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PLASTIC WASTE USE IN CONCRETE MIX

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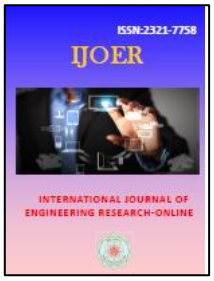

ABSTRACT

Concrete is a composite material mostly used in construction projects like road surfacing, residential houses, buildings, parking lots etc. It consists of cement (used as a binder) and mineral aggregate which are mixed together & laid down in layers then compacted. Now days, the steady increment in the developmental processes put us in a demanding situation to think of some alternatives for the improvisation in the characteristics of concrete and quality by applying some necessary modifications which shall satisfy both the strength as well as economic aspects. Also considering the environmental approach, due to excessive use of plastics in day to day business, the pollution to the environment is enormous. Since the plastics or plastics are not biodegradable, the need of the current hour is to use the waste plastic in some beneficial purposes. This paper presents a study conducted to know the behavior of Concrete mix modified with waste used plastic material. Various percentages of plastics are used for preparation of mixes. The role of plastic in the mix is studied for various compressive load carrying capacity of Concrete cubes with and without addition of plastic.

Key words: Plastic waste, concrete cube, compressive load, Bitumen, KN

1.0 INTRODUCTION

The main study of the project is to use waste plastics in concrete. It is essential to know the replacement of Plastic Aggregate (PA) in concrete which is acceptable for making of concrete. Used coarse aggregate having size 20mm, natural river sand and waste plastic were used in concrete mix and cubes are prepared for testing compressive load carrying capacity. Waste plastics are durable & non-biodegradable. The chemical bonds make plastic very durable and resistant to normal natural processes of degradation. Since 1950s, around one billion tons of plastic have been discarded, and they may persist for hundreds or even, thousands of years. The plastic gets mixed with water, doesn't disintegrate, and takes the form of small pallets which causes the death of fishes and many other aquatic animals who mistake them as food materials. Today the availability of the plastic wastes is enormous, as the plastic materials have become the part and parcel of our daily life. Either they get mixed with the Municipal Solid Waste or thrown over a land area. If they are not recycled, their present disposal may be by land filling or it

may be by incineration. Both the processes have significant impacts on the environment. If they are incinerated, they pollute the air and if they are dumped into some place, they cause soil & water pollution. Under these circumstances, an alternate use for these plastic wastes is required. Shukla and Jain [3] described that the effect of wax in bitumen can be reduced by adding EVA (Ethyl Vinyl Acetate), aromatic resin and SBS in the waxy bitumen. The addition of 4% EVA or 6% SBS or 8% resin in waxy bitumen effectively reduces the Susceptibility to high temperatures, bleeding at high temperature and brittleness at low temperature of the mixes. Collins Baker[4] observed that SBS modified asphalt mixes have longer lives than unmodified asphalt mixes. The addition of SBS polymer to unmodified bitumen also increases its resistance to low temperature cracking. Denning and Carswell [5] reported that asphalt concrete using polyethylene modified binders were more resistant to permanent deformation at elevated temperature.

1.1 Role of plastic or polymer in concrete: Modification of Concrete, with the synthetic polymer binder can be considered as a solution to overcome the problems, arising because of the rapid increase in loads and change in climatic conditions. Polymer modification can be considered as one of the solution to improvise the fatigue life, reduce the rutting & thermal cracking in the constructional structures. Cement, when blended or mixed with the polymer, forms a multi-phase system, which are not absorbed by the polymer. This increases the viscosity of the mix by the formation of a more internal complex structure.

1.2 Recent applications of plastic use: A 25 km plastic modified bituminous concrete road was laid in Bangalore. This plastic road showed superior smoothness, uniform behavior and less rutting as compared to a plastic free road which was laid at same time, which began developing "crocodile cracks" very soon after. The process has also been approved, in 2003 by the CRRI (Central Road Research Institute, Delhi).

Justo[1], at the Centre for Transportation Engineering of Bangalore University used processed plastic bags as an additive in asphalt concrete mixes. The properties of this modified bitumen were compared to that of ordinary bitumen. It was noted that penetration and ductility values of modified bitumen was decreasing with the increase in proportion of the plastic additive up to 12% by weight.

Mohammad T. Awwad [2] studied that polyethylene as one sort of polymers used to investigate the potential prospects to enhance asphalt mixture properties. The objectives also include determining the best type of polyethylene to be used and its proportion. Two types of polyethylene were added to coat the aggregate High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE). The Results indicated that grinded HDPE polyethylene modifier provides better engineering properties. The recommended proportion of the modifier is 12% by the weight of bitumen content. It is found to increase the stability, reduce the density and slightly increase the air voids and the voids of mineral aggregate.

Shankar et al (2009), crumb rubber modified bitumen (CRMB 55) was blended at specified temperatures. Marshall's mix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen (60/70) also. This has resulted in much improved characteristics when compared with straight run bitumen and that too at reduced optimum modified binder content (5.67%).

2.0 Basic raw materials used: The raw materials used are aggregates, cement, Water and waste used plastic. Aggregate constitutes the granular materials generally inert (chemically inactive), which give mass to the concrete when bound together by a matrix. In order that concrete may be durable, it is important that Aggregate is resistant to weathering action, should not contain any impurities. Coarse aggregate should be screened crushed rock, angular in shape, free from dust particles, clay, vegetation and organic matters. Fine aggregate should be clean screened quarry dusts. It should be free from clay, loam, vegetation or organic matter. A clean and clear water is used in the concrete mix. Ordinary Portland cement available in the market was used for the preparation of concrete cubes. Fig

1 & fig 2 shows the raw materials used such as aggregate, sand etc. The waste plastics after cutting in to pieces was used as raw material for preparation of the concrete cube samples. These plastic packets were collected, they were washed and cleaned by putting them in hot water for 3-4 hours and then dried. Specific gravity of the plastic was 0.905. The dried plastic packets were cut into tiny pieces of size 2 mm maximum. This is because when the plastic is to be added with bitumen and aggregate, it is to be ensured that the mixing will be proper. The smaller the size of the plastic, the more is the chance of good mixing.

Figure. 1. COARSE AGGREGATE

Figure.2. Aggregates, sand used for cube preparation

2.0 EXPERIMENTAL WORK: Experimental work consists of preparation of concrete using various raw materials such as aggregate, sand, water, cement and shredded waste plastic as shown above. The following fig 3, fig.4 and fig.5 shows the mixing of various raw materials, cube preparation and testing of concrete cubes using Universal testing machine. The concrete cubes were tested for 7days, 21days and 28 days for getting compressive load values and compared with the cubes tested without addition of plastic waste. Table 1.0 shows the compressive load values and percentage variation. An average of three cubes were tested for control and for each percentage of waste plastic. From the table 1.0 and Fig 6 and fig 7, It was found that there is increase in compressive load and percentage variation in load up to a concentration of 5% and thereafter decrease in load was observed.

Figure 3. Preparation of concrete mix

Figure 4. Concrete cube prepared for testing

Figure 5. Testing of concrete cube on UTM

Table 1. Compressive Load values at failure of concrete cubes in KN for different concentrations of plastic waste added in concrete cube preparation.

Waste Plastic Content (%)	Load value (for7 days)	% variation	Load value (for21 days)	% variation	Load value (for 28 days)	% variation
0	64.8	0	100.3	0	179.7	0
2.5	133.6	1.06	186.2	0.86	340.1	0.89
5.0*	185.8	1.87	288.1	1.87	458.6	1.55
7.5	140.5	1.17	187.2	0.87	350.3	0.95
10	130.5	1.01	175.3	0.75	289.5	0.61

*significant

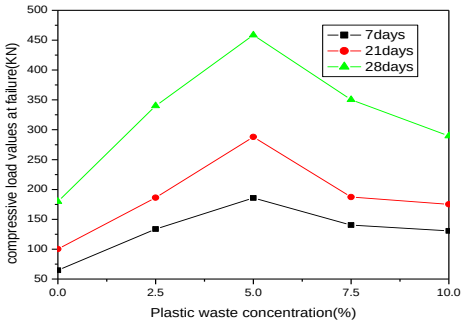

Figure 6. Compressive load values vs plastic waste

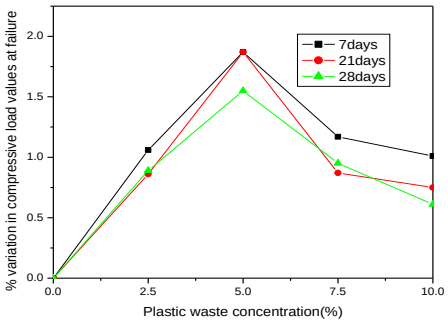

Figure 7. % variation in Compressive load vs plastic waste

CONCLUSIONS

- From the study of the behavior of plastic waste modified in Concrete mix, it was found that the modified mix possesses improved concrete property.
- It was observed that compression load value at failure increases with addition of waste plastic content up to 5%.
- It was found that the compressive load value decreases with waste plastic addition beyond 5% i.e. the resistance to deformations under heavy loads increases.
- Considering the above factors, It may be assured that more stable and durable mix for the constructional structure by polymer modifications can be achieved.
- This small investigation not only utilizes beneficially, the waste non-degradable plastics but also provides an improved concrete with better strength and longer life period.

REFERENCES

[1] Justo C.E.G. and Veeraragavan A "Utilization of Waste Plastic Bags in BituminousMix for Improved Performance of Roads", Centre for Transportation Engineering, Bangalore University, Bangalore, India, 2002.

[2] T. Awwad Mohammad and Sheeb Lina, the Use of Polyethylene in Hot Asphalt Mixtures, American Journal of Applied Sciences 4 (6) pp-390-396, 2007.

[3] Shukla, R.S. and Jain, P.K., Improvement of waxy bitumen by the addition of synthetic rubbers, polymers and resins. Highway Res.Bull., 1984, 38, 17–28 (Indian Roads Congress, Delhi)

[4] Collins, J.H., Bouldin, M.G., Gelles, R. and Berker, A., Improved performance of paving asphalt by polymer modification. Proc. Assoc. Asphalt Paving Technol., 1991, 60.

[5] Denning,J.H.and Carswell, J., Improvement in rolled asphalt surfacing by the addition of organic polymers, Report LR 989, TRRL, Crowthrone 1981.