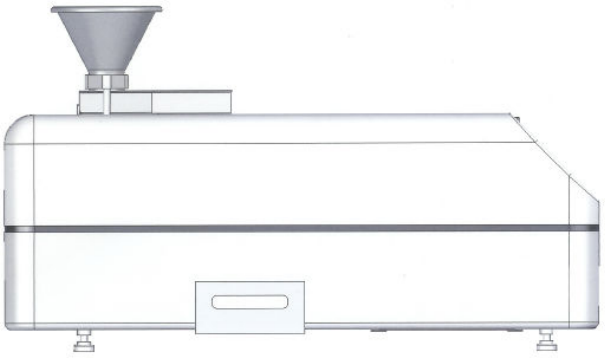
Application Note – Size & Shape Analysis

Microtrac Europe GmbH

Total Solutions in Particle Characterization

S11 – EPS (Expandable Polystyrene Spheres) – by Multi-Image Technology

Measurement System: PartAn 3001L



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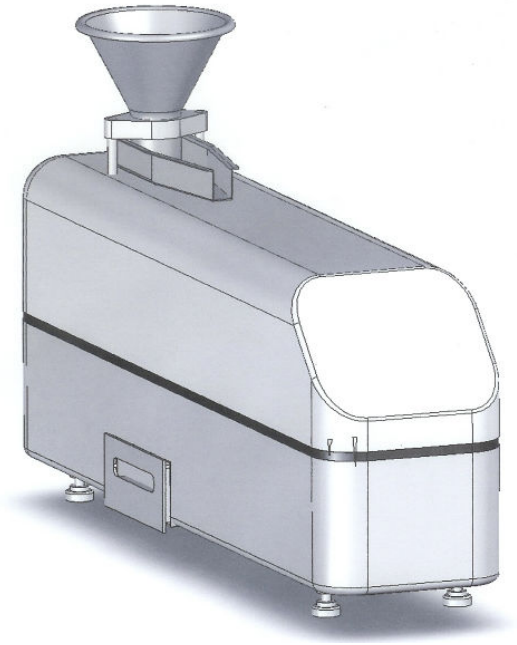
The requirement for quality standards is increasing steadily. In addition to other quality characteristics, such as **particle size distribution**, information on the **particle shape** (length/thickness; flakiness, etc.) is becoming more important when assessing material quality. Current conventional methods of analysis, such as sieving, are time consuming and provide insufficient detailed information.

In cooperation with our customers, AnaTec has advanced the further development of their PartAn System (Particle Analyser) with multi imaging technology. With the new **Multi-Image-System** it is now possible to acquire **much more precise** data on:

Particle size distribution, length-thickness calculation, the flakiness and sphericity of the particles.

With this Multi-Image method a full sample analysis is completed in less than 5 minutes. The raw data evaluation of the Multi-Image method shows excellent correlation to the more traditional, manually performed analysis methods.



This application covers especially the product EPS – expandable polystyrene spheres. The manufactures of EPS products are bound to specific quality requirements. A very important quality requirement is the information on the particle size distribution and the particle shape of the EPS beads. Therefore a frequent – if not continuous - particle analysis is essential to fulfil the specifications.

The PartAn particle analyser allows very accurate measurement of EPS products with a high repeatability and – compared to traditional sieve analysis – within a very short time.

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INTRODUCTION

The PartAn - Particle Size Analyser is an instrument for measuring the size distribution and shape of particles. This version has been built for laboratory use. Samples have to be taken manually from a flow of particles of the desired product and transferred into the instrument feed hopper. The vibration unit ensures a constant particle flow into the measurement area (camera – light source).

The particle analyser uses computer vision technology. An image is captured, stored in the computer where measurement analysis is completed.

Based on this EPS application it implies:

- **Measuring particle size**
- **Measuring particle sphericity**
- **Counting particles**

THE MEASUREMENT / FUNCTION

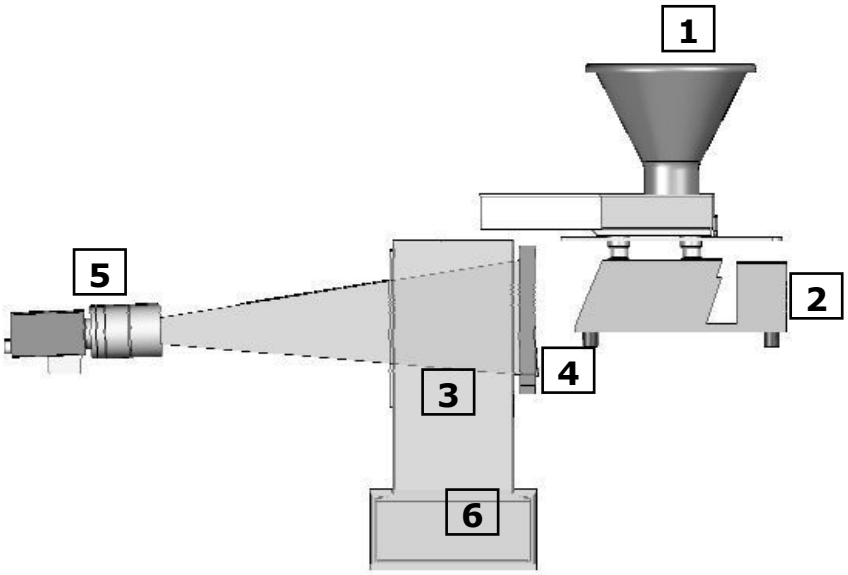


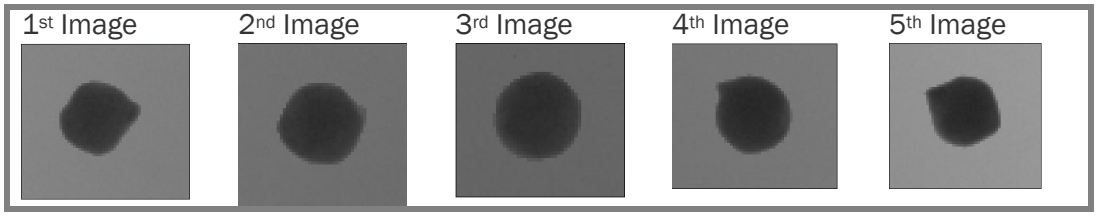
fig.: Sketch/internal structure

The sample material is placed into the hopper (1). The vibrator unit (2) creates a continuous single-layered flow of particles. The particles pass through the measurement area (3) between light source (4) and camera (5). Here the measurement takes place and finally the particles fall into the sample collection box (6).

When the light source emits a flash, the camera records images of the free falling particles and transfers the images to the computer. The images are analysed and calculations are carried out by the PartAn software. The measurement results and particle images are presented on the PCs-monitor in real time.

OPTION – Multi-Image

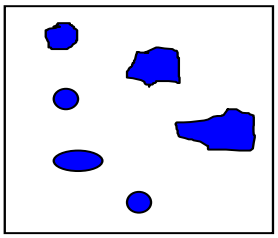
The PartAn 3001L is able to analyse the sample by multi-image mode with up to 170 images per second.
As every single particle is imaged several times and **captured from different angles**, the software is able to calculate very precisely the particle shape and gives much more precise information of the particle size distribution.
The image-sequence below is from the very **same particle**, which was **captured five times** while passing through the measurement area. During the fall it is natural that particles are tumbling. You can clearly see that the particle's shape and size is differing by each of the captured images. Based on this particle information data, the software is able to calculate a much more precise size and shape.



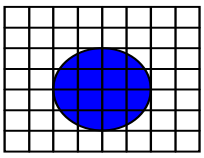
The standard method of digital-image-processing systems captures the particles **once** and calculations will be made on this single set of particle information.
These results can differ, depending on which angle the particle image is captured: round particle (3rd image); more uneven particle (L/T ratio) with 5th image.

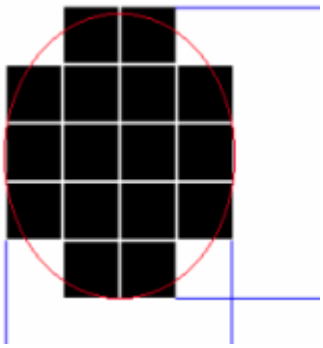
MEASUREMENT PRINCIPLE

The sketch below shows the example of one particle covering several pixels.



Detailaufnahme:





The following values are measured and calculated by:

Area	counts the number of pixels covered by the particle.
Circumference	counts the number of pixels around the particle.
Length	counts the number of pixels of longest dimension of each particle.
Thickness	counts the number of pixels of the thickness dimension of each particle.
Number	counts the number of particles

All other values / results are calculated from these basic values.

RESULTS

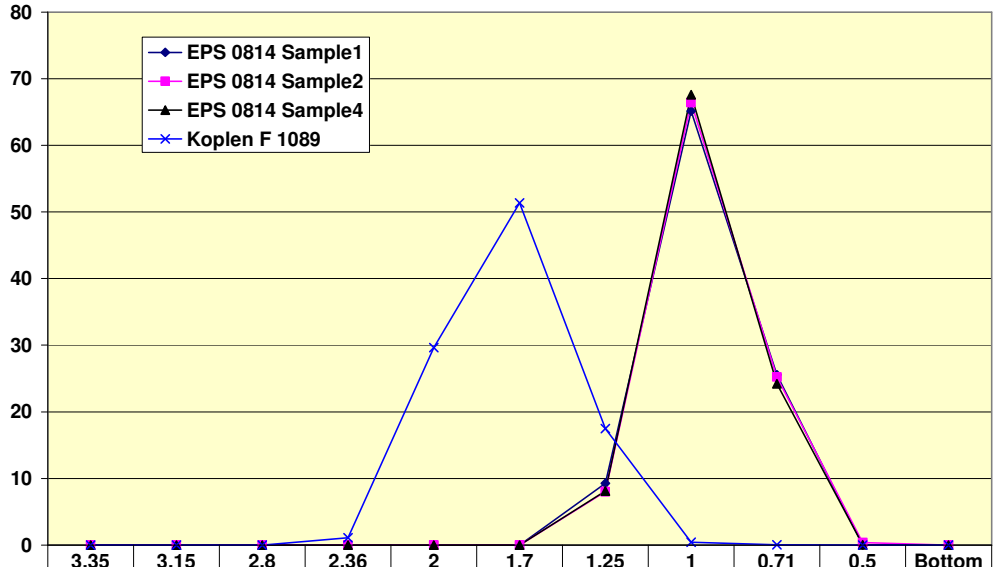
The analysis was done in the multi-imaging mode with 110 images per second.
The scale factor is 46.6 micron per pixel.
Every particle was analysed 5-6 times.
The analysis was done by the thickness of each particle – results based on this calculation showing a good comparison to the standard sieve analysis.

The table below is showing the measurement results of four EPS samples.

Particle size distribution

	Size classes in mm										
Sample name	**3.35**	**3.15**	**2.8**	**2.36**	**2.0**	**1.7**	**1.25**	**1.0**	**0.71**	**0.5**	**Bottom**
EPS 0814 Sample1	**0**	**0**	**0**	**0**	**0**	**0**	**9.28**	**65.14**	**25.57**	**0.01**	**0**
EPS 0814 Sample2	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**66.42**	**25.22**	**0.35**	**0.01**
EPS 0814 Sample4	**0**	**0**	**0**	**0**	**0**	**0**	**8.11**	**67.62**	**24.23**	**0.03**	**0**
Koplen F 1089	**0**	**0**	**0**	**1.11**	**29.66**	**51.32**	**17.45**	**0.42**	**0.03**	**0**	**0**

Particle size distribution by thickness (T) – graphical presentation

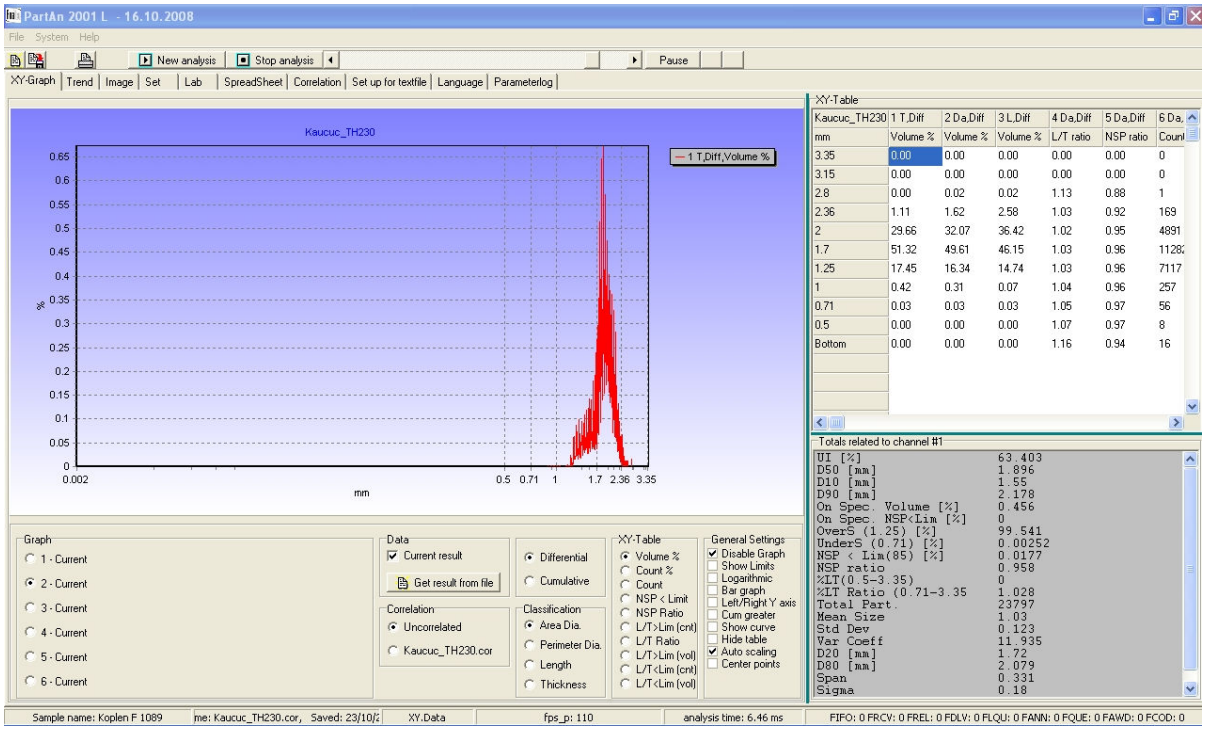


	3.35	3.15	2.8	2.36	2	1.7	1.25	1	0.71	0.5	Bottom
EPS 0814 Sample1	0	0	0	0	0	0	9.28	65.14	25.57	0.01	0
EPS 0814 Sample2	0	0	0	0	0	0	8	66.42	25.22	0.35	0.01
EPS 0814 Sample4	0	0	0	0	0	0	8.11	67.62	24.23	0.03	0
Koplen F 1089	0	0	0	1.11	29.66	51.32	17.45	0.42	0.03	0	0

Shape distribution by L/T = length/thickness and NSP = non spherical particles

L/T ratio											
Fractions used:	**3.35**	**3.15**	**2.8**	**2.36**	**2**	**1.7**	**1.25**	**1**	**0.71**	**0.5**	**Bottom**
EPS 0814 Sample1	0	0	0	0	0	0	1.04	1.04	1.05	1.09	1.19
EPS 0814 Sample2	0	0	0	0	0	0	1.06	1.05	1.06	1.08	1.12
EPS 0814 Sample4	0	0	0	0	0	0	1.06	1.05	1.06	1.09	1.17
Koplen F 1089	0	0	1.13	1.03	1.02	1.03	1.03	1.04	1.05	1.07	1.16
NSP ratio											
Fractions used:	**3.35**	**3.15**	**2.8**	**2.36**	**2**	**1.7**	**1.25**	**1**	**0.71**	**0.5**	**Bottom**
EPS 0814 Sample1	0	0	0	0	0	0	0.94	0.96	0.97	0.81	0.64
EPS 0814 Sample2	0	0	0	0	0	0	0.94	0.96	0.97	0.96	0.94
EPS 0814 Sample4	0	0	0	0	0	0	0.94	0.96	0.96	0.86	0.78
Koplen F 1089	0	0	0.88	0.92	0.95	0.96	0.96	0.96	0.97	0.97	0.94

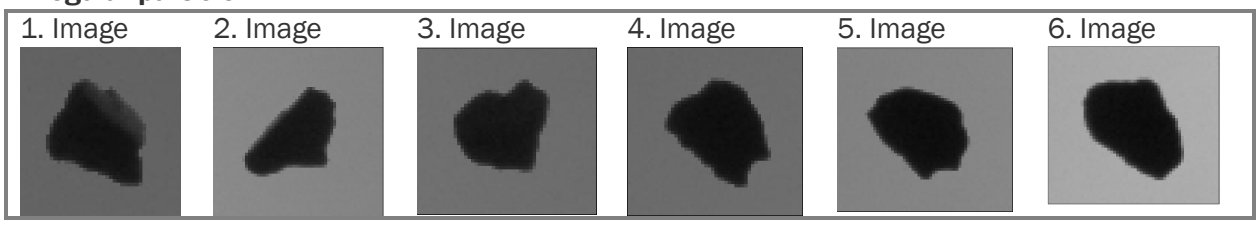
Screenshot of the PartAn Software



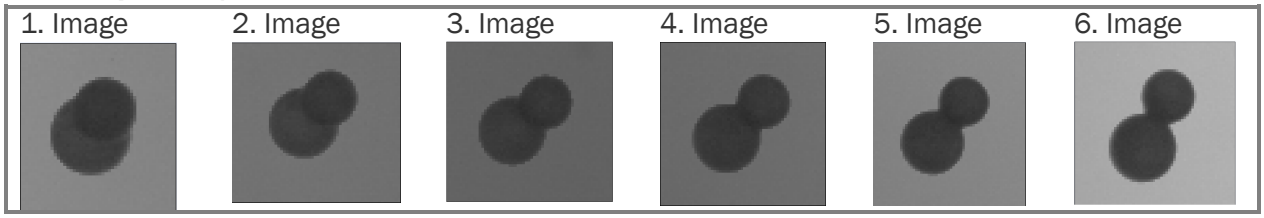
The PartAn software saves every picture of each imaged particle and the user can review the irregular particles after the measurement.

Sequences of different shaped particles; each single particle was captured 5-6 times:

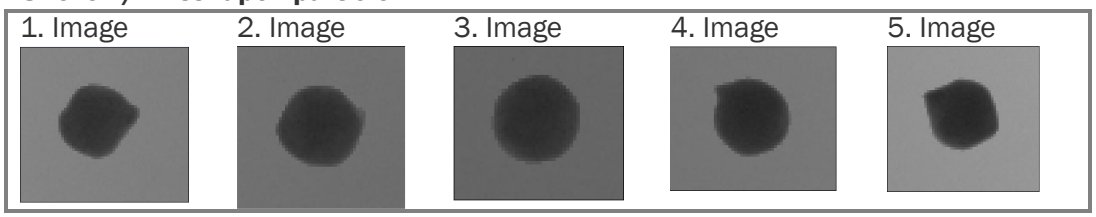
Irregular particle



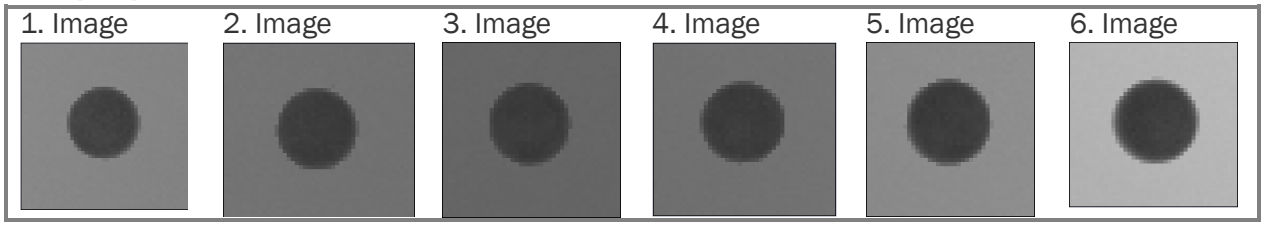
Double particle / Twin



Uneven / misshapen particle



On-spec particle



CONCLUSION

The PartAn 3001 L is able to analyse every particle of the EPS-sample several times and provides the following information:

- much more accurate particle size information
- much more accurate particle shape information
- amount of irregular particles
- filter functions for non round particles
- filter functions for length/thickness
- results very close to sieve analysis without fitting