UTILIZATION OF BLACK PULP LIQUOR AS CONCRETE ADMIXTURE

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Abstract : The importance of concrete in all civil engineering and building construction works is highly significant and valuable. The cost of construction materials is increasing day by day because of high demand, scarcity of raw materials and high price of energy. From the view point of energy saving and over consumption of resources, the use of alternative constituents in construction materials is now a global concern. From this, the extensive research and development works towards exploring new ingredients are required for producing sustainable and environment friendly construction materials.

Bagasse pulp liquor is one such material that can be used as a chemical admixture. Bagasse pulp is obtained as a by-product of paper manufacturing process. Around 5 million tons of bagasse pulp is obtained throughout the world each year. This material is a waste and is usefully disposed. However this can be changed as a admixture by its effective use in concrete. Black Pulp Liquor is added to fresh concrete, the concrete is then tested for workability, compressive strength, flexural, split tensile strength and setting time. Hence the cost is significantly reduced in construction industries by utilizing Black Pulp Liquor by-product.

1.1. INTRODUCTION

Waste management is a serious challenge for mankind. A simple solution is to utilize the waste. Since concrete has become a highly consumed product, its vast usage has become uneconomical. Hence replacement of traditional materials by these by-products is a good alternative. Admixture is defined as a material other than cement, water and aggregate that is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Chemical admixtures are of growing importance in today's construction industry due to their ability to modify the properties of concrete. Though there are many commercially available chemical admixture, it is eco-friendly and cheaper to use a by-product as a chemical admixture. Pulp is a by-product produced form paper mill, have chemical constituents similar to established chemical admixtures and hence they have potential to act as a one. In this study, black pulp liquor is experimentally investigated to be used as an admixture.

2.1. MATERIALS USED

Cement, Fine aggregate, Coarse aggregate, Water, Black Pulp Liquor

3.1. MIX DESIGN

As per IS 10262: 2009, mix design for M30 grade concrete is carried out.

Mix ratio

CEMENT	FINE AGGREGATE	COARSE AGGREGATE	WATER
413.33	674.8	1206.86	186
1	1.633	2.92	0.45

The ratio becomes in terms of per cubic meter of concrete is **1 : 1.633 : 2.92 :0.45**

4.1. TESTS ON CONCRETE

Table 4.1 Mix design for Concrete

Dosage	0%	1 %	2 %	3 %	4 %	5 %
Cement (kg)	450	450	450	450	450	450
Black Pulp liquor (ml)	0	1.86	3.72	5.58	7.44	9.3
Fine aggregate (kg)	619.97	619.97	619.97	619.97	619.97	619.97
Coarse aggregate (kg)	1182.276	1182.27	1182.276	1182.276	1182.276	1182.276
Water (ml)	186	184.14	182.28	180.42	178.56	176.7

4.1.1. FRESH PROPERTIES

SLUMP TEST

Table 4.2Slump test concrete

S.No	Description of Mix	Slump Value in mm
1	M30	28
2	BPL 1 %	125
3	BPL 2 %	178
4	BPL 3 %	165
5	BPL 4 %	156
6	BPL 5 %	140
7	BPL 6 %	132

4.1.2. HARDENED PROPERTIES OF CONCRETE

COMPRESSION TEST (CUBE TEST)

Maximum compressive strength of Concrete mix of 1% replacement of water with black pulp liquor was observed. Concrete with 2%. 3%, 4%, 5% replacement of water by pulp liquor gave lower values of compressive strength compared to the control mix for 7 and 28 day curing periods.

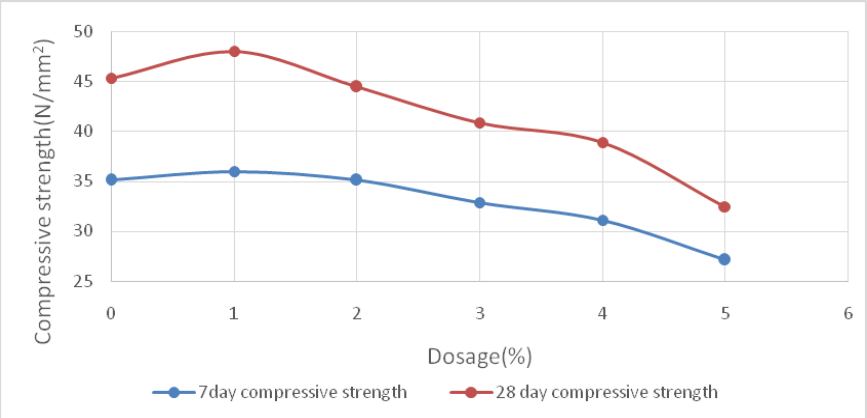

Fig. 4.1 compressive strength of concrete for different mixes

SPLIT TENSILE STRENGTH

Maximum split tensile strength was observed for concrete mix with 1% replacement of water with black liquor. Concrete mixes with 2%, 3%, 4%, 5% replacement of water with black pulp liquor reduces the split tensile strength for 7 day and 28 day curing periods when compared with control mix.

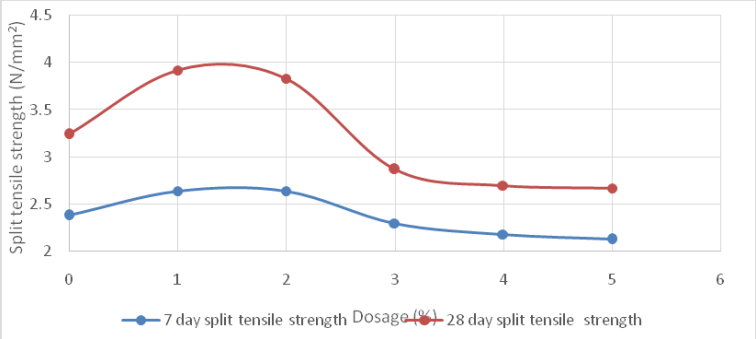

Fig. 4.2 split tensile strength of concrete for different mixes

FLEXURAL STRENGTH

Maximum flexural strength is observed for concrete with 1% replacement of water with black liquor. Concrete mixes with 2%, 3%, replacement of water with black pulp liquor reduces the split tensile strength liquor for 7 and 28 day curing periods.

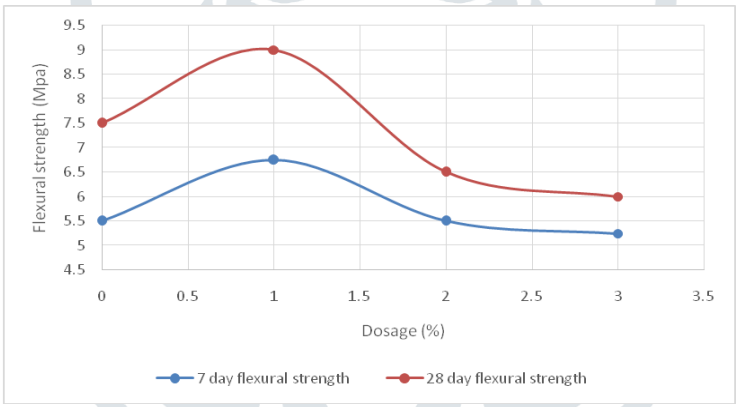

Fig. 4.3 Flexural strength of concrete for different mixes

SETTING TIME OF CONCRETE

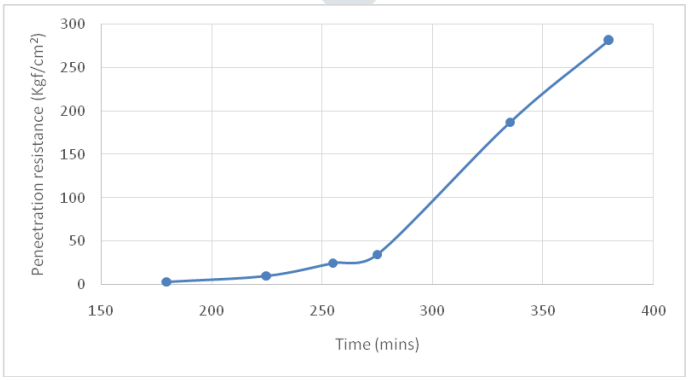

Fig.4.4 Initial and final setting time of concrete for control mix

Initial setting time-280 minutes **Final setting time** – 365 minutes

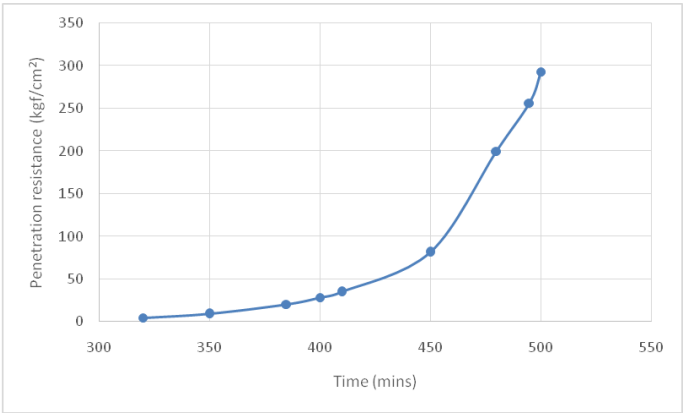

Fig.4.5 Initial and final setting time of concrete for 1% dosage

Initial setting time – 415 minutes **Final setting time** – 485 minutes

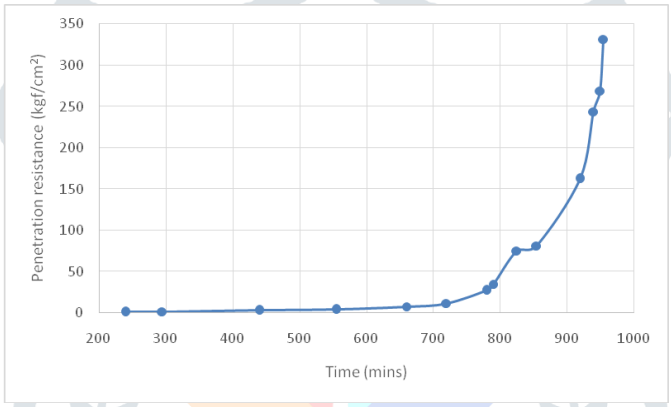

Fig.4.6 Initial and final setting time of concrete for 2% dosage

Initial setting time – 790 minutes **Final setting time**– 952 minutes

5.1. CONCLUSION

From the experimental investigation on concrete it was found that, maximum workability was observed for 2% replacement of water with black pulp liquor. For 1% replacement of water with black liquor, maximum compressive strength, flexural strength and split tensile strength was observed. Initial and final setting times were delayed with addition of black pulp liquor for 2% replacement of water with black liquor, the maximum setting time was observed.

Hence we can conclude that 1% replacement of water with black pulp liquor increases the fresh properties of the concrete, 2% replacement of water with black pulp liquor increases the mechanical properties of the concrete and acts as a set retarder. .

6.1. REFERENCES

1. **Jignesh Patel , Mithilesh Pandya , et.al (2011)** "Investiating effect of Black Pulp Liquor on the Properties of Concrete"
2. **S.Samia , A.Alaa , et.al (2011)** "Utilization of black liquor as concrete admixture and set retarder aid"
3. **Ganesh R. Mahalle., et.al (2018)** "Use of Lime Sludge and Pulp Black Liquor in Concrete"