# Engineering Properties of Dune Sand Reinforced with Sandstone Slurry

**Mayank Dave [1*], Deepanshu Solanki[2]**

[1*,]Department of Structural Engineering ,Jai Narain Vyas University, Jodhpur, INDIA

[2,]Department of Structural Engineering, Jai Narain Vyas University, Jodhpur, INDIA

*Abstract: The universal availability of soil at low cost and having basic construction properties offers great opportunity for skillful use as an engineering material. Soil is both a complex and highly variable material. Soil for a geotechnical engineer is the weathered material of earth crust, with or without organic matter. The bonding property of soil depends upon its particle size and is decreasing as the particle size increases. Stabilization of soil is techniques for improving the mechanical and engineering properties of soil. Improvement of the engineering strength properties of soil using the technique of soil reinforcement involves introducing elements that increase its tensile strength characteristics in order to make up for the limited ability of soil to resist generated tensile loads and shear stresses. The reinforcement elements absorb the loads that might otherwise cause the soil to fail in shear or due to excessive deformation. The stability and reliability of geotechnical structures can therefore be achieved by reinforcing the soil.*

*Keywords: Dune Sand, Permeability Test, Sandstone Slurry, Stabilization*

## 1 INTRODUCTION

The use of sandstone as a building material has increased around the world and sandstone quarrying and its wastes pose a potential threat to human health and the environment. More than 50% of the excavated stone is wasted in the form of scrap stone and waste slurry during sandstone quarrying and processing. Sandstone wastes can adversely change native soil properties and should be reused as construction material. Sandstone is accounted as one of the abundantly occurring dimensional stone that can be cut and polished to a desired form and shape. Sandstones are extensively used in construction work and serves as a decorative stone material due to its easy mouldability.

## 2 MATERIALS & METHODS

Sandstone Slurry has Accounting to the processes like mining, cutting, grinding and polishing, a huge amount of sandstone wastes is generated in every step. The sizes of these sandstone wastes vary to a maximum of 40mm and to a minimum of 0.005mm. In western Rajasthan, dune sand available in abundance, being loose and cohesion less in natural form poses a problem for base and sub-grade construction of flexible pavement, to the movement of the vehicles on road and the railway track due to its low CBR value and shifting nature. Dune sand has been successfully stabilized with various admixtures. Waste products such as carry bags, poly bags, Waste polythene and water bottle, coir, jute, fiber, stone waste, stone dust etc. can more economically be used for sand stabilization as compared to other methods. The main aim of present work is to develop a mix composition, which can be economically used for stabilization of dune sand with sandstone slurry/dust in any type of drying environment and sub base layer of flexible pavement. The investigation presents the findings of laboratory studies in stabilization of dune sand using Sandstone Slurry. Dune sand is found in abundance in Western Rajasthan. The dune sand has similar characteristics which are found in various Towns of Jodhpur. Hence the sand used in present study was brought location near khejarli villages, at about 30- 35 kms away from Jodhpur on Jodhpur-Jaipur Highway Road. Dune sand has nil cohesion and poor compressive strength and hence need stabilization

## EXPERIMENTAL PROGRAMME & RESULTS

It is proposed to evaluate stabilizing effect and use in flexible pavements of sandstone slurry with dune sand. The Endeavour is to assess the optimum amount of waste sand slurry material that can be mixed with dune sand for best stabilization effects and also the proportion which cause no or limited detrimental effects. Particle size distribution of dune sand & sandstone slurry Permeability by variable head test of dune sand and mix composition with sandstone slurry. First particle size distribution of sandstone slurry and dune sand is carried out afterwards MDD & OMC were obtained by carrying light compaction test also known as standard penetration test. Variable head permeability tests were carried out and the value of K was determined for the varying mix proprtions.

Table 1 Particle size distribution of dune sand

| S. No. | Sieve Size | Weight retained (gm) | % weight retained | Cumulative % weight retained | Cumulative % weight Passing | % Finer |
|---|---|---|---|---|---|---|
| 1. | 4.75mm | 2.0 | 0.2 | 0.2 | 99.8 | 99.8 |
| 2. | 2.36mm | 2.0 | 0.2 | 0.4 | 99.6 | 99.6 |
| 3. | 1.18mm | 2.0 | 0.2 | 0.6 | 99.4 | 99.4 |
| 4. | 600µ | 1.0 | 0.1 | 0.7 | 99.3 | 99.3 |
| 5. | 425µ | 2.0 | 0.2 | 0.9 | 99.1 | 99.1 |
| 6. | 300µ | 2.0 | 0.2 | 1.1 | 98.9 | 98.9 |
| 7. | 150µ | 904.0 | 90.58 | 91.68 | 8.32 | 8.32 |
| 8. | 75µ | 82.0 | 8.216 | 99.89 | 0.104 | 0.104 |
| 9. | Pan | 1.0 | 0.100 | 99.99 | 0.004 | 0.004 |

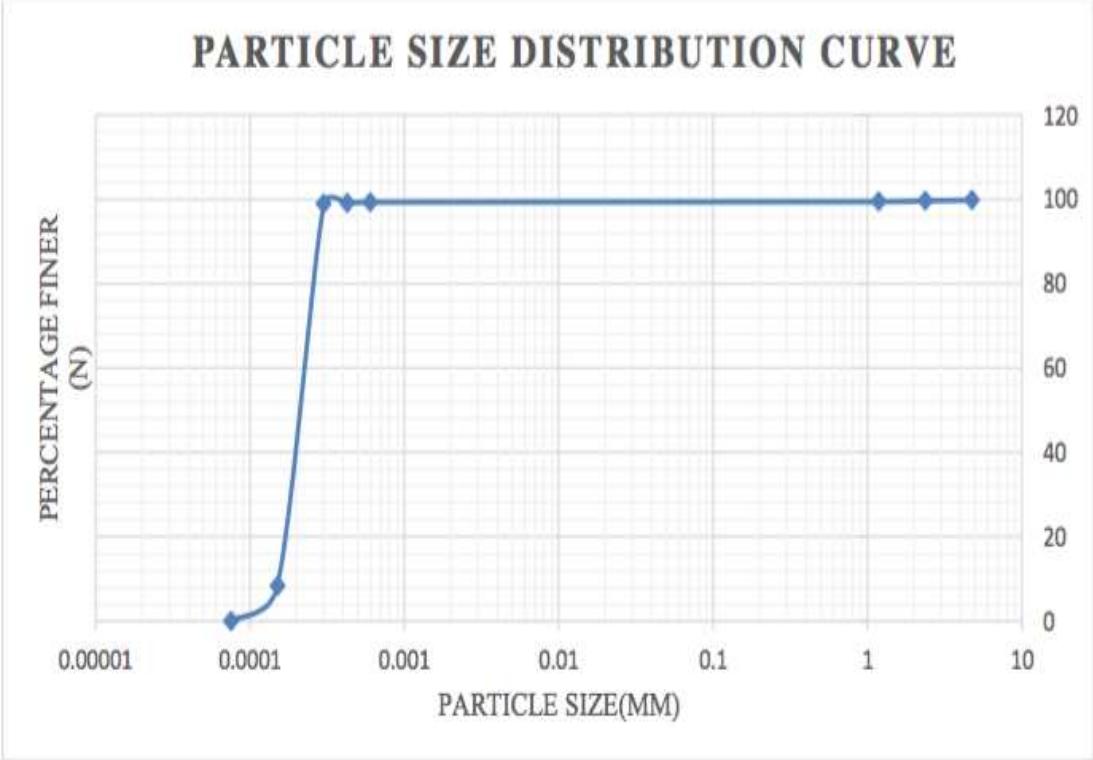
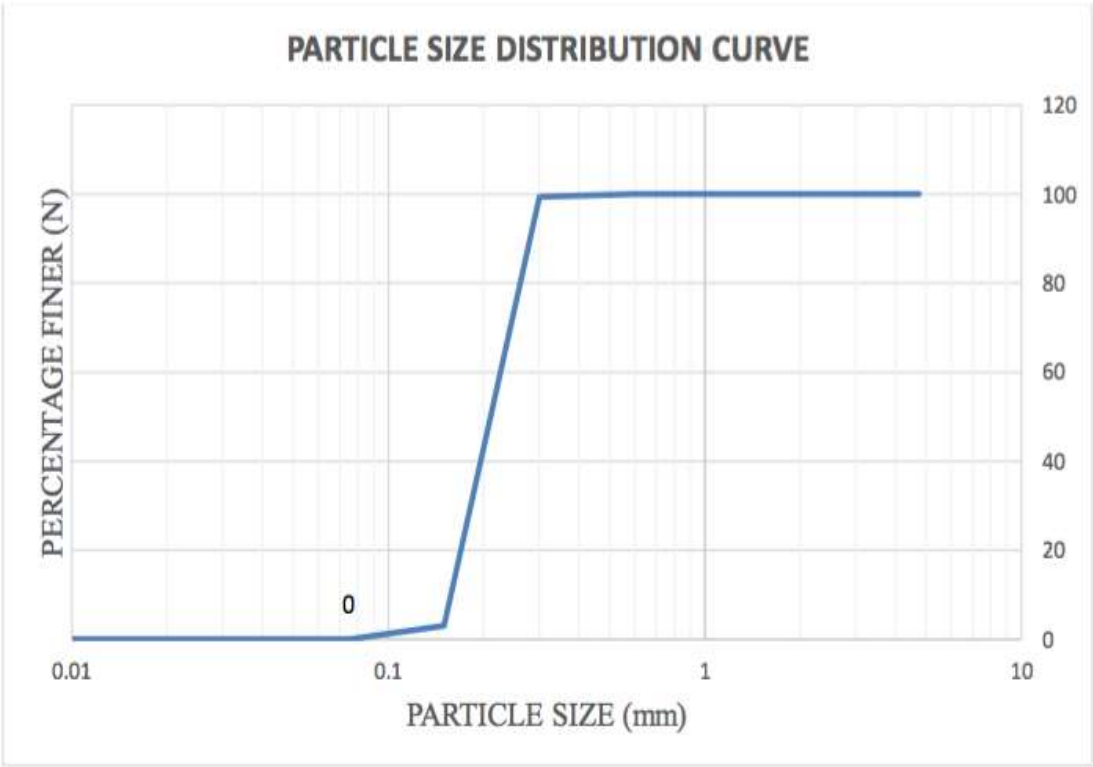
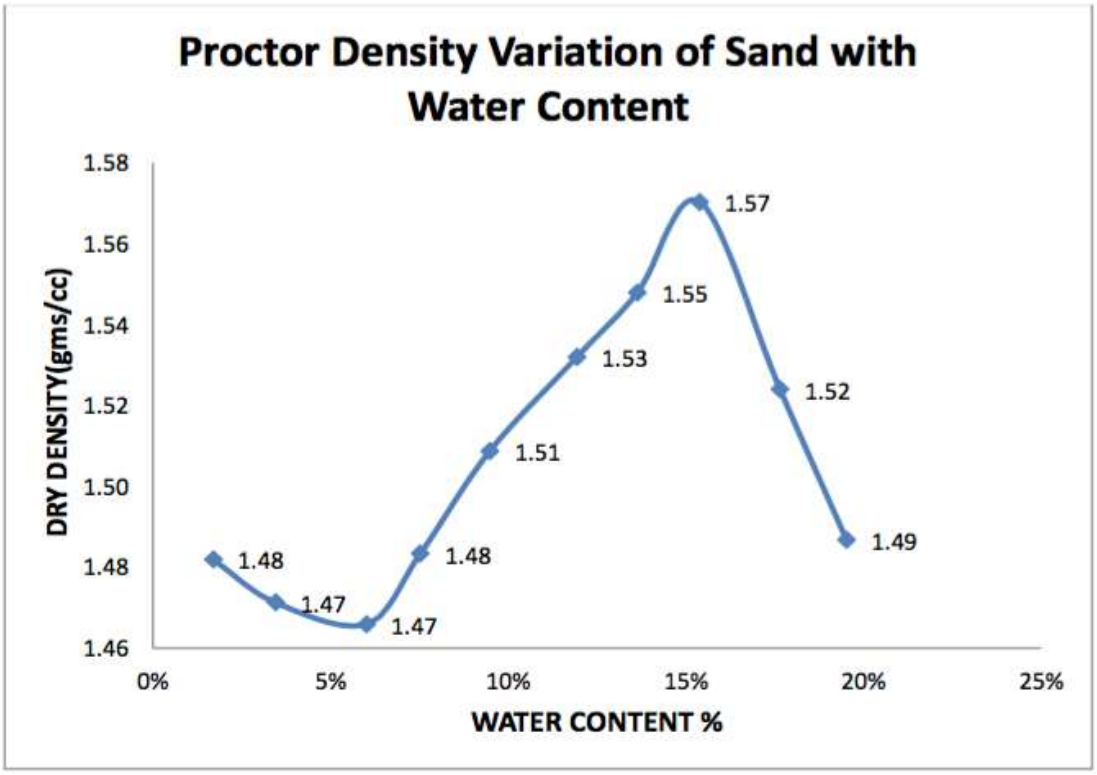


Table 2 Particle size distribution of sandstone slurry

| S. No. | Sieve Size | Weight retained (gm) | % weight retained | Cumulative % weight retained | Cumulative % weight Passing | % Finer |
|---|---|---|---|---|---|---|
| 1. | 4.75mm | 0 | 0 | 0.0 | 100.0 | 100.0 |
| 2. | 2.36mm | 0 | 0 | 0.0 | 100.0 | 100.0 |
| 3. | 1.18mm | 0 | 0 | 0.0 | 100.0 | 100.0 |
| 4. | 600µ | 0 | 0 | 0.0 | 100.0 | 100.0 |
| 5. | 425µ | 0 | 0 | 0.0 | 100.0 | 100.0 |
| 6. | 300µ | 6 | 0.6 | 0.6 | 99.4 | 99.4 |
| 7. | 150µ | 964 | 96.4 | 96.4 | 3.6 | 3.6 |
| 8. | 75µ | 30 | 3.0 | 3.0 | 0.6 | 0.6 |
| 9. | Pan | 0 | 0 | 0.0 | 0.0 | 0.0 |



Sieve Analysis Apparatus




The test was conducted in variable head permeameter according to IS2720 (Part XVII). Coefficient of permeability for dune sand mixed with sandstone slurry was determined to access effect of size and proportion of slurry. Test results have been calculated in table and discussed in next chapter. Mix compositions at optimum moisture content of sand used have been given in table

Table 3: Mix composition for variable head permeability test

| Mix No. | Sand + Sandstone slurry composition | Symbol |
|---|---|---|
| 1. | Dune sand 2kg | P0 |
| 2. | 3% sandstone slurry by weight i.e. 60gm + dune sand 5kg | P1 |
| 3. | 6% sandstone slurry by weight i.e. 120gm + dune sand 5kg | P2 |
| 4. | 9% sandstone slurry by weight i.e. 180gm + dune sand 5kg | P3 |
| 5. | 12% sandstone slurry by weight i.e. 240gm + dune sand 5kg | P4 |
| 6. | 15% sandstone slurry by weight i.e. 300gm + dune sand 5kg | P5 |
| 7. | 18% sandstone slurry by weight i.e. 360gm + dune sand 5kg | P6 |
| 8. | 21% sandstone slurry by weight i.e. 420gm + dune sand 5kg | P7 |
| 9. | 24% sandstone slurry by weight i.e. 480gm + dune sand 5kg | P8 |
| 10. | 27% sandstone slurry by weight i.e. 540gm + dune sand 5kg | P9 |
| 11. | 30% sandstone slurry by weight i.e. 600gm + dune sand 5kg | PA10 |

Test were performed on variable head permeameter as per IS 2720 (Part XVII). Mix composition on sandstone slurry in varying percentage 3%, 6%, 9%, 12%, 15%, 18%, 21%, 24%, 27% and 30% at dry density 1.57gm/cc of dune sand were tested. From the results obtained, it can be concluded that coefficient of permeability increases with increase in percentage of sandstone slurry in mix composition. For 3% mix composition K obtained $1.68\times10^{-3}$ cm/sec for 6% is $1.79\times10^{-3}$cm/sec and for mix composition 9% is $2.01\times10^{-3}$cm/sec. Results obtained have been graphically presented in figure 5.69 and tabulated in table 5.71.

Table 4 : Variation of Coefficient of Permeability with Mix Composition

| S.No. | Mix Composition | Coefficient of Permeability (K) (cm/sec) |
|---|---|---|
| 1. | PA0 | $1.41\ x10^{-3}$ |
| 2. | PA1 | $1.68\ x10^{-3}$ |
| 3. | PA2 | $1.79\ x10^{-3}$ |
| 4. | PA3 | $2.01\ x10^{-3}$ |
| 5. | PA4 | $2.21\ x10^{-3}$ |
| 6. | PA5 | $2.36\ x10^{-3}$ |
| 7. | PA6 | $2.52\ x10^{-3}$ |
| 8. | PA7 | $2.67\ x10^{-3}$ |
| 9. | PA8 | $2.80\ x10^{-3}$ |
| 10. | PA9 | $2.95\ x10^{-3}$ |
| 11. | PA10 | $3.10\ x10^{-3}$ |

## 3 CONCLUSIONS

MDD and OMC were obtained by light compaction test, further Variable permeability head tests were performed on the mix of dune sand and sandstone slurry. Results shows that sandstone slurry was best utilized to improve engineering properties of dune sand, binding properties were improved. The intensity of the stress on the subgrade was reduced.

**REFERENCES**


1. Madhavan P and Dr. Raj S Budhpura ground zero sandstone quarrying in India Studycommissioned by India Committee of the Netherlands, Mariaplaats 4e, 3511 LH Utrecht The Netherlands (2005) p.1-32
2. 2 Pratibha P, Ameta NK. Stabilization of dune sand with bentonite and lime. Electronic Journal of Geotechnical Engineering. 2013;18:2667- 2674.
3. Mohammed Y, Fattah HH, Ahmed SA.Compaction and collapse characteristics of dune sand stabilized with lime-silica fume mix. Earth Sciences Research Journal. 2016;20(2):1-8.
4. Tiwari SK, Sharma JP, Yadav JS. Behaviour of dune sand and its stabilization techniques. Journal of Advanced Research in Applied Mechanics. 2016;19(1): 1-15.
5. Sanjay G Ravi S. Geotechnical characterization of dune sands of the Thar desert. Cengrs Geotechnical Pvt. Ltd., B3/87. 2015.