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## Mechanical Behavior of Soil Cement Blends with Osorio Sand

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### Abstract

This paper presents the analysis made from the axial compression of the mixture between sand, Portland cement and water. In their given proportions, this mixture results in the named "soil cement" in which the amount of sand is strengthened by the bonding of cement through the sand voids, allowing the optimization of sandy soils exposed to large mechanical stresses, such as subgrade and base materials used in pavements. For this purpose, axial and diametral compression tests were conducted, molded with Osorio Sand, a common aggregate found in the south of Brazil with well-known characteristics. The composition were prepared with 3% and 7% of cement and 10% moisture content. For each one of the compositions were molded specimens for three void ratios, testing three specimens of each configuration for five different cure times, totalizing 144 specimens tested. The conclusions shows that the higher the cement percentage and smaller the void ratio, the bigger is the resistance, stabilizing the resistance increase around the fourteenth day. Also, values for initial shear modulus and Young's modulus are presented for the material.

*Keywords:* Soil Cement, Soil Reinforcement, Ground Improvement, Sand Improvement, Laboratory Testing.

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# 1 Introduction

Treatment of soils with cement is an attractive technique when the project requires improvement of the local soil for the construction of subgrades for highways and rail tracks, among others. This paper aims to evaluate the mixture product between Portland cement and Osorio Sand, a well-known aggregate from southern Brazil, when subjected to axial and diametral compression.

Three specimens were molded for each composition and cure age. The mixture has value of moisture fixed on 10%, while the cement percentage, void ratio and cure age were varied. Two different percentage of cement were tested: 3% and 7%, for the void ratio there was three different values: 0.60, 0.66 and 0.72, and the cure age when the specimens were test were seven, fourteen, twenty-eight and fifty-six days.

For each one of the configurations, the axial and diametral compression tests were conducted according to the Brazilian standard NBR 12025. The body of this paper will present the materials, methods, results and conclusions obtained.

## 2 Materials

Basically, three materials were used in order to mold the specimens: Osorio Sand, High Early Strength Portland Cement (CPV-ARI), and water. These materials will be described in detail in sequence.

### 2.1 Osorio Sand

The Osorio Sand is a fine aggregate commonly found in the city of Osorio, in southern Brazil. This type of sand is being commonly used, presenting a fine granulometry, round-shaped, uniform and free of organic matter. It was classified under ASTM D2487-06 as nonplastic uniform fine sand (SP). Mineralogical analysis showed that the sand particles were predominantly quartz. The properties and granulometric distribution are shown in table 1 and figure 1.

**Table 1 - Physical Properties of Osorio Sand**

<b>Properties</b>	<b>Osorio Sand</b>
Specific Gravity	2.65
Coefficient of Uniformity, $C_u$	2.11
Coefficient of Curvature, $C_c$	1.15
Grain diameter, $D_{10}$	0.09 mm
Grain diameter, $D_{50}$	0.17 mm
Minimum Void Ration, $e_{min}$	0.60
Maximum Void Ration, $e_{max}$	0.85

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