

S01 - Quality Control of Rice – by Multi-Image Technology

Measurement System: PartAn 3001 L



Together with other characteristics, the quality of rice is dependant to a great extent on the amount of cracked or damaged rice grains.

During mechanical treatment some grain breakage will occur.

The evaluation of the amount of damaged grains is still detected manually. This means that a certain amount of rice grains will be measured and counted by hand which is very time-consuming and not very

effective as only a small sample can be measured.

Due to this, a manual control is only undertaken every hour during the production process. A manual separation of the cracked grains from the intact grains is carried out. The fraction of broken grains is weighted and the percentage of broken grains can be calculated. Some grains must be measured by hand (slide gauge) when it is not quite clear if the grains can be classified as cracked rice or as full grain. The average length of the rice must be predefined to calculate the so-called $\frac{3}{4}$ grain. According to a rice-guideline 50 pieces of full, un-cracked rice grains will be taken randomly from a batch, sorted out and measured manually. The whole procedure takes around 20 minutes.

With the new multi-image technology the PartAn 3001 L allows a quick, reproducible analysis, with absolute values and a high rate of sample throughput. Instead of 100 manually measured rice grains, the PartAn can analyse thousands within a very short time (30 grains per second). All data regarding grain length, $\frac{3}{4}$ grain and cracked rice fraction is available immediately. If needed, the data can be transferred automatically to an external database or to a process control system. Installation as an online-system for continuous process control is also available. AnaTec offers a complete solution from one source, which is the delivery and installation of the analyser as well as the sample systems and sample preparation – all controlled by the PartAn software.

For 23 years AnaTec has developed proven in-depth experience and guarantees a short implementing time as well as links to other process control systems.

The Measurement

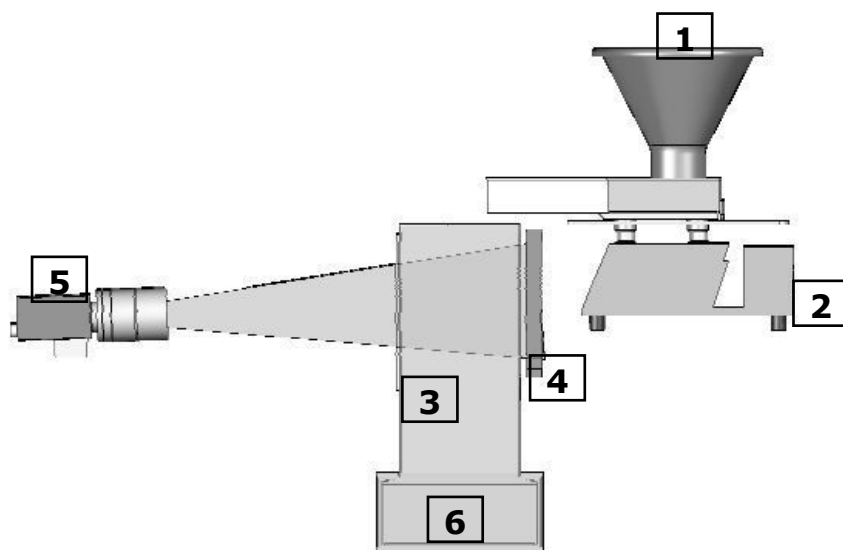
In the laboratory:

A sample is loaded into the funnel (1). The PC-based analyser controls the sample dosing system (2); this guarantees a continuous, single layered particle flow. The particles fall through the measurement zone (3) between the light source (4) and the high-resolution camera (5) where high-contrast silhouettes images are formed.

The light source is controlled by the camera and delivers - due to the very short acquisition time - precise image information for the multiple calculation of each single particle in real time.

The high accuracy of the results requires the imaging and calculation of several hundreds of image frames per second. During the measurement the user can view, in real-time, the development of the results and the particle images on the monitor. The generated raw data can be calculated to the users needs and will be saved as a final result. Another feature allows the storing of single image data or image series, which can be used for documentation and off line analysis.

The measured sample is collected in the container (6).



Multi-Image - Technology

The particles enter the measurement zone with a given motion, when leaving the dosing feeder system turbulent air circulation causes the particles to rotate in free fall.

While passing through the measurement zone multiple images are captured of each particle at different angles with the high-speed camera. The Multi-Image software uses this information from each particle to calculate the precise particle dimensions, particle volume and particle shape - all in real time.

The photo-optical technology used in the AnaTec Partan 3001L allows the system to capture each particle in different orientations. The information from each single-image is the basis for the calculations and analysis. Based on this basic data the results are extremely accurate, as illustrated in the following image series. Conventional photo-optical systems will not display the broken rice fragments to the same accuracy as the AnaTec 3001L system.

Results: Length of rice corn

This analysis was completed with several hundred images per second in Multi-Imaging-Modus. Each single rice grain was captured 7 times and accordingly calculated. The longest circumference of the particle was selected to analyse and classify the particle size.

The following images of the rice grain in free fall are shown clearly and an evaluation of a each grain can differ depending upon which angle the particle image is captured.

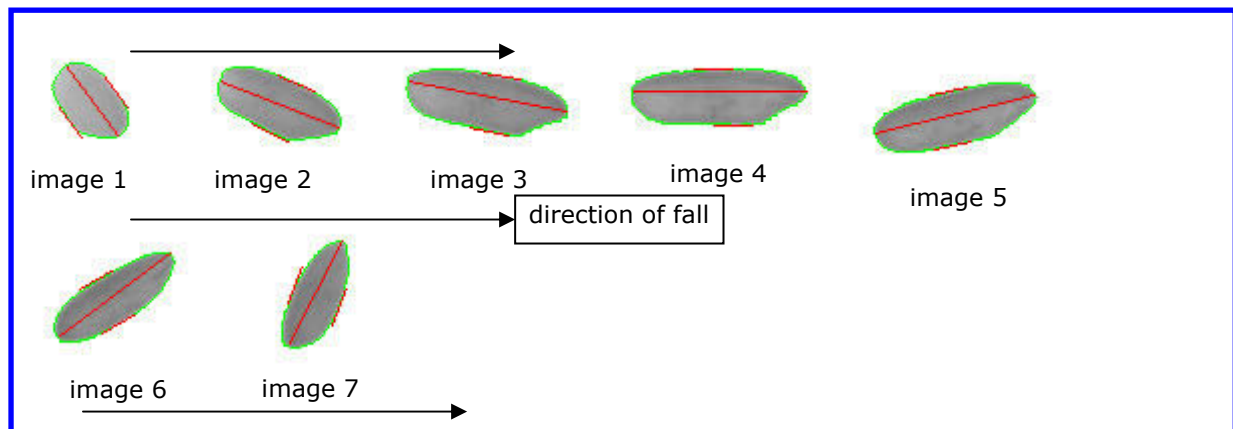


Image 1	Image 2	Image 3	Image 4	Image 5	Image 6	Image 7	Length in mm depending on captured angle
3.39	4.98	6.31	6.80	6.43	5.43	4.58	

Comparative analysis of PartAn 3D results and the results originated from the manual measurement are showing a good correlation of the broken rice fraction (in %).

With a much higher confidence level, the PartAn is detecting the average rice grain length with slightly higher values.

The PartAn 3001L takes approx. 3.5 minutes for a complete analysis of a “100 g-rice sample”; the manually measurement of a “20 g-rice sample” takes about 20 minutes. To simulate a theoretical amount of 100 g, the results of the manual measurement will be multiplied by five. But this procedure involves the risk of a high statistical uncertainty.

The following tables show the results of different rice samples (each sample was analysed 5-times by the PartAn 3001 L).

Greek parboiled 105 g			
measurement	time Min./Sec.	broken rice in %	average length in mm
1	03:41	5.58	6.23
2	03:40	5.51	6.21
3	03:40	5.32	6.23
4	03:42	5.59	6.21
5	03:41	5.5	6.22
manual measurement 20 g	10:00	5.6	6.2

Greek parbolled 220g			
measurement	time Min./Sec.	broken rice in %	average length in mm
1	07:32	3.95	6.24
2	07:39	4.06	6.23
3	07:45	4.07	6.23
4	07:43	3.99	6.24
5	07:33	3.94	6.25
manual measurement 20 g	10:00	4	6.2

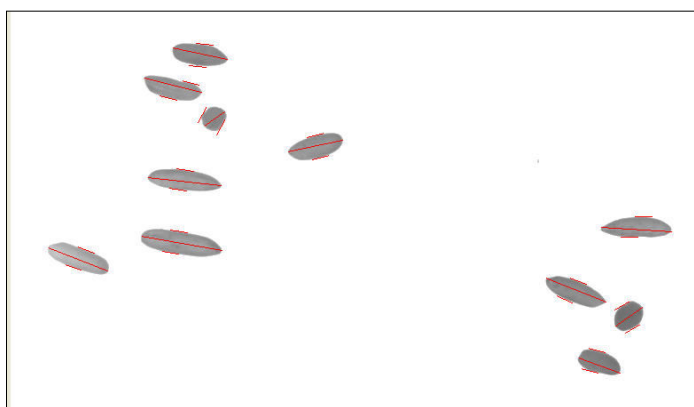
Basmati 102 g				
measurement	time Min./Sec.	broken rice in %	average length in mm	3/4 corn in %
1	04:15	8.66	7.01	5.74
2	04:13	8.6	7.00	5.77
3	04:01	9.38	6.98	5.76
4	04:08	8.78	7.00	5.76
5	04:05	8.86	6.98	5.76
manual measurement 20 g	10:00	8	7.2	5.4

Parbolled 99,5 g				
measurement	time Min./Sec.	broken rice in %	average length in mm	3/4 corn in %
1	03:30	7.02	6.56	5.47
2	03:28	7.07	6.55	5.48
3	03:32	7.25	6.56	5.46
4	03:25	7.08	6.54	5.46
5	03:32	7.18	6.56	5.46
manual measurement 20 g	10:00	7	6.5	4.9

The PartAn 3D results show a very good correlation to the conventional but time consuming manual measurement.

Example: image during the PartAn measurement

The user can view the rice grains during the measurement and obtain a visual impression of the sample. The red marks indicate the length and thickness of the rice grains.



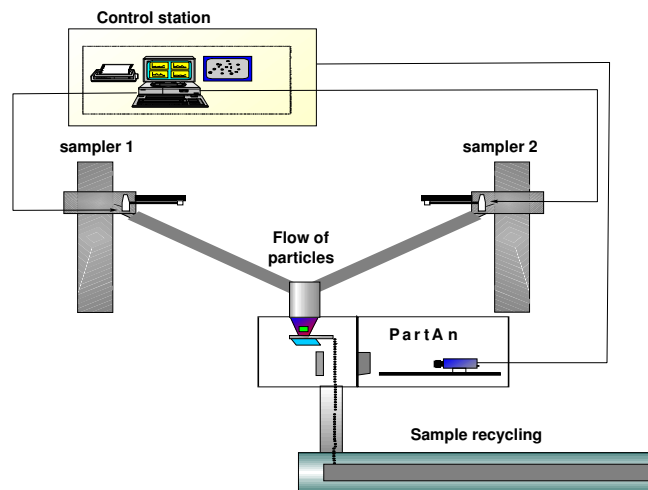
Viewing the sample during the actual measurement is of great advantage if the PartAn system is working online. The data acquisition is user-independent and the process can be observed visually in real-time.

At the end of an online-analysis, all results are transferred to a process control system, where the acquired data is available to control the process.

Each captured particle image frame is saved in a special format by the PartAn software. The image data can be surveyed, compared, saved, printed and transferred.

Layout of an online construction:

AnaTec's modular online concept allows control of several product lines with just one analyser.



Typical PartAn Online Installations



CONCLUSION

The advantages of the PartAn 3001 L Multi-Image:

- Precise particle size information
- Precise particle shape information
- Precise information of particle structure
- Function to filter, sort and classify particles of different shapes
- Length/thickness filter and sorting function
- Physical expedient comparison of results to e.g. sieve results without modulation