# Application Note 2.1

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## Dynamic Shape Analysis using the Ankersmid DSA-10

### Introduction

Many properties of particulate materials are affected by their shape as well as their size.
The rheology of a liquid or solid powder flow is directly affected by the shape of the particles within it, as well as by their size. Measuring and understanding the shape allows control of the flow properties. Shape is one of the factors that determine the ability of a material to compact. Optimizing the strength of the resulting brick or the amount of material that can occupy a given volume is made possible by controlling particle shape, and size.

#### DSA-10 – Dynamic Shape Characterization System

The Ankersmid Dynamic Shape Analyzer, DSA-10, is a complete shape characterization system for particles in motion. Comprehensive particle analysis is obtained through the unique combination of a synchronous strobe light source and video microscope technology. All particles are fully classified by numerous shape parameters including Diameter, Shape Factor and Aspect Ratio* (roundness).

**Fig. 1 – DSA-10 System**

An automatic flow controller (LFC-101) is used to flow the particles through the measuring cell. A video microscope camera synchronized with strobe light captures “still” images continuously while particles are in dynamic flow. The images are enhanced, processed, and analyzed automatically to ensure full representation of the sample. Accurate results are produced in a fraction of the time normally required for microscopic observation.

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## Summary

### Shape Parameters

Over 30 Shape parameters can be selected among which: Shape Factor and Aspect Ratio.

**Aspect Ratio** – Shape parameter of an object given as the ratio between the min ferret diameter to the max ferret diameter. The factor is 1 for a perfect circle and close to 0 for a line.

Aspect Ratio = (Min Ferret) / (Max Ferret)

Figure 2 shows the calculation of the Shape factor:

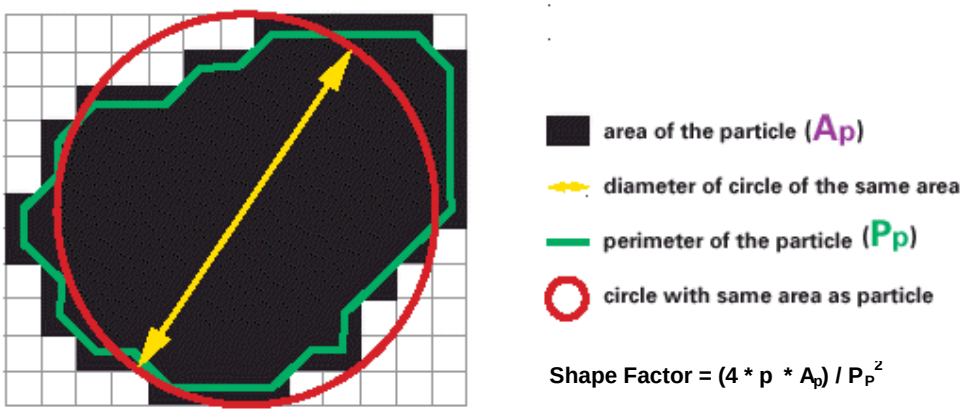


**Fig. 2: Shape Factor Calculation**



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Characteristics of the Shape Factor and Aspect Ratio of several kinds of particles are displayed in table 1:

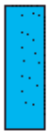
| Shapes |  (Opaque) |  (Transparent) |  |  |  |  |
|---|---|---|---|---|---|---|
| Shape Factor | 1 | <0.1 | 0.785 | 0.604 | 0.436 | 0.160 |
| Aspect Ratio | 1 | 1 | 0.707 | 0.577 | 0.250 | 0.100 |

**Table. 1: Shape Factor & Aspect Ratio Characteristics**

### Data Output

Graphs and tables of all selected parameters can be constructed and separate images can be stored. Figure 3 shows some examples of data output.

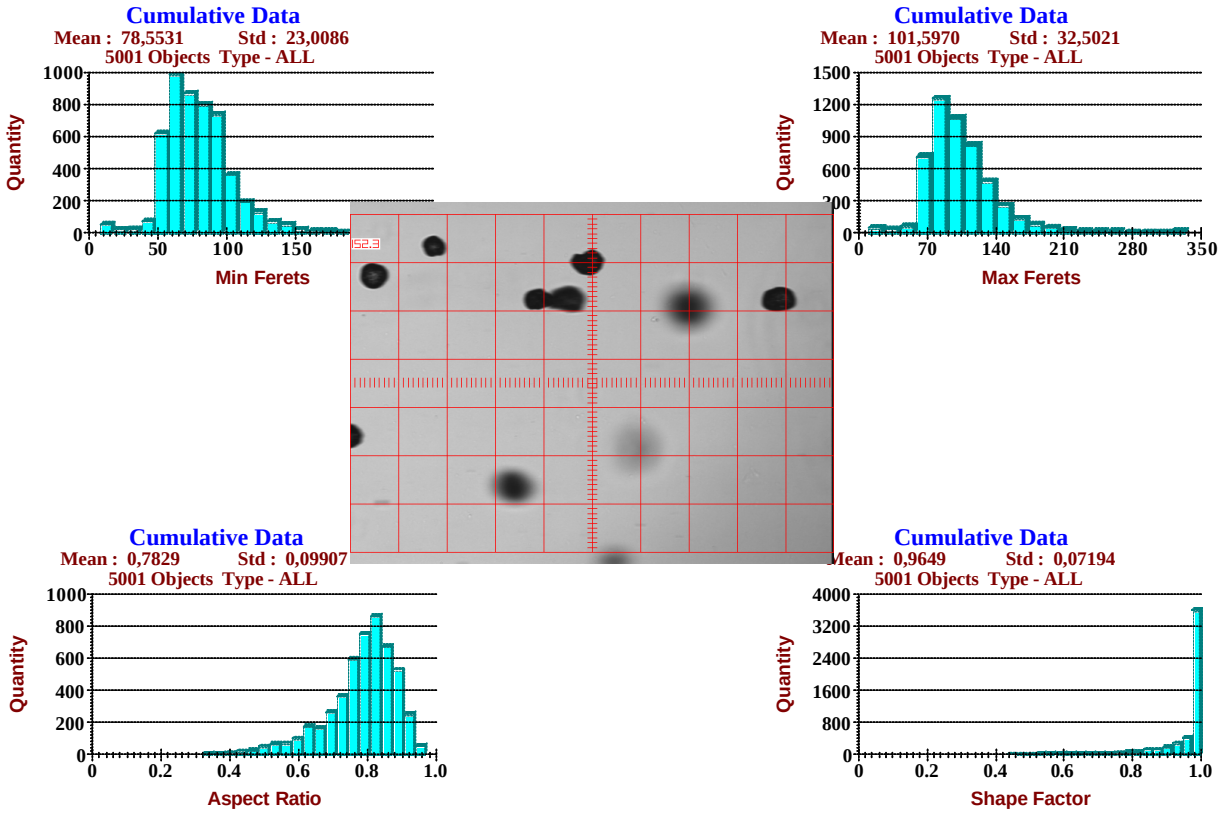



**Figure 2: WSHAPE Data Output**

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## Applications

### Aggregation

Aggregates show up clearly in the particle images and have a different Shape Factor and Aspect Ratio compared to that of the individual particles, providing valuable information about the particulate state of any material.

### Glass beads

With applications from reflective coatings to pharmaceuticals, glass beads are widely used. Quality Control of the final product requires confirmation of the circularity of the material.

### Toners

Toner manufacturers have found that the size and shape of the toner particles influences the performance of the toner. In addition to there being an optimum size, an optimum shape influences the flow properties and charging capability.

Toner manufacturers aim to produce toner particles that are as close to spheres as possible i.e. with a Shape Factor and Aspect Ratio close to 1. Toners with a low Shape Factor (~ 0.6) will result in poor flow properties and a wide variation in electrostatic charging from particle to particle. This is seen as trailing phenomena in the resulting fixed image.

### Abrasive / cutting powders

Characterization of particle size and shape of polishing or grinding materials offers improved quality control of particles used for polishing and cutting. A spherical particle will probably be less abrasive.

Silicon Carbide powders are widely used to slice silicon wafers in the semiconductor industry.

Suppliers and users of these powders had noticed different cutting performance of powders with the same size distribution, one powder allowed faster, coarser cutting but with more surface scratching whilst another material caused slower, thinner cuts with less scratching. By using a combination of both size and shape information both supplier and consumer can optimize their process.



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