Today, we will:

- Discuss particle vs. steam plumes and how to distinguish them (Slides)
- Start talking about **particles** (sizes, shapes, terminology, classifications, etc.) (Slides)
- Introduce the concept of **number concentration** and various **mean particle diameters**

Summary Comparison of Steam Plumes vs. Smoke/Particle Plumes:

Steam plume	**Particle (smoke) plume**
well-defined boundaries	fuzzy boundaries (not well defined)
very white (like clouds)	can be various colors
ends abruptly	does not end – just slowly dissipates

See Powerpoint slides on course website. (Slides_Steam_vs_Particle.pdf)

Particles (sizes, shapes, EPA definitions, how they move, how they interact with our lungs, how to remove them, etc.)

See Powerpoint slides on course website. (Slides_Particles.pdf)

Example: Comparison of arithmetic mean diameter based on diameter vs. mass

Given: Three particles occupy a cubic meter, as shown in the table. The density of the particles is 1000 kg/m^3. [Some people call this *unit density*, which is the density of water.]

To do: Calculate and compare $D_{p,\text{am}}$ (diameter) and $D_{p,\text{am}}$ (mass).

Solution:

Particle ID	D_p (micron)	$m_p = (\rho_p \pi D_p^3)/6$ (μg)
1	1	5.23599×10^{-7}
2	2	4.1887×10^{-6}
3	3	1.41372×10^{-5}

Example: Calculation of number concentration from mass concentration

Given: The $PM_{2.5}$ mass concentration of a sample of city air is right at the NAAQS limit for 24-hour exposure, namely 35 μg/m^3. The density of the particles is 1250 kg/m^3. The mean particle diameter based on mass is measured to be $D_{p,\text{am}}$ (mass) = 1.5 microns.

To do: Calculate the number concentration of particles, $c_{\text{number},j}$ in units of millions of particles per cubic meter. [Be careful with the units – answer should be between 10 and 50.]

Solution: