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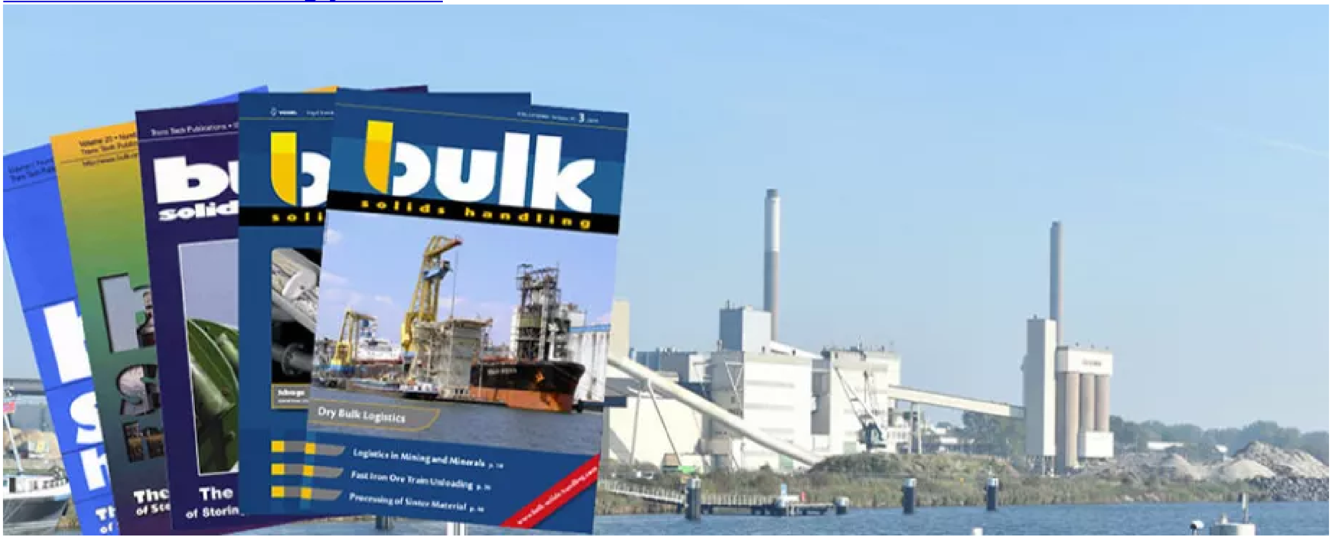

Research Paper

Frequency Distribution of Voids in Monolayers of Randomly Packed Equal Spheres

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Single layers of randomly packed equal spheres of different materials encapsulated between two glass plates were created. These layers were then subjected to an optical scanning procedure that could continuously scan the "Voronoi Cells ' generated within the assembly. The whole experimental set up was geared to a calibrated recorder as well as a microprocessor to determine the frequency distribution of voids in such random two-dimensional assemblies. The experimental results obtained are shown to be in agreement with statistical mechanical theory due to M. Shahinpoor.

1. Introduction

This research report summarizes certain initial phases of a design set-up for optical scanning and measurement of data that are associated with the frequency distribution of voids in randomly packed monogranular layers.

The purpose of the research has been to determine experimentally the actual frequency distribution of voids in randomly packed two-dimensional granular materials. The "Voronoi Cells'' were originally intended to be considered as the characteristic microelements in such two-dimensional granular assemblies. The frequency distribution density is a normalized pdf pertaining to the ratio of the number of voids whose area is within a narrow band of void space to the total number of individual voids. The void ratio space is spanned by the void ratios of various "Voronoi Cells' from a minimum void ratio em to a maximum void ratio of eM.

The actual random two-dimensional packing of equal hard spheres (steel, plastic glass, nylon Teflon Canadian beans etc.) are prepared as a single layer. These layers are sandwiched between two transparent glass plates in a space with a circular geometry (Figs. 1, 2, 3, 4, 5, 6, 7, 8). The actual design details pertaining to the construction of these encapsulated single layers ot granular materials are described in the next section. These encapsulated single granular layers are then rotated and slightly oriented with respect to the gravitational axis in order to create random two dimensional aggregates or visible regions of random two dimensional aggregates. The justification for randomness is based on the fact that by rotating the single layer a large number of slip lines for finite shearing is created within the two dimensional aggregate. These finite shearings, according to known experimental and theoretical observations [1], [21, then create regions possessing critical densities which correspond to the most random packing state in which the frequency distribution density of voids is uniform. However, for general random packings the frequency distribution density is subject to change. This is what we intend to measure in the present research investigation.