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Flow experiments in a rotating drum and a conveyor belt flume

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The movement of natural phenomena such as debris flows is difficult to describe on a process – oriented basis. As a result, often simple rheologic models, considering debris or mud flows as non – Newtonian, homogeneous fluids are applied for hazard zoning. Although these approaches do not reflect the mechanics of the process in detail, rheologic models can be used for engineering applications. To gain better understanding of the flow behaviour of such mixtures of great variability in material composition, a vertically rotating drum and a conveyor belt flume have been built. Both facilities allow to establish quasi-stationary conditions for an extended time period and to measure relevant flow parameters. The diameter of the rotating flume is 2.5 m, channel width is 0.45 m, and the maximum rotational speed is around 30 revolutions per minute, corresponding to a mean speed of the examined mixture of $\sim$4 m/s. Measured parameters include flow geometry, mean and surface velocity, total boundary shear stress, normal stress and shear stress along the bottom close to the centreline of the flow. The conveyor belt apparatus has a channel length of 2.5 m and a width of 0.12 m. The slope of the channel can be varied between 0° and 30°, the maximum rotation velocity of the conveyor belt is 3 m/s. The measured parameters are mean velocity and surface velocity, flow depth, and inclination of the flume.

Experiments with a viscous fluid of varying viscosity (Carbopol Ultrez10$^{\textcircled{R}}$) have been performed with both setups and Bingham parameters are derived using different simple approaches. Comparison with independent measurements carried out in a conventional co-axial cylinder rheometer (Bohlin Visco 88) shows that both setups give consistent results and can be used for a global rheologic analysis of non-Newtonian fluids.