15.DyeTech1

Monday, March 15, 2010 4:17 PM

Today

Finish clouds 1 critiques
Start specific FV techniques: Dyes

Admin

- http://gopro.com/careers Internships and full time jobs at GoPro, makers of Hero cameras.

SPECIFIC FV techniques

Boundary techniques. Boundary between 'seeded' and unseeded fluid.
Choice depends on physics desired
I DYES Today. Mostly in water.
2 Aerosols Particles. Mostly in air for boundary effect.

In this class, often visualization technique determines physics examined, but usually physics are determined by system under study, and FV technique applied should not disturb the flow/physics

I Dye Considerations:

1)Want dye to NOT disturb flow
2)Want dye to show up - HIGH VISIBILITY
3) Special techniques

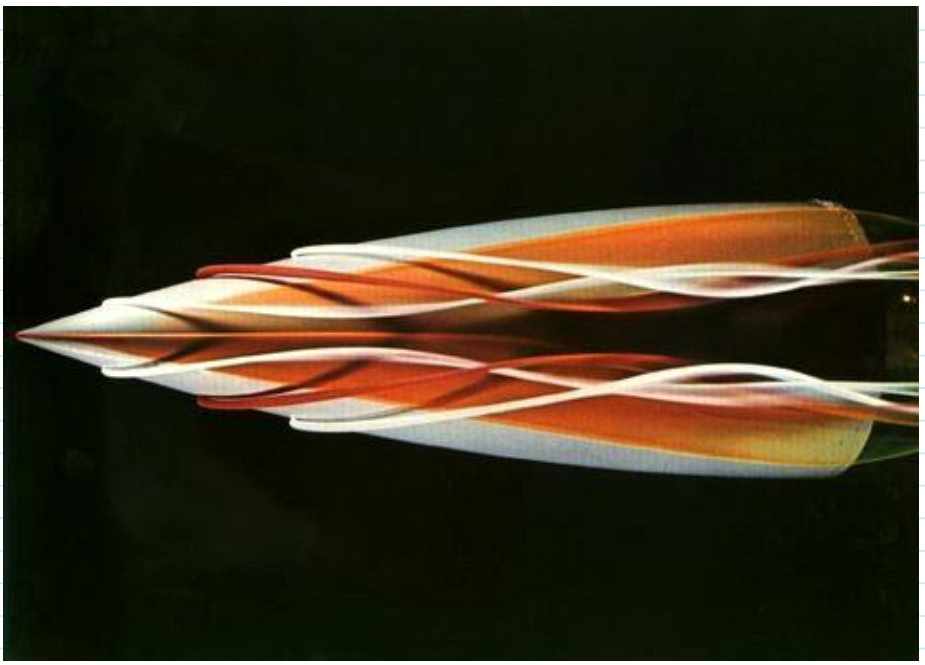
1) Not Disturb flow "How?"

Minute paper -Groups

Similar densities
Viscosity
Solubility
Inject far enough away to not disturb by injection
Use enough volume appropriate to unseeded fluid
Match speeds
Premix before starting flow
Try a preshaped container and removed
Don't disturb with injection device (syringe)
Shape of injector; streamline

Answers:

- Match fluid properties, including velocity(speed and direction)
    - Density
    - viscosity
    - Polarity; miscibility; (will it mix)
    - pressure
    - Temperature
    - contrast
    - Molecular weight
- No chemical reaction
- Match vorticity as well as velocity
- Inject upstream of test section
- Allow for equalization time
- Use small ports, minimize volume injected,
- Consider location of injection; reveals different physics http://media.efluids.com/galleries/laminar?medium=113



by Henri Werlé, at
ONERA = NASA of France
Master of colored dye streams

Avoid injection altogether: Coat object with alcohol-dye mixture or water soluble paint, let dry, then tow in tank. Shows vorticity layer, wake, boundary layer

Or coat short strings on a rake. OK for low speed, short run times

- Match fluid properties between dye and medium

Density
Temperature
Viscosity
Surface tension (match intermolecular forces)

Minimize chemical reactions (unless needed)
Diffusion coefficient

N.J. Mueschke et al., "Measurements of molecular mixing in a high-Schmidt-number Rayleigh-Taylor mixing layer," *Journal of Fluid Mechanics* 632, J. Fluid Mech. (UK) (2009): 17-48.

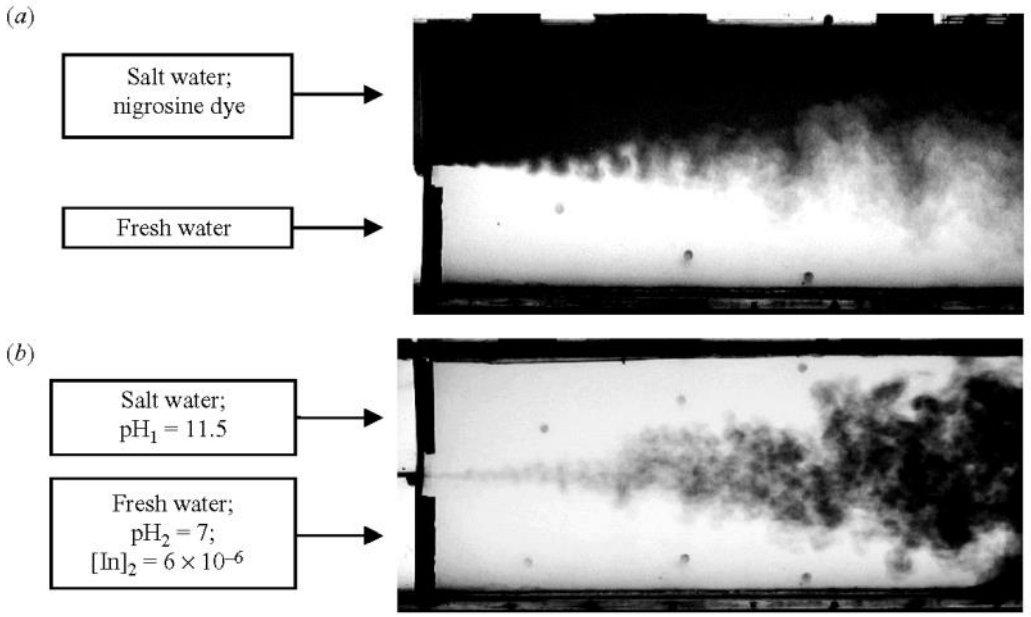


FIGURE 4. Photographs (contrast enhanced for visualization) of the buoyancy-generated mixing layer in a typical water channel experiment. (*a*) Nigrosine dye was added to the top stream. (*b*) Phenolphthalein was added to the bottom stream, which changes to its pink form as the two streams molecularly mix (here, "pink" is shown as dark regions within the mixing layer).

Ph indicator, shows where mixing got to molecular level.

Tough to match all these properties- Dye properties are different from ambient fluid.
To match density, try a premix:

For food dye in water, premix dye (dense, sinks in water) and isopropyl alcohol (floats) to get neutral buoyancy in water

The concentration gradient between dyed and undyed fluid may cause dye to diffuse too rapidly, misleading when studying mixing. Turbulence also causes fast diffusion, making visualization of the overall flow structure difficult. Try some milk or latex paint to slow diffusion.
Famous example:

Cloud tank was invented by Douglas Trumball to make realistic clouds in 'Close encounters of the third kind' (1980's sci fi). Used many times since
http://www.youtube.com/watch?v=hxgVKWe5Vm0

Alberto Seveso: http://burdu976.com/?portfolio=a-due-colori