

13.DyeTech 1

Monday, March 15, 2010
4:17 PM

Today

Start specific FV techniques. Dyes

Admin

- April 3, 1 – 3 p.m. – Norlin Library E260
Photoshop CS6 – De-Mystify Photo Editing
Audience: Faculty, staff, and students wanting to gain a greater understanding of digital imaging, video editing, and image.

In this 2-hour hands-on workshop participants will learn how to use Photoshop CS6 to quickly correct, blur, and create amazing photo effects. We will also build a short video using Photoshop's new video editing technologies.

Individuals with colorado.edu accounts may sign up here:

<https://www.colorado.edu/oit/node/11251>.

- Invite friends, family to Lobby Show Friday 5/3, 2 pm-4pm. Help set up at 1 pm. Not required, but fun to show off your work this semester

**Minute paper: Group dynamics. Have you been able to meet? If not, why not?
What can be done?**

SPECIFIC FV techniques

Boundary techniques. Boundary between 'seeded' and unseeded fluid.

Choice depends on physics desired

1 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

! 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

Match fluid properties, including velocity(speed and direction)

Density

viscosity

Polarity; miscibility; (will it mix)

pressure

Temperature

contrast

Molecular weight

No chemical reaction

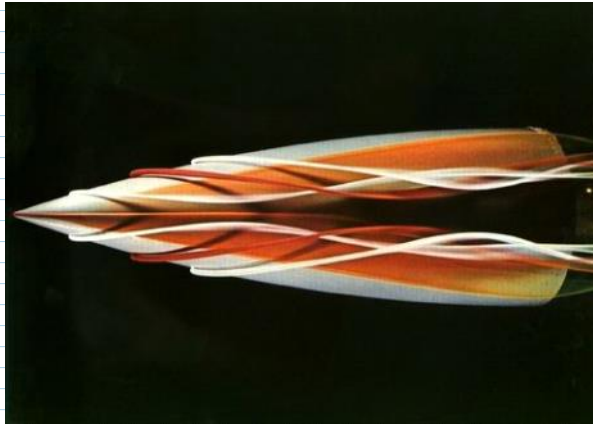
Match vorticity as well as velocity

Inject upstream of test section

Allow for equalization time

Answers:

- Match flow speed when injecting
- 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, 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.

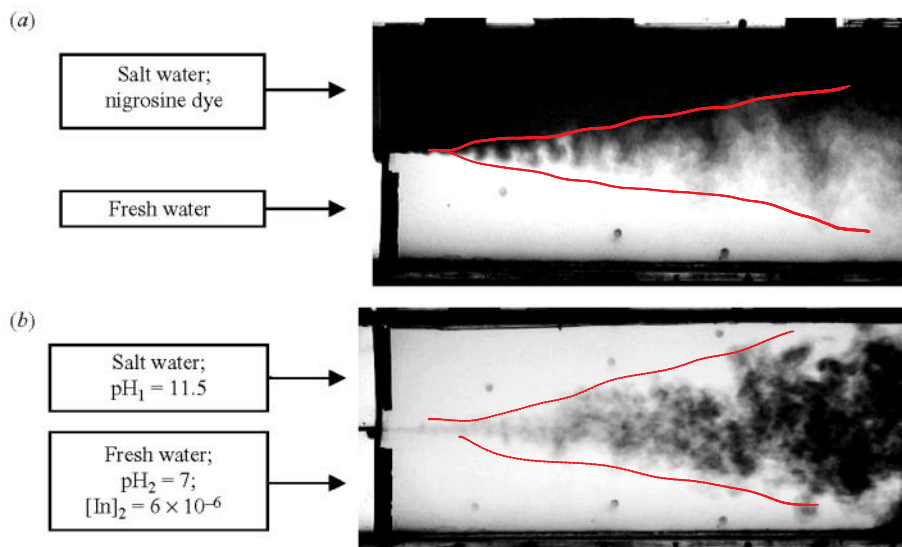


FIGURE 4. Photographs (contrast enhanced for visualization) of the buoyancy-generated mixing layer in a typical water channel experiment. (a) Nigrosine dye was added to the top stream. (b) Phenolphthalein was added to the bottom stream, which changes to its pink form as the two streams molecularly mix (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 Trumbull 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=2Ps0iXwS60E>

~~FAIL~~

More info in [Special Effects article](#)

http://www.americanheritage.com/articles/magazine/it/2007/1/2007_1_10.shtml

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

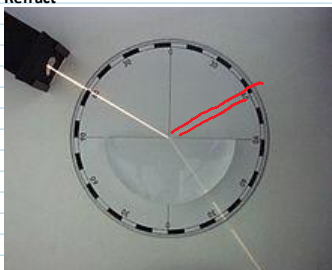
Dyed fluid = want MAXIMUM interaction with light

Minute paper: list the ways that dye (or any molecule) can interact with light (from external source, later will talk about emitted light)

Refraction	Emission
Absorption	Fluorescence
Diffraction	Excitation
Reflection	
Scattering/diffusion	
Transmission	

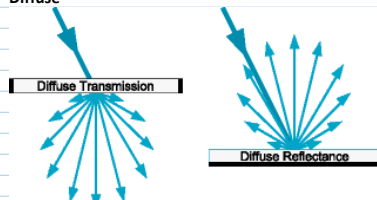
- Transmit

- Refract



<http://upload.wikimedia.org/wikipedia/commons/thumb/1/13/F%C3%A9ny%C3%B6r%C3%A9s.jpg/220px-F%C3%A9ny%C3%B6r%C3%A9s.jpg>

- Diffuse



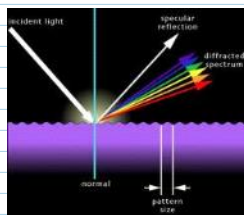
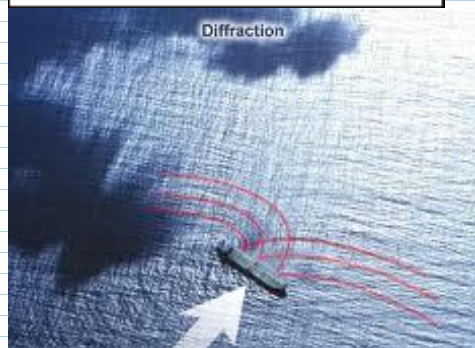
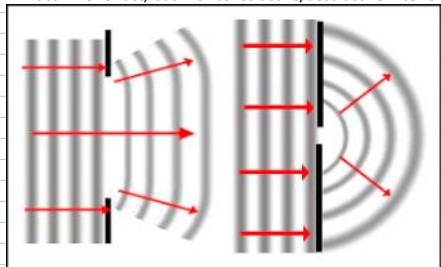
Diffuse transmission and reflectance.

<http://library.thinkquest.org/26162/manili.htm>

- Reflect

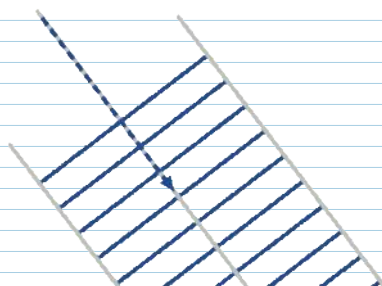
- Specular
 - Diffuse, scatter

- Diffract: Like refract, but with constructive/destructive interference



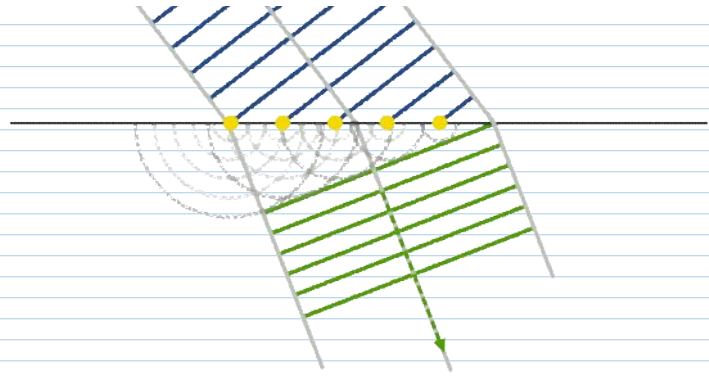
http://www.meted.ucar.edu/marine/riocurrents/NSF/media_gallery.php

http://www.tufts.edu/as/tampl/projects/micro_rs/theory.html





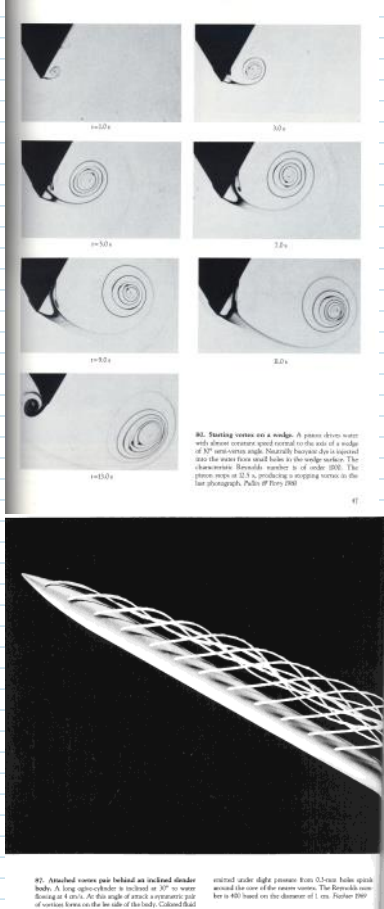
http://www.meted.ucar.edu/marine/ripcurrents/NSF/media_gallery.php



- Absorb
- Big 4: Refraction, reflection, diffraction, absorption.
- Disperse, any of these, but
 - Affect differently based on wavelength
 - leads to chromatic aberration, prisms, cloud iridescence (diffraction around particles; interference)
 - Birefringence = 2 indexes of refraction

http://www.ualberta.ca/~pogosyan/teaching/PHYS130/FALL_2010/lectures/lect35/lecture35.html

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



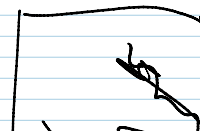
81. Attached vortex pair behind an inclined slender body. A long apparatus is inclined at 30° to water flowing at 4 cm/s. At this angle of attack a symmetric pair of vortices forms on the lee side of the body. Colored fluid injected under slight pressure from 0.5 mm holes spirals around the axis of the vortex system. The Reynolds number is 400 based on the diameter of 1 mm. Further 1989

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

Minute paper: Which is better for a dark backdrop: smooth or rough/matte?

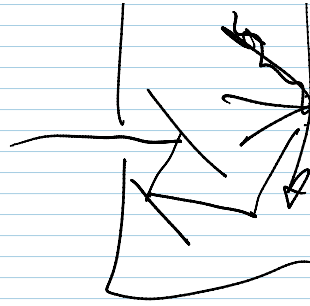
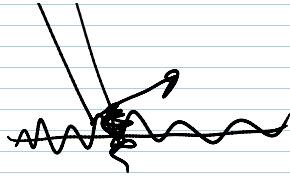
Dark Backdrop
ROUGH
+ beam light

laser light trap



ROUGH
+ trap light
diffuse

SMOOTH →
REFLECTION



Smooth is good if you can control what the specular reflection shows. If not, rough is better.

