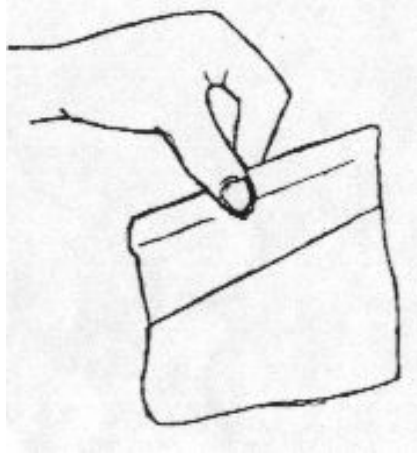


Avalanches in a sand pile

Aim: Showing the difference between static and kinetic friction.

Subjects: 1K20 (Friction)

Diagram:



Equipment: Flat transparent zip lock bag, half-filled with sand.

Safety:



Avalanches in a sand pile

Presentation: Starting with the level of sand in the bag horizontal, slowly rotate the bag about a horizontal axis perpendicular to the bag.

When the sand surface makes a certain maximum angle with the horizontal an avalanche occurs, after which the angle of the sand stabilizes at some smaller angle. The same behaviour repeats itself if you continue rotating the bag.

Explanation: We can understand the basis for the two angles in terms of the different values of the static and sliding (kinetic) friction coefficients. The top layer of sand can be considered as the slope of the incline. The angle of incline increases as the bag is rotated. When the angle of incline reaches $\tan \theta = \mu_s$, the sand will begin to slide.

This causes the shape and slope of the pile to change. The avalanche stops when the angle of incline satisfies: $\tan \theta < \mu_k$.

Sources:

- Ehrlich, R., Why Toast Lands Jelly-Side Down: Zen and the Art of Physics Demonstrations, pag. 44.