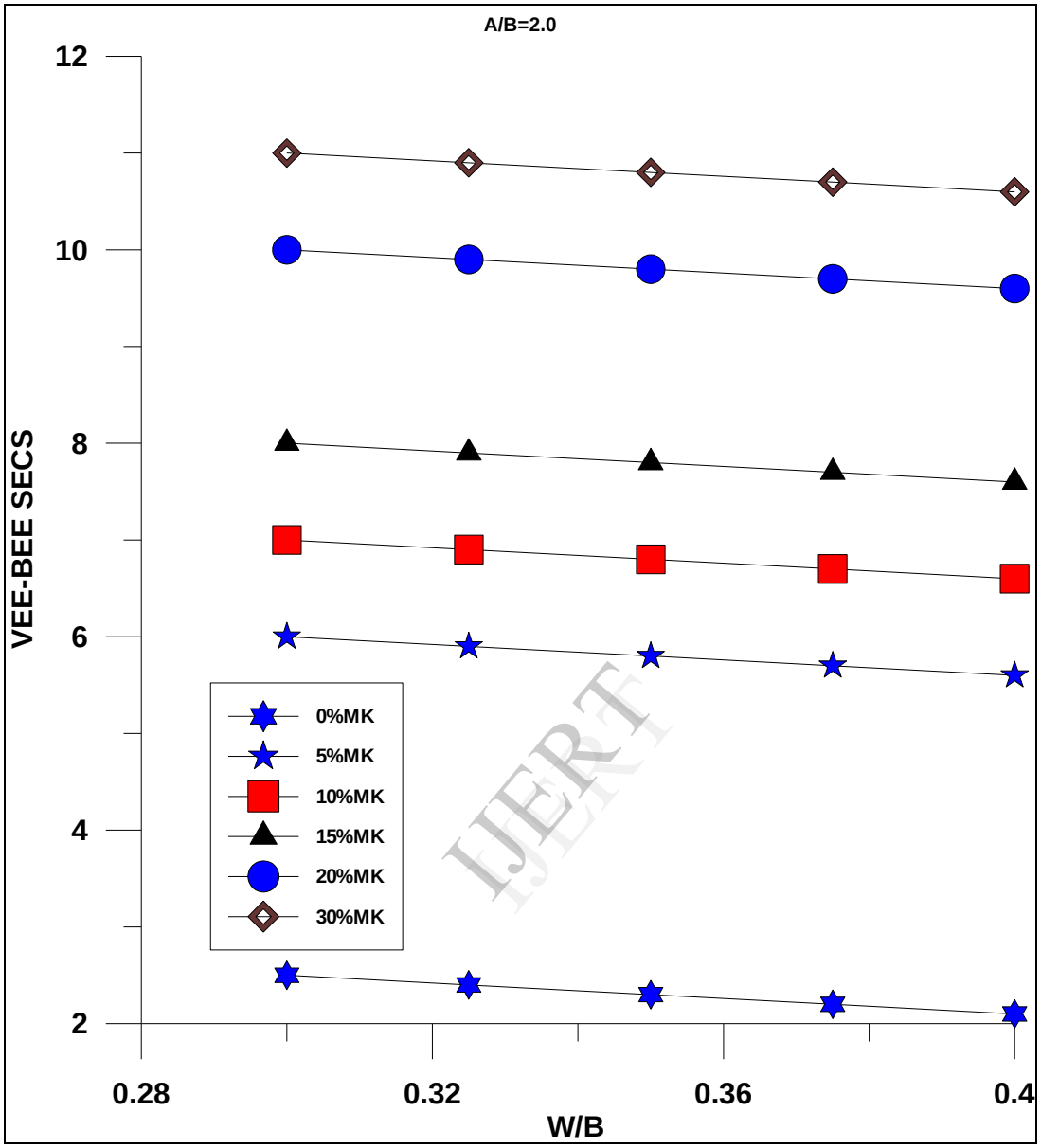

FIG.2.1 Workability Curve Of 0 % NRL

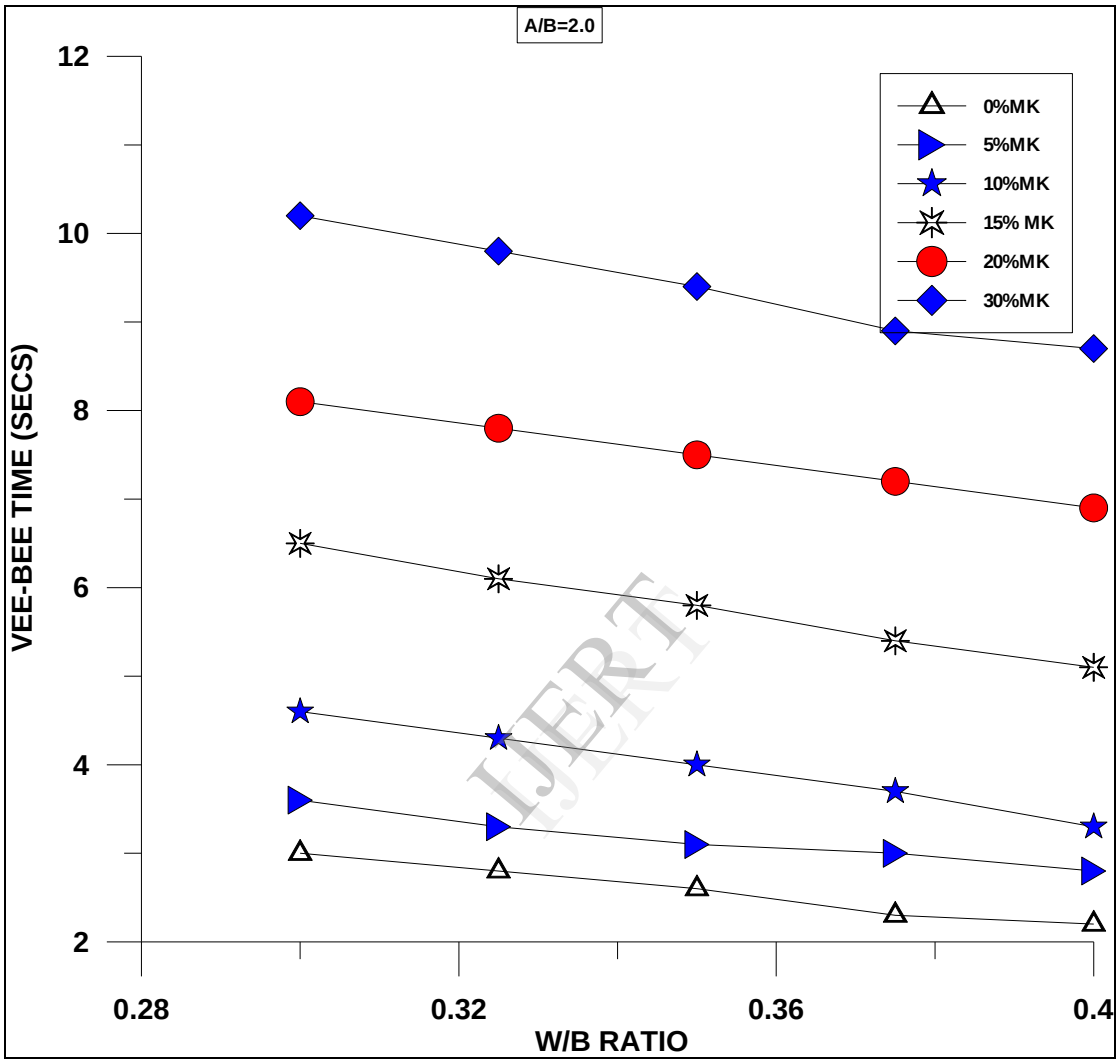

FIG.2.2 Workability Curves Of 0.5 % RLMKHPC

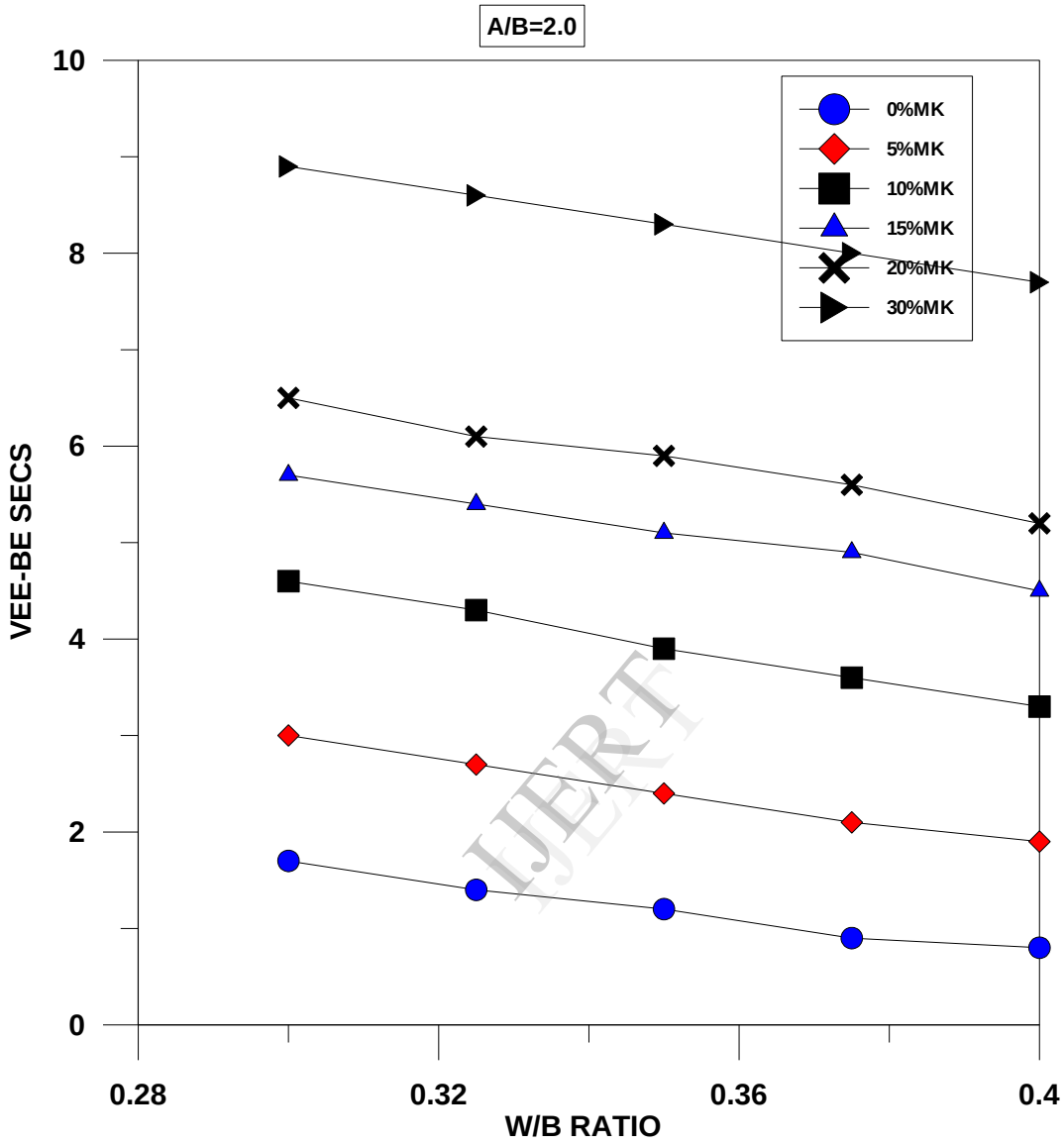

FIG.2.3 Workability curves of 1% RLMKHPC

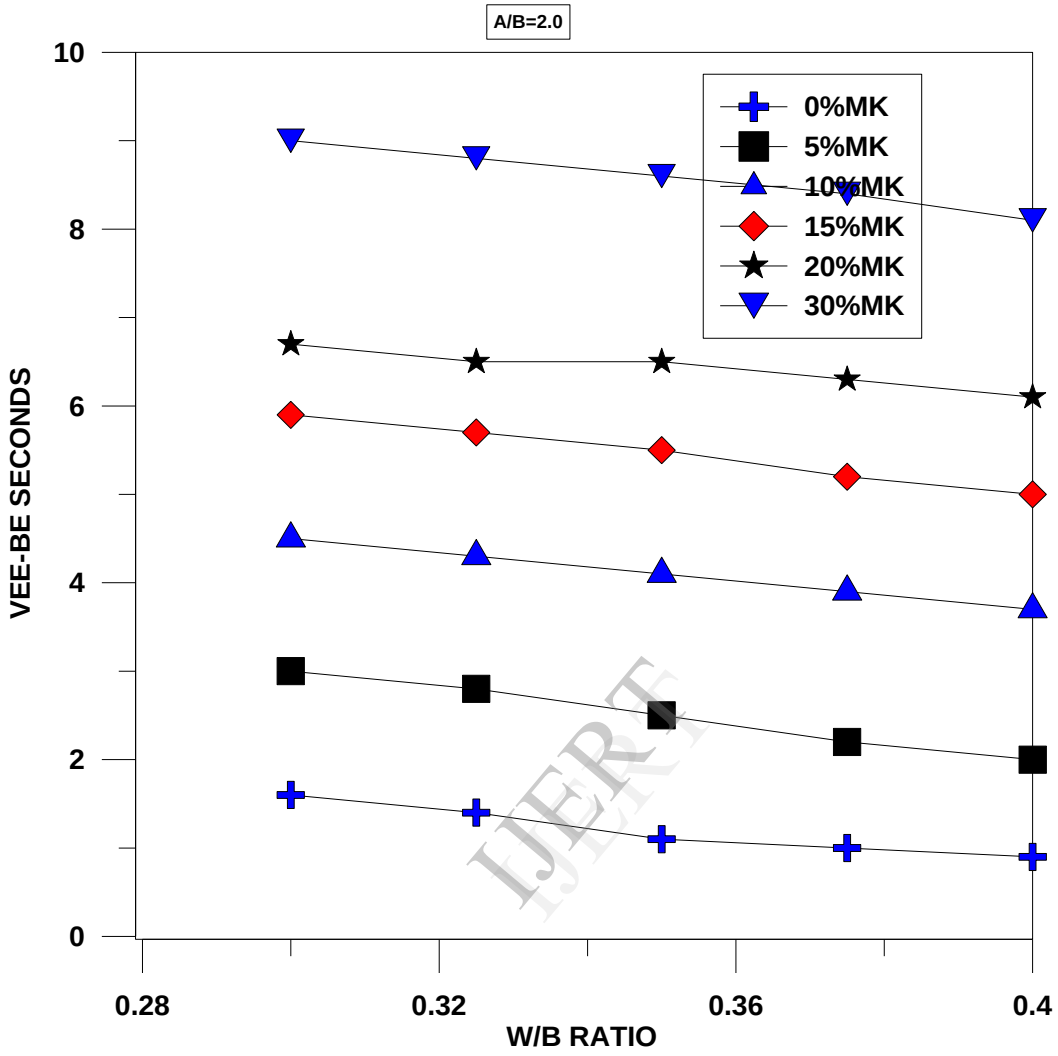

FIG 2.4 Workability Curves Of 1.5%RLMKHPC

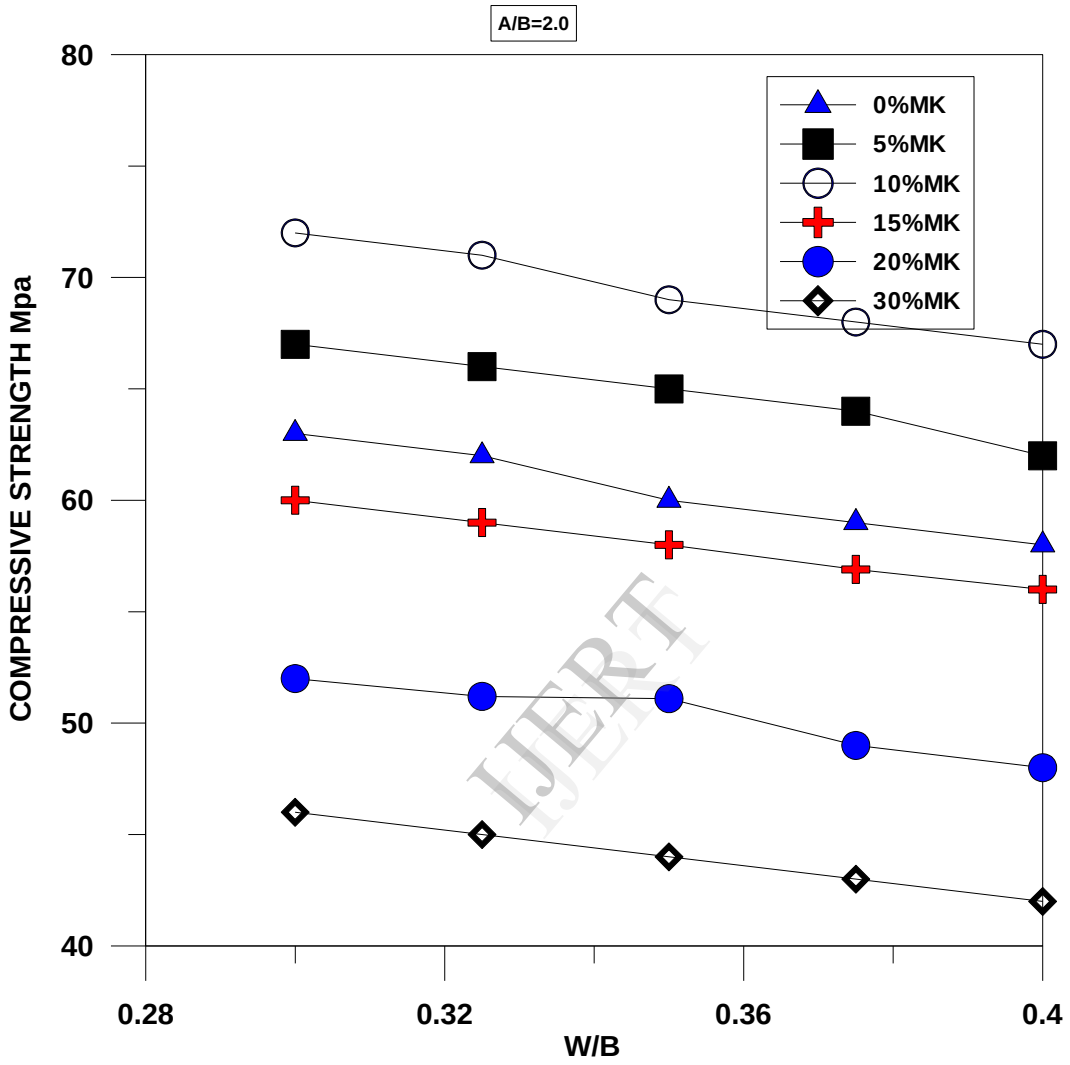

FIG 3.1 Compressive Strength Of 0 % RLMKHPC

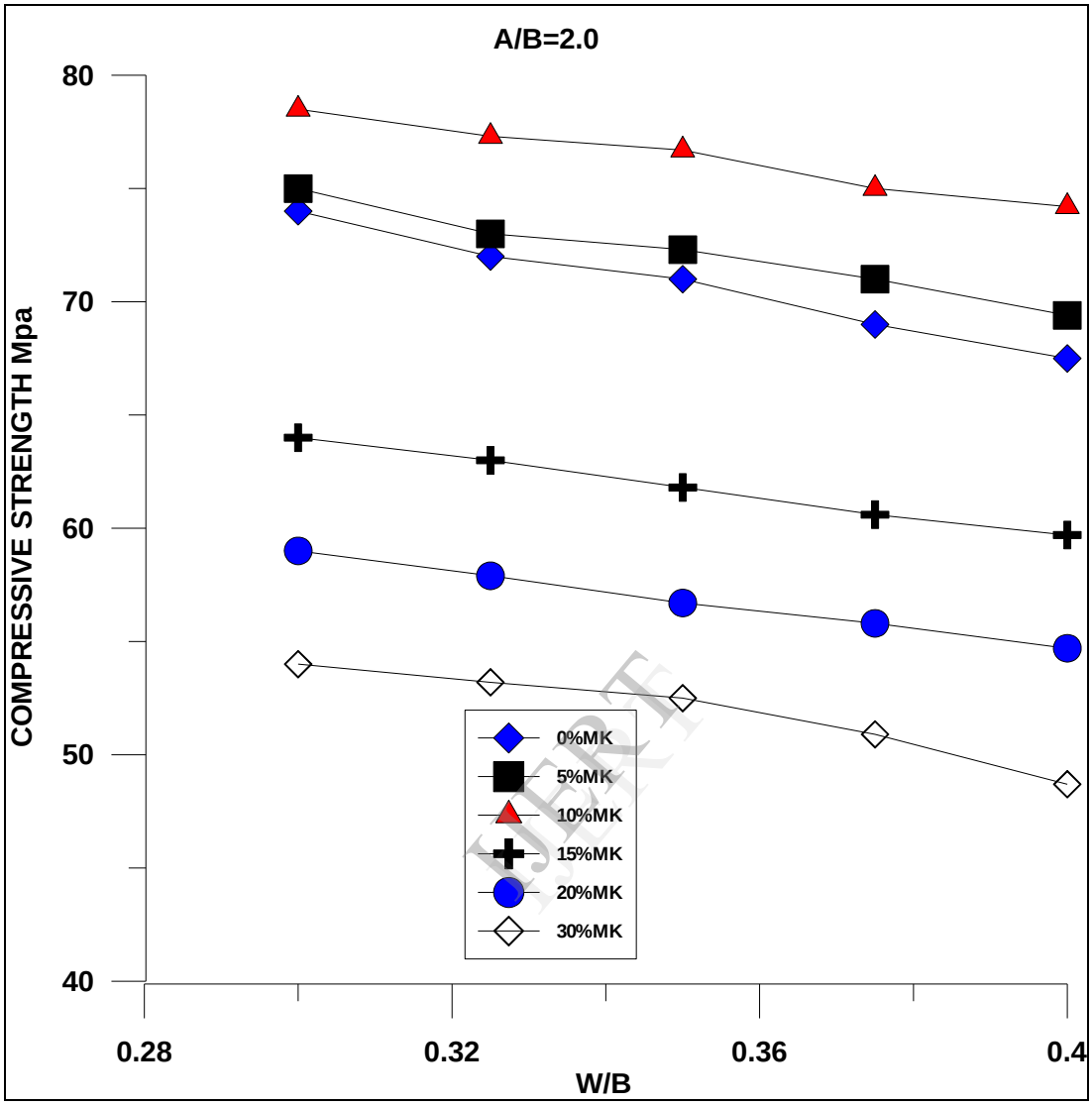

FIG 3.2 Compressive Strength Of 0.5%RLMKHPC

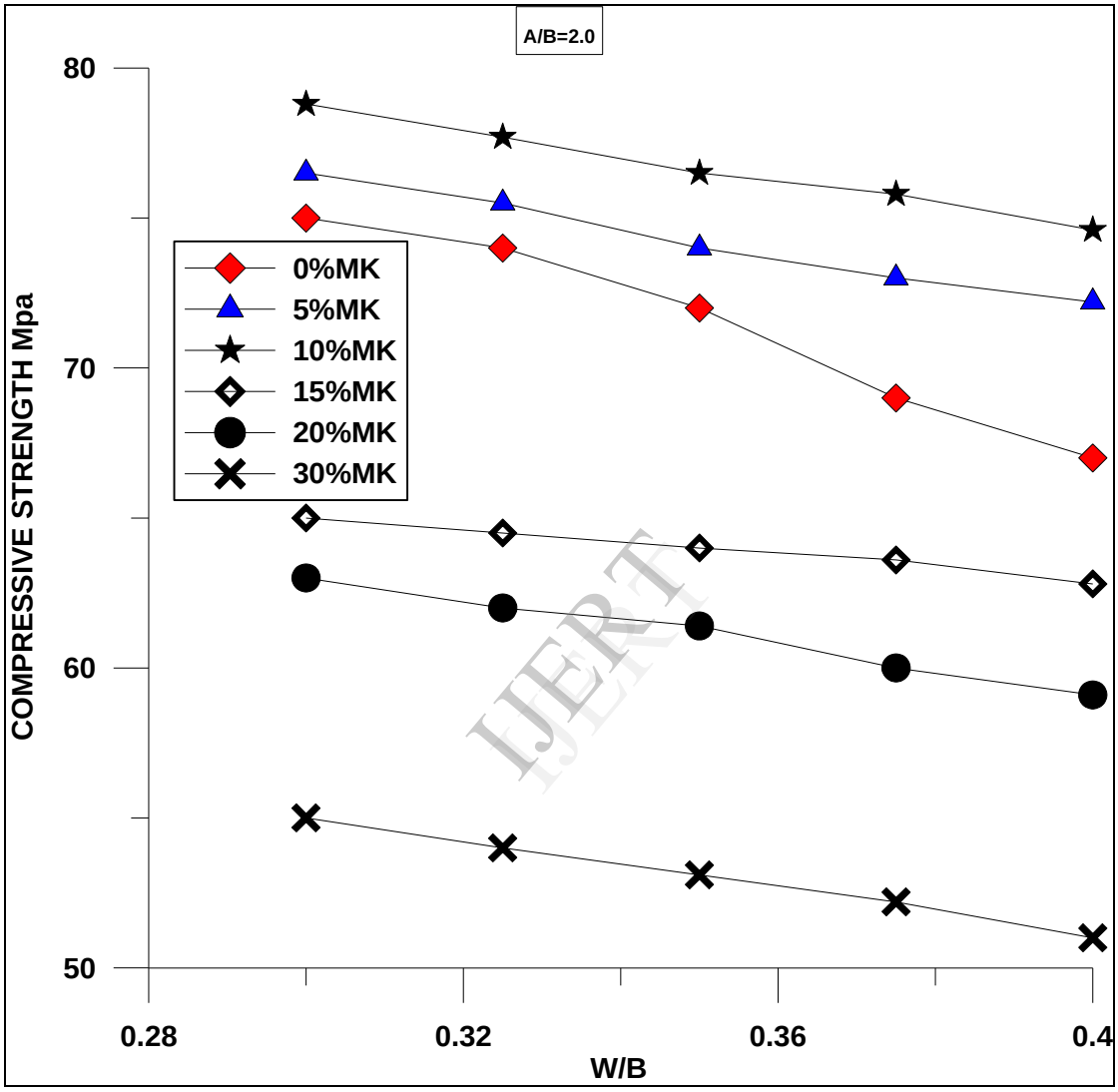

FIG 3.3 Compressive Strength of 1% RLMKHPC

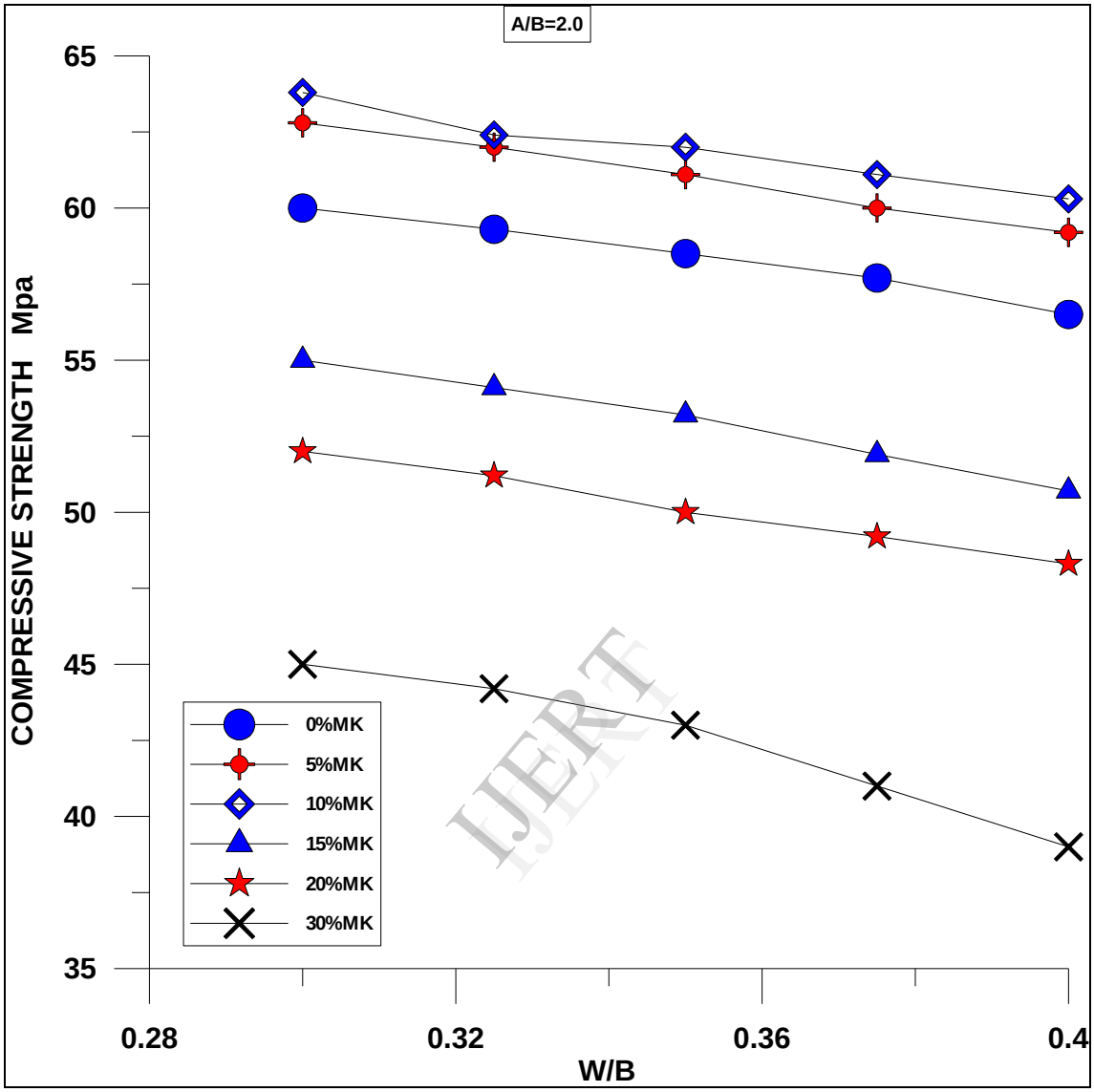

FIG 3.4 Compressive Strength of 1.5% RLMKHPC

The workability of RLMKHPC in Vee-Bee seconds curves are also presented in figs.2.1,2.2,2.3,& 2.4.From the workability curves we can conclude that more the percentage of rubber latex and Metakaoline less is the workability. This is due to the fact that excess latex pushing aggregates further away thus creating a room for higher absorption.

The compressive strength curves are presented in Figs, 3.1, 3.2, 3.3 & 3.4.respectively. From the curves it is observed that the compressive strength increases with the percentages of natural rubber latex and it is observed that there is a decrease in compressive strength when the dosage of rubber latex is increased. Thus it is concluded that at a dosage of 1% of natural rubber latex the compressive strength is maximum. However, where durability supersedes strength, more latex can be added beyond 1 & 1.5% for better protection.

4.0 Conclusion

- Addition of natural rubber latex at very low percentages will yield good compressive strengths and flexure strengths thus making the construction durable and economical.
- Use of Metakaoline in concrete also results in boosting up of compressive strength thus making the construction economical by replacing the cement by 10%and up to 15%.
- Inclusion of appropriate dosage of natural rubber latex into concrete as a modifier enhances its durability and improves its water exclusion capacity.
- The material (rubber latex) has excellent potential for use in various fields and seems to be on the right path in initiating research into applications of latex modified concrete.

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