A Glance into Particle Size Application

Throughout it's over 30 years of operations, our PSA technologies has been providing effective and extensive application solutions to variety of industries and research fields.
The following describes some examples for it.

- Agrochemical Industry
- Cement Industry
- Ceramics Industry
- Chemical Industry
- Cosmetics Industry
- Environmental Industry
- Food & Drink Industry
- Mining & Minerals Industry
- Paint, Ink & Surface Coating Industry
- Pulp & Paper Industry
- Pharmaceutical Industry

Agrochemical Industry

Agrochemicals play a significant role in food production, both for the elimination of pests and weeds and for the optimization of fertilizers.

P.S.A. systems contribute to optimizing the performance of Agrochemicals, not only to their production; in many cases, the effective delivery of pesticides and herbicides is heavily dependent on the particle size distribution of sprays and dusts.

Pesticide sprays

Droplet size of pesticide sprays is of paramount importance. Droplets that are too large only wet the top of the leaves and run off quickly; large droplets are extremely wasteful (one 500 µm droplet is equivalent to 125,000 10 µm droplets).
Droplets that are too small will drift into neighboring fields, creating a health hazard; their small size also means they will evaporate rapidly.
Droplets that are perfectly sized, coat the leaves evenly (including the undersides), aren't evaporated too quickly and do not drift.

Fertilizers and pesticides in powder form

Agricultural storage conditions are notoriously variable - damp is always a problem. Sacks full of fine powder can set like concrete and quickly become unusable on exposure to damp. Granulating or pelletizing the bulk chemicals inhibits capillary action so that the bulk of the product remains relatively unaffected by damp storage conditions.

The uniformity of the chemical formulation of granules will depend on the component ingredients having been sufficiently finely milled prior to granulation or pelletization.
However, material, which is milled too finely, will produce pellets or granules that are difficult to dissolve compared with pellets made from coarser powders, which fall apart more quickly when immersed in water.

Cement Industry

About 1% of the world's electrical supply is used in crushing and grinding cement. This amazing statistic underlines the necessity of controlling the production process to ensure that expensive energy is not wasted.

The economic factor is probably the most important reason why particle size analysis is so important to the cement industry. During the grinding process, only a small proportion of the introduced energy is used for the crushing of the clinker and gypsum particles - the rest is liberated as heat and noise - both environmentally undesirable.
Various strengths of cement can be produced from the same clinker by varying the particle size. For example, rapid hardening cements giving faster hydration and strength development are produced by grinding more finely than would be the case for ordinary Portland cement.

Cement particle size can be measured dry using a dry powder feeding system or wet in a non-aqueous dispersion. There is no clear preference, as it seems that dry measurements are extremely rapid and gives good comparability with wet measurements.
It is sometimes of interest to perform measurements to establish hydration rates and this can be done reproducibly by pre-dispersing a dry sample and dispersing it in water. Monitoring the change in the particle size distribution as the water hits the sample.

Ceramics Industry

The performance of ceramic materials i.e. the mechanical strength of the final product is dependent upon the physical properties of the powdered material and the dispersed slurry.

Of particular importance is the particle size values and distribution of the ceramic powders. The particle size defines the time and temperature required to attain full density during sintering (finer particles require shorter sintering times).
A direct relationship also exists between particle size and the pore size observed in the green body. Large particles tend to pack inefficiently, leading to large pore sizes. These pores are found to remain during sintering, thus reducing the strength of the final product. Packing can be improved by reducing the particle size.
The use of poly-disperse ceramic powders can also be advantageous, as the small particles present in these powders will fill the voids between the larger particles, thus reducing the overall pore size.
Finally, the presence of large agglomerates must be avoided as these can lead to defect formation during sintering, as agglomerated grains tend to grow more quickly than well-dispersed particles, again reducing the strength of the final product.

Chemical Industry

There are well known diverse needs of the chemical industry, such as improving laboratory productivity and operational efficiency.

From rugged instruments and software, reliable support and service, to a vast reservoir of knowledge, experience and expertise, it's recommended to choose a PSA supplier that actually has what it takes to achieve the technical needs and business challenges of this rough industry.

Developing new or improved products quickly and maintaining or improving batch-to-batch quality and consistency are two cornerstones of a chemical business. Competitive pressures never stop and the customers expect products to perform exactly the same every time they buy it.

Whether its new product development or quality assurance and control, PSA Instruments provides a wide range of particle characterization solutions and support that can help maintaining competitive edge.

Cosmetic and Personal Care Industry

The cosmetic and personal care industry has an extremely diverse range of products. In all of them, the particle size and/or shape are key indicators of its final performance.

Sprays

Anti-perspirants and hair sprays are classic examples in which the particle size governs the performance of a product. If the particle size of an anti-perspirant is too small it will not block the pores in the skin and not stop the user sweating.
The hold of a hair spray (soft or firm) depends directly on the gel particle size produced by the can.
It is especially important that there are no particles of a size small enough that could be inhaled by the user.

Toothpaste

Toothpaste generally consists of an abrasive material and a whitener; normally these are minerals such as calcium carbonate and titanium dioxide. The particle size distribution of these will determine the color of the toothpaste, its mouth feel and how effective it is in plaque removal.

Lipstick

The color density of lipstick is influenced by the type and particle size distribution of the pigments used. The degree of gloss or frosting is achieved by varying the particle size distribution - greater frosting is achieved by a wider particle size distribution. Color bleeding or feathering is influenced by the amount of fines in the product, which also affect the staying power.

Mascara

Filaments (threads of silk) are present in some mascara products. They give body and added length to the eyelash. Agents are also added to hold the curl without flaking. Tight particle size control of the substrate

helps the formulators to achieve these aims; a larger particle size distribution of the agents makes flaking more likely.

Eye Shadow

When formulating an eye shadow, a product that is permanent is required and in some cases the particle size can influence the degree of frosting. Generally a good eye shadow may be defined as one, which exhibits a fine size distribution. This means it is more likely to blend into the skin, be more durable and prevent creasing in the fold of the eyelid.

Foundations, concealers and blushers

The particle size of a foundation should not be too small as to block up the pores but not so large that the fine lines in the face are accentuated. Particle size analysis is particularly important in the analysis of fumed silica (one of the major ingredients in soft gels and creams). The smaller the size, the greater the surface area the less material required for the desired viscosity. If the particle size of a blusher is too large it will not spread well.

Moisturizers

Moisturizing products need to rapidly absorb into the skin. Liposomes are often used. The size of such products is usually less than 1 µm.

Exfoliates and Emery Boards

These generally contain abrasive agents such as ground apricot kernel. A larger size distribution is required in order to abrade the dead skin. In more sensitive areas of the body such as the face, a finer particle size is often used. The particle size distribution of the abrasive used in emery boards is also important, as the size will influence the degree of abrasiveness.

Nail Varnish

The particle size distribution influences the setting time and how chip proof and durable the nail varnish is. If the particle size is too large flaws will appear in the nail varnish commonly known as streaks.

Environmental Applications

Particle size analysis and the study of zeta potential are important in a variety of environmental applications.

Soils and sediments are an important category of materials in the field of particle size analysis. Particle size is important as it determines many aspects of the strength and stability of a soil and properties related to transport and retention of water, heat and nutrients. In the case of sediments it may well give important information about the origin and distribution of material through the action of tidal, wind and other flows. Often the examination of the size of pollen granules present in the sediment can provide important information about a site (such as what types of plant life were present many years ago).
Although characteristics vary depending on origin and method of collection, it is generally true that a typical sample covers a wide size range and may contain material of all sizes. This may range from the sub micron area (clays), silt (2-60 µm), sand (60-2000 µm), gravel (2-60 mm), bouldery gravel (60-200 mm) and boulders (anything larger). For such samples the method of sampling is paramount. To get a representative soil sample

it should be divided on a spinning riffler into enough material needed for a single measurement. This will greatly increase sample to sample reproducibility.
Modern PSA techniques offers many advantages over traditional methods performed on soils; sample volumes required are low, the analysis is rapid and reproducible and modern instruments offer choices of sample presentation techniques. The sample can be analyzed either wet or dry.

Dry presentation is suitable for a freely flowing soil that requires little additional dispersing action. Such a sample is likely to be soil from a desert region. Any trace of water present will prevent analysis by dry dispersion. Most fresh soils are measured wet for this reason. Fresh soil will nearly always contain material with material outside the measurement range of the instrument, so a sieve is used to take a "top cut" of the sample.

Food & Drink Industry

The food and drink industry deals with the greatest diversity of materials encountered in any single production activity. Food producers are committed to providing food and drinks of consistent quality and uncompromising safety. Consumers will obviously accept nothing less.

P.S.A. instruments are used throughout the food production chain, from the inspection of raw materials and ingredients to new product development, quality control and packaging.

Many characteristics of foodstuffs are determined by the size of the particles in their constituent materials or in the end product. The taste and feel of chocolate for example, the dissolution rates of milk and coffee, the stability of cream liqueurs, and the viscosity of emulsions are all influenced by particle size. Particle size also characterizes other processes such as the emulsification of mayonnaise and the crystallization of sugar. It can be an indicator of unwanted processes like creaming and phase separation and is a critical QC parameter.

Whatever the process, it is important to understand exactly what it is that must be measured to ensure that sampling is correctly conducted. It is also important to ensure that samples have been correctly dispersed in an appropriately inert medium.

Successful particle sizing of creams, milk and emulsions requires an easily cleaned system capable of handling small volumes of liquid and the ability to measure particle size accurately with high resolution.

Freeze-dried and friable materials such as instant coffee, dried milk and chocolate crumb require a system that will measure the particles as non-destructively as possible.

The appearance of a haze in beer and wine is unwelcome to the brewer, as it occurs or is noticed only in the final stages of the process. It is often due to the presence of yeast, yeast debris or aggregated proteins. As well

as spoiling the aesthetic appearance of the drink, it can affect the taste and smell of the product which is obviously of great importance to the consumer. Studying the colloidal parameters that are responsible for particle stability and flocculation can assist in identifying the origin of the problem.

Mining and Minerals Industry

Mining and minerals industries deal in large quantities of materials where particles range in size from sub-micron to boulders. High tonnages of raw materials are subjected to milling and classification. The reliable analysis of particle size distribution provides feedback for process management.

For Minerals applications, the majority of added-value is provided by the process system, i.e. raw material costs are low. At the same time, production levels are high (10-200 ton/hr). The economic characteristics of this industry are high capital and energy costs of production. Thus it is important to maximize the efficiency of production.

High throughput and the large sample volumes involved make full automation of sample handling desirable. Statistically representative measurement of particle size distributions is particularly important requiring sample dispersion units capable of maintaining large particles in suspension.

Developing new or improved products quickly and maintaining or improving batch-to-batch quality and consistency are two cornerstones of this business. Competitive pressures never stop and customers expect products to perform exactly the same every time they buy it.

Paints, Inks and Surface Coatings Industries

Particle size governs many key properties that are important to the coatings industry. For example, flocculation, hue/tint strength, hiding/transparency, dispersability, stability, gloss/flatting and film appearance, viscosity and weather resistance.

Other properties related to dry paint applications (powder coatings) include flowability and materials handling issues. Particle size determination thus is a key feature of the characterization of pigments, fillers and additives that are present in wet and dry applications.

Paper and pulp

Paper is manufactured from pulped wood fibers, fillers, pigments and flocculent additives. Fillers, such as clays or chalk, are added to make the paper opaque. Dyes and pigments, such as titanium dioxide, are added to modify the brightness of the finished product. Improving the retention of these constituents is of prime importance during the paper making process.

Particle size plays an important role in the paper making process. The particle size of the raw materials used in the process needs to be carefully monitored as variations may lead to poor quality products. For example, the size distribution of titanium dioxide particles used as a pigment in the paper making process will have an effect on the brightness of the finished product.

Pharmaceutical Industry

The key role of particulate materials throughout the pharmaceutical industry is drug discovery, development and manufacture.

Particle characterization systems have applications right from the start of the drug discovery process, through early method development stages, into manufacturing and through to final quality control. This applies for both particle and droplet size measurement and dispersion stability applications.

The ability to understand and control parameters such as particle size distribution contributes significantly to the development of effective medicines and efficient manufacturing processes.

Reliable particle shape characterization provides more data to understanding the reasons for deviations from manufacturing specifications and enables the development of more robust production processes.

As pressure increases to reduce production time and costs, there are specifically developed instruments for in-process particle sizing, embedded as an integral part of many process lines, bringing insight and control to manufacturing procedures.

Accurate characterization is essential and compliance with FDA and GMP guidelines must be clearly documented. The analytical instruments used must be designed, manufactured and serviced using practices and procedures that guarantee the accuracy and precision of the results. These instruments must be relied upon today and for many years into the future.