# ON-LINE ANALYSIS OF BROAD SIZE DISTRIBUTIONS OF COARSE PARTICLES IN INDUSTRIAL PRACTICE

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Laser diffraction (LD), with reference to the analysis time, is highly advantageous for the automation of particle size analysis. The high measuring frequencies allow a quasi continuous measuring operation. The fineness values obtained from the particle size distribution (PSD) can be transformed into electrical signals for automatic process control. For industrial applications, an IP55 -encapsulated measuring system was developed containing a standard laser diffraction analyser with a measuring range of 0.5/18 - 3500µm. The performance of the system was proven under very hard environmental conditions:

- broad particle size distributions
- long focal distances (TOPMICRON)
- cleaning of the room by waterjet
- industrial environment with
- strong vibrations
- dust explosion proof conditions

The systems had to work 24 hours a day, 7 days a week with only one visual inspection per day.

Keywords: on-line particle size analysis, broad particle size distribution, industrial measurement, IP 55, coarse particle sizing

## INTRODUCTION

Although the reproducibility of LD-instruments[1] is very high[2,3] the stability of coarse measuring systems had to be increased severely. This is especially valid for broad distributions, where the weak signal requires very stable measuring conditions.

For standard LD-instruments the measuring range determines the focal length. Using a single lens, the focal length of that lens determines the housing dimensions. To measure particles up to 3500µm a 2m focal length is required. A 2m long instrument would be very unstable, especially in industrial surrounding. A combination of lenses, called TOPMICRON modules extends the measuring ranges and reduces the housing dimensions simultaneously. This new technique was necessary to make LD fit for use in this size range.

The special optics was an important step but alone not sufficient. The stability of measurements had to be increased with special software: Real-time data pre-processing for TOPMICRON modules improved reproducibility of the calculated particle size distributions. This software is able to suppress erroneous data during the measurement.

The third step was the complete encapsulation of the system which was also needed in dust explosion endangered production areas.

All steps together made it now possible to measure even extreme particle size distributions without any trouble (e.g. brown coal or coarse coffee powder see chapter Results).

**RESULTS**

COARSE COFFEE POWDER

First test of new measuring range must be the reproducibility. Figure 1 demonstrates that there is still a high reproducibility of the calculated particle size distributions even for broad and coarse distributions. The coffee was measured with a dry disperser RODOS and a 10mm injector, pre-acceleration unit and encapsulation of the measuring zone called dry measuring cell.

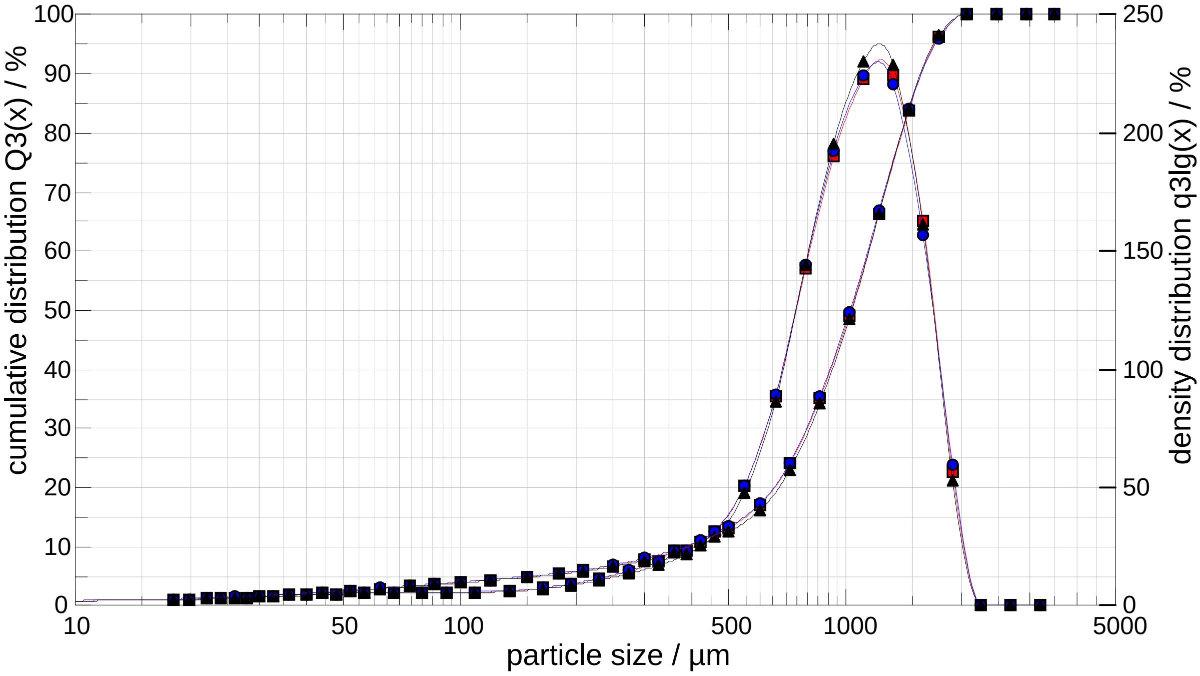


Figure 1: Three measurements of coarse coffee powder

MIXTURE OF POTASSIUM SALT AND GLASS BEADS

A strong test for every particle sizer is the measurement of mixtures. The material used for this test was a mixture of potassium salt and quasi mono-disperse black coloured glass beads shown in the photograph of Figure 2. Figure 3 shows the result demonstrating the excellent resolution and precision of instrument and its optics.

Although dispersing is not so critical in the size range under discussion, a dispersing device must be provided. Dropping the particles through a special shaft with built in impact walls is sufficient. It is also important that the particles must not re-enter the measuring zone, so it is best is to let them fall directly through it. A newly developed measuring zone with an open bottom is able to meet these requirements.

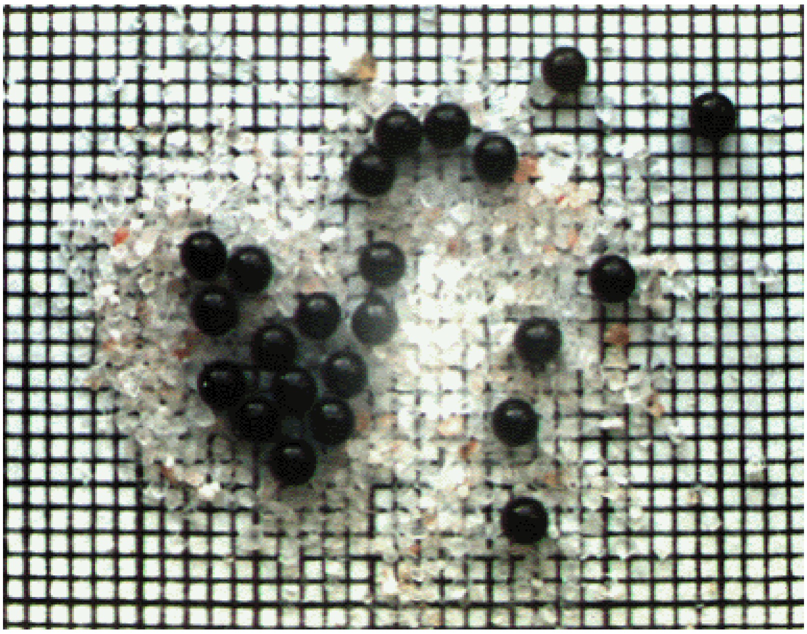

Figure 2: Photograph of a sample of mixture of potassium salt and quasi mono-disperse black coloured glass beads. The grid spacing is 1 mm.

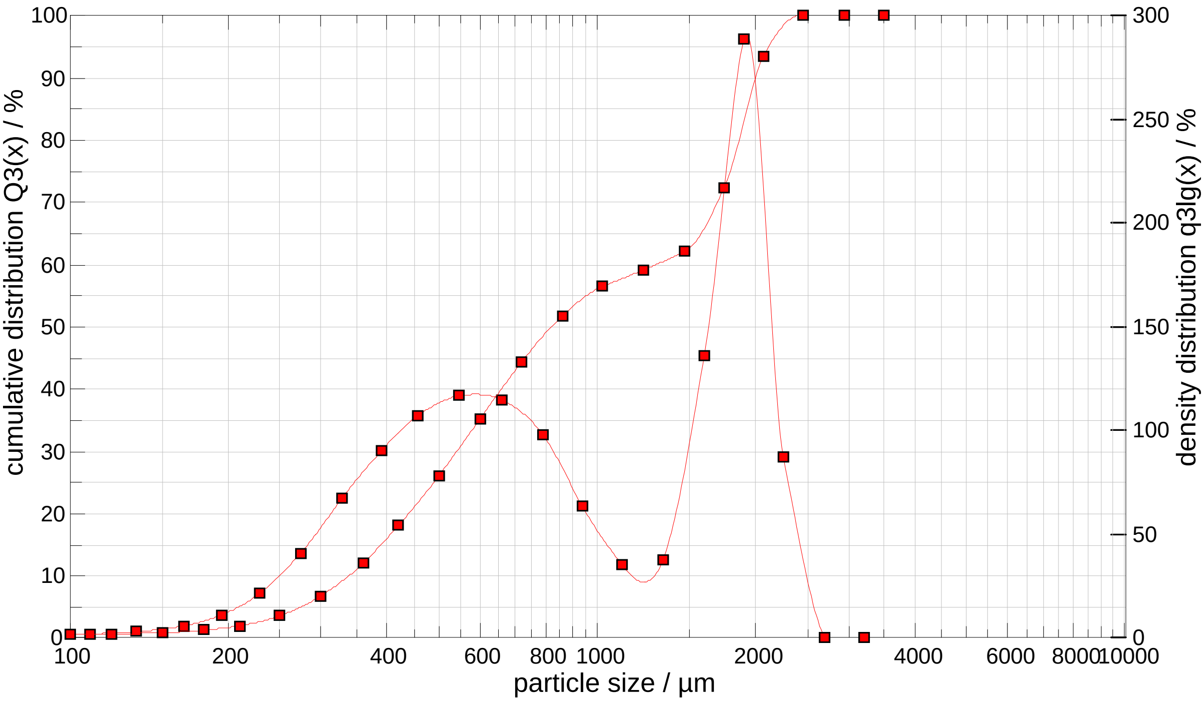


Figure 3: Three measurements with the mixture of potassium salt and quasi mono-disperse black coloured glass beads.

## BROWN COAL POWDER

Even broader than the previously shown coffee was the brown coal photographed in Figure 4. Excellent sample splitting ensures that the reproducibility is still very good as demonstrated in Figure 5. The brown coal needed a dry dispersing system because of its remarkable amount of fines on the sticky product. The production line of this product had to be controlled over 24 hours.

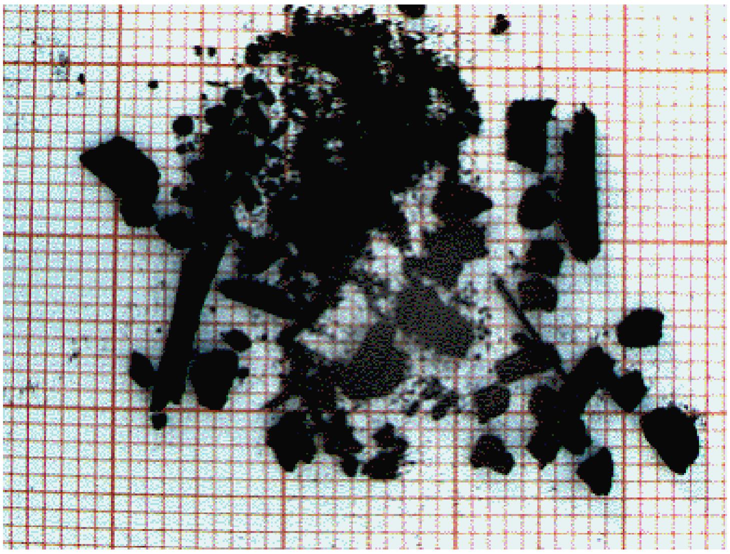

Figure 4: Photograph of the sample of brown coal powder. The grid spacing is 1 mm

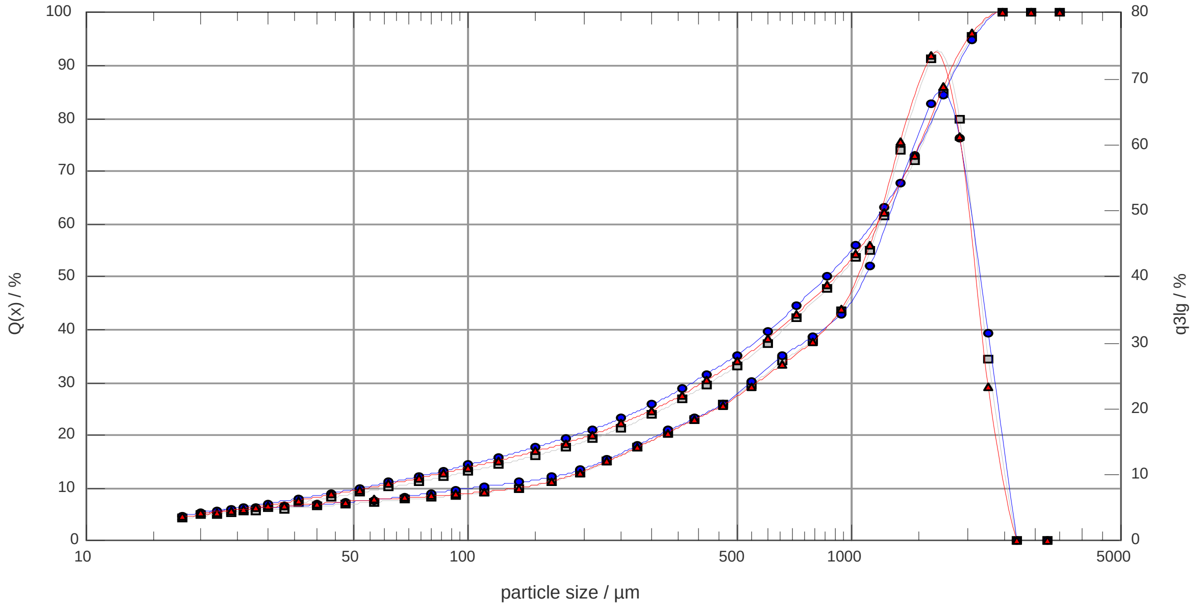


Figure 5: Three measurements of brown coal powder after sieving, mesh width 2.8 mm. measured with dry disperser, 10mm injector, pre-acceleration unit and dry measuring cell.

BROWN COAL ON-LINE APPLICATION

The importance of correct sampling increases with the broadness and the coarseness of the PSD. For the on-line application, a special rotating sample coupler ROPRON[4] was chosen because of its capability to give a continuous and representative sample.

A photograph of the realised plant can be seen in Figure 6. This also demonstrates the very harsh conditions of the installation. The measurement instrument is completely encapsulated by a IP55 housing. This is not only for protection against destruction, although it helps, but also against the hard waterjet which is used every day to clean up the room to protect against dust explosion. This was the only precondition for which it was helpful to install the on-line system within a dust explosion environment.

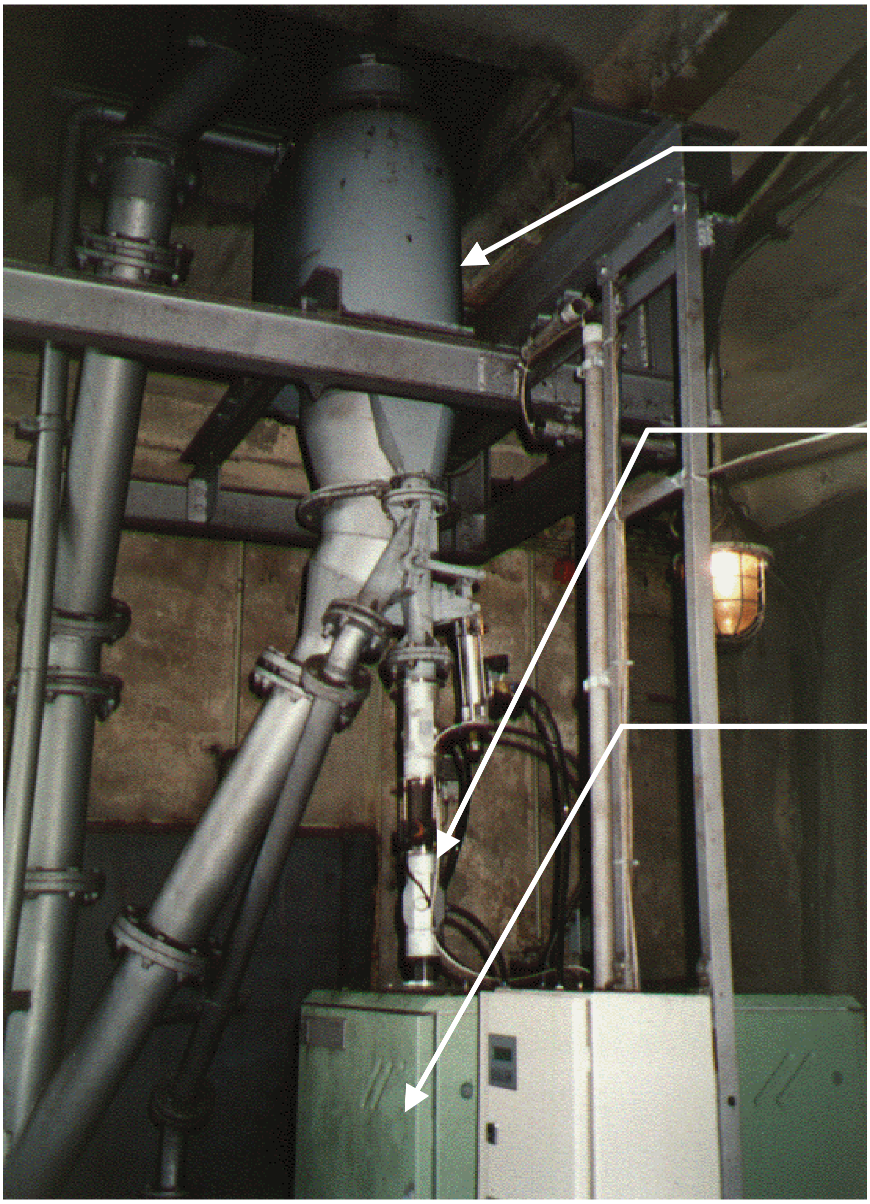


Figure 6: on-line particle-sizing includes automatic sampling

ON-LINE RESULTS

Figure 7 shows the impressive performance of the previously described system over approximately one week. Easy to see are the different stages of production, the fluctuations and the pauses as well. The system was driven completely automatically with only one visual inspection per day.

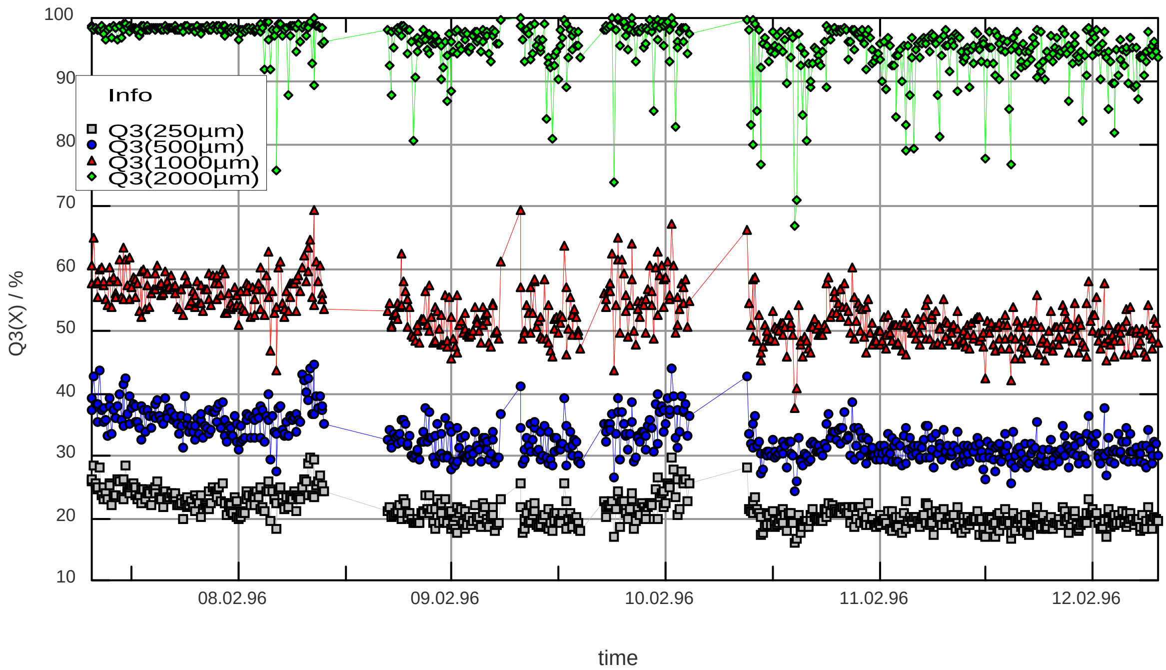


Figure 7: On-line measurements of brown coal over one week; (602 measurements).

## CONCLUSIONS AND OUTLOOK

The stability of measurements was increased by shortening the instrument using special TOPMICRON optics. Together with the new real time data pre-processing software and the complete encapsulation it was possible to get stable reproducible results. This was demonstrated by the results of the on-line system working 24hours under very hard industrial conditions. The influence of disturbances were reduced by the complete encapsulation of the system.

The measurement of even extreme particle size distributions in the measuring range of 0.5/18 - 3500µm are possible without any trouble

The measurement of very coarse particles is normally the standard domain of sieving. The extension of laser diffraction (LD) to a measuring range up to 8750µm was now claimed[5] making use of its advantages of short analysis time and extremely high reproducibility, making it suitable for the automation of particle size analysis.

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