Experimental Study on Use of Phosphate Aggregate In GSB Layer of Pavement

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Abstract- *Traditionally, the materials which are used in highway construction are also used in other construction activities (like buildings, industrial set ups, dams, power houses etc.). Aggregates for base and sub-base use are composed of sand, crushed aggregates, gravels or natural materials that provide the necessary strength and durability. To meet the enormous demands of construction the above natural aggregate resources are heavily consumed for the construction of roads, especially in urban markets.In this study I will focus on To check the usability of different non-conventional materials as partial replacement of crushed aggregates in pavement granular sub-base. To compare the strength with and without replacement of non-conventional materials in granular sub base. To perform cost calculation with and without use of non-conventional materials in granular sub base.*

Keywords- non-conventional materials, phosphate rock aggregate, GSB Layer

I. INTRODUCTION

Now-a-days the depletion of natural resources has been a major issue in the construction sector from which the road segment cannot be excluded. Because of the extensive road construction processes the aggregate demand is so huge that lots of blasting, quarrying, crushing and transportation activities are consuming a lot of energies, but also the aggregate materials are depleting fast and are in short supply.
The generation of a vast quantity of waste materials from industries like iron, steel, coal, etc. is causing a shortage of dumping space and creating severe environmental pollution. Solid waste generation from steel industries such as power plant fly ash, acid sludge from by-product plant, tar sludge, B.F. slag, steel slag, coke breeze, calcined lime, dolomite dust and steel scrap etc. are generated in vast quantities causing environmental degradation.

Materials to be use in study:

Waste phosphate rock aggregate from fertilizer units:

Phosphate rock is grinded for production of phosphoric acid for production of phosphor based fertilizers. The particles sizing from 16 mm – 40 mm however are rejected as it is costly to produce acid from this sized aggregates. Due to its hardness characteristics there is potential to use rejected phosphorous stone aggregates in granular sub-base.

Table 1:-Physical properties of waste phosphate rock

Property	Value
Textural form	Nodular, Granular
Color	Reddish brown
Specific gravity	2.79
Hardness	5.5 on Moh's scale

Fig.1:- Rejected phosphorous aggregates at GNFC

II. OBJECTIVE OF THE STUDY

1. To perform cost calculation with and without use of non-conventional materials in granular sub base.
2. To compare the strength with and without replacement of non-conventional materials in granular sub base.
3. To check the usability of different non-conventional materials as partial replacement of crushed aggregates in pavement granular sub-base.

III. LITERATURE REVIEW

By R. Vishal, In Present study Researcher was intended to utilize the locally available material in road construction in sub base layer. Four locally available material near Roorkee are chosen, the materials are river bed material,

coarse sand fly ash and stone dust. To evaluate the material properties static and dynamic tests are conducted.

Yash Pandey conducted studies to check the usability of low fuel content coal rejected from power plant as partial replacement of crushed aggregates in granular sub base. One of the problems in our country is to have quality roads in cities and villages to have better connectivity. Some of the villages have no roads and for that the inefficiency of the system prevailing including the engineers is blamed.

Souvik roy& Aman patidar conducted their study to check the usability of over burnt brick bats as partial replacement of coarse aggregates in pavement subbase. In North-Eastern region of India, there is an acute scarcity of stone aggregates.

IV. EXPERIMENTAL METHODOLOGY

Experiments to be performed: The tests required to be performed are as below:-

1) Sieve analysis
2) Specific gravity and water absorption test
3) Aggregate impact test
4) Los Angeles abrasion test
5) Shape test
6) Permeability test
7) CBR test

Gradation analysis:

Sieve analysis for different sizes of aggregates had been carried out through different sets of sieves as per codel guidelines.

First of all the aggregates were placed in oven and heated at 110° C temperature for period of 24 hours.

MORTH specifications in Table 400.1 have been considered for gradation analysis.

Source of aggregates: - Krishna Corporation, Sayla
Weight of aggregate sample: - 12520 grams.

V. RESULTS & ANALYSIS

Proportion mix design with crushed aggregates and different types of materials like RCA (Rejected coal aggregates) and PA (Phosphorous Aggregates) are describe below.

Table 2: Proportion Mix Design

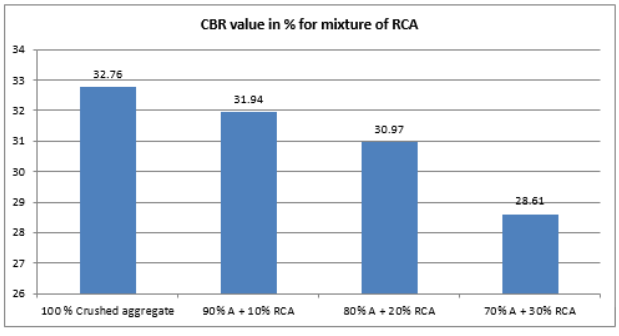
Sr. No.	Proportion Mix Design
1	100 % Crushed aggregate
2	90% A + 10% PA
3	80% A + 20% PA
4	70% A + 30% PA

PA (Phosphorous Aggregates):

California bearing ratio test results for various proportions:

The CBR test was done on GSB mixes for the 4-days soaked samples as per IS.2720 Part-16:1987. Normally the CBR value at 2.5 mm penetration which is higher than 5 mm is reported as the CBR value of the material. However, if the CBR value obtained from the test at 5 mm penetration is more than that 2.5 mm, then the test is repeated for checking.

Test	Proportion	CBR Value (%)	MORTH Specification
CBR Test	100 % Crushed aggregate	32.76	30% Minimum
	90% A + 10% PA	33.19	
	80% A + 20% PA	34.67	
	70% A + 30% PA	35.12	



Graph-1: Results of CBR Value (%) with Different Proportion

VI. CONCLUSION

The main aim of present study was to check the usability of rejected coal aggregate and phosphate aggregate in GSB layer of pavement. To justify objectives various tests had been conducted on various proportions of normal aggregates and replacement materials. Following conclusions were drawn from the study.Various tests were conducted on different proportions, out of which 70% normal aggregate + 30% phosphate aggregates had been found best proportion.

GSB-I grading has been chosen for present study purpose. Results of gradation for crushed aggregate, RCA & PA are within permissible limit.

As per MORTH 5th revision value of CBR for subgrade material should be 30% minimum. It is not achieved with increasing coal replacement but with increasing phosphate aggregate the value of CBR increasing.

GSB-I grading is for strength purpose it is having low permeability value. But for all the proportions the minimum permeability value had been achieved.
With replacement of phosphate aggregates we can save material cost by INR 297500/- for 1 km, 2 lane road.

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