DEM simulation of triaxial tests of railway ballast fouled with desert sand

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ABSTRACT

Some high-speed rail lines go through desert zones where sand particles transported by winds may foul track ballast layers. This fouling can be troublesome since it increases the stiffness of the layer and reduces its capacity to absorb vibrations from the rolling stock.
We have studied this phenomenon through both laboratory and numerical experiments.
In the laboratory, we have performed two kinds of experiments: 9 inches triaxial tests and physical modelling in the CEDEX Track Box testing facility. The latter is a unique 1:1 model of railway track section (of dimensions 21 m x 5 m x 4 m) that has been built to model high-speed rail lines (with passenger and freight trains passing at velocities of up to 400 km/h). The laboratory experiments have allowed us to measure the change of stiffness with the fouling level (represented through the void contamination index, VCI).
The numerical simulations were carried out with the Discrete Element Method and reproduced the triaxial test conditions. Due to the considerable different size of railway ballast and sand grains, we used idealized packings of spherical particles to study this phenomenon. We have paid particular attention to the sample size effects and have measured the evolution of the stiffness with the fouling up to high values of VCI. The results obtained from these idealized systems have been contrasted to the results of the laboratory experiments performed with real railway ballast and sand.

REFERENCES

[1] J. Estaire, V. Cuéllar and M. Santana, "Track stiffness in a ballast track fouled with desert sand". *GEORAIL International Symposium*, (2017).

[2] I. Buddhima, N. Ngoc Trung, R. Cholachat and J. S. Vinod "Behavior of Fresh and Fouled Railway Ballast Subjected to Direct Shear Testing: Discrete Element Simulation", *International Journal of Geomechanics*, **14** (1), 34-44 (2014).