THE BULK DENSITY OF MIXTURES OF PARTICLES OF DIFFERENT SHAPES

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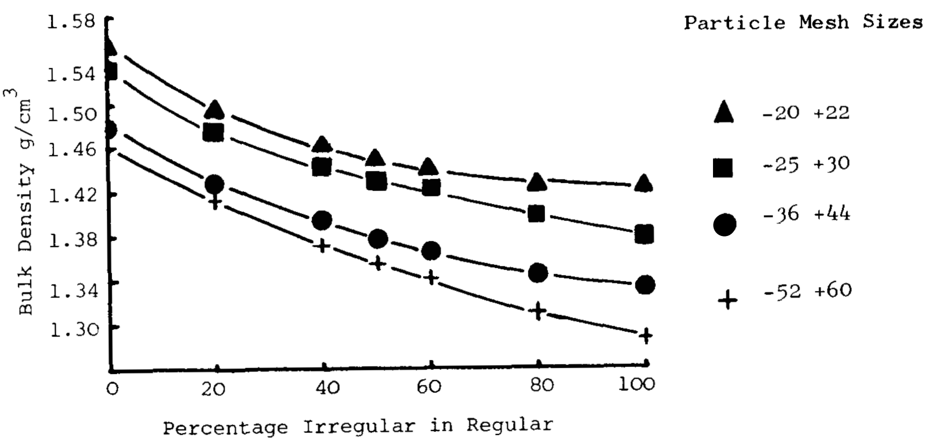
Naturally-occurring sand has been sorted according to size and shape using methods previously described (Ridgway & Rupp, 1969). Various mixtures were then prepared, containing known proportions of two components having the same size and different shape. For each mixture the loose (poured) bulk density, crater angle of repose, flow rate through an orifice, specific surface area and porosity were measured. A monolayer of each mixture was prepared and the areal voidage measured by a light-reflection technique (Deer & others, 1968) and by an image-analysing computer.

The bulk density, crater angle of repose, and flow rate through an orifice have smaller values than those that would be expected on the basis of there being a linear relationship between the properties of the two components being mixed. The increased porosity of the mixtures was most apparent for the loose poured state: tamping brought the value for the consolidated bed into the straight line relationship. The areal voidage was greater than that calculated from a linear relationship.

Previous work on the effects of particle shape on the bulk properties of particulate materials has related only to fractions containing particles all of one size and shape, and the resultant changes in bulk density have been partially explained as due to alterations in packing (Heywood, 1946). The present work has shown that both regular and irregular particles have packing capabilities that are disrupted by the presence of particles of the opposite kind. Thus both spherical and aspherical particles have a voidage structure that makes the voidage of one kind inaccessible to particles of the other.

The graph shows the relation between the bulk densities of mixtures of various proportions of regular and irregular particles for four particle sizes. In all cases the bulk density of the mixture is less than would be expected from a linear relationship between the constituents.



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