16.DyeParticles

Monday, February 28, 2011

12:26 PM

Today:

Admin

Lens cleaning

Boundary visualization

- Dyes
- Particles

Admin:

Vision Research High Speed demo back to 2 pm tomorrow

Hele Shaw cell is ready for use

Team 1 Y

Team 2 Maybe

3/6 3 Y 7 Y

4 Y 8 Y

5 Y 9 Y

6 Y

3/18

Lens cleaning

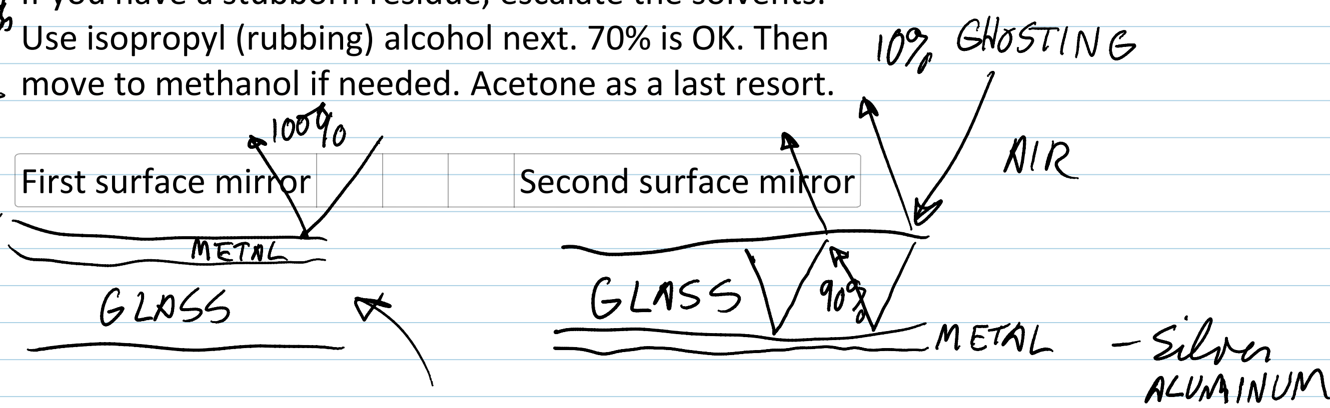
1) Use gentle air blast to remove loose particles. 'Canned air' is OK if you don't overdo it: don't let liquid propellant come out. Blower brush is OK, but beware dirty brushes.
2) Start with gentlest solvent; condensed breath. Examine lens surface for smudges. If it looks clean and smooth, just let condensate evaporate. If smudges seen, gently rub with balled up FRESH SHEET of Kodak lens tissue. Other brands seem harsh. Rub just until dry, don't rub without moisture present. Check with another breath. Repeat if needed.
3) If you have a stubborn residue, escalate the solvents. Use isopropyl (rubbing) alcohol next. 70% is OK. Then move to methanol if needed. Acetone as a last resort.

OK for AR coating optics

NOT FS mirrors

DSLR

OH projector



I) Dye Considerations:

1)Want dye to NOT disturb flow

2)Want dye to show up - HIGH VISIBILITY

High Visibility: Want good contrast between dyed and ambient fluid.

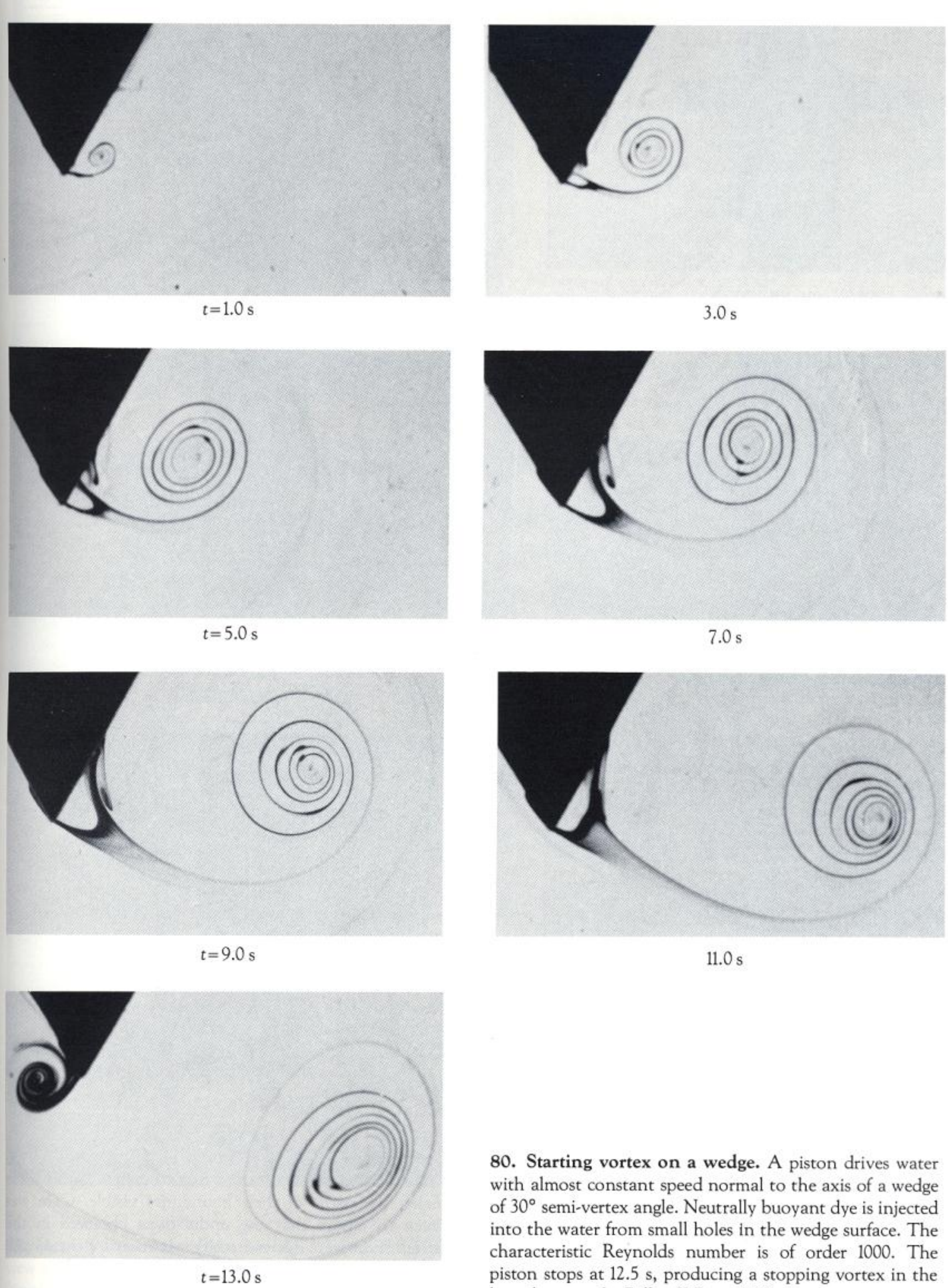
Ambient fluid = transparent = NO interaction with light

Dyed fluid = want MAXIMUM interaction with light

Minute paper: list the ways that dye can interact with light

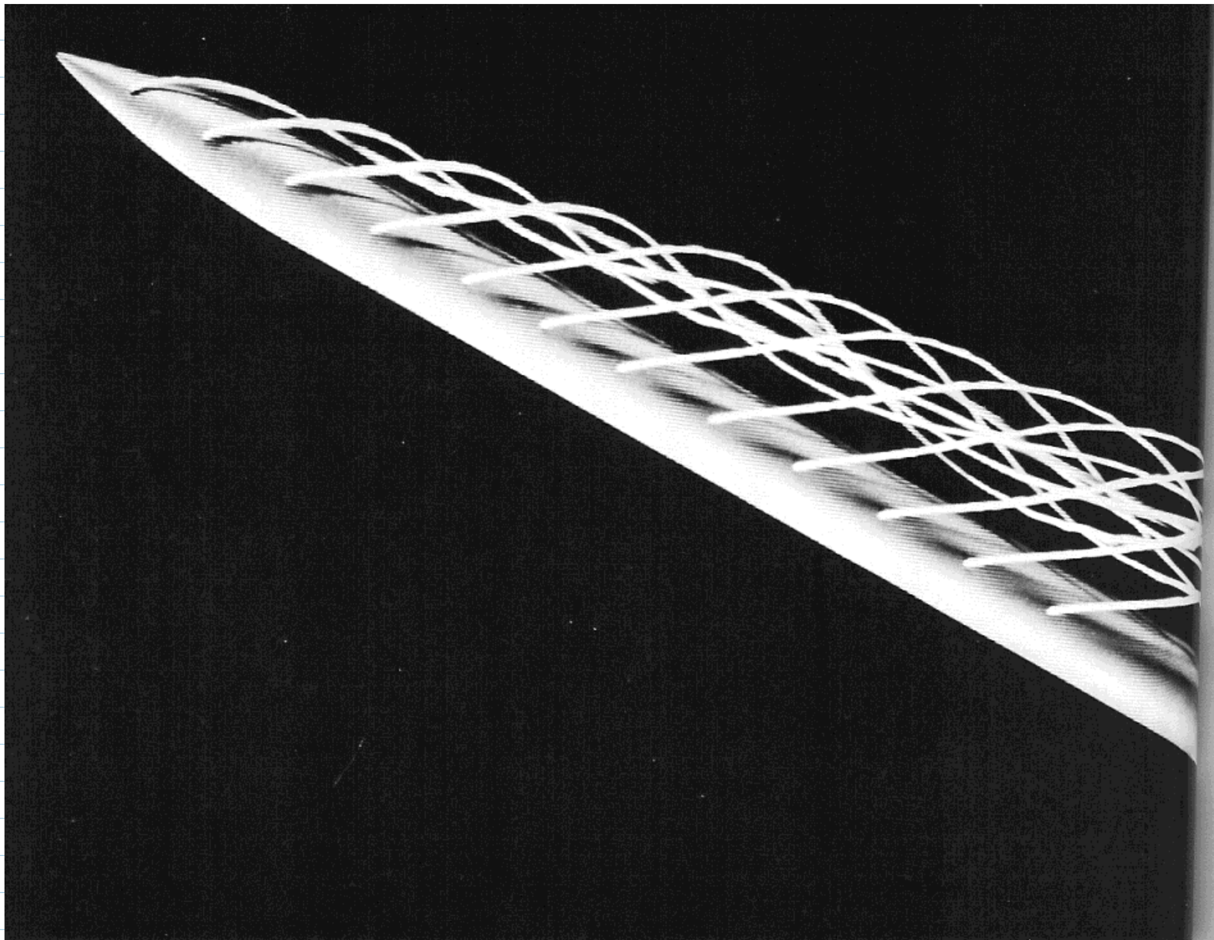
Scatter
Absorb
Emit
Reflect
Refract

Make sure lighting and backdrop are appropriate for the type of light interaction.



80. Starting vortex on a wedge. A piston drives water with almost constant speed normal to the axis of a wedge of 30° semi-vertex angle. Neutrally buoyant dye is injected into the water from small holes in the wedge surface. The characteristic Reynolds number is of order 1000. The piston stops at 12.5 s, producing a stopping vortex in the last photograph. *Pullin & Perry 1980*

REFLECTION



87. Attached vortex pair behind an inclined slender body. A long ogive-cylinder is inclined at 30° to water flowing at 4 cm/s. At this angle of attack a symmetric pair of vortices forms on the lee side of the body. Colored fluid emitted under slight pressure from 0.3-mm holes spirals around the core of the nearer vortex. The Reynolds number is 400 based on the diameter of 1 cm. *Fiechter 1969*

REFLECTION

SPECULAR

DIFFUSE

E.g.:
Dye = dark food color. Absorption is primary, so use bright backdrop
Dye = milk. Scatter is primary; use black backdrop

Light Emitting fluids

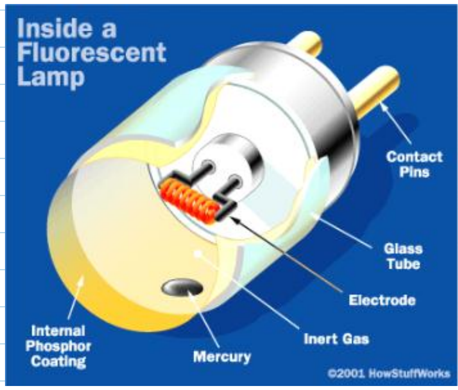
Black Body Radiation = yellow flame color, from BBR of soot particles. Random λ (wavelength) photons from thermal energy

Luminescence = cold body emission, usually at specific λ.

Fluorescence = absorb at a specific short λ, emit at a longer λ.

E.g. some laundry detergents and fabric softeners absorb in the UV, and emit blue or orange

Fluorescent bulbs: Current is conducted through mercury vapor, energizes it to emit UV photons which hit a phosphor coating on the inside of the tube, which then emits visible light.



http://home.howstuffworks.com/fluorescent-lamp.htm/

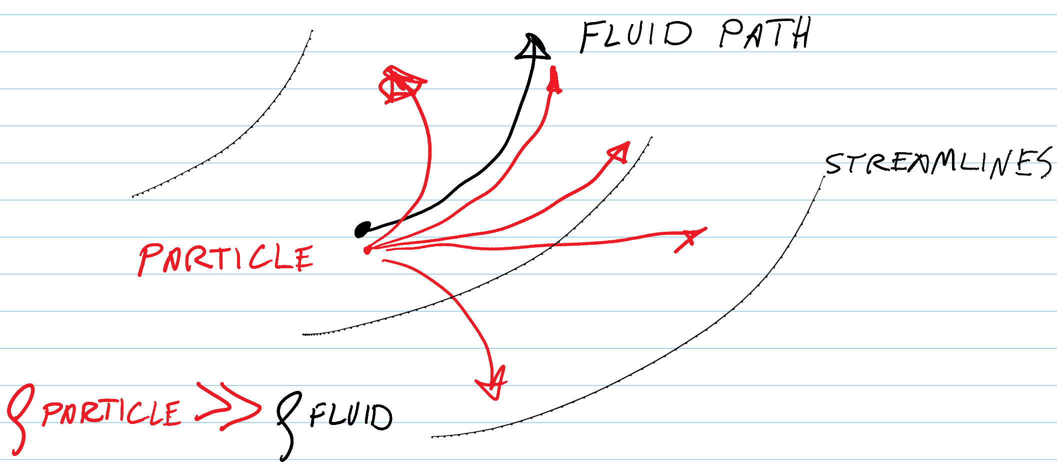
Chemoluminescence - Cyalume, flames
Electroluminescence - LEDs, sodium vapor, mercury vapor lamps etc. Specific λ.
E.g. electric pickle http://www.youtube.com/watch?v=tMhXCG6k6oA
Laser : population inversion, specific λ, resonant cavity with mirrors.

II Particles, heavy seeding
Number density high enough to look like a dye

Similar considerations to dyes:
1)Want particles to NOT disturb flow
2)Want particles to show up - HIGH VISIBILITY
3)Particles must track with the flow ← BIG DIFFERENCE

3) When will particles track well, be good tracers?

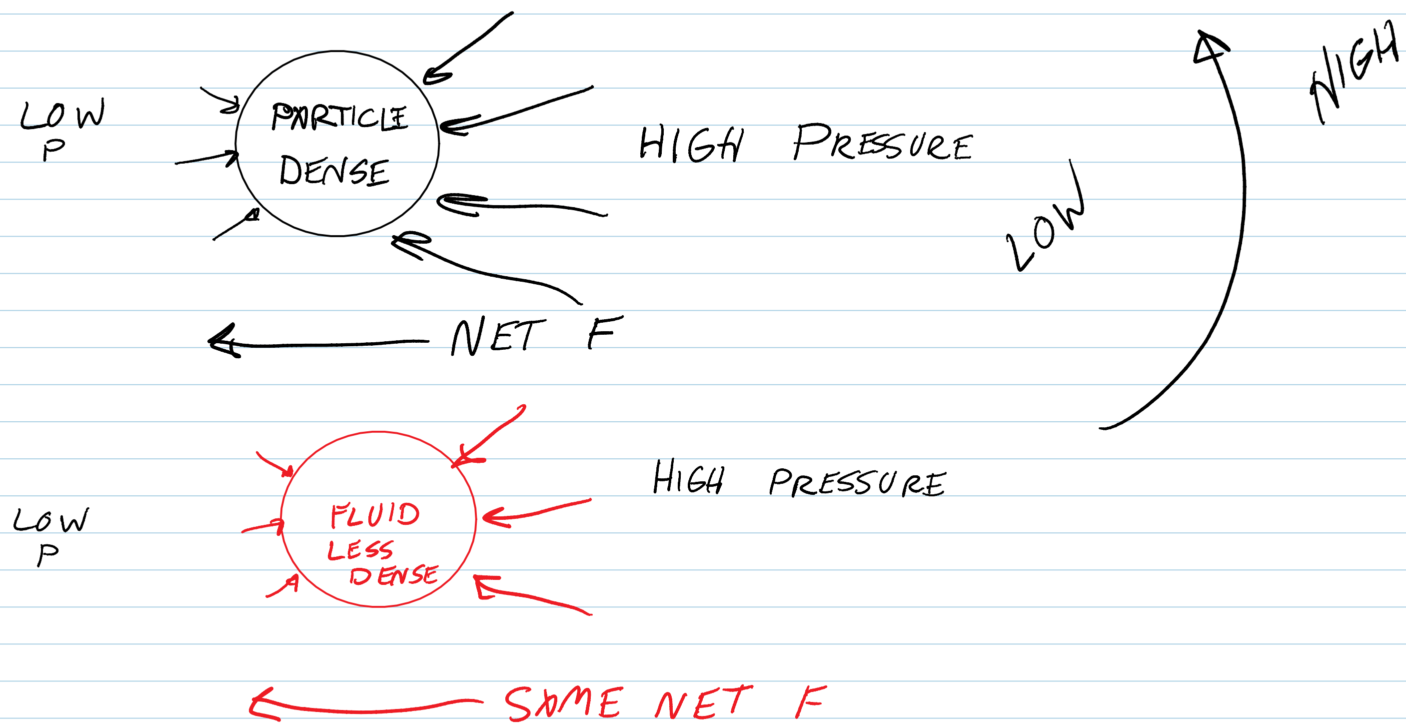
Minute paper: Consider a curved streamline. Consider a small particle, much denser than the fluid, BUT small enough that gravity is negligible compared to forces of the fluid on the particle. (diameter ~ 100μm) What will the particle path look like compared to the fluid path? Sketch.



Next, consider same scenario, but a bubble instead of a particle. $\rho_{BUBBLE} << \rho_{FLUID}$

For particles (or bubbles) to track with the surrounding fluid, they must accelerate the same as the neighboring fluid

Newton's Second Law: $\sum F = ma$
Forces on particle:
Body: gravity, neglect.
Surface: normal = pressure, parallel = shear $\Big\}$ from fluid



Which will accelerate more?

What makes streamlines curve?