IRON OXIDES

Iron oxides are used in a wide variety of forms and have many uses. The majority are used as pigments or for their magnetic properties. Particle sizing in each of these applications is critical to final product performance.

Summary
Synthetic iron oxide powders are used primarily for their pigmentary and magnetic properties (although not all types of iron oxide are magnetic). The category of iron oxide powders includes all types of synthetic iron oxides (hematite, magnetite, maghemite, etc.) and ferrite powders also, as the latter materials have as their main constituent ferric oxide (Fe_2O_3). Iron oxide powders are the most widely used of all colored inorganic pigments, used in concrete products, paints, plastics, and other media. Due to their chemical and magnetic properties, iron oxide powders also find significant commercial usage in electromagnetic components, catalysts, toners, magnetic recording media, and other applications.

Manufacturing Methods

Iron oxide has been produced commercially for the better part of a century, but the industry is expanding due to growth in certain market segments. The low manufacturing cost is due to a variety of different methods, including converting scrap iron into premium iron oxides. Also iron sulfate collected from the waste sulfuric acid used to wash sheet steel, and from by-products generated through the production of titanium oxide.

Pigment Applications

Hematite (Fe_2O_3) is an iron ore and its blood red color (in the powdered form) lends itself well in use as a pigment. Natural iron oxides include a combination of one or more ferrous or ferric oxides, and impurities, such as manganese, clay, or organics. These impurities can sometimes impose limitations on its applicability.

Synthetic iron oxide pigments are one of the most popular color pigments worldwide for coloring concrete products, including ready-mixed and stamped concrete, concrete blocks, bricks and paving stones, roofing tiles, architectural precast products, colored mortar cement, stucco and grout. Other applications include pigments for inks, paints, cosmetics, wood, tiles, ceramics, and anticorrosive coatings used in the manufacture of automobiles and ships.

A full range of color pigments, including yellows, reds, blacks and browns, is produced for a variety of applications. Synthetic iron oxides can be produced in various ways, including thermal decomposition of iron salts, such as ferrous sulfate, to produce reds; precipitation to produce yellows, reds, browns, and blacks (e.g., the Penniman-Zoph process); and reduction of organic compounds by iron (e.g., nitrobenzene reduced to aniline in the presence of particular chemicals) to produce yellows and blacks. Reds can be produced by calcining either yellow or blacks.

Magnetic Applications

Magnetite (Fe_3O_4) is a natural magnet, hence the name. Magnetic iron oxide particles form a powder that is used to coat polyester film base in the manufacture of video and audio tapes. The MIO particles give the tapes their

magnetic quality to pick up sound and images. These materials, made from metal/barium ferrite magnetic particles, have been further enhanced with the application of a thin film of iron oxide, placed directly over the magnetic recording layer.

Magnetic ferrite materials can be grouped into two types: soft ferrite and hard ferrite materials. Soft ferrite materials are used in the deflection yokes of TV monitors, power transformers and noise filters, while hard ferrite materials are used in the magnetic roles found in motors and printers. Powders made up of ultra fine ferrite particles can be applied directly onto PET films and papers to create prepaid cards and magnetic tickets. Ferrite materials even provide solutions in quest for protection from the electromagnetic waves emitted by digital equipment.

Toners

The toners used in printers, copiers and fax machines employ the color and magnetic characteristics of iron oxide. The high-quality images they produce are possible in large part due to the particulate shape of iron oxide, being spherical and highly uniform. Colored toners are being developed.

Other Applications

Because it is harmless and nonpolluting, iron oxide is used by a broad range of industries as a functional and/or environmental material. Iron oxide has also been found to be an excellent damping agent against unwanted sound intrusion. Automobile makers and construction companies apply it in cars and buildings. Furthermore, iron oxide has been found to effectively reduce the generation of dioxin, a substance that has lately become the subject of serious environmental concern.

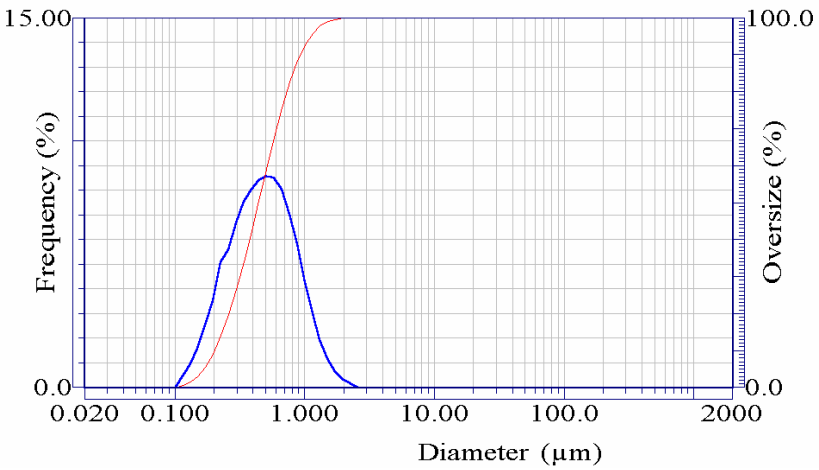
Other applications include grinding materials, combustion-control agents for waste incineration, catalysts for petrochemicals, water treatment agents, vibration-damping materials, and materials for agricultural use.

Measuring Particle Size

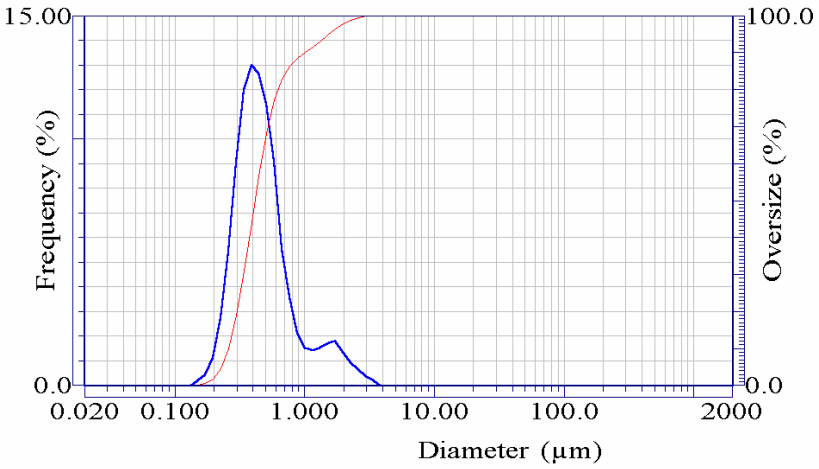
Due to the wide range of applications, a number of different models have been used to measure the particle size of iron oxide materials. Depending on the specifics of the application and the size range, the LA-300 or LA-930 may be most appropriate. The LA-930 measures the finest grades and is compatible with a wide range of organic solvents.

Horiba LA-930 Particle Size Analyzer

Iron oxide pigment
Median: 0.442µm
Mean: 0.514µm
Iron oxide pigments are usually dispersed in water with 0.1% sodium pyrophosphate surfactant. Ultrasonic treatment may be necessary to disperse agglomeration.



Magnetic iron oxide dispersion
Median: 0.414µm
Mean: 0.546µm
Usually dispersed in water with 0.1% sodium pyrophosphate. Due to the magnetic nature of the material and the fine particles, ultrasonic treatment is usually necessary prior to measurement. It is often necessary to leave ultrasonics on during the measurement cycle. If the iron oxide is already dispersed in a coating dispersion, a compatible dispersion fluid may need to be selected.



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