

19. Particles 3

Wednesday, November 11, 2015 2:26 PM

Last time: Particle generation in air: Smoke

Today:

Fog

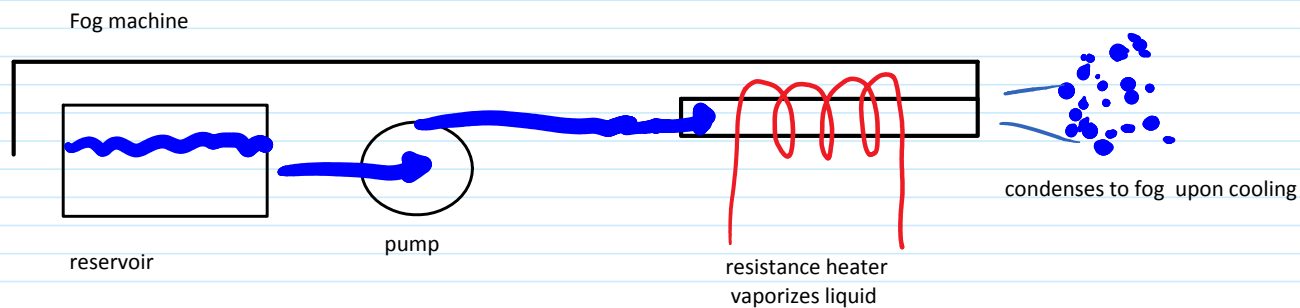
Particle gen in water

Minute paper: Group dynamics. Have you been able to meet? If not, why not?

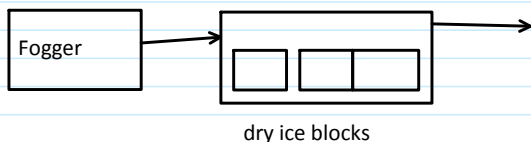
What can be done? Anonymous is OK.

Best/worst aspects of your FV team

Stage fog = Water + glycerin or propylene glycol. Additive slows evaporation



Small machines: heater too small to run continuously. Buy at Target, 1 month before Halloween for \$35.



For fog-on-the-ground: chillers

Approximately 1 micron diameter droplets.

Yoshida, T., Y. Kousaka, and K. Okuyama. "A New Technique of Particle Size of Aerosols and Fine Powders Using an Ultramicroscope." *Industrial and Engineering Chemistry, Fundamentals*, Ind. Eng. Chem. Fundam. (USA), 14, no. 1 (February 1975): 47–51.

Large machines: can run continuously. For professional stage and theaters. \$1000. Mfg: Roscoe, Le Maitre. 1 gallon lasts 4 hrs, \$30.

Health effects are minimal, except to asthmatics and opera singers.

Varughese, Sunil, Kay Teschke, Michael Brauer, Yat Chow, Chris van Netten, and Susan M. Kennedy. "Effects of Theatrical Smoke s and Fogs on Respiratory Health in the Entertainment Industry." *American Journal of Industrial Medicine* 47, no. 5 (2005): 411–18. doi:10.1002/ajim.20151.

Wills, J. H., F. Coulston, E. S. Harris, E. W. McChesney, J. C. Russell, and D. M. Serrone. "Inhalation of Aerosolized Ethylene Glycol by Man." *Clinical Toxicology* 7, no. 5 (January 1974): 463–76. doi:10.3109/15563657408988020.

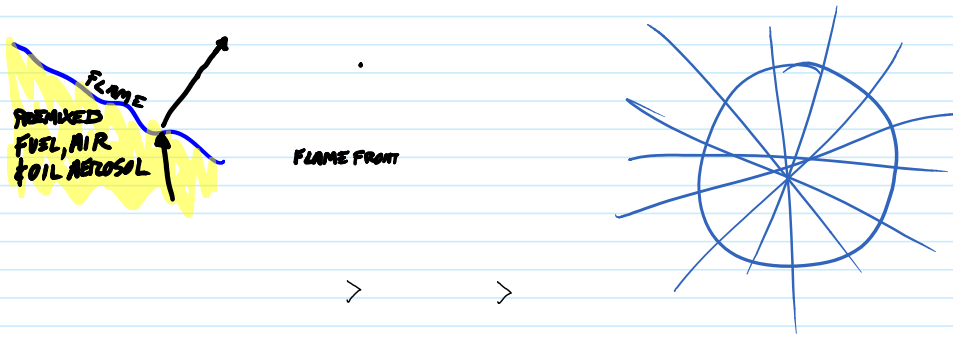
Yoshida, T., Y. Kousaka, and K. Okuyama. "A New Technique of Particle Size of Aerosols and Fine Powders Using an Ultramicroscope." *Industrial and Engineering Chemistry, Fundamentals*, Ind. Eng. Chem. Fundam. (USA), 14, no. 1 (February 1975): 47–51.

C) Oil aerosols

Won't evaporate unless burned. Oil has low vapor pressure.

Use medical or Bernoulli atomizer/nebulizer

Can be used to mark flame fronts. Illuminate fog with a laser sheet = "laser tomography" in 1980s.



Danger! Oil aerosol will coat lungs = pneumonia = death

"Guidance-for-Aerosol-Applications-of-Silicone-Based-Materials.pdf." Accessed November 11, 2015.

<http://sehsc.americanchemistry.com/Research-Science-Health-and-Safety/Guidance-for-Aerosol-Applications-of-Silicone-Based-Materials.pdf>.

Discusses oil aerosol effects in general.

JEAN R. HERTZBERG, MEHDI NAMAZIAN, and LAWRENCE TALBOT. "A Laser Tomographic Study of a Laminar Flame In a Karman Vortex Street." *Combustion Science and Technology* 38 (1984): 205–216.

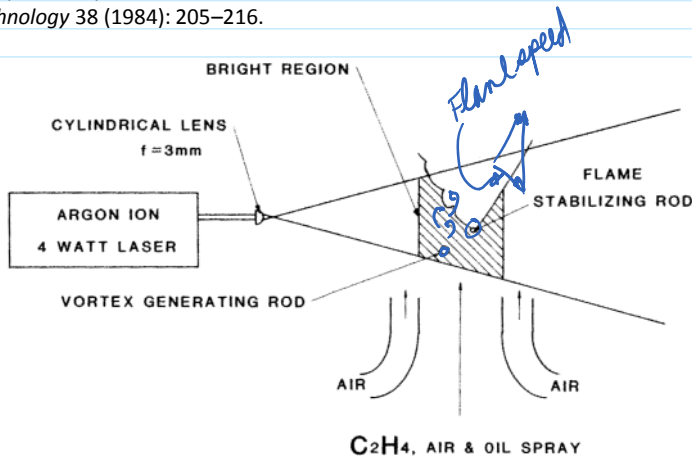


FIGURE 1 Experimental apparatus. The bright region is a cloud of oil droplets illuminated by the laser.

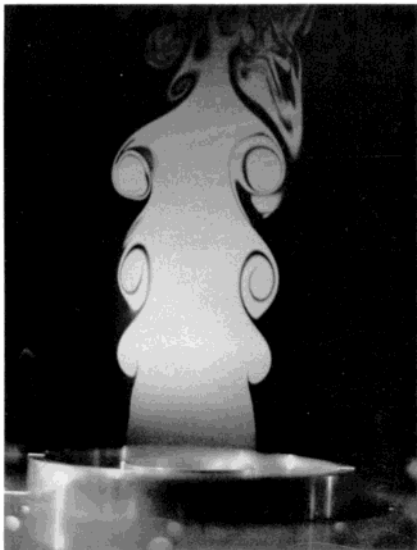


FIGURE 4 Example of tomography. Free jet, 1.2 m/s, issuing into stagnant room air.

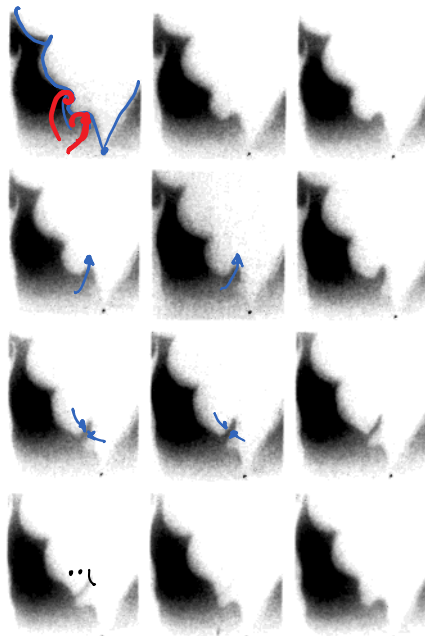
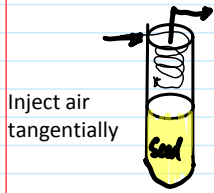


FIGURE 6 Example of tomography with combustion: from high-speed 16 mm film. The flame appears as the boundary of the dark V-shaped region. One complete cycle of interaction with vortex street is shown.

D) Dusts

AlO₂ = alumina, aluminum dioxide. Polishing powder, available in submicron diameters. Inexpensive.
Won't burn; is already fully oxidized. Good for imaging individual particles in flames.
Aerosolize in a cyclone seeder:



Large particles centrifuge to walls. Only small particles that track the flow can exit through the center. Like a Dyson vacuum cleaner.

For heavy seeding, try a fluidized bed.



air injected below

Particles for Water

Hydrogen bubbles (discussed below)
Electrolytic precipitation

Rheoscopic fluids:

Pearl Ex (art pigment, TiO₂ coated mica)
Pearl Swirl (Steve Spangler Science)
Kalliroscope: expensive Pearl Swirl
fish scales?

Blackstock

For individual particle images (PIV)

Corn starch (diluted)
Glass or polystyrene microspheres
Latex bubbles
Rust (filtered)
Alumina
Wax beads (Pine Sol)

Neutral buoyancy

Pine pollen (floats on surface)

Lycopodium powder (also used as flash powder) ← *available*
<http://vimeo.com/89491724> Cymatics