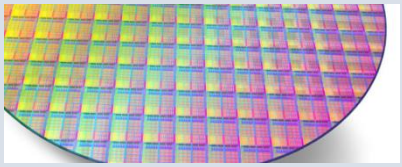
P.S.A. APPLICATIONS

- Nearly all industries and research fields that handles materials, needs or demands to analyze Particle Size and/or Shape
- Each application is specific to an industry or research field
- Most of the PSA market is built to address specific applications only
- DIPA2000i suits nearly all known applications
- Its recommended to start application sales at most comfortable and known market segments, then progress to new grounds

ABRASIVES

- An abrasive is used to polish or remove excess material from a surface by rubbing it against the surface material.
- For effective polishing, abrasive particles need to be harder than the surface material.
- Abrasives are also used in grinding, cutting, drilling, sanding etc.
- The abrasive particle size distribution is critical in surface smoothness and material removal rate. Agglomeration is a common phenomenon in abrasives.
- A narrow particle size distribution is preferred because smaller particles lead to agglomerates.
- These agglomerates may damage the material surface by scratching.
- The abrasive particle size distributions are traditionally measured using sieves and sedimentation methods.
- The DIPA2000i is an alternate method for the abrasive industry - being simple, robust, reproducible and producing faster and more accurate results.



AGROCHEMICAL

- Agrochemicals play a significant role in food production, both for the elimination of pests and weeds and for the optimization of fertilizers.
- 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 500µm droplet is equivalent to 125,000 10µm droplets.
- Droplets that are too small will drift into neighboring fields, creating a health hazard.
- Their small size also means they will evaporate rapidly.
- Also, the interaction between the particles can cause instability and affect rheological properties, which impacts their flow properties.
- Droplets that are perfectly sized; coat the leaves evenly (including the undersides), don't evaporate too quickly and do not drift.

ASPHALT

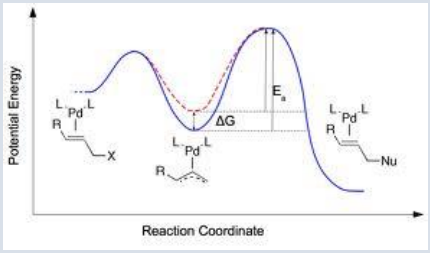
- Asphalt is used as a binder with aggregates in road (pavement) construction and as such determines performance and lifetime.
- Additives such as polymers, crumb rubber, oils and pH adjusters are used to enhance mechanical properties in modified asphalt binders.
- Asphalt emulsions are also used as water-proofing and re-surfacing materials.
- DIPA2000i can determine Asphalt properties:
  - Formulation development and quality control metrics
  - Determination of Mixing and Compaction Temperatures
  - Blend testing of Warm Mix, Crumb Rubber and Recycled Asphalt Paving (RAP)
  - Particle sizing of emulsion profiling
  - Benchmarking and comparison of competitive products, based on PSA characterizations.

CARBON

- Elemental carbon in its many forms is a material used throughout industry and is still finding exciting new application areas.
- Direct cost savings and product optimization are evident in many areas:
  - Tire life is extended approximately 3-fold (5000 to 15000 miles) with the use of carbon black benefiting us all in the pocket (collectively trillion of dollars) - and this from natural gas that may have otherwise been wasted
  - Black paints and lacquers possess approximately double the lifetime through the reinforcing power of colloidal carbon and its ability to screen out injurious actinic radiation.
  - Printing inks give clear, instantaneous imprints due to colloidal carbon black.
  - Rubber insulation – additional insulating and protective value due to the inclusion of colloidal carbon.
  - Separation of octahedral and distorted diamond (the latter of less value).
  - Optimization of particle size and flow properties of liquid coal slurries used in power stations potentially saves the economy billions of dollars.

CATALYSTS

- Proper PSA detection capabilities in the areas of heterogeneous catalysts and catalyst preparation leads to extended lifetime and cost savings in production.
- An optimal size range exists for a catalyst and catalyst support that will maximize its lifetime while retaining its activity.
- The accuracy and precision of the DIPA2000i PSA characterization equipment allow that range to be more than defined - it is possible to push to the limits allowing catalyst lifetimes to be extended.
- Product optimization and characterization application areas include:
  - FCC catalysts where a prediction of the attrition rate and thus the lifetime can be made from the slope of the pressure-size titration in a dry analysis.
  - Metal and alloy catalysts.
  - 'Black' metal catalysts such as platinum and palladium where costs are paramount and usage needs to be restricted.
  - Raney nickel for fat hydrogenation.



CEMENT

- Particle size affects strength, development, transportation, quality and drying time of cement powders.
- Currently cement PSA is analysed in both wet (alcohol) and dry powder forms.
- The largest contribution to cement strength comes from particles smaller than 30μm.
- There are many stages in cement production that need size characterization:
  - Early Stage (>10μm)
  - Hardening Process (10-30μm)
  - Final Stage (3-30μm)
- Generally speaking, the more particles between 3-30μm, the better the cement quality is.
- In the grinding process, over grinding will be at high costs and yield too many particles smaller than 3μm that in turn will produce too much heat during solidification, too fast sedimenting, and too many cracks.
- On the other hand, under grinding will result in too many larger particles that in turn will prolong solidification time and reduce strength.

CERAMICS

- The performance of ceramic materials i.e. the strength of the final product is dependent upon the dynamic mechanical properties of the powdered material and the dispersed slurry (slip).
- The particle size defines the time and temperature required to attain full density during sintering (finer particles require shorter sintering times).
- 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 fired product.

CHOCOLATE

- Chocolate taste and texture are what matter most to the consumer.
- For the manufacturer, product consistency, quality control and cost-efficient production are vital to maintain brand reputation.
- Understanding, monitoring and controlling particle size and particle shape, in air or liquid, are key factors in ensuring consistent, high quality production, as are managing the flow and rheological properties of chocolate.
- Important monitoring in Chocolate production:
  - Monitor the quality of incoming raw materials
  - Optimize grinding, blending, cinching and tempering processes
  - Improve product quality and performance
  - Minimize process downtime
  - Increase productivity and yields
  - Ensure brand consistency.

COFFEE

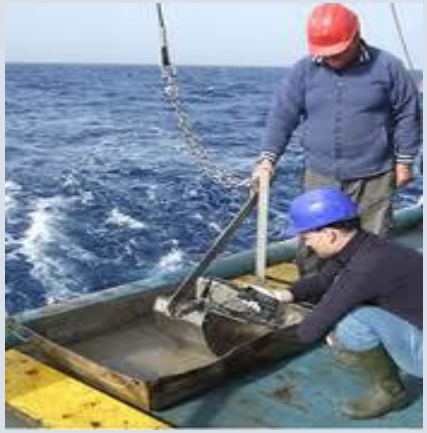
- The particle size of ground coffee is an extremely important parameter in determining the final characteristics of the brewed product.
- Care needs to be taken during grinding to ensure that the resulting particle size matches the required taste profile for the product being made.
- DIPA2000i provides a robust method for monitoring the particle size of coffee, providing the ability to resolve changes in both the coarse and fine particle fraction during milling.
- Heated products can be analyzed at authentic temperatures.
- As such, the technique is a useful tool for controlling grinding processes and improving product consistency.
- There are also costs associated with over-grinding a batch; by using the DIPA2000i, the particle size of large amounts of sample can quickly be determined, without any user-to-user variability.

COSMETICS

- Cosmetics are available in a variety of suspensions such as emulsions, gels, lotions, suspensions or creams containing particles.
- The particle size in cosmetics determines the overall functionality, stability and skin feel.
- The particle size distributions of both dry and liquid cosmetics are essential for product properties and quality.

DRILLING FLUIDS

- A drilling mud, or drilling fluid, is an oil or water-based mix of minerals (barite, calcium carbonate), salts and polymers formulated to protect the drill and the shaft during oil or gas production.
- Analysis of drilling muds and drilling mud constituents is necessary to understand, monitor and control the Particle size distribution and shape consistency to prevent aggregates that might cause damage, prevent the escape of gas and block pores.

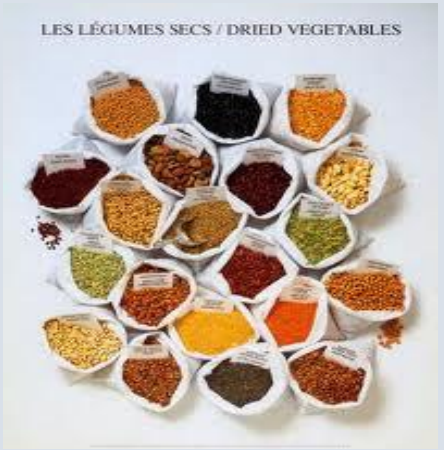


DRINKS INDUSTRY

- The formulation of any flavor emulsion can be optimized by looking at the particle size and shape.
- This will influence its appearance (cloudiness) and its stability as final product.
- The characterization of emulsion based drinks formulations (cream liqueur, color emulsion, flavor emulsion) can be analyzed to understand, control and optimize:
  - Shelf life, it can be increased by optimizing the formulation, and how particle size may change over time, reducing sedimentation or creaming in the product.
  - Sugar crystals can be a problem in some flavorings, particle size analysis can spot the outsize particle before they become an issue.
  - Characterization of milk products.
  - Emulsion measurements.
  - Milk Homogenization.
  - Emulsion storage.
  - Milk powder hydration/rehydration.

DRY FOOD INGREDIENTS

- Dry food ingredients come in many different forms, but are normally either milled to a final size or created to be a certain size via a process such as spray drying.
- Bread loaf volumes are affected by the size and shape of flour.
- Material characterization of dry food ingredients enables:
  - A consistently sized material to be produced
  - The shape and size of a material to be measured enabling understanding of how it packs and flows.
  - The size and shape of a dry ingredient will influence how it hydrates (and any flavor it may impart) or dissolves, and the rheological behavior of it in solution can be monitored and correlated against initial size and shape.

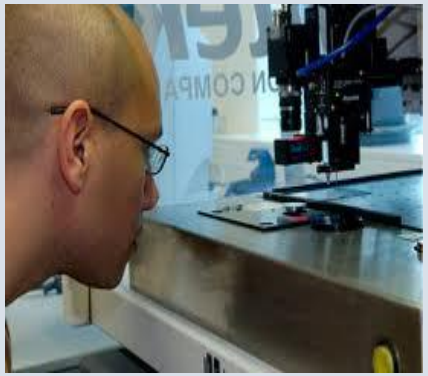


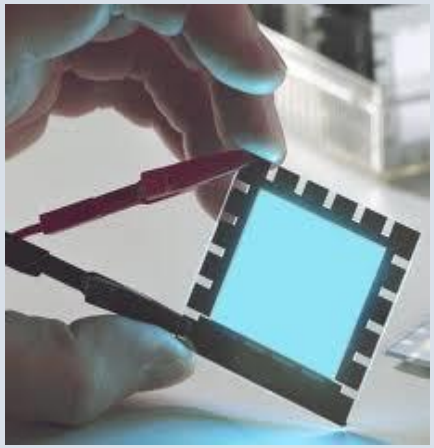
ELECTRONICS

- Measuring particle size and particle shape is important in the electronics industry especially during the manufacture of raw materials for integrated circuits used in most electronic equipment such as computers, mobile phones and digital appliances.
- The presence of a single oversize particle can cause damage to a wafer or a failure in an LCD.
- Typical Applications:
  - CMP (Chemical-Mechanical-Polishing) slurries used in polishing silicon and other wafers for photovoltaic cells production
  - Solder particles and screen print inks used in printed circuit boards
  - Silver, conductive carbon and pastes used for PCB's and a variety of displays (EL, LCD, LED)

ELECTRONIC DISPLAY

- Electronic displays are increasingly becoming cheaper, larger, brighter and more efficient.
- In order to achieve these properties, the characterization of particle size during the manufacture of components is essential.
- Typical characterizations:
  - Colored dye materials used in the TFT-LCD's.
  - Conductive pastes used for making back-to-front connections in LCD's, EL's and other display types.
  - Oversized particles which cause shorts within the display area and cause splaying of edge connections outside the display area
  - Precursors used in the electro-optic industry for making transparent conductive coatings





ENERGY & ENVIRONMENT

- The energy and environment sectors rely on materials, whether these are common, such as sand for water treatment, or highly engineered, e.g. complex lithium compounds for the fastest battery technologies.
- The performance of these various materials will depend on their physical properties.
- Material characterization is therefore critical to providing optimized solutions across the energy and environment industry.
- For analyzing solids, suspensions, gels, or solutions, DIPA2000i systems can help in:
  - Increase battery capacity and charging speed.
  - Improve the efficiency of solar cell wafer manufacture.
  - Understand the slurry pumping transport properties for nuclear waste and water treatment.
  - Rapidly determine soil texture.
  - Optimize water treatment protocols.

FOOD & BEVERAGE

- Particles in the food and beverage industries are in the forms of powders, emulsions or suspensions.
- The properties of food and beverage, such as flavor and taste, texture, appearance, color, stability, shelf life, and rheological properties are greatly influenced by particulates in the products, especially their size distribution and surface charge.
- For examples, the particle size distribution affects the dustiness and transport properties of dry powders and the sensorial properties of ice creams, chocolates, ketchup, and etc.
- Particle size analysis is also very important to size reduction processes of foodstuff such as milk homogenization and flour milling.

FORMULATE GREASE & LUBRICANTS

- Particle size analyzers can be used to quantify Particle size and stability of colloidal lubricant suspensions.
- These characteristics can easily be correlated to the samples microstructure, processability and ultimately its in-use performance.
- The use of particle size and shape together are a powerful tool to help chemists correlate their sample results with formulation changes, leading to an optimized end product.

HOMOGENIZATION PROCCESSES

- The efficient operation of homogenization and emulsification processes rely on continuous particle size analysis for:
  - Consistent endpoint detection.
  - Product quality.
  - Minimizing energy consumption.
  - Green manufacturing.
- Droplet size is a Critical Quality Attribute (CQA) in emulsion stability and dose content uniformity for pesticides and pharmaceuticals products.
- In contrast, the droplet size of oil-in-water emulsions, in areas such as crude oil processing, influences the separation characteristics of these immiscible liquid mixtures and their behavior in hydro-cyclones and other key unit operations.
- Generally the finer the droplets, the more stable the emulsion; however, producing fine droplets is more energy-intensive.
- Tightly controlling droplet size, to a specification just fine enough to meet stability targets, is highly effective in minimizing energy consumption

METAL

- The manufacture of metal powder includes a wide variety of processes for many different applications.
- The conversion of the powder into finished product, such that metal particles bond together is a procedure that needs to be closely monitored.
- Incorrect particle size and particle size distribution, particle shape, surface area, and density can lead to poor metal powder compaction and sintering.
- DIPA2000i makes it easy to test particle size and particle shape in both wet and dry environment during research and development and for quality control during manufacture in order to:
  - Improve final product performance.
  - Optimize production processes
  - Understand the mechanical strength by monitoring:
    - The extent of contact between metal particles or compression ratio (e.g. surface area, density).
    - The nature of packing behavior (e.g. aspect ratio, shape irregularities).

MINNING & MINERALS

- Minerals are used as abrasives, as raw materials for other processed products such as cements, or just simply as components for mixtures.
- Size distribution of mineral dry powders or powders in suspension is very important in monitoring milling processes and quality controlling final products.
- Both dry and wet measurements are required for this industry.
- For powders having a precise size distribution, the DIPA2000i is perfectly suitable.
- Ores are separated by grinding, mixing with a collector, suspending and floatation.
- The efficiency depends on adsorption between the collector and the mineral that can be controlled by adjusting surface charge of the particles.

OIL IN WATER SEPARATION

- Continuous, timely particle size analysis is required to demonstrate the efficiency of filters used to separate water droplets from fuel oils.
- Application which requires technology suitable for:
  - Dirty process streams.
  - High pressure measurement.
  - Explosive duties.
- Fuel filters remove rust, paint chips and any undissolved water to ensure efficient and safe combustion within the engine.
- Large water droplets are reasonably easy to remove, but increasingly the water is present in the form of a fine emulsion due to the presence of fuel additives which act as surfactants.
- Particle sizing systems span the particle size range up to several mm and measure at a frequency that comfortably exceeds the requirements of the standard for filtration test rig monitoring (i.e. one averaged distribution per minute).

OIL & PETROCHEMICALS

- Petrochemicals are derived from refined crude oil and are used to produce a range of industrially important materials including organic chemicals, fuels, waxes, polymers and detergents.
- The petrochemical industry is usually divided into upstream and downstream operations.
- The upstream sector is associated with recovery and production of crude oil while the downstream sector refers to the refining process and distribution of these materials.
- For complex petrochemical systems, such as oil and water emulsions, particle size is a key material parameter for material performance.

PETROLEUM

- In petroleum industry particle characterization is often a daily routine for businesses related to drilling mud, injection water, sediments, and field exploration.
- Many petrochemical products, such as purified terephthalic acid (PTA) and other polymeric products such as latexes often have particle size distribution as one of the quality control parameters.
- DIPA 2000, both wet and dry analysis options can be used in these fields, serving both for laboratory use and for On-Line PSA monitoring.

Petroleum Refinery

PIGMENTS & TONERS

- Most pigments are dry colorants, usually ground into a fine powder.
- As such they are suspended in a medium or vehicle for use in production.
- Toner is also a powder but used specifically in laser printers and photocopiers to form the printed text and images on the paper.
- Toner particles are melted by the heat of the fuser, and bind to the paper.
- Although traditionally the average size of toner particles was 14–16 micrometers diameter, the particle size of more current toner products has been reduced to 8–10 micrometers in order to obtain 600 dots per inch resolution.
- Toner particles can be measured in heating conditions by the DIPA 2000.
- Particle size and its distribution are critical in order to produce a powder suitable for use in printers.

PHARMACEUTICALS

- Size distributions of particulates in pharmaceutical products affect the safety, side effect and efficacy of the products.
- Particle characterization is a critical component in every stage of R&D, preclinical and clinical trial of many pharmaceutical products and is widely used in Process Analytical Technology (PAT).
- Size distribution analysis, impurity and aggregation counting and particle surface charge analysis are used in characterizing drug carriers such as liposome and nanoparticles, parenterals, oral suspensions, vaccines, dermatological products, tablet production, and etc.

POWDER COATINGS

- Powder coatings are dry powder polymers that have a particle size in the range of 30 to 50 µm.
- These coating materials can be thermoplastic or thermoset polymers.
- The DIPA 2000 particle size & shape analyzer can be used in the study of powder coatings.
- This instrument, together with DT's industry and application knowledge, can be used to:
  - Characterize the particle size and poly-dispersity of the powder coating particles.
  - Analyze both the particle size and particle shape of the powder coating samples.

SOIL & SEDIMENTS

- Soil analysis often relies on particle size distribution measurement to provide insights into soil deposition history, composition, and physical properties.
- Popular applications involve clay or sand analysis as well as rock porosity.
- These fundamental tools are used daily around the world by environmental, geotechnical, and oil exploration professionals who use them to enable their insights into what lies beneath (and on top) of the earth.
- The DIPA 2000 analysers are suitable for customer satisfaction & supports soil analysis in a wide variety of settings.

WATER QUALITY

- Sizing particles in water allows water treatment plants to monitor and optimize their processes.
- One goal of any drinking water plant is to yield a finished product free of solid particles
- Therefore it is very important to select a highly accurate method for testing the final product. The DIPA 2000 is suitable for monitoring and sizing particles in water.
- From ultra-clean waters for the semiconductor industry to sediments in murky waters for evaluating filtration efficiency, the use of the DIPA 2000 provides a fast, easy, accurate and automatic method to analyse particles size.
- Particle are being analysed individually giving the technique high resolution & accuracy.