DISTRIBUTION BASES

Particle size results are generally displayed as a volume-based distribution. Depending on the instrument type used or the intended application of the data, other distribution bases may be selected. A thorough understanding of the meaning of these different distribution bases is essential to providing useful and equivalent data.

Background

Most modern particle sizing instruments measure size distributions in terms of area or volume. Instruments that detect volume directly produce tabular and graphical data that represent particulate volume as a function of particle diameter. Those that directly detect area convert those data into volume numbers and thereby produce volume distributions. All computations are based on the assumption that the particles are spherical.

Conversion of Measured Data

Particle counters produce similar results, but do it on an individual particle basis. These devices make available a particle count, from which they calculate the area or volume values. Most industrial applications require particle size distributions in the form of volume or weight. The absolute number of particles is generally not relevant and tends to be misleading because of the large bias toward the small particle end of the size range.

There are occasions in which particulate area is of interest. This usually occurs for very small particles in the so-called colloid range (sizes of approximately several nanometers to several micrometers). The ratio of surface area to volume is very high for small particles, and surface chemistry becomes significant in particle-particle interactions in that range.

There may be occasions in which a user will desire a particulate count or number from an instrument that measures volume or area of particulate samples. Computers can easily convert volume into particle number by dividing the volume of a single particle in each size range into the total volume in each respective size range. There is a significant risk of large errors at the low end of the size range because small amounts of particles on a volume basis produce very large numbers of particles in the lowest size channels.

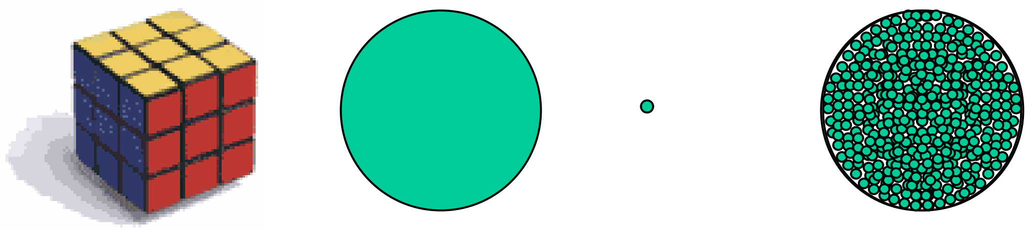
Volume Relationship with Diameter

For each decade (10x) of decrease in particle size, the number of particles increases by 1000 times for equal volumes of particulate material. For example, if a single particle with a diameter of 1 micron were broken into particles with a diameter of 0.1 micron, it would result in 1000 particles from that one particle. Therefore, this conversion should be performed with a great deal of caution in interpretation of the resultant particle number data.

One must be conscious of this relationship when interpreting data which may have a few (by number) small particles which don't show up in the final volume based distribution, or a few large particles, which by number, may initially seem to be over-emphasized.

Technical Note

Distribution Bases



Diameter = 3
Volume = 27

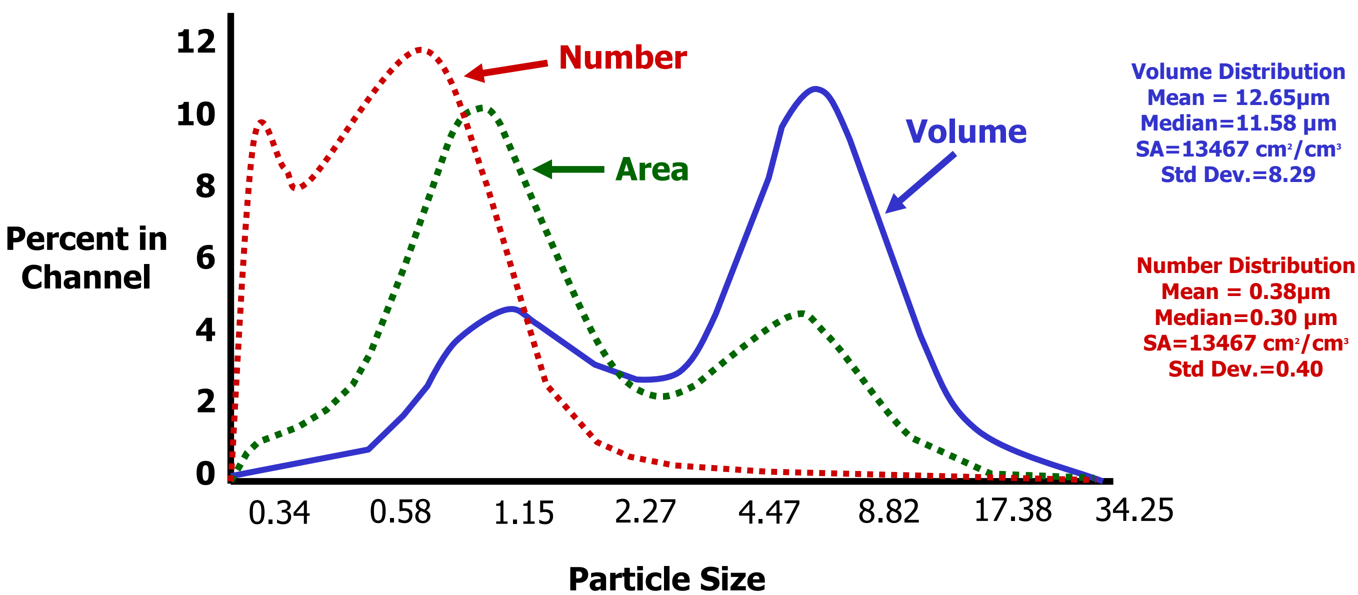
1.0 µm

0.1 µm

The volume of 1.0 µm filled with 1000 0.1 µm particles

In the examples above, an increase in the diameter by 3 increases the volume by 27. An increase in the diameter by 10 increases the volume by 1000.

A particle size distribution is usually computed on the basis of VOLUME percent in each size range or channel. It can be recomputed as an AREA distribution or a NUMBER distribution. The plots below are the same analysis, converted to the distribution bases. While these presentations are all exactly the same data, the different shape of the curve can lead one to treat them as different results. Particularly when comparing data from different instruments, it is critical that the data be viewed in the same format.



For further information on this document or our products, please contact:
Horiba Instruments, Inc.
17671 Armstrong Ave.
Irvine, CA 92614 USA
(949) 250-4811
www.horiba.com