*IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*
*e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 1 Ver. I (Jan- Feb. 2015), PP 61-64*
*www.iosrjournals.org*

# Effect of Stone Dust On Some Geotechnical properties Of Soil

Naman Agarwal
*M. Tech. student, Department of Civil Engg., G.B. Pant University of Agriculture & Technology, Pantnagar, India*

***Abstract:*** *Stone dust is a kind of solid waste material that is generated from stone crushing industry which is abundantly available. It is estimated that each crusher unit produce 15%-20% stone dust. Disposal of such wastes poses lots of geoenvironmental problems such as landfill disposal problems, health and environmental hazards. The best way to eliminate these problems is to make use such waste. Keeping this in view an experimental study was conducted on locally available soil by mixing it with Stone Dust. The effect of randomly distributed Stone Dust on MDD, OMC, Specific gravity and CBR has been discussed in this paper. The percentage of stone dust by dry weight of soil was taken as 10%, 20%, 30%, 40% and 50%.The first series of compaction, specific gravity and CBR tests were conducted on the soil and the same tests were conducted in the second series on soil samples mixed with stone dust. Laboratory experiments favorably suggest that mixing stone dust with soil would be effective in improving soil properties.*

***Keywords:*** *CBR, MDD, OMC, specific gravity, stone dust*

## I. Introduction

Disposal of waste is a challenge for all developing countries mainly due to the increasing generation of waste, the high costs associated to its management and the lack of understanding over a diversity of factors that affect the different stages of waste management. Stone dust is also a solid waste material that is generated from stone crushing industry which is abundantly available in India. **Soosan et al. (2001)** identified that crusher dust exhibits high shear strength and is beneficial as a geotechnical material. Stone dust is a material that possesses pozzolanic as well as coarser contents in it while other materials like fly ash possesses only pozzolanic property and no coarser soil particles.

Significant improvement in the properties of soils is reported by different researchers by mixing it with stone dust. In this study stone dust by dry weight of soil was taken as 10%, 20%, 30%, 40% and 50% taken and mixed with the soil so as to examine the effect of mixing on OMC, MDD and CBR properties of soil.

## II. Literature Review

Very little information has been published on the engineering properties of stabilised soil using stone dust. However, many studies are reported on use of stone dust with/without lime and/or fly ash.

**Roobhakhshan and Kalantari (2013)** conducted consistency limit, standard compaction test, unconfined compressive test and CBR test and concluded that there is remarkable influence on strength and CBR value at 1% lime + 6% waste stone powder for CBR and 7% lime + 6% waste stone powder for U.C.S which are optimum percentage.

**Sabat (2012)** conducted series of tests and concluded that addition of quarry dust decreases Liquid limit, Plastic limit, Plasticity index, Optimum moisture content, Cohesion and increases shrinkage limit, Maximum dry density, Angle of internal friction of expansive soil.

**Satyanarayana et al. (2013)** conducted plasticity, compaction and strength tests on gravel soil with various percentage of stone dust and found that by addition of stone dust plasticity characteristics were reduced and CBR of the mixes improved. Addition of 25-35% of stone dust makes the gravel soil meet the specification of morth as sub-base material.

**Ali and Koranne (2011)** presented the results of an experimental programme undertaken to investigate the effect of stone dust and fly ash mixing in different percentages on expansive soil. They observed that at optimum percentages, i.e., 20 to 30% of admixture, the swelling of expansive clay is almost controlled and there is a marked improvement in other properties of the soil as well. It is concluded by them that the combination of equal proportion of stone dust and fly ash is more effective than the addition of stone dust/fly ash alone to the expansive soil in controlling the swelling nature.

**Bshara et al. (2014)** reported the effect of stone dust on geotechnical properties of poor soil and concluded that the CBR and MDD of poor soils can be improved by mixing stone dust. They also indicated that the liquid limit, plastic limit, plasticity index and optimum moisture content decrease by adding stone dust which in turn increases usefulness of soil as highway sub-grade material.

## III. Material used

### 3.1 Soil

The soil for this study was procured from the campus of G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India. The material was extracted from 60cm below the ground surface. Index properties of the soil were determined as per IS codes and are presented in Table-1. The soil is classified as CL.

**Table 1:** Index properties of soil

| Property | Value |
|---|---|
| Natural Moisture Content (%) | 11.11 |
| Particle Size distribution | |
| Sand (%) | 23.6 |
| Silt (%) | 61.4 |
| Clay (%) | 15 |
| Specific Gravity | 2.40 |
| Liquid Limit (%) | 19.5 |
| Plastic Limit (%) | 7.14 |
| Plasticity Index (%) | 12.86 |
| OMC (%) | 16.5 |
| MDD ($g/cm^3$) | 1.76 |
| CBR Soaked (%) | 1.95 |

### 3.2 Stone Dust

Stone dust for this study was purchased from Pal Stone Industry, Halduchaud, Uttarakhand, India. Index properties of the stone dust were determined as per IS codes and are presented in Table-2.The stone dust is classified as SP. Stone dust was randomly mixed with soil samples in 10%, 20%, 30%, 40% and 50% of the dry weight of soil.

**Table 2:** Index properties of stone dust

| Property | Value |
|---|---|
| Natural Moisture Content (%) | 9.11 |
| Particle Size distribution | |
| Sand (%) | 97.1 |
| Silt (%) | 2.9 |
| Specific Gravity | 2.76 |
| Liquid Limit (%) | NP |
| Plastic Limit (%) | NP |
| Plasticity Index (%) | NP |
| OMC (%) | 11.5 |
| MDD ($g/cm^3$) | 1.97 |
| Angle of internal friction (degree) | 35 |
| Cohesion ($kN/m^2$) | 0.07 |
| CBR Soaked (%) | 11.5 |
| CBR Unsoaked (%) | 26.28 |

## IV. Experimental Programme

In order to determine maximum dry density (MDD) and optimum moisture content (OMC) of unstabilized and stabilized soils, standard proctor tests were conducted as per IS:2720 (Part VII)-1980. In present investigation CBR test was determined as per recommendations in IS:2720 (Part 16)-1987 and specific gravity is determined by using pycnometer method as per IS:2720 (Part III)-1980.

## V. Results and Discussion

### 5.1 Effect of Stone Dust on OMC, MDD

The MDD of soil was found to increase from 1.764 $g/cm^3$ to 1.891 $g/cm^3$ with the increase in percentage of Stone Dust (Fig.1). On the other hand, OMC of soil decreases to 13.25% from 16.5% with the increase in percentage of Stone Dust (Fig.2).

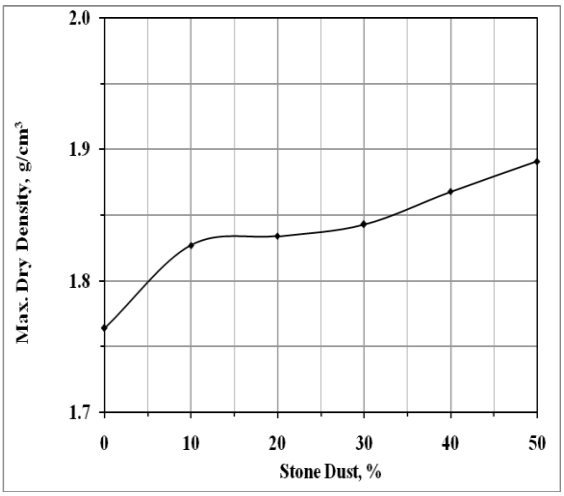


**Fig.1** Variation of MDD of soil mixing with Stone Dust.

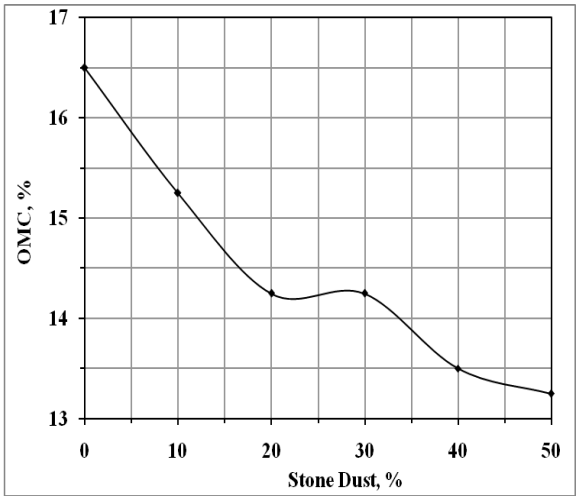


**Fig.2** Variation of OMC of soil mixing with Stone Dust.

### 5.2 Effect of Stone Dust on specific gravity

The specific gravity of soil first increases to 2.96 from 2.4 with the increase in percentage of stone dust from 0% to 30% and subsequently it decreases to 2.82 on further increasing the stone dust content to 50% (Fig.3).

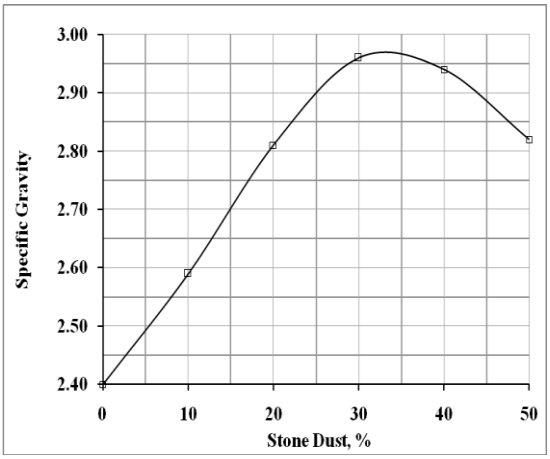


**Fig.3** Variation of specific gravity of soil mixing with Stone Dust

### 5.3 Effect of Stone Dust on CBR

Fig.4 shows the variation in soaked CBR value with different percentages of stone dust. The CBR of soil first increases to 2.91 from 1.95 with the increase in percentage of stone dust from 0% to 30% and subsequently it decreases to 1.94 on further increasing the stone dust content to 50%.

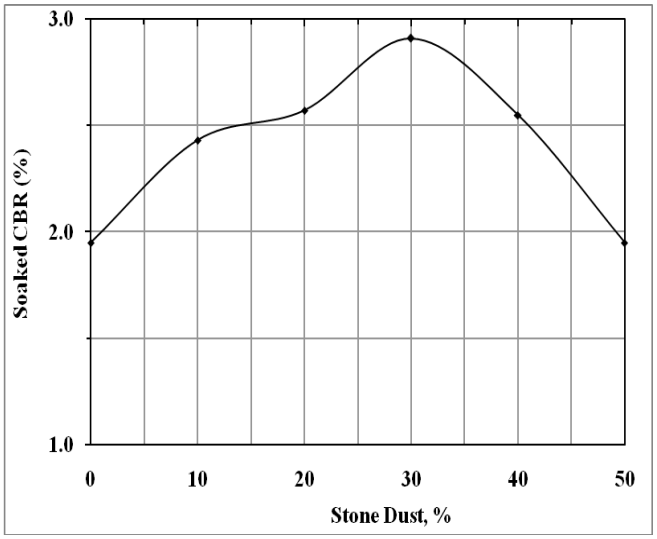


**Fig.4** Variation of CBR value of soil mixing with Stone Dust

## VI. Conclusion

1. Adding 50% of stone dust is effective in decreasing optimum moisture content of soils which is advantageous in decreasing quantity of water required during compaction.
2. The study also reveals the fact that with increase in the percentage of stone dust MDD of soil increases.
3. Mixing of soils with stone dust is also found to improve its CBR. Adding only 30% of stone dust is found to increase the CBR of soil by nearly 50%.
4. There is a great effect on specific gravity of soils on mixing stone dust with them. Adding 30% stone dust is found to be optimum in case of specific gravity.

## References

[1]. Soosan, T.G.; Jose, B.T. and Abraham, B.M. (2001). Use of Crusher dust in embankment and highway construction. Proc. Indian Geotechnical Conference, December, Indore, 274-277.
[2]. Roobhakhshan, A. and Kalantari, B. (2013). Stabilization of Clayey Soil with Lime and Waste Stone Powder. Int. Journal of Scientific Research in Knowledge, vol. 1, issue 12, 547-556.
[3]. Sabat, A.K. (2012). A Study on Some Geotechnical Properties of Lime Stabilized Expansive soil-Quarry Dust Mixes. Int. Journal of Emerging Trends in Engineering and Development, vol.1, issue 2, 42-49.
[4]. Satyanarayana, P.V.V.; Raghu, P.; kumar, R.A. and Pradeep, N. (2013). Performance of Crusher Dust in High Plastic Gravel soils as road construction material. IOSR Journal of mechanical and civil engineering, vol.10, issue 3, 01-05.
[5]. Ali, M.S. and Koranne, S.S. (2011). Performance Analysis of Expansive soil Treated with Stone Dust and Fly Ash. EJGE, vol.16, 973-982.
[6]. Bshara, A.S.; Bind, Y.K. and Sinha, P.K. (2014). Effect of Stone Dust on Geotechnical properties of Poor soil. Int. Journal of Civil Engineering and Technology (IJCIET), vol. 5, issue 4, 37-47.