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Applications of Rubber mixed Fly Ash and Waste Polyhtene in Roads Construction

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ABSTRACT

Fly ash is a non-plastic, cohesion-less fine grained material. It is highly erodible and needs to be stabilized to remain in place. Making use of the inherent pozzolanic behavior, fly ash can be stabilized easily and economically. Stabilized fly ash has greater resistance to erosion, high strength and relatively impervious.

Recycling of waste construction materials saves natural resources, saves energy, reduces solid waste, reduces air and water pollutants and reduces greenhouse gases. The construction industry can start being aware of and take advantage of the benefits of using waste and recycled materials.

Keywords: rubber, flyash, crumbed, stabilizers, roads.

INTRODUCTION

Fly Ash and Polythene Wastes are two abundantly available waste materials, with several good characteristics, making them suitable for bituminous road construction. The plastic waste will improve some properties of the bituminous mix and also solve environmental problems. Fly ash is the finely divided residue that results from the combustion of pulverized coal. It can be used as cost-effective mineral filler in hot mix asphalt (HMA) paving applications. Several studies suggested that the use of recycled materials has positive impact through different aspects. This include the benefits in enhancing sustainability of the construction industry while reducing cost, providing solutions to environmental pollution and reducing the need for natural resources. Use of plastic waste and fly ash is an innovation in road construction to help save environment from pollution and bring down cost as the expenses on tar and other conventional materials would be brought down by 10 per cent.

One of the major benefits of using fly ash is that it will considerably reduce the use of natural raw materials and thus will enhance industrial sustainability. However, the ash that isn't used ends up in landfills or containment ponds. In order to increase its utilization, an investigation was carried out to evaluate its potential to use as mineral filler in bituminous mix. Disposal of waste has become a great problem in cities .Disposal of waste plastic bags is one such menace. The main problem with plastic is, it will be thrown on roads and dumped in dustbins and drains. The waste plastic bags, which are dumped, find their way into drainage systems and aesthetic problems. One of the promising option currently under investigation is the use of such waste plastic to modify the bituminous mixes used for paving roads .The plastic waste need to be process separately. This plastic will improve some properties of the bituminous mix and also solve environmental problems. Solid plastic litter generated from used plastic goods and grocery bags is non bio-degradable (Jain et al, 2011) and its disposal is a serious concern.

LITERATURE REVIEW

Researchers have been working under this topic for past many years to create sustainable material for construction with a view to reduce environmental pollution and simultaneously to safeguard dwindling natural resources. Few of the outcomes are as follows Waste products are used to produce materials suitable as aggregates or fillers in concrete which not only provide a partial solution to environmental and ecological problems and it can also significantly improves the microstructure, and consequently the properties of concrete[1]. With the use of waste materials not only make the cement concrete less expensive, but it also provide a blend of tailored properties of waste materials and portland cements suitable for specified purpose [2].

During the last two decades India has seen a remarkable economic growth. According to central pollution control record (CPCB). Our country produces 5.6 million tons of plastic waste per year and the waste recycled is 9,200 tons per day which is approximately 60 % of the total waste, that means 40 % is even remain indisposed very few institutions and organization in our country employed bags and waste plastic in various forms, whose results are very encouraging, but the secondary market for reclaimed waste are not matured till now.

In India the gathering, transportation and dumping of solid waste are very irrational and tumultuous. Uncontrolled disposal of waste on periphery of cities has creates hazardous landfills, by which very severe environmental danger regarding groundwater and exceeds to global warming. If there will be restriction on the adoption of plastic, it would be more difficult and inconvenient , the situation will be more dangerous as health and safety decreased drastically and most important environmental anxiety would be complex.

In order to obtain knowledge of the most advanced use of waste and recycled materials, the author reviewed these and other studies. For instance, James et al. (2009) researched the potential use of Recycled Concrete Aggregate (RCA) and Fly Ash (FA) in concrete pavement. The recycled concrete came from a demolished local site. Their research revealed that using RCA up to 25% and FA up to 15% will not have a significant difference (if any) in strength compared with concrete containing virgin aggregate. Thus, using RCA and FA in concrete pavement may promote economical and environmental benefit.

Hamoush et al. (2011) investigated a new improved engineered gladding stone for better toughness, ductility, durability and thermal resistance. In their research, the back layer of the stone utilized recycled crumb rubber, which provides a combined solution for energy saving and environmental concerns. The results of adding crumb rubber showed a reduction in the material unit weight, enhanced ductility and toughness and improved thermal resistance.

MATERIALS AND METHODS

The details about fly ash and the stabilizers used are described in the following sections:

Fly Ash

The fly ash can be collected from an electrolytic precipitator of various thermal power plants. It is grey in color and consists of predominantly silty material. This fly ash is anthracitic class F fly ash and has low lime content. The grain size distribution, chemical composition and geotechnical properties of fly ash are different.

Stabilizers

The stabilizers used in the study are ordinary portland cement and crumbed rubber. The sources of the stabilizers are also varies for the final product.

Testing program

Unconfined compression tests are conducted on statically compared fly ash samples in stabilized and unstabilized form.. Daily records of the temperature humidity and rainfall are maintained for the entire curing period.

Laboratory curing

After preparation of the sample, it will be kept in polythene bag and closed with a rubber band. Proper identification marks are made on the polythene bag using a permanent marker. The polythene bag was kept in a desiccators with water at the bottom and closed tightly with a lid. The desiccator was kept inside the temperature controlled room of the laboratory.

Natural Environment Curing

Samples are cured in open atmosphere to study the effect of temperature, humidity and rainfall on strength characteristics of stabilized fly ash. The samples are cured inside the laboratory for 7 days before placing them in the open environment. The samples are kept on the terrace of the building. The samples are restrained in position by surrounding them with hall pins on a thermocoal sheet. The samples are protected properly on all sides and at top to shield the samples from disturbance due to birds, etc.

Testing procedure

Unconfined compression test are conducted on stabilized and unsterilized fly ash samples using strain controlled triaxial testing machine. The deformation rate for laboratory cured and unsterilized fly ash was 0.4064 mm/min.

In order to study the effect of immersion in water on strength, the laboratory cured samples are tested with and without immersion in water before the test.

Laboratory cured samples

After the required period of curing, the samples are removed from the polythene bags and weighed. They are tested in a strain controlled triaxial testing machine at a deformation rate of 0.4064 mm/min. The entire sample after the test are kept inside an oven for determination of water content.

Natural environment cured samples

Most samples are more or less dry when they are removed from open terrace after the curing period and in that state would have very high strength. In order to simulate the least favourable water content during testing, the samples are immersed in water for 6-8 hours before testing.

The weight of the samples was taken before immersion in water. The water on the surface of the samples was wiped gently using a filter paper. They are trimmed from both ends to have plane surface and the final length of the samples was measured. The diameter of the samples was unaffected by the impact of rainfall. The samples are weighed including the trimmed mixture to determine the loss of material due to erosion. Then the sample was tested in a triaxial testing machine with reduced deformation rate based on final length of the sample. The moisture content of the sample was determined after the test.

Unconfined Compression Tests

The required quantities of fly ash and stabilizers, corresponding to dry unit weight requirement are calculated. An additional 2 grams of mixture was taken to compensate for losses during the preparation of samples. The total stabilizer content was kept constant as 4 percent of dry weight of fly ash. The fly ash and stabilizers are mixed together in a clean bowl in dry state, so as to have a uniform distribution of constituents in the mixture. Distilled water was added to the dry mixture as per the requirement of moulding water content and mixed well to form a homogeneous mixture.

The mixture is compacted in a cylindrical mould of 37.7 mm diameter and 73.5 mm long. Static compaction technique was adopted and compaction is done thrice alternatively from both ends of the mould to achieve uniform compaction. The sample was trimmed at both ends if required and extruded from the mould by using a hydraulic jack extruder.

The weight of the sample was measured in an electronic balance.

Two methods of curing namely, laboratory curing and natural environment curing are adopted.

DISCUSSION

Use of rubber in the road construction

Now-a-days very few percentages of squander tyres are being discarded. The recycled tyres rubber is used to make new tyres, in construction Industry, sports activities, agriculture sector, as a molded rubber product. There is an immense opportunities in the combination of tyres into asphalt. The 'wet process' is hereby 40 years old and various roads are laid down using this technology with very encouraging results as they are also improving the performance of the road. But the method is still struggling for coming in the mainstream of the construction industry. There are mainly two methods by which we can use waste tyres into the road construction.

They are mainly:-

1. Wet process high viscosity
2. Wet process no agitation

The wet process high viscosity was invented by Charles Macdonald. This method has various benefits which are mainly linked with the binder's capability increasing elasticity and viscosity at a high temperature. The recycled tyres rubber modified bitumen (RTR - MB's) that enables rotational viscosity threshold of 1500 cps at 177 ^{0} C over the interaction period should be described as 'wet process' high viscosity. Wet process high viscosity binders typically needed at least 15 % CKM to achieve the threshold viscosity for some specifications. The continuous agitation is needed with special equipment to keep RTR particles uniformly distribution. This process is categories in following technologies which tells us in brief the benefits and limitations of the wet process high viscosity. A. Asphalt rubber binder B. Bitumen rubber binder C. Crumb rubber binder.

Use of Waste Polythene in the road construction

The waste polythene is used in the road construction as a mixing material in the top layer, but its utility is not limited as polythene can also be used as reinforcement in the sub grades, the polythene waste can be used as strip in the soil, it is an effective and dependable technique to improve the strength of sub grades in soil. Better sub grade require comparatively thinner section especially in the flexible pavement as compare to the weaker or untreated sub grade which results into cost reduction also. The increasing use of geo textiles or polymeric reinforcement like geo grids in the geotechnical application encourages using the plastic waste in the sub grade. In comparison with systematically reinforced soil, randomly distributed fiber reinforced soil, randomly distributed fiber reinforced soil has been found effective in improving the soil CBR reported in the literature. Polythene container generally made up of high density polyethylene (HDPE) dispose immediately after use. HDPE will collect and recycle but the secondary market of HDPE is not yet so effective and developed and the solid waste reaches more than 50 million tones.

The most appropriate way to use plastic waste is to use them in engineering application. The recycled HDPE strip can be very useful, easy, and economical to improve the properties of soil in sub grades as compared to geo grids.

FUTURE SCOPE

The following studies are suggested to be carried out to understand more about the strength behavior of stabilized fly ash.

1. Study about pozzolanicity of fly ash
2. Study of morphology and mineralogy of fly ash in stabilized and unstabilized forms.
3. The effect of various stabilizers in different proportions and combinations on the UCS.
4. The effect of stabilizers on the UCS of fly ash - soil mixtures.
5. The effect of inclusion of fibers on the strength behavior of stabilized fly ash - soil mixtures.
6. The effect of variation in water content and density on strength of stabilized fly ash – soil mixtures.
7. The effect of variation in deformation rate on the UCS of stabilized fly ash - soil mixtures.

8 The effect of method of curing on the UCS of stabilized fly ash - soil mixtures.

CONCLUSION

From the study of some of the methods in which waste products are used in so many ways in the road construction by which we can utilize the plastic waste, industrial waste, agricultural waste, in addition to this they can also improve various properties of roads specified by various authorities. Plastic wastes is a menace and has become a serious problem, especially in urban areas, in terms of its misuse, its dumping in the dustbins, clogging of drains, reduced soil fertility and aesthetic problems etc. Provisions are running in construction is recycling of solid waste as to decrease the demand of fresh constituents in construction reducing the disposal of waste So we can say that there is dual benefit to use these methods in various places majorly in low volume roads where loading conditions are limited and economy can be maintained which is very important for any developing country especially like India.

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