

# Employment of Banned Plastic Cover Bag wastes as Partial Replacement to Fine Aggregate in Cement Mortar

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**ABSTRACT:** In the present scenario world wide interest in waste recycling is increased due to the lack of natural resources. More than 15,000 tons of plastic wastes is produced daily in India, out of this 6,000 tons of plastic wastes last not collected and trash according to government census. In this contest the disposal of plastic waste and flyash is causing serious threat to the environment.

So in this study attempt is made to replace the volume of sand by 10%, 20%, 30%, 40% and 50% by banned plastics. It is also checked for the optimum mix proposition based on the corresponding strength. In an advanced stage materials are heated for different temperatures to estimate the optimal strength.

In concern with results of different proportions with normal temperature and varied temperature, it can be concluded that a mixed proportion of 10% replaced volume of sand with normal temperature gives better results compared to the other mix proportion.

**KEYWORDS:** Banned Plastic Cover Bag Wastes, Temperature, Cement Mortar, Compressive strength,

## I.INTRODUCTION

Plastics have become an essential piece of our day by day lives. Plastic utilization and production of plastic wastes keep on presenting nature concerns worldwide. Plastic is a smooth, flexible, low thickness, durable, strength and affordable price that's why it is used in numerous applications such as commercial products, packing items, parcel bags, household utensils, goods transportation and many other purposes. Today globally more than 100 million tons of plastic waste is generated every year compared to the 1950s where only 5 million ton plastic wastes yearly. Globally the recycling of plastic has gone increasing considerably to overcome the problem of solid waste management. Recycling of plastic wastes is difficult due to mixing nature and difficult to identify, segregate and classify. The landing filling of plastic wastes needs a lot of area and money which also causes problems with environmental pollution. The burning of plastic wastes will release dangerous gases into the atmosphere. Recycling and utilizing plastic wastes as a new product will decrease the environmental pollution and cost of management.

Many researchers studied the nature of plastic wastes employed in cement mortar and concrete. The less inflow of chloride particles and good thermal resistance by plastic bag wastes as aggregate in cement mortar (Youcef and Rabehi, 2012). The workability of concrete mix having aggregates as plastic depends on their shape and size. It is observed that there is a decrease in slump due to flaky porous plastic aggregates and increase in slump for spherical shaped plastic aggregates (Saikai and Brito, 2012). The properties of plastic totals influences the functionality of concrete that is when increment in flakier and sporadic shape will diminish the functionality of concrete (Silva *et al.*, 2013). The reused plastic replacement improves the open porosity, causing an abatement in flexural and compressive quality, with an increment in permeability. The plastic wastes as aggregate will act as thermal insulators in cement mortar (Colangelo *et al.*, 2013). The study on physical and mechanical properties of self compacting mortar using plastic wastes as fine aggregates shows good results for 50% replacement. There is a reduction in compressive strength of mortar from 15% to 33% for 20% to 50% of plastic as replacement. (Brahim Safi *et al.* (2013). The compressive strength of lightweight aggregate in plain concrete is 7N/mm<sup>2</sup> from the study of fractional substitution of sand in concrete (Sojobi and Owama, 2014). The maximum porosity at 20% replacement is 19.9% for polyethylene, 17.2% for PVC, 16.5% for polyethylene+PVC in the study of studied the mechanical and thermal performance of concrete and mortar cellular materials containing polyethylene and PVC plastic unwanted at varying percentage (Daniel Velasco Nieto *et al.*, 2016). The usage of two kinds of waste plastic Polyethylene Terephthalate (PET) and Low Density Polyethylene (LDPE) utilized as fine aggregate in sand concrete is explored (Debieb *et al.* 2016). The diameters of slump flow extend from 675 and 710 mm for self compacting plastic waste concrete. Self-compacting plastic waste



cement could be created upto 35 MPa compressive strength (Sheelan and Nahla, 2017). It is found that the strength decreases as the percentage of fine aggregates replacement increases (Manendra Vaitla *et al.*, 2018). There is a decrease in compressive strength because of improper binding with waste plastic aggregates and mortar paste. The impact resistance of PET plastic wastes aggregates mixed concrete will modify ductile nature of concrete (Rajat Saxena *et al.*, 2018). The study on the productive utilization of electronic plastic wastes particles in light weight concrete as coarse aggregates (Mary and Needhidasan, 2019).

**II. MATERIALS**

**2.1 Cement**

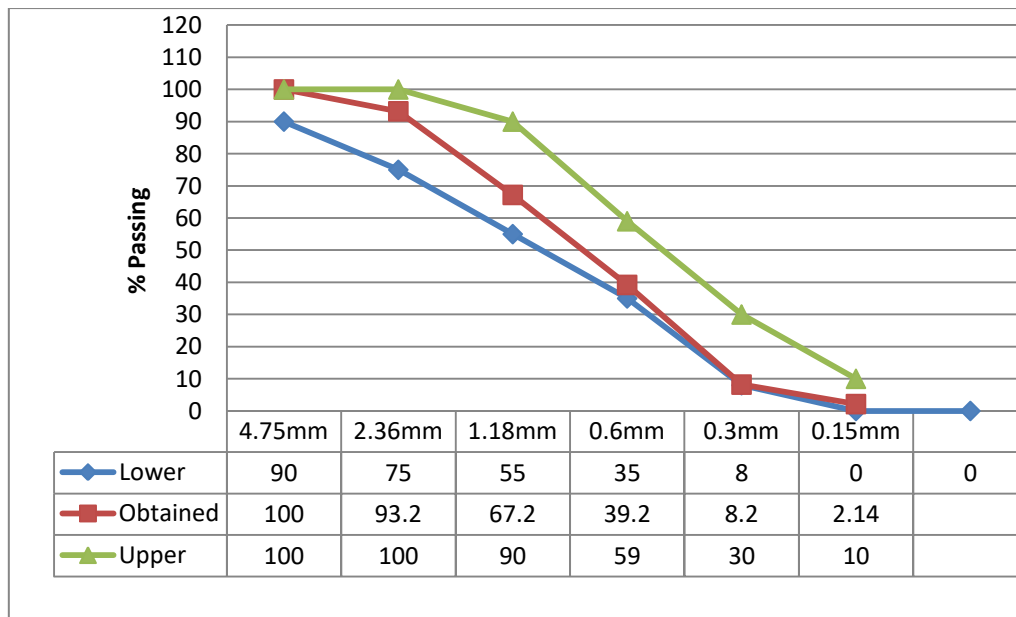
The Portland Pozzolana Cement in accordance with IS 1489:2015 was utilized for casting cement mortar cubes. The cement test conducted based on IS 4031:1988 is presented in table 1.

**Table 1. Physical Properties of Cement**

Physical Properties	Results
Specific Gravity	3.12
Fineness Modulus	2.77
Normal Consistency	32%
Initial Setting Time	95min
Final Setting Time	290min

**2.2 sand**

The natural river sand of Zone II with a specific gravity 2.63 and water absorption 2.5% conforming to IS 2116:1980. As per IS 2386 (part 1):1963 the sieve analysis of the sand is presented in chart 1.



**Chart 1. Gradation Graph of Sand**

### 2.3 Banned Plastic Cover Bag Wastes

The Manufactured fine aggregates by banned plastic cover bag wastes of Zone II gradation with a specific gravity 1.01 and water absorption 0% conforming to IS 383:1970. As per IS 2386 (part 1):1963 the sieve analysis of the plastic wastes is presented in chart 2.

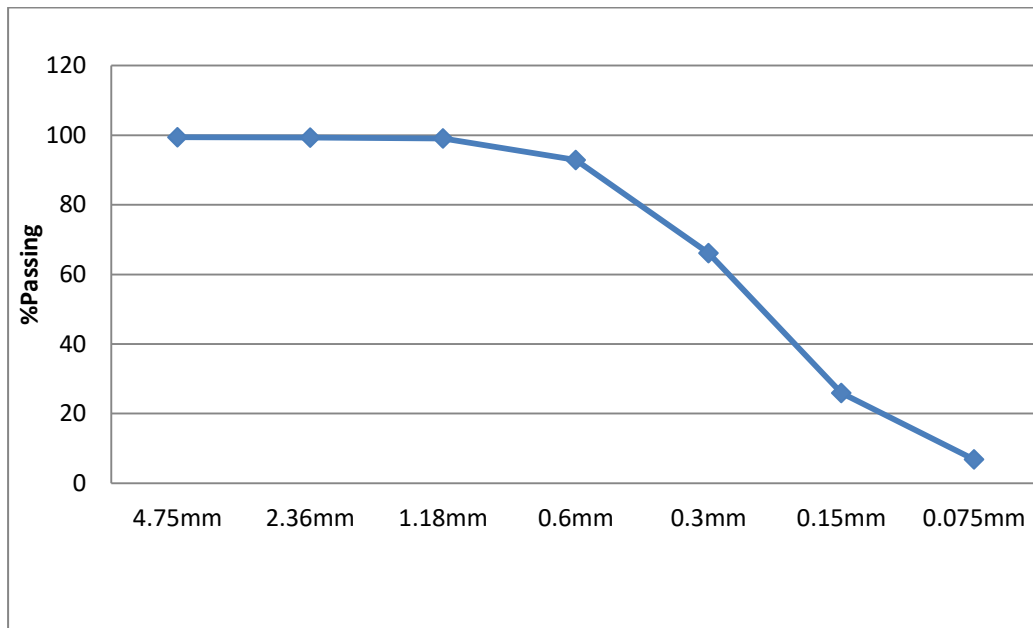


Chart 2. Gradation Graphs of Banned Plastic Cover Bag Wastes

### III. METHODOLOGY

#### 3.1 Collection of Banned Plastic Bags:

The plastic bags which are banned from the government are collected from plastic selling shops and municipal recycling bins which are shown in figure 1. These plastic bags are separated into different colors and sizes.



Fig. 1. Collected banned plastic bags

#### 3.2 Crushing of Banned plastic Bags:

The collected banned plastic bags are crushed into small pieces of size 4mm-7mm using a crushing machine which is shown in figure 2.



**Fig. 2. Crushed plastic bags**

### 3.3 Grinding of Banned plastic bags:

The Crushed plastic pieces are sent to a grinding machine where plastic pieces are grinded with a certain temperature which is shown in figure 3. The hot temperature will melt and grind the plastic into particles by adding little amount of water for cooling. After cooling, the obtained plastic wastes are in grounded form which is shown in figure 4.



**Fig. 3. Grinding of plastic Wastes**



**Fig. 4. Grounded Plastic bags**

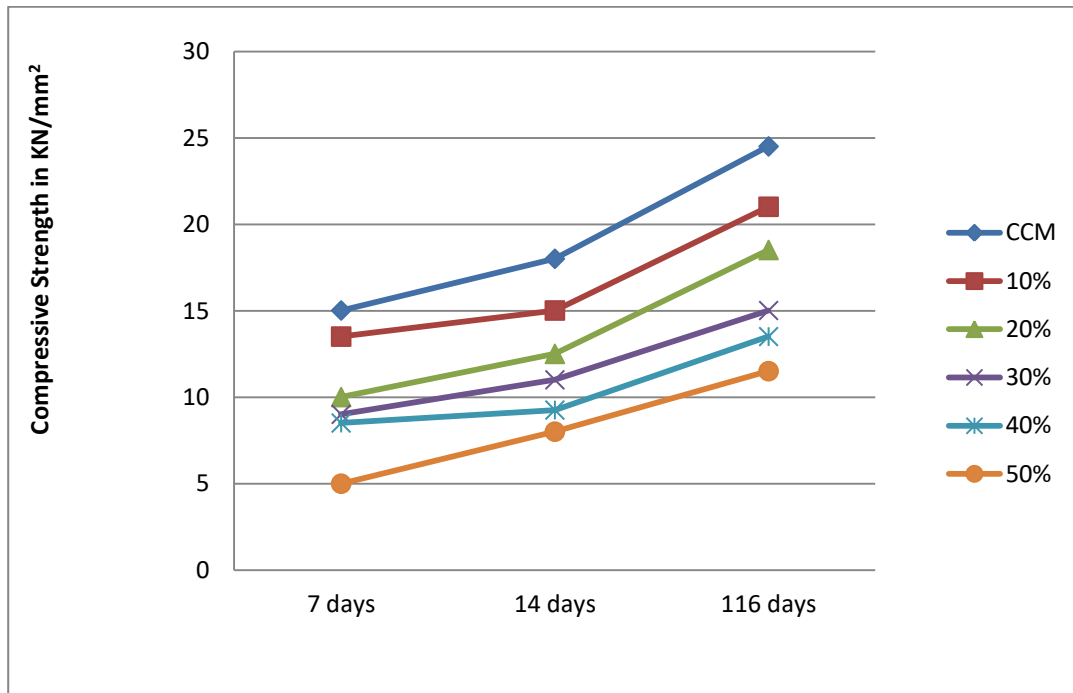
### 3.4 Mix Proportion

The cement mortar cubes is casted for size 70mm X 70mm X 70mm at 1:3 mix ratio. The fine aggregate replaced by plastic wastes at varying proportions of 10%, 20%, 30%, 40% and 50% by volume of sand. In the advanced stages, the varying mix proportions are heated to different temperatures at 70<sup>0</sup>C, 80<sup>0</sup>C, 90<sup>0</sup>C and 100<sup>0</sup>C are casted. The casted cement mortar cubes are tested for compressive strength at 7, 14 and 28 days on three trials for each set.

## IV. RESULTS AND DISCUSSIONS

### 4.1 Compressive Strength for Normal Room Temperature Mix

After the curing of specimens for 7 days, 14 days and 116 days, according to IS: 4031-Part 6: 1988 the cement mortar cubes are tested for compressive strength. The three specimens were taken from each mix proportion were kept opposite to cast side and load applied at a rate of 350 kg/cm<sup>2</sup>/min. The converted values are tabulated in chart .3 based on the failure load.



**Chart 3. The Compressive Strength Results of Different Mix Proportions of Cement Mortar for Normal Room Temperature Mix at 7 days, 14 days and 116 days in KN/mm<sup>2</sup>**

All mixed propositions show lesser compressive strength than standard cement mortar at 7 days, 14 days and 116 days. The 10% replacement of fine aggregate by plastic waste in cement mortar has more compressive strength than the other percentage replacement of fine aggregate in cement mortar. The compressive strength of 10% replacement of fine aggregate by plastic waste is lesser than the cement mortar without replacement. Therefore, 10% replacement of fine aggregate by plastic waste is the optimal percentage replacement to fine aggregate in cement mortar. From chart 3, there is a decrease in the compressive strength of the cement mortar when plastic wastes percentage increased in the cement mortar. The compressive strength decreases from 15 KN/mm<sup>2</sup> to 2KN/mm<sup>2</sup> for 7 days, 18KN/mm<sup>2</sup> to 8 KN/mm<sup>2</sup> for 14 days and 24.5 KN/mm<sup>2</sup> to 11.5 KN/mm<sup>2</sup> for 116 days. The decrease in compressive strength when increase in the plastic wastes percentage is due to the smoothness of plastic wastes compared to natural river sand. And also due to poor bonding between plastic waste and cement will cause early failure when load is applied (Sheelan and Hilal 2017).

**4.2 Compressive Strength For Different Temperature Mix**

After each mix proportion are heated to each temperature mix casted and curing of specimens for 106 days. According to IS:4031 (Part 6) 1988 the cement mortar cubes are tested for compressive strength. The three specimens are taken from each mix proportion and each mix temperature was kept opposite to cast side and load applied at a rate of 350 kg/cm<sup>2</sup>/min. The converted values are tabulated in chart 4, 5, 6,7 based on the failure load.

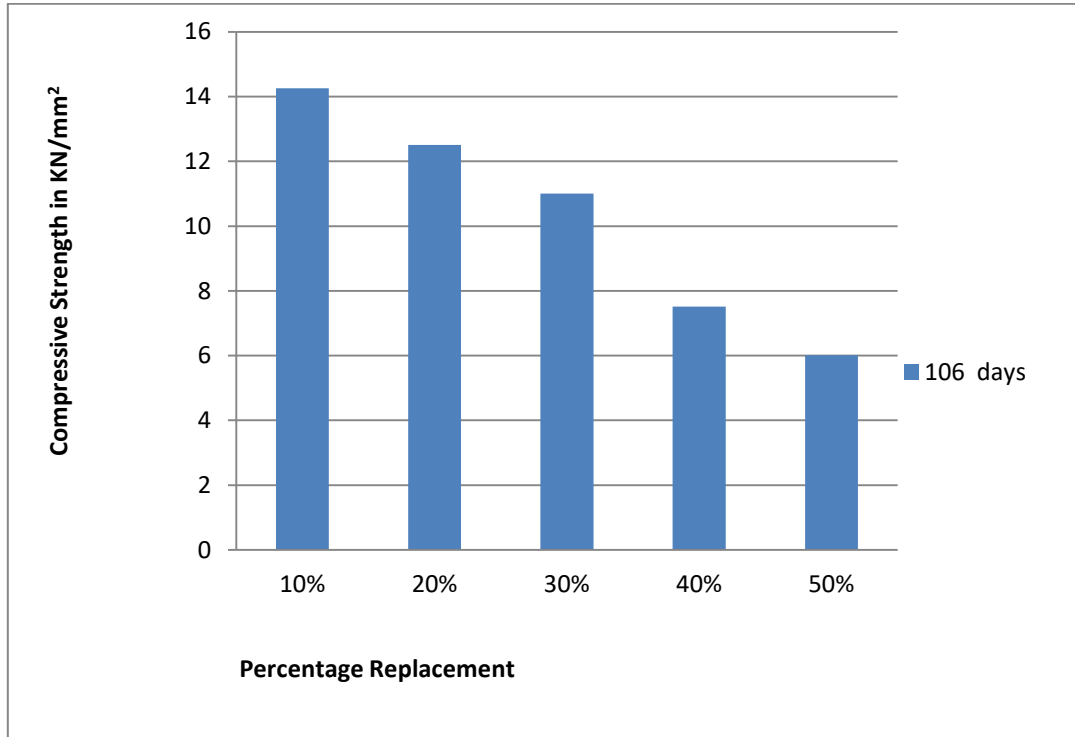


Chart 4. The Compressive Strength Results of Different Mix Proportions of Cement Mortar for 70<sup>0</sup>C Temperature Mix at 106 days in KN/mm<sup>2</sup>

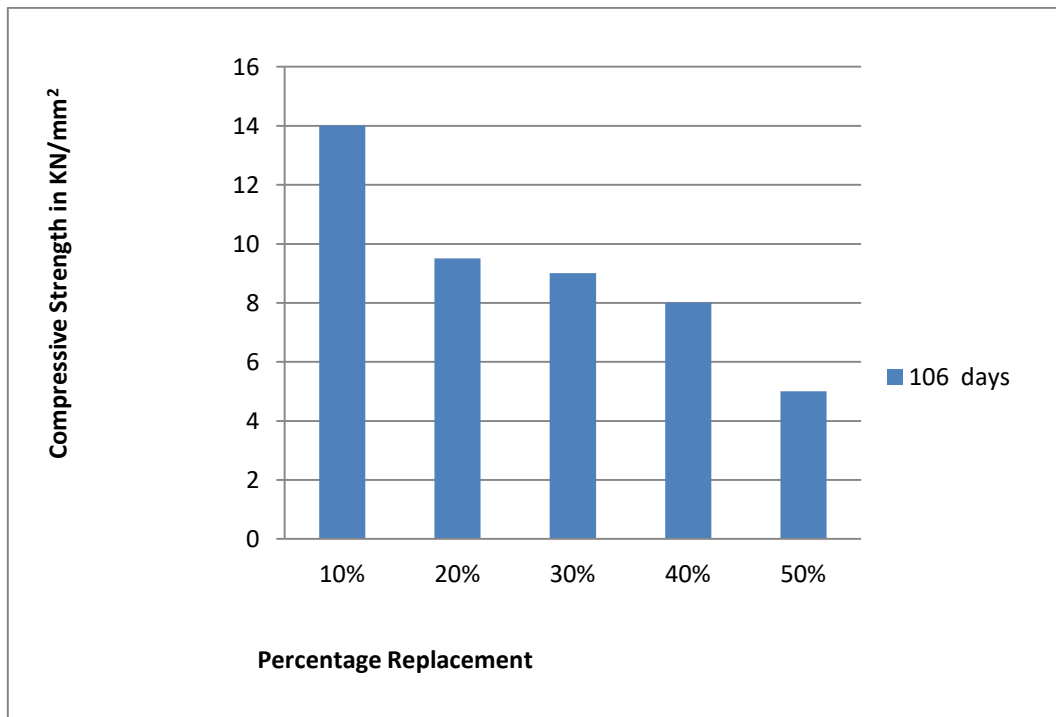


Chart 5. The Compressive Strength Results of Different Mix Proportions of Cement Mortar for 80<sup>0</sup>C Temperature Mix at 106 days in KN/mm<sup>2</sup>



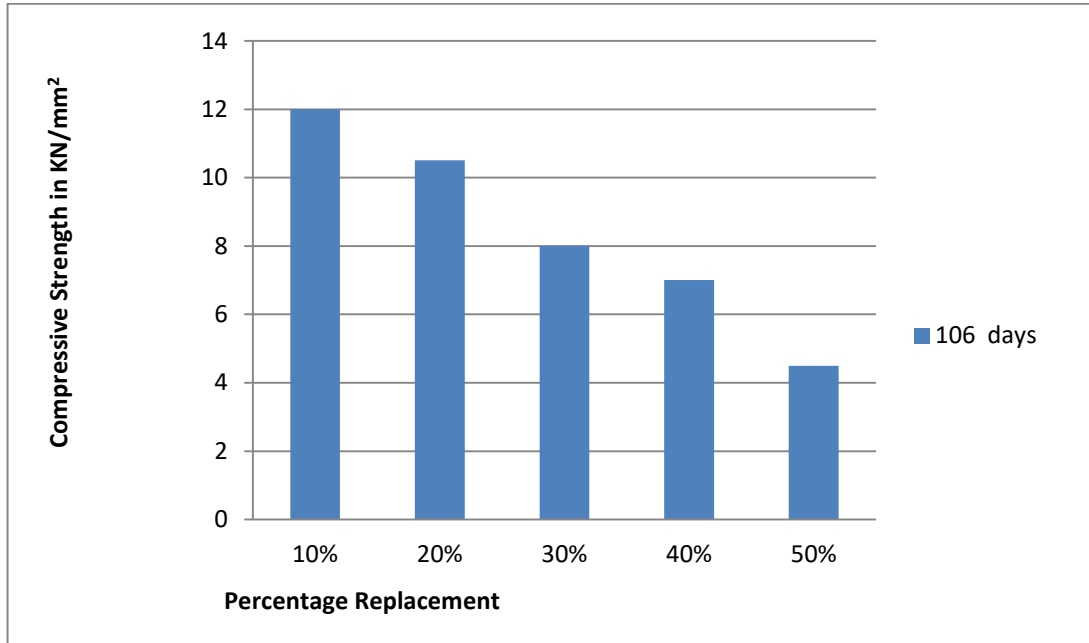


Chart 6. The Compressive Strength Results of Different Mix Proportions of Cement Mortar for 90<sup>0</sup>C Temperature Mix at 106 days in KN/mm<sup>2</sup>

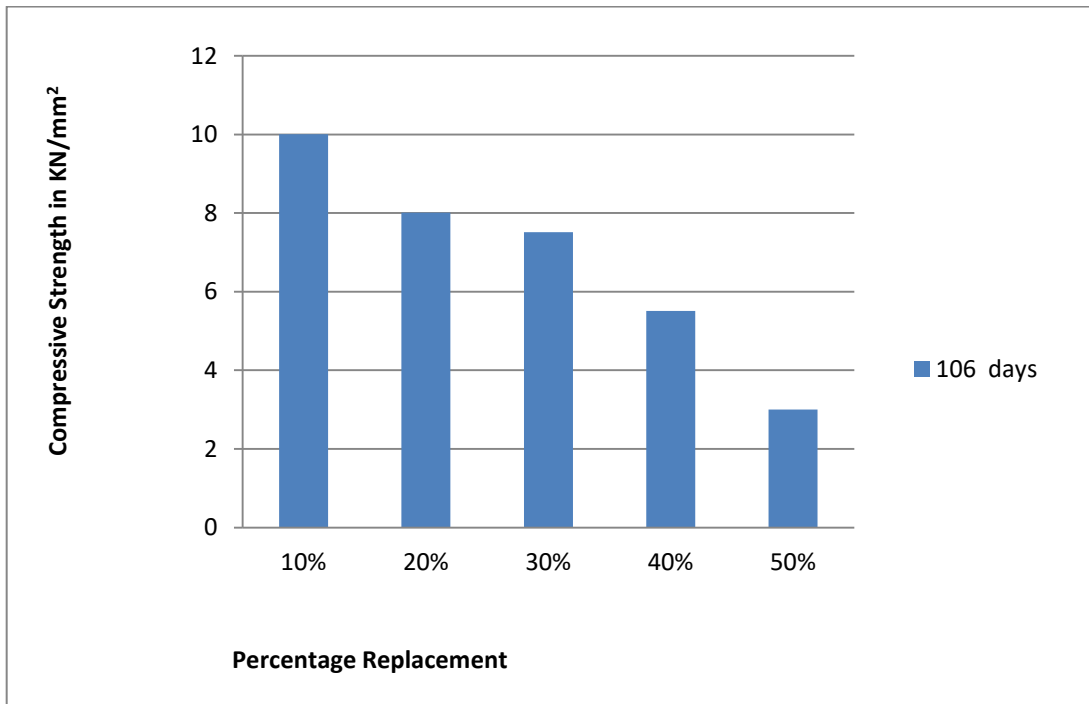


Chart 7. The Compressive Strength Results of Different Mix Proportions of Cement Mortar for 100<sup>0</sup>C Temperature Mix at 106 days in KN/mm<sup>2</sup>

All the temperature mixing and mix proportion show less compressive strength than normal room temperature mixing. There is a 52% decrease in compressive strength when the temperature of mixing increases compared to normal room temperature of mixing. The 70<sup>0</sup>C temperature mixing shows more compressive strength than other temperature mixing. From chart 4,5,6 and 7, the 10% replacement of fine aggregate by plastic wastes in cement mortar shows more strength compared to other percentage replacement in all temperature mixes. The 10% replacement is taken as the optimal percentage mix proportion from 70<sup>0</sup>C, 80<sup>0</sup>C, 90<sup>0</sup>C and 100<sup>0</sup>C temperature mixing. The increase in the temperature mix

shows a decrease in the compressive strength. The compressive strength for optimal percentage at 106 days reduces to 2% for 80°C temperature mixing, 16% for 90°C temperature mixing, 30% for 100°C temperature mixing compared to 70°C temperature mixing. The decrease in compressive strength when the increase in temperature mixing is due to melting of minute and smooth plastic wastes in the cement mortar mix compared to normal room temperature mix. And also poor bonding between plastic waste and cement will cause early failure when load is applied.

## V. CONCLUSIONS

From the present research study, the following conclusions can be concluded based on the results and observations.

- 1) The optimum strength is obtained for 10% replacement of fine aggregate by plastic wastes in cement mortar cubes.
- 2) The cement mortar cubes casted at normal room temperature has more strength compared to different temperature mixing of cement mortar from the observation.
- 3) From the observation, the increase in the percentage of plastic waste replacing fine aggregates in cement mortar will cause a decrease in the strength of cement mortar.
- 4) When the mix proportion is heated to a different temperature it melts the minute plastic wastes in the mix which will cause the decrease in compressive strength of the cement mortar.
- 5) From the observation, the increase in mix temperature will decrease the strength of cement mortar.
- 6) The plastic wastes are lighter than the natural fine aggregate which can be utilized in plastering purpose, lightweight mortar, partition wall and many other.

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