PARTICLE SIZE ANALYSIS OF SYNTHETIC DIAMOND ABRASIVES

Diamond is one of the hardest materials known to man. As such, it makes an ideal abrasive for applications such as grinding wheels, hones and dressing tools. The finer grades (less than 325 mesh/44 microns) are called diamond micron powders and are used in a powder or slurry form for a variety of polishing and lapping applications.

Manufacturing synthetic diamonds

Synthetic diamond production yields a wide array of shapes and sizes. Polycrystalline diamond is produced by shock synthesis, which uses graphite as the base carbon material. This is exposed to a controlled explosion, which transforms the graphite into 100-angstrom microcrystallites of diamond. These microcrystallites then bond together to form polycrystalline particles as large as 100µm. These powders are well suited for applications that call for both high material-removal rates and smooth surface finishes, such as super-polishing sapphire, monocrystalline ferrites, and titanium carbide.

Monocrystalline powder is another commonly used form of synthetic diamond. The synthesis necessitates a long time period of closely controlled high temperature and high pressure to produce a powder that has special physical properties that result directly from the manufacturing process. An example is a friable powder, in which the particles break and expose fresh, sharp cutting surfaces during use. The size and physical properties of monocrystalline diamond powder make this product more suited to specific applications than polycrystalline powder, such as loose-abrasive lapping and polishing of carbides and certain ceramics.

Because all of these production methods produce a wide distribution of particle sizes, from nanometers to almost millimeters, measurement and classification of the particles is important. After classification, the various grades can be sold for specific applications. Also, reclaimed fines are sometimes mixed with larger sized material to re-create the desired size range for polishing purposes. Such practices require close monitoring of size distributions of the individual components, as well as the final blend.

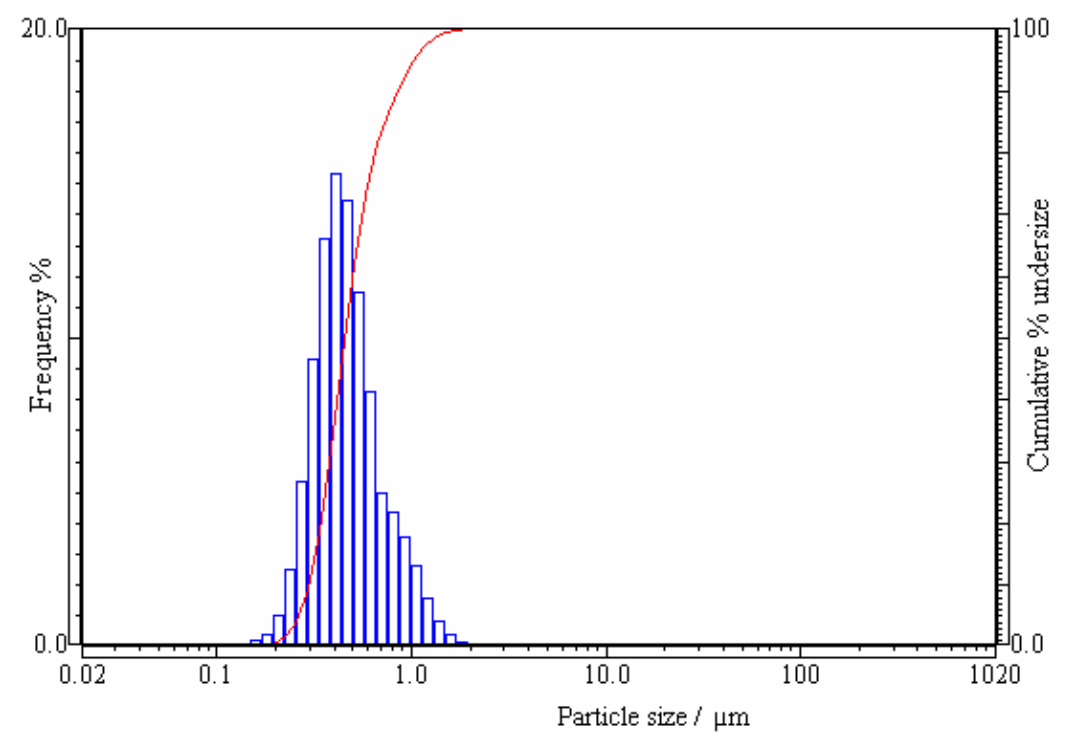
Current Methods of size analysis

Horiba's LA-910 and LA-930 particle size analyzers have proven particularly popular for this application with numerous installations in the industry. The stability, broad size range, and ease-of-use make it ideally suited to the quality control in the manufacturing process.

LA-930 Particle Size Analyzer

Example data

A good example of the use of diamond abrasives is in the polishing of hard disk drives for computers. The hard disk is a metal or glass disk, coated with a thin layer of magnetic material. The data is stored by this magnetic media. The surface flatness of these disks is critical for proper application of the magnetic materials, which are critical to the data storage capacity. These hard disks are polished to an appropriate degree of flatness with a fine diamond slurry. An example of a particle size distribution for such a slurry is shown in the figure below.



Analytical test method

RI of diamond – 2.42 (RRI – 1.82 in water)
Dispersant fluid – Diamond powders are usually dispersed in water with a small amount (usually 0.1%) of sodium pyrophosphate surfactant.
Dispersion requirements – Ultrasonic dispersion may be required for some of the finer grades.
Pump speed – 2 or 3 are usually sufficient for the finer grades

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