

ON-LINE, REAL-TIME PARTICLE SIZE MEASUREMENT OF MINERALS, CEMENTS

Malvern Instruments has extensive experience in on-line, real-time particle size measurements of Minerals. With over 150 instruments installed world - wide, the EPCS particle size sensor provides a fast, robust measurement device capable of real-time process control.

Major customers in the minerals industries include the following partial list of examples:

- **Cements**
- **Calcium Carbonates**
- **Talcs**
- **Gypsum**
- **Silicates**
- **Phosphates**

The Need for On - Line, Real - Time Particle Size Measurement and Mill Control

For Minerals applications, the majority of added - value is provided by the process system, i.e. raw material costs are low. At the same time, production levels are high (10-200 ton/hr). The economic characteristics of this industry are high capital and energy costs of production. Thus it is important to maximise the efficiency of production.

Continuous size distribution data and dedicated hardware enables automatic process control, minimising the time between process upset detection and correction, which in turn minimises the need for storage and re-blending of high volumes of off-spec production. Increased productivity is the major benefit of EPCS for this industry:

Process Optimisation:

- The first step is to determine the level of plant variability and discover where process improvements can be made, e.g. separator stability, bag house recycle, etc. This step alone can pay back the cost of the EPCS.

Increased Productivity:

- Once production inefficiencies have been diagnosed and corrected, continual size measurement allows maximisation of product throughput, while maintaining basic product size quality. Thus, over-grinding to ensure quality is minimised.



Process Control

- Real-time measurement allows immediate identification and correction of process upsets, resulting in maximum product throughput.
- Frequent measurement (up to once per second) and the elimination of manual sampling and sample transport reduces potential measurement error.

Increased Operator Safety:

- Automatic measurement and remote operator control minimises personnel exposure, increasing safety.
- Robust design requires minimal maintenance and handling by plant operators.

EPCS is hardened for Abrasive Materials:

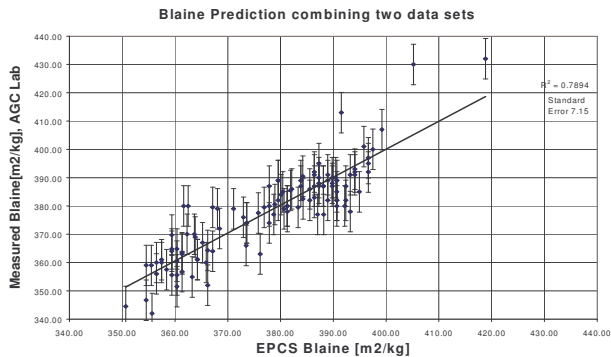
Minerals tend to be abrasive. Minimal equipment maintenance is a requirement for reliable operation. EPCS has been designed for long-life and ease-of-use.

- Ceramic liners (and long life) for all wear parts.
- Rugged enclosure for Optics and Electronics withstands vibration and high temperatures.
- Minimal maintenance for window cleaning; 15 minutes per month.

Cement Industry Measurements:

The cement industry has been using the Blaine number (cm^2/gm) as an industry standard for predicting ultimate strength for decades. Its capabilities and deficiencies are well known.

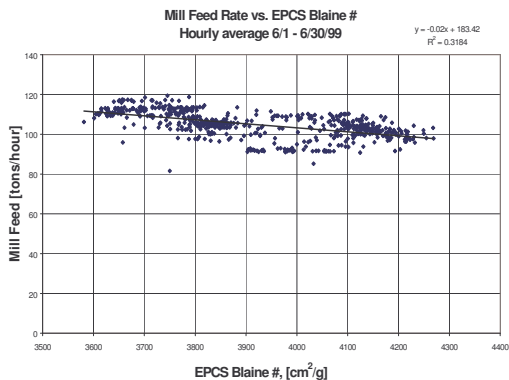
The EPCS measures the specific surface area (SSA) (m^2/m^3) in conjunction with the size distribution. The figure below shows a comparison between the EPCS SSA and the traditional Blaine number measured by pressure drop.



The error bars represent 1.8 % RMS errors for the standard Blaine method. The statistical correlation with EPCS is well within these error bars.

Operation with continuous feedback control using the EPCS reduces the standard deviation to less than 1%, almost halving the uncertainty of the traditional Blaine measurement. This allows one to reduce the Blaine number requirement, which improves productivity by 2% for every 100 cm^2/gm decrease in SSA or Blaine as shown in the Figure below.

Higher Blaine numbers require more grinding time, which requires a reduction in the mill feed-rate. For this application it was determined that the strength requirements could be met with Blaine number values 250 units smaller, so that the production rate could increase by 5%!



If you would like to learn more, request the following published papers from your Malvern Representative: **Malcolmson, A.P., Holve, D.J., "In-Line Particle Size Measurements for Cement and other Abrasive Process environments"**, IEEE/PCA 40th Cement Industry Technical Conference, May, 1998, Rapid City, S.D. Also see **Jensen, S., Holve, D., "In-Process Particle Size Measurements for Diagnosis, Optimization, and Control"** Paper presented at Eng. Foun. Conf., CONTROL OF

PARTICULATE PROCESSES VI, Sept. 19-24, 1999, Queensland, Australia.

Calculating ROI for EPCS

Malvern Instrument's EPCS is proven to reduce batch transition times and off-spec production through automatic, real-time feedback for process control. Malvern Instruments has developed a ROI calculator for the EPCS system (available from your local representative). Using average industrial estimates, EPCS can be expected to provide (through productivity increase and reduced measurement costs) a 5-10% increase in profit per year, as follows:

Productivity Improvements:

Steady State Improvements: 3%

Continuous measurement allows process optimisation including maintenance of optimum feed-rates and mill speeds, maximising production rates, and reduction of "insurance" over-grinding to meet basic specs.

Reduced Batch Start-up Time: 1%

Real-time measurement allows immediate line control, minimising costly time to steady-state production.

Reduced Process Upsets: 1%

Continuous measurement and real-time process control identifies and corrects for upsets as they happen, reducing off-spec production.

Using the ROI calculations for EPCS, this 5% increase in line productivity can generate a 10% increase in bottom-line profit. For many Cement producers, this equates to a 3 month ROI, and \$400,000/year additional profit. Contact a Malvern Representative to estimate your own ROI using your own numbers for capital equipment, labour, and energy costs.