



S O L U T I O N S



TONERS

ON-LINE PARTICLE SIZING SOLUTIONS

APPLICATIONS

Dry Milling

Dry Classification

Wet Polymerization

ANALYZER SYSTEMS

Insitec T

Insitec L

Voyager

Parsum

"Our Insitec instruments have contributed to saving over a hundred thousand US dollars per year in operation costs"

Dr Tom McHugh, Managing Director,
NexPress Solutions Ltd.

WWW.MALPS.COM



WHY RUN BLIND?

REAL-TIME YIELD MONITORING

Falling world toner prices and an intensely competitive market are making improved product quality and process efficiency critical targets for toner manufacturers. Particle size is a key product property for toners as it directly affects toner performance at the printer head. On-line particle size analysis can lead to improvements in product quality and can additionally deliver variable cost benefits. Malvern has extensive experience in developing and supplying on-line particle size analysis solutions which allow manufacturers to quickly and easily identify ways to improve process operation. The widespread industrial usage of Malvern's instruments is testament to their industrial robustness, relevance and usefulness.

Particulate systems can be monitored and controlled using a range of Malvern solutions (see figure 3).



The Importance of Particle Size

- Toner particle size affects not only the resolution of the final image but the overall handling and performance of the product
- When laser printers were first introduced toner particles were on average 12 μm in diameter. To achieve the current standard of 600 dpi, particles around 8 μm in diameter are required. The trend is towards smaller particles with narrower particle size distribution
- Particle size distribution is key as larger particles can result in blockages and very fine particles adhere to the print head surface
- Traditionally particle size has been monitored using an off-line, electrozone counting method. This approach is associated with inaccuracies and time delays which directly impact on the effectiveness of process control

Malvern Insitec

An integrated solution for on-line analysis

The Insitec system has been specifically developed for industrial use. It uses a laser light scattering technique to rapidly generate complete particle size distribution data and requires no calibration. System reliability is extremely high and maintenance requirements are minimal. Dust and vibration do not affect operation. Hygienic fittings ensure that complete cleaning can easily be carried out between production campaigns. Different versions of the Insitec are available for either wet or dry applications making the technology suitable for most toner production facilities.

Malvern's solutions-based approach extends to the provision of proven, automated sampling systems. The Jetstream eductor is designed to extract a representative sample from dry process flows of up to 50 t/hr. The Gulfstream eductor performs a similar function for wet applications. In-line dry and wet flow cells are also available for dilute process streams. All

sampling systems are tailored to the individual application.

Two software packages, Malvern Link and RTSizer, ensure that the data measured by the analyzer can be effectively used in the manufacturing environment. These packages generate data in the required form, control the sampling/analysis and integrate the system with existing process control platforms. Once again the system is individually tailored to a specific application allowing the parameters of most interest to the user to be reported.

Insitec is the ideal instrument for measuring intermediate and final grade toner for dry milling and classification unit operations, and also in liquid-based chemically produced toner. By combining the output of two or more instruments in the same line at different points in the process, real-time unit operation efficiencies can be monitored.

Malvern Parsum

Parsum probes use spatial filter velocimetry, a counting technique that is used to characterize process streams containing coarse particles. This analyzer has the advantage of a very simple installation, as it is an in-line probe requiring minimal installation work. The probe delivers a chord-length distribution useful in monitoring feeds to mills, dry mills and classifiers. Parsum has a range of measurement zone interfaces which allow it to be tailored to the requirements of the process stream, and an intrinsically safe version is also available. Real-time data transfer to the process control system is possible using 4 - 20 mA current loops.

The Benefits of On-line Analysis

Meeting the challenges facing toner manufacturers

The rich flow of particle size data that results from the installation of an Insitec system allows toner manufacturers to more closely monitor product quality, tighten process control and improve process knowledge. The quality of data produced not only allows the effectiveness of manual process control to be significantly increased but also opens up a route to fully automated control. On-line analysis allows manufacturers to optimize their processes in two distinct ways:





One shot optimization

- Options for hardware and operational improvements are identified. Clients have reported re-specifying classifier motors, altering mill nozzles and optimizing purge air flows as a result of on-line particle size analysis
- Previously unrecognized links between process variables are observed or discovered. This can lead directly to improved manual or automated control

Real-time optimization

- Periods of transient operation are more tightly controlled since the result of any intervention is immediately obvious
- Mill/classifier variables can be optimized whilst keeping the product within specification, thereby reducing waste and facilitating automated control
- Process upsets can be easily identified and corrective action taken in a timely manner

Multiple analyzers additionally allow real-time yield to be estimated offering further scope for optimization.

The impact of on-line analysis on product quality can also be marked. Typically particle size distribution is tightened leading to improved toner performance, and batch-to-batch variation is reduced. The following examples illustrate the benefits achieved by toner manufacturers using the Insitac system.



Transient Operation

Cutting mill start-up times

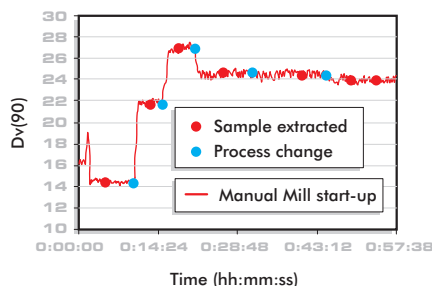


Figure 1: Off-line size analysis used to start-up mill

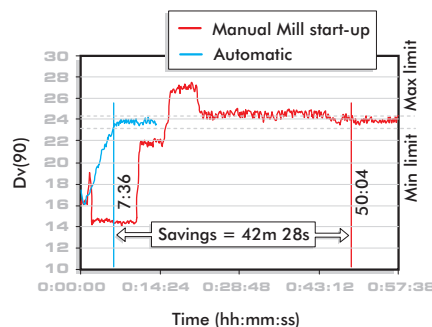


Figure 2: Comparison of analysis techniques at mill start-up

Figure 1 shows mill start-up under manual control at a toner site. During start-up an iterative procedure is followed in which action is taken, the mill is allowed to steady, a sample is removed and analyzed to determine the results of the action, and then further action is taken. The time delay is evident. It takes around 50 minutes to reach the required steady state. Figure 2 shows the same mill proceeding to steady state using on-line analysis. In this case there

is no time delay. The desired particle size is achieved as quickly as the processing equipment will allow. The saving in time is around 42 minutes. The time saving is obviously valuable and additional savings in the form of reduced waste and energy consumption further enhance the benefit obtained.

Improved Process Knowledge

Data mining using on-line particle size analysis

Whilst the installation of on-line analysis frequently allows simple correlations to be easily observed it also allows more complex data analysis techniques to be exploited. At the Nexpress toner production facility, data generated using an Insitac analyzer has been used in a data mining exercise designed to highlight ways to tighten particle size distribution, maximize yield, minimize specific energy usage and maximize throughput. Data mining is a technique designed to abstract relationships between variables from large databases.

Findings from the study highlighted the factors resulting in differing performance between the lines and validated the general control philosophy used at the site. In addition the study showed that parameters previously thought to be relatively unimportant could in fact have a marked impact on plant performance and energy usage. The study allowed the relationships between different variables to be quantified and as a result the quality of information available to operating staff making process changes has been significantly enhanced.

Overall Nexpress has estimated that the improvements in yield, energy use, and throughput, identified as a result of the study will reduce operating costs by around \$200,000 per year. In addition to these variable cost gains Nexpress has also tightened particle size distribution thereby improving product quality.





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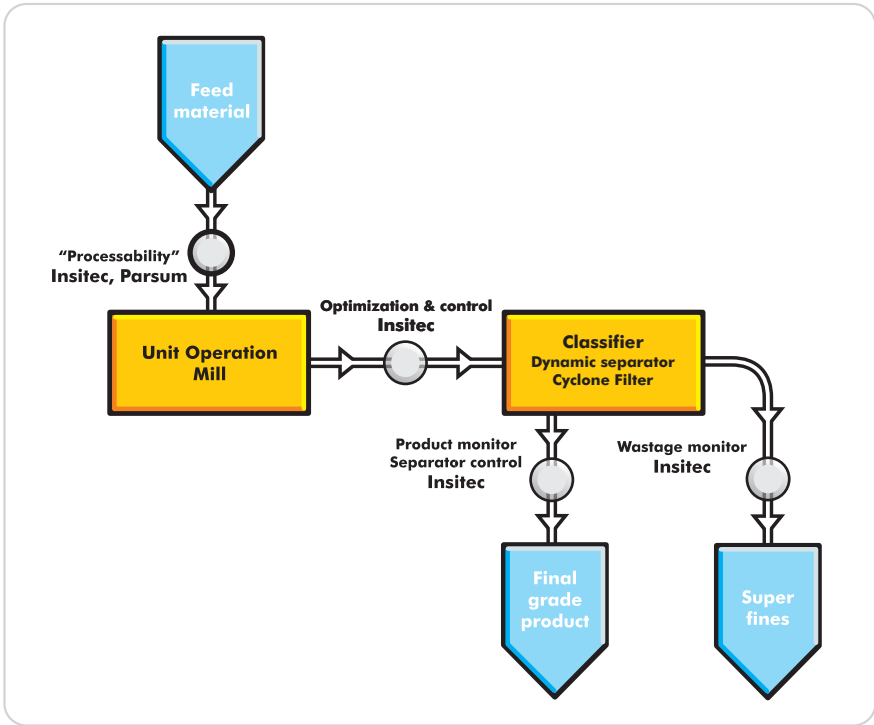
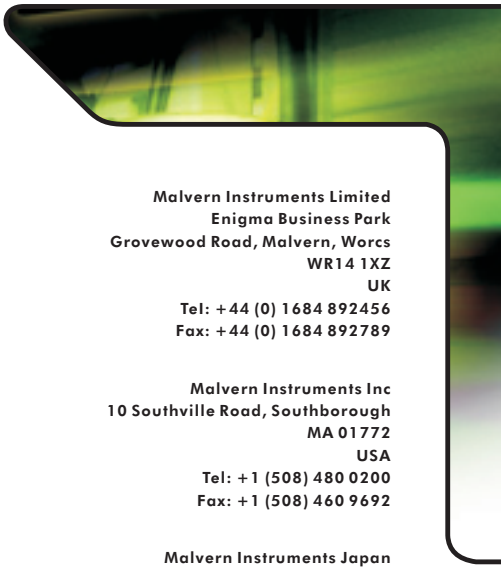


Figure 3: Generalized dry toner milling flow diagram showing analyzer locations and function.

Process stream	Particle size range	Analyzer	Process interface
Dry powders	0.5 - 1000 μm	Insittec	Jetstream eductor
Wet suspension	0.5 - 1000 μm	Insittec	Gulfstream multistage diluter
Dry powders	50 - 3500 μm	Parsum	In-line probe



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