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Experimental study of the subaqueous granular dam-break problem

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Subaqueous granular dam-break problem, which involves both granular and fluid, is of great interesting in geophysics flow and coastal engineering. As an initial value problem, it is easy to control for experimental study. Flow phenomena in this problem are rich as multiple granular phases coexist simultaneously and transform to each other during the whole process. Thus it could be used as a benchmark case for theoretic and numerical models of the granular-fluid mixture. In this study, we carried out a series of subaqueous granular dam-break experiments with monosized spherical particle of 4mm in diameter and liquids with various viscosity but the same refractive index with the particle. A rectangular dam of particles is placed in a very narrow channel, of which the width is only 20% larger than the particle diameter. After the gate of the dam at one side being quickly lifted, the particles could flow freely and the movement of both the particles and the fluid are recorded with a high speed camera in 1000 fps. We developed numerical tools to calculate the position, velocity and rotation of each particles, while the fluid field is obtained with traditional PIV. It is found that the granular flow could be divided into three regions including a liquid flow controlled surface, a slide dominated shallow layer beneath it, and particle solid phase at the corner. And the viscosity of the liquid plays a significant role in controlling the collision of the particles, which seriously damp the granular temperature of the system. This study is potential to serve as a benchmark case for many of the newly developed numerical models.