Influence of grain shape and grain size distribution on connectivity of pores in granular materials.

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Transport properties such as electrical conductivity and permeability are sensitive to the connectivity of pores. Pore structure in granular materials varies with the shape and size distribution of grains. In order to understand the influence of the shape and size distribution of grains, electrical conductivity and permeability were measured on granular materials saturated with 0.1 mol/L KCl aqueous solution. Spherical glass beads and oblate quartz sand of various sizes were employed. The ratio of conductivity to porosity was significantly higher in glass beads than in quartz sand. This observation suggests that a higher connectivity of pore is established in glass beads than in quartz sand. The influence of the size distribution of grains was studied on mixtures of small (D=0.2 mm) and large (D=1 mm) glass beads. The porosity deceases from 36% to 22% as the fraction of large grains increases 0% to 60%. Electrical conductivity decreases with decreasing porosity, while permeability shows a small decrease. As the fraction of large grains increases from 60% to 100%, the porosity increases from 22% to 36% and permeability increases by around 2 orders of magnitude. This change suggests that the pore size steeply increases as the fraction of large grains increases from 60%, since permeability strongly depends on the size of pores. X-ray micro CT observation was conducted to examine pore structure.

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