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PERFORMANCE OF PALM BIODIESEL CONTAMINATED SAND-CONCRETE INTERFACE

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Abstract: This paper deals the laboratory results of palm biodiesel contaminated sand-concrete interface performance. The simple shear test was carried to get interface results. Mining sand with various percentage of palm biodiesel addition is used for this research. The tests were performed with consideration of two different interfaces, that is smooth interface and rough interface. From this experimental study it is ascertained that shear strength is based on the palm biodiesel content in the mining sand and the concrete surface texture. The results also conclude that sand-concrete interface failure envelopes are in the forms of sliding and deformation.
Key Word: interface strength, mining sand, palm biodiesel, shear testing, sliding.

I. Introduction

The shear strength is an important factor to be considered for stability criteria of soil. Many scientists carried out research an soil structure interface but few only investigated on oil infected soil interaction. During transportation time, most of the oil leakage occurs. When oil leakage is ocuring,the soils may be contaminated and removal of this oil is very difficult. Biodiesel , Which has similar characterisation to diesel fuel, is a renewable fuel which can also be used as cleaning agent. This biodiesel is proved to the best alternate fuel to meet soil contamination due to oil leakage. Biodiesel being an ecofriendly fuel is expected to be in very high demand in the upcoming future. This study highlights the chemical process 'Transestrification' in which palm biodiesel was attracted from palm oil. This paper also deals with the study of shear strength parameters of palm biodiesel with mining sand concrete. Both rough as well as smooth interfaces were considered for experimental investigation.

II. Processing of Soil Sample and Palm Biodiesel Preparation

Soil required for the research work is taken from the mining area. Sieve tests were carried out in the taken sample. Sand is graded as per ASTM classification (D422). As per ASTM the specimen taken is ascertained to be poorly graded. The particle size the specimen is 0.25 mm. Its uniformity coefficient, C_u is 2.08 and curvature coefficient, C_z, is 1.47. The sand taken from the mining area has an angular shape. Also the sand has a specific gravity of 2.63. In this research work 2:8 ratio is used i.e. 20% pure palm oil with 80% petroleum diesel called B20 palm biodiesel.

III. Modified Direct Simple Shear Experimental Procedure and Apparatus

The equipment used for the shear test is designed as a computer-controlled interface testing system. This system works such that the sample considered for testing is sheared. The shearing takes place in only one direction. The combination of sand and palm biodiesel is taken in a rubber membrane which is reinforced. The rubber membrane has a capacity of holding in it, a soil mass of 70 X 25 mm. The soil mass is reinforced with a 2mm metal washer. The sample taken for testing is taken on a concrete plate that is rectangular in shape. The tests were conducted both on the smooth as well as rough interfaces. Air piston is used for the application of normal stress. The horizontal force in this loading system is driven by a motor drive. Load cell is used to determine the horizontal load. Linear variable differential transducers are used to find the vertical and horizontal displacements.

IV. Soil-Concrete Interface Tests

The experiments were carried out with palm biodiesel mixed with mining sand. The experiments were performed in both the extreme type of interfaces i.e. rough and smooth interfaces. The sketch for shear displacement of the considered soil specimen is shown in Figure 1. The experiment is done using shear interface apparatus. It is necessary to find the variation of sliding deformation and shear deformation of the soil specimen taken. Hence two different sets of shear displacements were taken. Linear varying displacement transducers were used to measure these shear displacement. The tangential displacement δ_p is also calculated. And also the sliding deformation for the interface δ, is also determined.

All the tests were done with the help of computer-controller direct shear apparatus. The shear tests were carried out on medium dense soil samples for both clean soil as well as soil sample mixed with palm biodiesel. For this, Palm biodiesel contamination percentage (ω) of 0%, 3%, 6% , 10% and so on by dry weight are determined in this research work. Mining sand and biodiesel in varying percentage were mixer thoroughly. The normal stresses in the range of 50 kPa, 100 kPa and 200 kPa were applied. Rate of shearing was 0.3 mm/min. After the test is being carried out, all the data collection were performed by a computer software facilitated with a data possession system.

V. Experimental Results and Discussion

Under different normal stress conditions, a number of shear tests were performed on the test sample. The tests were performed against both rough as well as smooth interfaces. Figures 2 shows the variation of Normal displacement for different normal stress values. This considers the Smooth concrete Interface. As the interface roughness and the normal stress increases, it was found that the normalized stress ratio also increases. Similarly, the normalized shear stress ratio decreases as the palm biodiesel content increases. This scenario is due to the fact that the increase in the percentage of palm biodiesel will make the soil more lubricant and also cause the soil to slide easily leading to the decrease in the strength. When interface roughness increases, it was found that the shear strength increases along with soil dilatancy.

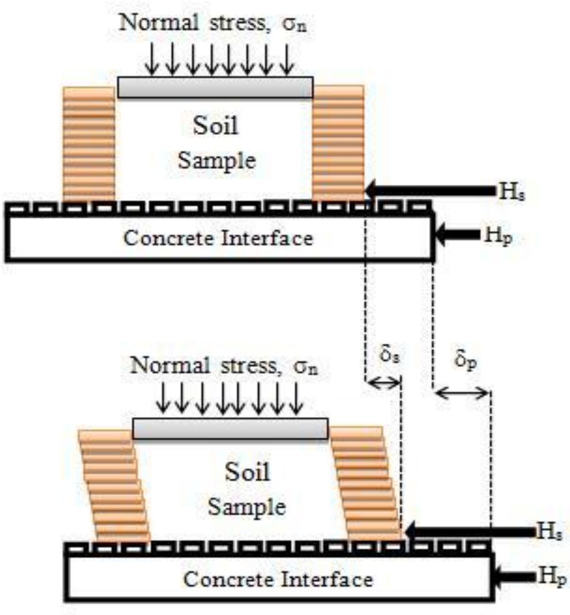
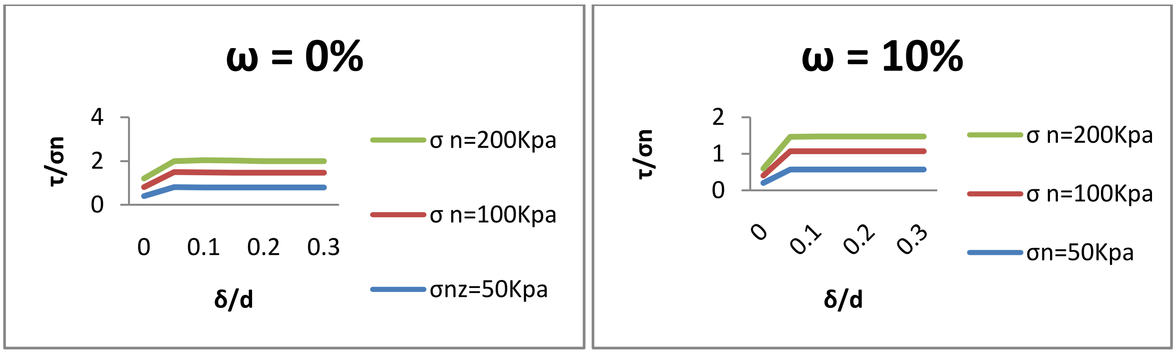


Figure 1: Sketch showing shear displacements



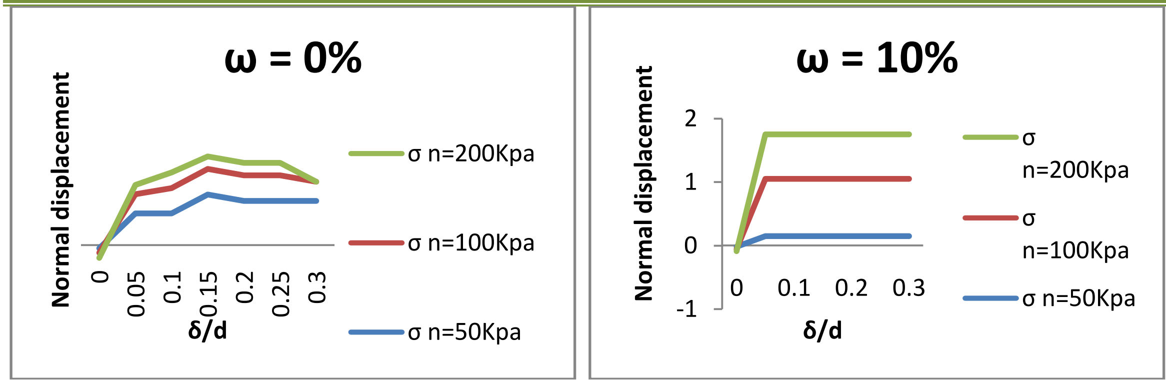


Figure 2: Graph showing the variation of Normal displacement for different normal stress values (Smooth Interface)

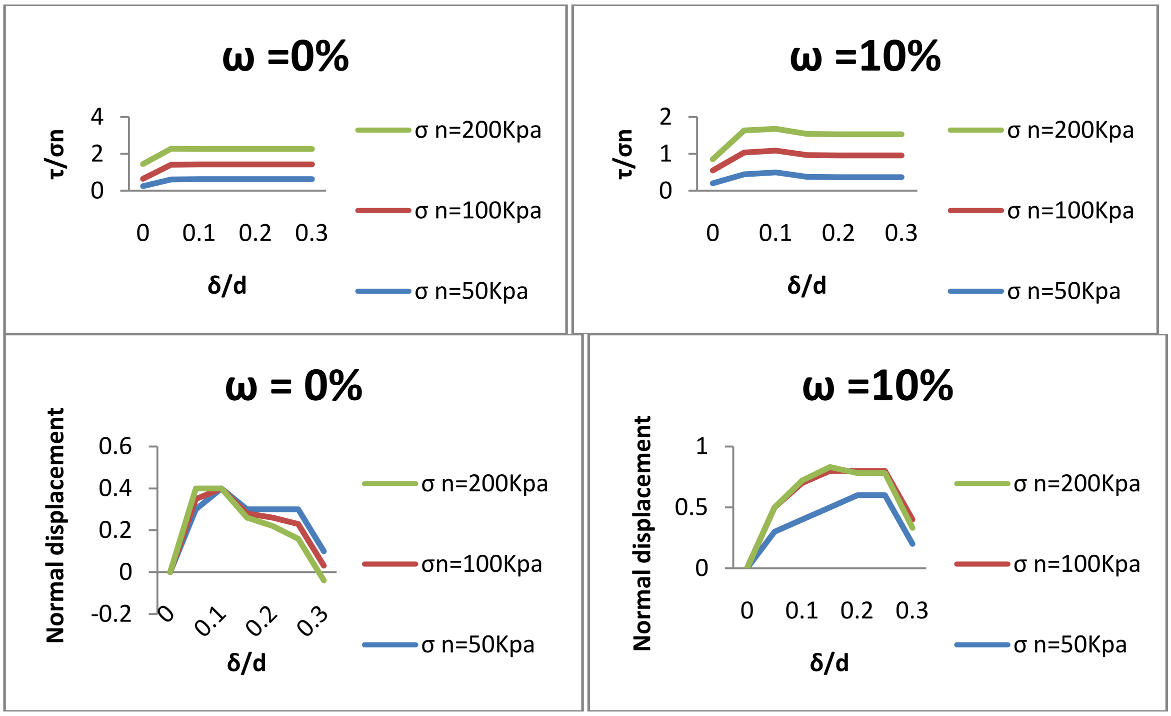
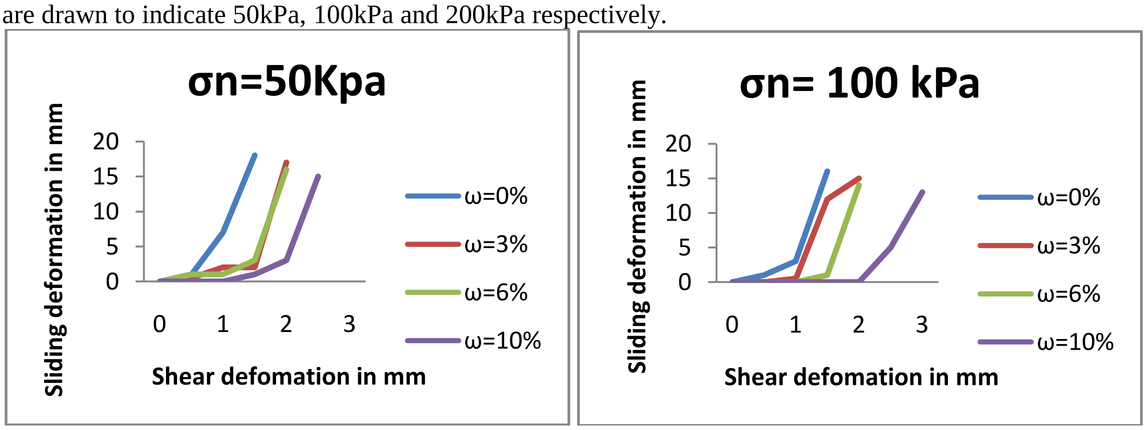


Figure 3: Graph showing the variation of Normal displacement for different normal stress values (Rough Interface)

The relationship between the sliding deformation and shear deformation are shown in Figure 4. Separate graph are drawn to indicate 50kPa, 100kPa and 200kPa respectively.



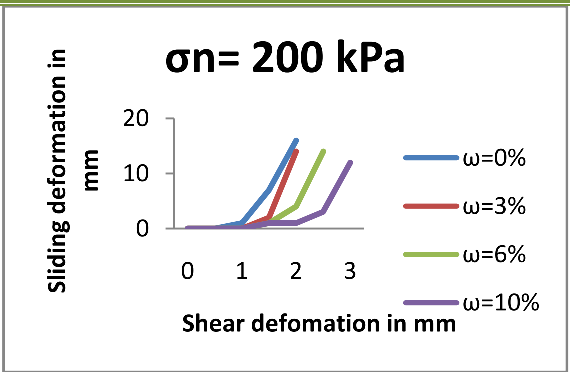


Figure 4: Sliding deformation Vs Shear deformation (Smooth Interface)

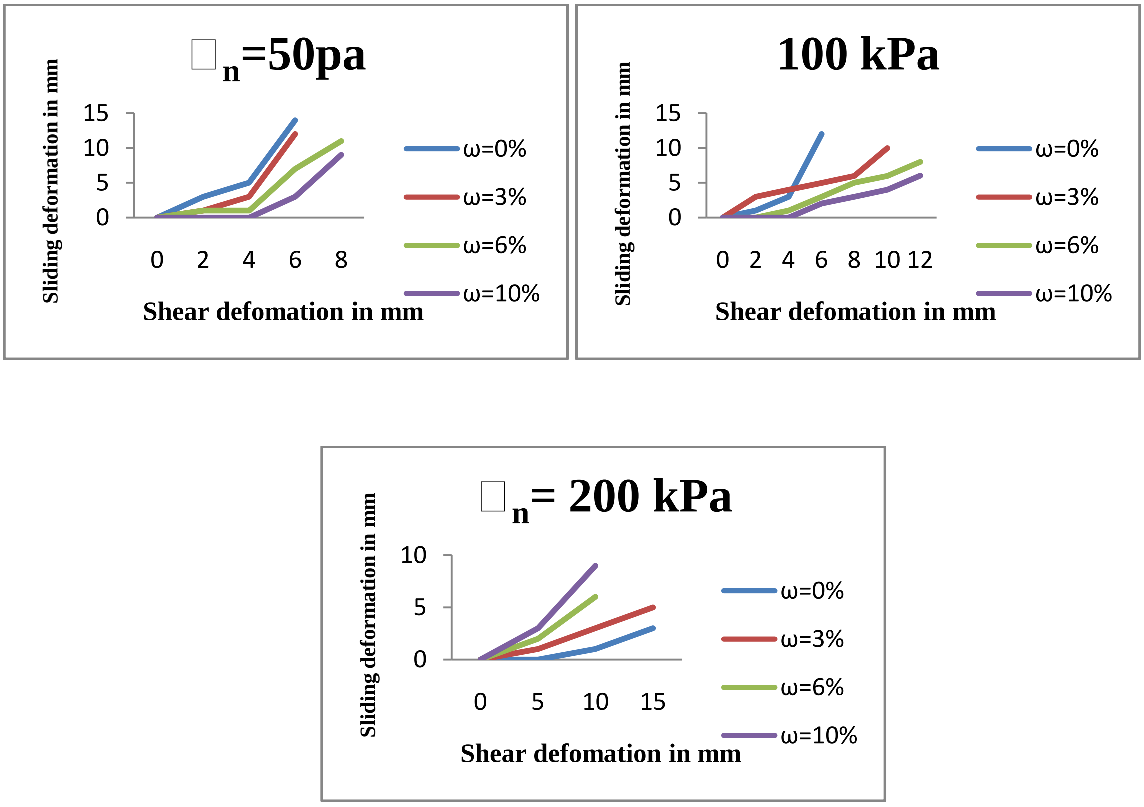
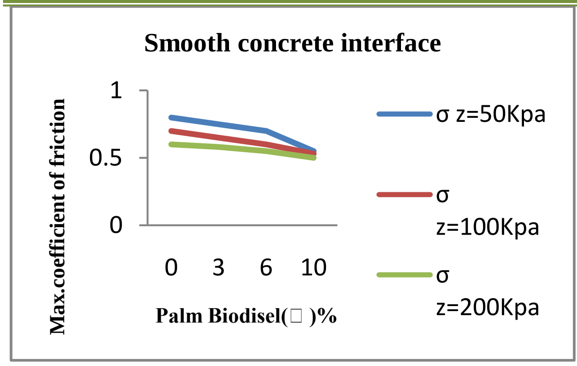


Figure 5: Sliding deformation Vs Shear deformation (Rough Interface)

Failure patterns are plotted for smooth as well as rough concrete interfaces. It is ascertained that the uncontaminated specimen shows larger stress ratio. Failure envelopes for varying percentages of palm biodiesel are plotted in Figure 6, from which it can be noted that the maximum coefficient of friction also decrease with increasing palm biodiesel content.



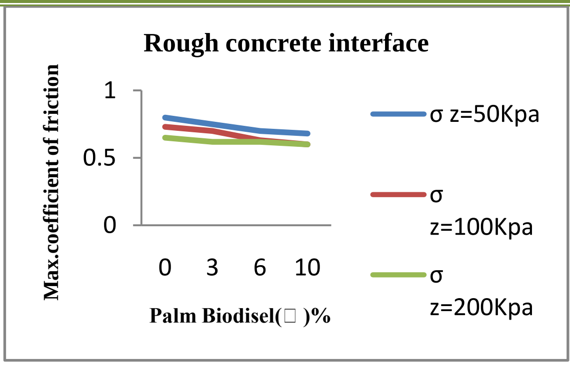


Figure 6: Graph showing Failure Envelopes

It can be seen from Figure 7 that there is a change in the friction angle of the soil with varying the percentage of the palm biodiesel. It is noted that as the palm biodiesel content increase the friction angle of the soil decreases automatically this is same for both the rough as well as the smooth interfaces. Hence as the viscosity of the oil increases, the soil friction angle decreases.

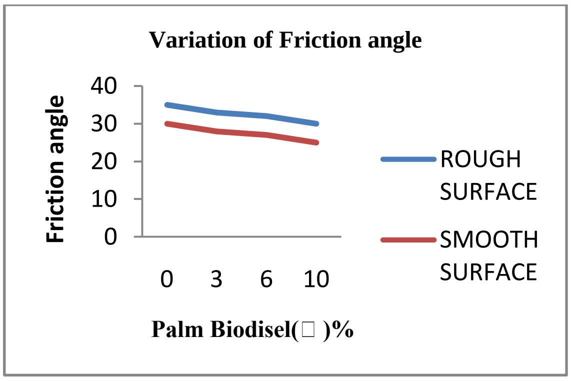


Figure 7: Graph showing the variation of friction angle with varying percentage of palm biodiesel

VI. CONCLUSIONS

From this research work on shear test in palm biodiesel mixed with sand concrete interface, following results are obtained from this experimental work,

- Rough concrete interface has higher shear strength compared to smooth concrete interface.
- Palm biodiesel content increases with increase in normal strength and shear strength also increases.
- In smooth interface shearing of specimen occurred along a thin surface
- In rough interface shear zone was identified in the soil specimen

- With increasing palm biodiesel content, the friction angle is decreased owing to the hike in the viscosity of the soil. It can also be noted that it is due to higher interface roughness.

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