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# STABLISATION OF SOIL WITH MARBLE WASTE ON HIGHWAY SHOULDERS

**Dharma Prakash Sharma*, Gokul Prasad Sharma**

* Research scholar ,Department of Civil Engineering Bhagwant University Sikar Road Ajmer(Rajasthan),
Research scholar ,Department of Civil Engineering Bhagwant University Sikar Road Ajmer(Rajasthan),

## ABSTRACT

Large volumes of earthen materials are used in construction each year in India and elsewhere. The wastes generated from these materials can be utilized in various applications including highway shoulders. In this study, three different types of wastes namely local soil of Jaipur city and marble dust are used. These wastes were mixed with natural soils as a potential alternative filling materials in the highway shoulders. Two types of natural soils were mixed with 0%, 5%, 10%, 15%, and 20% of, marble dust. Standard compaction, permeability and saturated California Bearing Ratio (CBR) tests, and analysis were performed on two types of natural soils, containing three industrial waste types in different ratios. The study indicates that the marble dust and waste sand are fairly good additive materials in highway shoulders fill and reaction substantially improves their CBR, swelling ratio and water conductivity. It was found that a clear optimum replacement level of 15% for all of these by products for medium and low plasticity type of soil.

**KEYWORDS:** Earthen material, Highway shoulders, California bearing ratio, Low plasticity type.

## INTRODUCTION

Marble in Rajasthan is 90% of the total reserves in India. It is available and mined in Ajmer (Makrana), Rajsamand, Udaipur etc. The mining operations creates considerable wastes of the order of 70% .The distribution of waste can be assessed as mine waste 50% , processing waste 5% .Thus the main product ,marble is only 30% for utilization. Processing in gang saws, marble block produce marble slurry, a fine white powder and a waste which is subsequently disposed on agricultural fields fertile or barren, pasture lands, river beds, road sides, empty lands and catchment areas.

According to estimation there are 1100 gang saws operating in rajasthan. In gang saws about 30% of marble blocks are converted into powder and it is about 1.5 million tons per annum .Requirement of water in the processing plants is about 2,75,000 liters per hours. Water gets badly polluted during processing. A` filter press' is a key component in the eco friendly for marble processing .The amount of water ,which is otherwise disposed around the processing plants is saved and can reused and recycled in further processing .

In the absence of research, dumping of marble slurry is unscientific and continues environmental hazards in land, water and air, Lack of utilization in the industry and construction activities further multiplies the complexity .Water logging and loss of water table compound the complex situation. Due to alacrity of the marble slurry, fertility of the soil is reduced. Dumped wastes dry fast suspends Recycling of marble dust for environment improvement at various places of its production and dumping is a major exercise, at present and in near future before it is too late and the damages reach a point of no return. All efforts are required to find its properties for utilization, recycling, conservation of natural resources and environmental aspects. Repeated experiments can surely validate the technology of converting a waste into an important industrial byproduct.

The main objectives of the research on marble slurry are as under:

1. Characterization – to identify useful properties and characteristics of marble slurry in the solid (powder) state. Analyze and calculate interims in positive and negative forms. Equate and observe analogies with other existing construction materials.
2. Utilization – To experiment on marble slurry together with available soil for scientific stabilization in engineering practice. A variety of utility products and techniques like stabilization can be developed and made/manufactured from/by marble slurry both in domestic and industry area's either substitute or right

replacement ,whether whole or partially , be attempted scientifically.

Presently disposal of marble slurry is responsible for many environmental hazards and disasters. One of them causing fatal disease silicon's to everyone involved in slurry production from the beginning to the final irresponsible dumping at locations that will consuming slurry in soil stabilization technique can be a solution par excellence.

An alternative to the present dubious dumping practice shall be examined. Bagged storage shall be scrutinized for future use. It will be proved that "utilization is a better way of dealing the problem of slurry disposal".

Conservation Resources – based on utilization, Natural resources saved shall be assessed. Marble slurry, which at present is a waster product, could be save valuable natural resources which are on the verge of extinction. It shall be indicated that a waste product could become a byproduct saving all important natural resources

Environmental Aspects — presently marble slurry is an ugly pollution material and it will be shown horribly it is effecting the living and non living through land, water and air degradation. Awareness to this proposition shall be emphasized. Relief from environmental excess shall be investigated. Environmental conditions shall be linked to above objectives of characterization, utilization and saving natural resources towards a better positive state.

## METHODOLOGY

**TABLE 1**
**PHYSICAL PROPERTIES OF MARBLE SLURRY**

| Property | Result |
|---|---|
| Bulk Density (gm/cc) | 12 - 14 |
| Specific Gravity | 2.65 - 2.82 |

**TABLE 2**
**PARTICLE SIZE DISTRIBUTION OF MARBLE SLURRY**

| Particle size (mm) | % Finer by volume |
|---|---|
| 363.1 | 100 |
| 193.0-205.8 | 90 |

Source: Research Paper on use of "Incorporation of Marble Sludge in Industrial Building Eco-blocks or Cement Bricks Formulation" by Fakher J. Aukour

**CHEMICAL ANALYSIS OF MARBLE SLURRY**

**TABLE 3**
**CHEMICAL ANALYSIS OF MARBLE SLURRY**

| Test carried out | Test value % |
|---|---|
| Loss on ignition | 34.8 - 43.2 |
| Silica | 0.33 - 1.20 |
| Alumina | 1.04 |
| Iron Oxide | 0.12 - 0.28 |
| Lime | 49.07 |
| Magnesia | 0.82 - 1.8 |

***Table 4 Index Properties of the Samples used***

| Sample | Clay (%) | Silt & Fine Send (%) | G | LL (%) | PL (%) | PI (%) | SL (%) | ISSCS | Swelling Potential |
|---|---|---|---|---|---|---|---|---|---|
| Sample1 | 36.1 | 61.1 | 2.63 | 96.0 | 21.4 | 74.6 | 15.0 | CH | Very high |
| 5%MD | 29.0 | 70.6 | 2.65 | 76.1 | 25.0 | 51.1 | 16.4 | CH | High |
| 10%MD | 28.1 | 71.7 | 2.68 | 75.2 | 28.2 | 47 | 18.0 | CH | High |
| 15%MD | 26.5 | 73.0 | 2.73 | 72.2 | 30.3 | 41.9 | 20.1 | CH | High |
| 20%MD | 25.1 | 74.2 | 2.75 | 71.0 | 31.1 | 39.9 | 21.5 | CH | High |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25%MD | 21.6 | 76.5 | 2.77 | 68.4 | 32.1 | 36.3 | 23.0 | CH | High |

G: Specific gravity, LL: Liquid Limit, PL: Plastic limit, PI: Plasticity index, ISSCS: Indian Standard Soil classification system

## SAMPLE PREPARATION

The soil sample was prepared by replacing the natural soil 10% betonies to make it more expensive, afterwards marble dust was added to the sample in the proportion of 0% to 25%at the interval of 5 %( by weight). Tests were performed on total six different samples First of all ,the mixed material were sieved through 2.36 mm sieve and then oven dried at $60^0$c for 24 hrs. Now all the materials were mixed thoroughly by trowel .Index properties of the samples are shown in table no.4.

Proctor's compaction test, Altenburg's limit, specific gravity tests and hydrometer test were performed according to IS: 2720 .Specific gravity test was performed by Pycnometer for each sample. Classification of soil has been done according to Indian standard soil classification system (ISSCS) .Clay and silt percentages were found by grain size distribution from hydrometer test.

## RESULTS AND DISCUSSIONS

The huge production of marble waste from marble cutting industry and fly ash from thermal power plants has been creating enormous problems of environmental pollution. This waste material may be effectively used in the highways in shoulders, in sub bases after stabilizing with marble slurry waste etc. with natural soils which can be low or medium plasticity soil for the sake of safe disposal. The disposal of marble waste is not enough in the ratio as it is being produced. Researchers have been investigating different types of waste materials as additive components in soil. This brings no. of benefits such as:-

1) Waste material increase the soil strength, bearing capacity, grain size distribution and also decrease some geometrical parameters such as compressibility, permeability and swelling capacity.
2) Physical and chemical pollution of soil, water and air due to waste material are reduced in the environment.
3) In various engineering fields such as highways ,building,canals,health and sanitation, air fields decorative & ornamentation pieces cement concrete pavements and in the bricks industry

In this study for evolution of strength stiffness of shoulders soil is stabilized with by-products of fly ash and marble slurry are done.

In table 1, 2 &3 physical & chemical properties of marble slurry have been shown.
Table 4 shows that mixture of 15% gives the near to highest results. Although at some points the results at 10% is higher but looking to cost vise factors, 15% mix proportion of soil with marble surrey waste on the highway shoulder is advisable

## CONCLUSION

- In this study stabilized artificial soil samples were obtained by adding 5, 10, 15, 20, and 25 % of marble slurry and then the effect of waste type on the consistency limits and compaction parameters of the samples were examined. The following conclusion was drawn from the result of the laboratory tests.
- The addition of the marble dust to the soil reduces the clay contents and thus increases in the percentage of coarser particles.
- It reduces the liquid limit, raises the shrinkage limit and decrease in the plasticity index of the soil and thus swelling percentage.
- By curing the sample, the rate of swell and swelling percentage decreased. Therefore expansive soil can be replaced by marble dust for reducing the swelling up to 20% to 25 % because there is not much difference in swelling potential and rate of swell up to adding of 25 % marble dust.

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