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# EXPERIMENTAL INVESTIGATION ON THE STRENGTH PROPERTIES OF CONCRETE SELF CURED WITH PARAFFIN WAX

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**ABSTRACT-** *Wax is one of the latest materials being studied by engineers in concrete technology mainly for its phase change – temperature adjustment property. Paraffin wax added concrete is proved to be self-curing and it make sure that the concrete is free from water evaporation and hence improve its water withholding capacity compared to usual concrete. But strength of the concrete self-cured with paraffin wax is less than conventional concrete hence it is required to be improved by some method. The addition of fly ash to improve the strength of concrete self-cured with paraffin wax is studied through the research work. The experimental research work consists of comparing the properties of self-cured M35 concrete with 0%, 0.5%, 1%, 1.5%, 2% paraffin wax liquid and M35 concrete with 0%, 0.5%, 1%, 1.5%, 2% paraffin wax liquid as well as 40% fly ash. The compressive strength, split tensile strength, flexural strength are conducted for comparing the mixes. The aim of the research is to propose a self-curing, phase changing and better strength concrete.*

***Key words:*** *paraffin wax, fly ash, self-curing, compressive strength, split tensile strength, flexural strength.*

## 1. INTRODUCTION

Concrete self-cured with paraffin wax have application in high and low temperature region due to its temperature adjustment property. The paraffin wax in the concrete changes phase from solid to liquid and vice versa at hot and cold region respectively, thus reduces the cracks. However concrete self-cured with paraffin wax does not meet the strength of conventional concrete. The possibility of improving strength of concrete self-cured with paraffin wax is studied through this research. Mineral admixture fly ash was added to this concrete with the aim of increasing strength. Comparative study of self-cured conventional concrete and concrete self- cured with paraffin wax based on compressive , tensile and flexural strength are conducted.

## 2. EXPERIMENTAL INVESTIGATION

### 2.1 METHODOLOGY

Relevant tests were carried out for the materials used in the study including cement, fly ash, paraffin wax, aggregates, super plasticizer. M35 concrete with 0%, 0.5%, 1%, 1.5%, 2% paraffin waxes by weight of cement were prepared and self-cured for 28 days (MP mixes). These mixes are denoted by MP0, MP0.5, MP1, MP1.5, MP2 respectively. Fly ash based M35 concrete with 40% fly ash replacement for cement and 0%, 0.5%, 1%, 1.5%, 2% paraffin waxes by weight of cement were also prepared and self-cured for 28 days (MFP mixes). These mixes are denoted by MFP0, MFP0.5, MFP1, MFP1.5, MFP2 respectively. Then these mixes were subjected to compressive, tensile and flexural test and the results were compared.

### 2.2 RESULT AND DISCUSSION

Table 1 shows the compressive, tensile and flexural test results of all mixes.

**Table 1** : Strength value

| Mix | Compressive strength ($N/mm^2$) | Split tensile strength ($N/mm^2$) | Flexural strength ($N/mm^2$) |
|---|---|---|---|
| MP0 | 24.09 (7 DAY) | 3.36 | 5.25 |
| MP0.5 | 38.51 | 3.67 | 5.4 |

| | | | |
|---|---|---|---|
| MP1 | 40.92 | 3.9 | 6.1 |
| MP1.5 | 43.4 | 4.31 | 6.3 |
| MP2 | 42.5 | 4.15 | 6.35 |
| MFP0 | 24.87(7 DAY) | 3.746 | 5.9 |
| MFP0.5 | 40.77 | 4.02 | 6.8 |
| MFP1 | 43.96 | 4.41 | 7 |
| MFP1.5 | 44.45 | 4.52 | 7.3 |
| MFP2 | 43.8 | 4.39 | 6.5 |

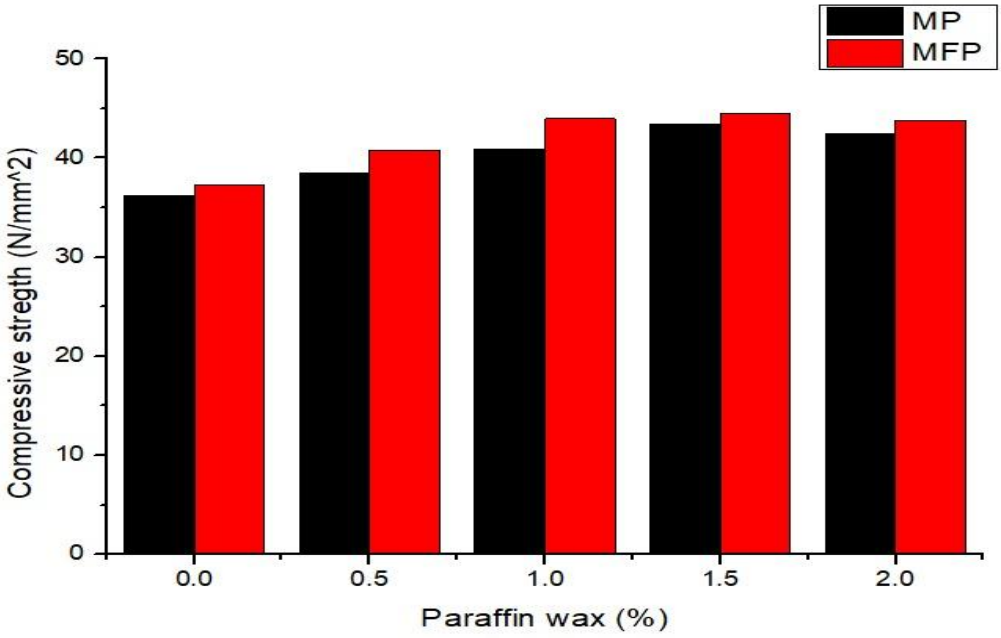


**Fig 1**: Compressive strength diagram

Fig. 1 shows the compressive test results of the study. The black colour indicate mix with paraffin wax and red colour indicates mixes with fly ash and paraffin wax. The compressive strength of fly ash and paraffin wax added concrete is greater than only paraffin wax added concrete. The graph of fly ash and paraffin wax based concrete shows steep increase in strength at 0.5 to 1%, then it slightly increases at 1.5% and then slightly decreases at 2%. While paraffin wax based concrete shows steep increase in strength up to 1.5% and then decreases at 2%. The strength is maximum at 1.5% for both type of mix (MP1.5 = 43.4Mpa, MFP1.5 = 44.45 ). This shows 1.5% is enough dosage for self-curing the concrete mix. After 1.5%, the compressive strength has decreased due to reduced cement content by replacing high percentage of paraffin wax or over dosage of paraffin wax. This highlights the benefit of water curing compared to self-curing. The maximum compressive strength attained by PW added mix was at 1.5% is attained by fly ash added incorporated mix at just 1 % PW dosage. This shows the strength of concrete self-cured with paraffin wax can be improved by adding fly ash. This also indicate paraffin wax is compatible with fly ash concrete

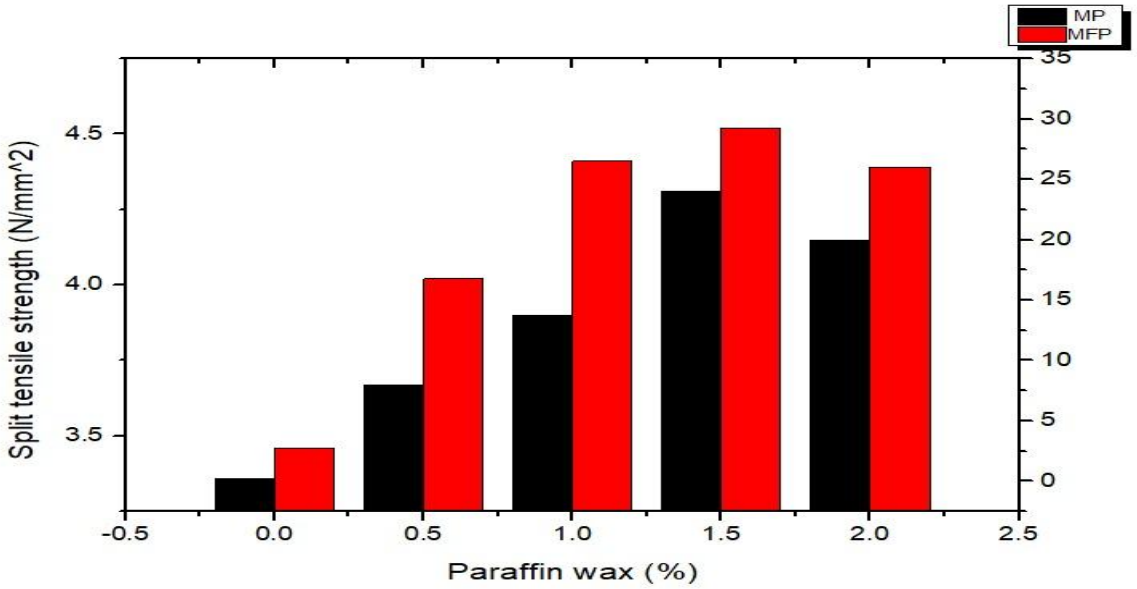


**Fig 2**: Split tensile strength diagram

Analyzing fig. 2 we can understand that the tensile strength graph shows similar trend to compression graph. The maximum value of tensile strength is at 1.5% of paraffin wax dosage. At 1%, the fly ash added concrete attain a strength greater than that of maximum strength attained by only paraffin wax added concrete at 1.5% .

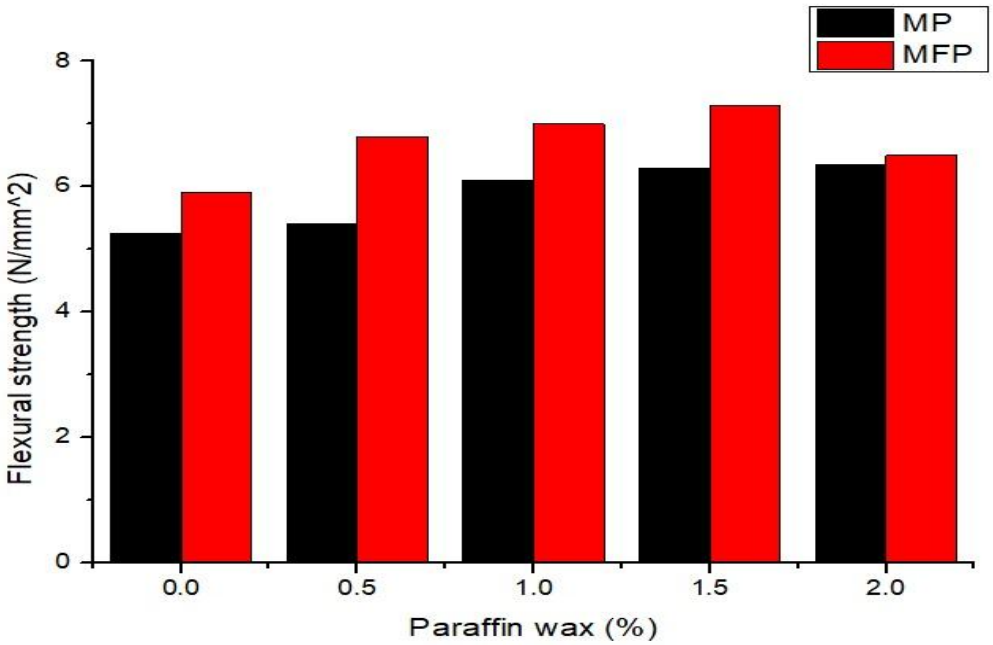


**Fig 3**: Flexural strength diagram

From fig. 3 we can understand the flexural strength trend was slightly different than compression and tensile strength graph. Fly ash and paraffin added concrete shows increase in strength in all Paraffin wax dosages than paraffin added concrete similar to compression and tensile strength. But with just addition of 0.5% PW, fly ash incorporated concrete shows a strength of 6.8Mpa while the maximum flexural strength shown by paraffin wax added concrete was 6.35Mpa. The flexural strength of fly ash and paraffin added concrete increased to 7.3Mpa which was very near to the strength of control mix at 1.5%. Then there was sudden steep decrease of strength to 6.5Mpa at 2% indicating the over dosage. This shows change in PW dosage can affect the flexural strength performance of fly ash concrete largely. While in case of paraffin added concrete the over dosage does not have much effect up to 2% PW as the flexural strength value remained constant for 1.5% and 2%.

## 3. CONCLUSION

The compression (19.92%), tensile (28.27%) and flexural strength (20%) of self-cured M35 concrete increases with addition of paraffin wax up from 0% to 1.5%. Because as the paraffin wax (self-curing agent) dosage increase in concrete mix, better water retention and continuous hydration process of cement paste results in less void and pores and great bond force between cement and aggregate. After 1.5%, the strength decreases as the cementitious content is reduced due to high percentage replacement of paraffin wax. This is due to lowest available cement content and high water availability. The compressive, flexural and tensile strength has increased with replacing cement with of 40% fly ash. This is because of the pozzolanic activity of fly ash. Compared to optimum MP mix (concrete self-cured with paraffin wax), the compressive, tensile and flexural strength increased by 4.87%, 4.9% and 15.87% for optimum MFP mix (fly ash based concrete self-cured with paraffin wax). Better strength concrete can be made with incorporation of fly ash in concrete self-cured with paraffin wax.

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