

Free Fall Experiment of Glass Beads in Inclined Water Tank  
- Group Effect of particles in pyroclastic flow and avalanche -

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Both pyroclastic flow with eruption of a volcano and avalanche at snow-covered mountain are commonly a phenomenon where mixture of particles and fluid fall down at a slope. Purpose of this study is to investigate the group effect of many particles in the mixture. In order to realize the fluid on inclined slope, clear acrylic square pole filled with water is fixed with a pedestal, at arbitrary inclination angle. The side length of square is 10cm, and height of the pole is 50cm. In addition, the pole is marked in each 10cm from the top. In order to realize free fall down of particles group, glass beads with same size are dropped down from the bottom at top of the inclined water tank. Furthermore, in order to investigate group effect of particles, the number of the glass beads was changed from 1 to 2, 3, 4, 5, 6, 10, 20, 30 and 50.

In each experiment, the terminal velocity of the glass beads group is measured. The method of measurement is that

1. A smart phone is set to timer mode.
2. Both free fall of the glass beads and indication of the timer are recorded as a movie, using a digital camera of home appliances.
3. The time when the group of the glass beads pass by the marks on the water tank are read with low speed playing, and the data is converted to velocity data.

In the range from one particle experiment to 5 particles experiment, each bead fall down in almost same speed. In the six or more particles experiment, the particles group broke apart in lengthways. The ranking of each bead is changing each other. However, both the head bead and the end bead are always recognized. As a result of velocity measurement of the head bead and the end bead in each time, it was found that each velocity is almost same, after passage time through the first mark. Therefore, total average of the top bead velocity and the end bead velocity in each passage time is regarded as the terminal velocity of the beads group.

A result of the three kind of experiment series is shown by fig. 1. Not only the larger is inclined angle the larger is the terminal velocity, but also, we can see interesting common features in any inclined angle. That is,

1. In the range that the number of particles is from 1 to 3, the larger is the number of particles the smaller is the terminal velocity of particle group.
2. In the range that the number of particles is from 4 to 6, after ones jumping of the speed, the larger is the number of particles the smaller is the terminal velocity of particle group again.
3. In the range that the number of particles is from 6 to 50, the larger is the number of particles the larger is the terminal velocity of particle group on the contrary.

It is implied that the effect of group of particles is able to categorized into three kind systems. About the fall down of the mixture of particles group and fluid, a simple model was supposed. a interpretation against changing tendency of the terminal velocity was tried.

Keywords: pyroclastic flow, avalanche, Laboratory Experiment

