

SMS-204: Integrative marine sciences.

Lab 5, Settling, drag and swimming in high and low *Re* flow.

Today you will investigate the drag experienced by bodies in different flows.

Station 1. Choose two clay models (4 of each kind) and a sphere (2 of the same kind) to represent similar phytoplankton; select the clay ball such that it weighs the same or slightly less than the phytoplankton analogues.

In two graduated cylinders, one with Glycerin and the other with water, measure the settling velocity of your models (one sphere and two phytoplankton similar analogues in two different orientations) using a stopwatch and a ruler. Can you get the non-spherical objects to settle slower than the spheres (even though they may be larger)? In what orientation are they slowest?

Compute the Reynolds number of the flows produced by the models and sphere in water and in glycerin using: $\mu_{\text{glycerin}}=14.2 \text{ Pa s}$, $\rho_{\text{glycerin}}=1.17 \text{ g cm}^{-3}$, $\mu_{\text{water}}=0.001 \text{ Pa s}$, $\rho_{\text{water}}=1.0 \text{ g cm}^{-3}$. How do they compare to phytoplankton in the ocean (assume a phytoplankton of about $10 \mu\text{m}$ settling at about 50 m/day):

	Model I				Model II				Sphere in Water	Sphere in Glycerin
	Glycerin		Water		Glycerin		Water			
	Orientation I	Orientation II								
Size										
Weight in Air										
Velocity										
Re										

Station 2. Sinking in stratified fluid. You have a cylinder stratified with normal Karo on the bottom and Karo-light at the top. Observe the settling of several spheres released within a small time interval in the fluid. Is the settling (and spacing between balls) affected by the change of density and viscosity of the fluid? Can you think of oceanic/limnological (lake) conditions for which this demonstration may be relevant?

Station 3. Sedimentation tube: simulate a nephloid (near-bottom) storm by reversing the tube and letting the particles settle. Watch the settling as function of time as well as the water turbidity. Describe to your team member what is going on.

Station 4. Swimming at low and high Re :

You have several bath toys/swimmers. Take one and have it swim in water. Measure its velocity. Now put it in Glycerin. How fast does it swim? Why are there differences?

Station 5. Feeding at low Re :

Try to catch plastic balls in glycerin using a spoon, a fork and knife. Do not use the air-corn syrup interface or the glass walls. Which utensil can get closest to the particle and in what orientation? What does it teach us about filter feeding on particle at low Re ?

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