Particle Size as Related to Inhalation/Ingestion Exposure and the December 2017 Contamination Spread at the Plutonium Finishing Plant

March 2018

CH2M HILL Plateau Remediation Company (CHPRC) has partnered with the 222S Laboratory to evaluate particle size from a collection of air and smear samples preceding and following the December 2017 contamination spread. Preliminary information indicates the particles were blown along the ground and may have broken up, contributing to the windblown spread of discrete, relatively large (upwards of 100 micron) radioactive particles. The large size of the particles helps explain why continuous air monitors didn't detect the contamination.

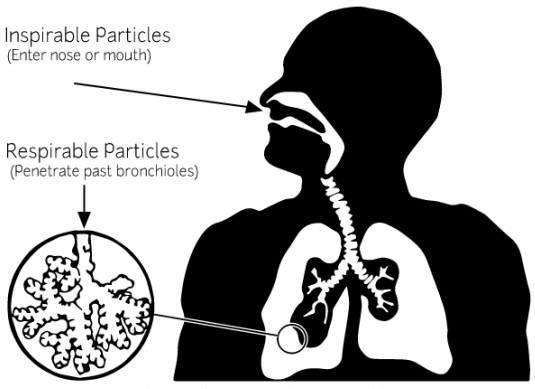
When we talk about hazardous particles, sometimes they are so small we can't see them. Our ability to see a particle depends on its size. We typically can see a particle that is around 50-60 "microns." A micron is one millionth of a meter or 0.001 millimeter…pretty small. Typical printer paper is about 100 microns thick, for example, and an average human hair is about 70 microns thick.

How large a particle is also affects how it moves in the environment, how far it moves, and how long it hangs in air. Particle size is also important in determining whether a particle can be breathed into the lungs. A respirable particle (one that can reach the lungs) is a particle around 10 microns or less. Larger particles may still be inhaled, but the body has built in defense mechanisms to keep them from reaching the deep portions of the lung.

Larger particles become lodged in the nasal passages, throat, trachea, larynx, and larger passages of the lung (bronchi). From there, these larger particles are picked up by mucus and removed from the respiratory tract by coughing or swallowing.

When radioactive particles are breathed in, respirable particles result in an inhalation exposure, versus larger particles that result in an ingestion exposure when swallowed.

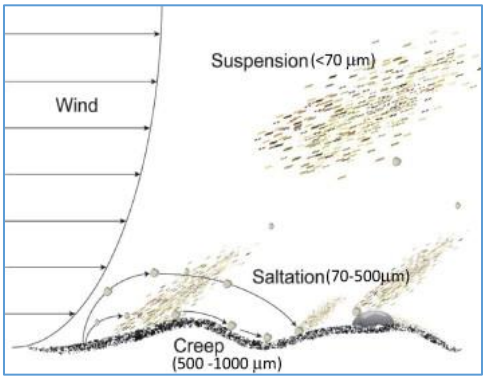
Both respirable and non-respirable particles can be suspended in air. As we know all too well in the Tri-Cities, wind can move dust particles and distribute them. The higher the wind, the more small and large particles are blown around. Some large particles can be suspended in a high wind, but will drop out in eddies or when the wind speed drops.



particles in the nose, throat, and lungs
an edited version of Figure 4-1 EPA/600/R-95/115

When we look at particle size and how that influences movement in the wind, particles can move in different ways.

- Particles “ride the wind” for varying distances (smaller particles tend to go father), and eventually settle out. Referred to as suspension and deposition.
- Very large particles can be pushed along, rolling along the ground, referred to as creeping.
- Sometimes large particles actually bounce on a surface. As these large particles bounce, they can break into smaller particles, referred to as saltation and attrition.



This chart illustrates how wind speed reacts with particles of different sizes.