



S Y S T E M S



# PARSUM IN-LINE PARTICLE SIZERS

PROCESS PROBES FOR DRY POWDER STREAMS

## APPLICATIONS

Granulators  
Spray-Driers  
Fluidized Beds  
Pharmaceuticals  
Detergents

"The Parsum probe gives a better quality and a better process, which means for us less off-spec material. It makes for a more stable process"

Armin Reimann, production manager at Stockhausen GmbH Germany (in PBE International, 05/2002)

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PROCESS SYSTEMS  
WHY RUN BLIND?



# REAL-TIME SIZING UP TO 5000 μm

Being able to measure powders *in situ* and in real time enables the informed decision making necessary to understand, control and improve processing. Malvern's Parsum Probe uses the established technique of Spatial Filter Velocimetry to make size and velocity measurements of gravity-fed or pneumatically flowing particles from 50-5000 μm, directly in the process line.



## Rugged Industrial Solution

Parsum is small compact and robust. IP65 dustproof and waterproof, and with an intrinsically safe option available, it is suitable for any industrial environment - and is already proven in a wide range of processing applications. Weighing just 1.5 kg, the probe is easily installed directly in the process line, eliminating the need for sampling. Complementing Malvern's Insitac range of on-line particle size analyzers, Parsum is designed primarily for dry processes at particle concentrations of below 120,000 ppm (volume). A range of accessories extends its use into high concentration.

Parsum can be integrated into new or existing process facilities to provide real-time analysis for full feedback control.

## Measurement Principle

Parsum uses the technique of Spatial Filter Velocimetry to measure particles. The sensor works on a fiber optic patented measurement principle and simultaneously measures the size and velocity of individual particles. Statistical techniques associated with the technique allow calculation of chord length

distributions. It requires no calibration, allows constant measurement with no time gaps in the data, and does not assume that particles are spherical.

### Spatial Filter Velocimetry

Using Spatial Filter Velocimetry, size and velocity can be extracted from particles as they pass through a laser beam and cast shadows on to a linear array of optical fibers (see figure 1).

A burst signal is generated due to the particle crossing fiber bundles labelled "burst a" and "burst b". The frequency of this signal is measured by photodetectors and is proportional to the particle velocity  $v$ . Knowing the spatial filter constant  $g$ , the velocity  $v$  can be calculated. As the particle passes through the beam, a secondary "pulse" signal is generated by a single optical fiber. Knowing the time  $t$  of the pulse signal, and the velocity  $v$  of the moving particle, the chord length  $x$  of the particle can be calculated.

By accumulating results from individual particles (typically 3000-10,000 particles over a period of 30-120 seconds), the chord length and velocity distributions are calculated. Parameters derived from the chord length distribution eg  $X(10)$ ,  $X(50)$  and  $X(90)$ , can be correlated against other particle size analyzer results.

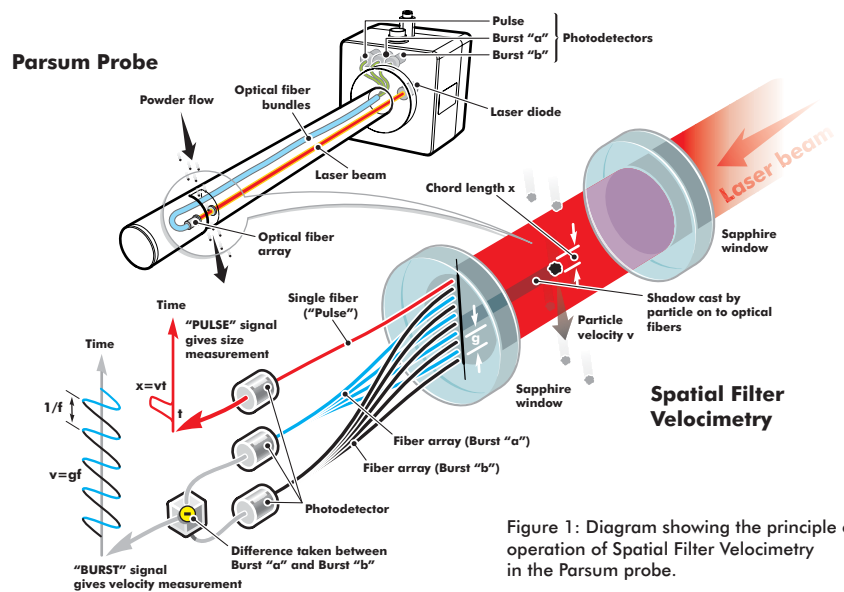
## Parsum Systems

A choice of three Parsum In-line Particle Probes (IPP) allows the system to be matched to individual processing conditions.

### IPP 50

The standard unit for larger particles and all types of granulates

- Real-time sensor
- Measures particles with average size 50 - 5000 μm and velocity 0.01 to 20 m/s
- Easily installed directly into gravity-fed or pneumatic lines
- Automatic feedback to central control room or computer
- Minimal installation effort
- No alignment required
- No field calibration needed
- Strong stainless steel construction
- Window cleaning eliminated





- Real-time data link to process control systems using 4 - 20 mA outputs

#### IPP 50-S

For more concentrated systems and materials that are cohesive and require dispersion

The IPP 50-S has all the features of the IPP 50 and covers the same measuring range, but additionally includes a compressed air supply. This allows its use in specific processes to prevent fouling of the optics and where materials require dispersion to break up agglomerates. It is also the system of choice for sticky or wetter materials.

#### IPP 50-SE

An intrinsically safe unit with a low power output that enables its use in hazardous environments



The IPP 50-SE can measure in process lines with a rating of Ex-Zones 0 and 20 (according to ATEX 100). It is distinguished from the IPP 50 and 50-S by its low power input, through which the ignition safety type "intrinsic safety ib" is achieved. A range of flow cells are available to further tailor the installation to the specific process conditions.



#### Case Study Stockhausen GmbH

At Stockhausen GmbH, data generated using a Parsum system have been used to improve both process control and product quality. At this plant, which belongs to the Performance Chemicals division of Degussa AG, hydrophilic polymers known as superabsorbents are manufactured for use in products such as diapers. A stable product particle size distribution is a key requirement since variability can impact adversely on feeding and dosing systems.

Superabsorbent with the required properties is manufactured by drying, milling and sieving a polymer gel produced by polymerization of an acrylic acid monomer solution. Early attempts by the company to improve particle size analysis at the facility proved unsuccessful, as a result of difficulties in obtaining a representative sample, but after impressive Off-line trials with a Parsum probe, an In-line system was purchased in April 2000. A second probe was installed a year later on an identical line nearby. A particular attraction of the Parsum was the in-line nature of the analyzer, negating any requirement for sampling.

The in-line systems have been installed in pipes beneath the sieves to monitor particle size distribution of the product. Any drift in product particle size is now observed immediately and appropriate changes to the milling process are made. Damage to the sieves such as screen breaks is also rapidly detected. In general, process operation is much smoother and the amount of off-spec material produced has been

decreased. The Parsum has needed no maintenance since its installation and it has not been necessary to switch back to the previously used analysis schedules at any time. Final product quality has also been improved.

#### Case Study Granulation monitoring

Two Parsum probes were installed at a chemical plant in Germany. One probe was inserted into the process line directly after the fluid bed granulator. It was installed in a gravity line to measure the pre-product while the other probe was installed after the coating process to measure the final product. The company measures the Dv 10, 50 and 90 and sends the feedback signal to their control room. The data are essential in helping to control their granulation process granules which are used in detergent manufacture.

Figure 2 compares the in-line continuous measurement of the Parsum probe to an off-line manual sieve analysis. A sieve analysis was done every two hours to control the entire process, while the Parsum sends data to the operators in their control room continuously in real time. There is a strong correlation between the two methods, but the Parsum results show the more erratic nature of the particle size, since the time between measurements is much smaller. Using the Parsum data, the operator can adjust the granulation process control more often to produce much less particle size variation in the pre-carbonate granules than would be possible by sieve analysis alone.

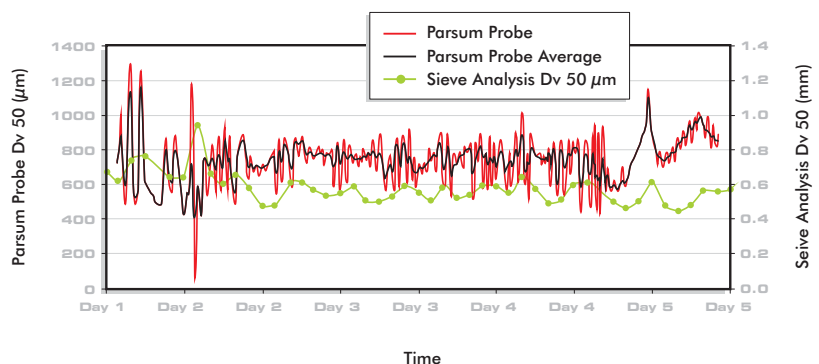


Figure 2: Comparison of Dv (50) time history for real-time Parsum probe with off-line sieving.





## Specifications

<b>Probes</b>	IPP50 Standard IPP50-S Same as IPP50 with air purge on measurement window IPP50-SE Same as IPP50-S with Intrinsic Safety
<b>Sensor</b>	Applies an extended fiber optic local filter method (Spatial Filter Velocimetry)
<b>Installation</b>	Inserted directly into process line. Usually retrofitted easily in pipes, vessels and reactors
<b>Process Interface Kit</b>	Range of flowcells Weld stub to be installed on process line Feed-thru piece to hold probe Tri-clamp to hold probe to feed-thru piece
<b>Cables</b>	50 m supplied with system (maximum cable length depends on particle velocity)
<b>Site Requirements</b>	Installation location to be specified following consultation with Malvern Process Specialist Installation of support stub in process line Conduit laid for cables to computer and control room Minimum 120V AC 5 amp power supply
<b>Software/Hardware</b>	In-line Particle Probe Software v 5.x NI 5102 A/D Converter card Field mounted computer with MS-Windows 2000 and XP
<b>Feedback Control Options</b>	PCI 6308A D/A Converter Card (4 - 20 mA outputs) RS485 Interface card
<b>Measurement range</b>	Particle Size 50 - 5000 $\mu\text{m}$ Velocity 0.01 - 20 m/s
<b>Materials</b>	316L SS for In-line probe Sapphire, epoxy resin optics Pressure-cast aluminium for electronics enclosure
<b>Concentration</b>	200 - 120,000 ppm volume content depending on particle size and velocity
<b>Data rate</b>	Up to 1000 Hz, dependent on process conditions
<b>Max Operating Pressure</b>	4 bar
<b>Operating Temp</b>	-20°C to 85°C at measuring point -10°C to 60°C on probe housing
<b>Industrial Protection</b>	IP65 (probe)
<b>Max number of Instruments/PC</b>	4
<b>Dimensions</b>	Tube length = 280 mm (11 in) Tube diameter = 25 mm (1 in)
<b>Weight</b>	1.5 kg approx
<b>Air Supply (IPP50-S and IPP50-SE only)</b>	2 adjustable air flow meters Pulse flow with adjustable timer or continuous air flow Requires dust-free instrument grade compressed air (max flow 20 l/min)
<b>Intrinsic Safety (IPP50-SE only)</b>	The IPP50-SE is intrinsically safe Explosion Group Class IIB Temperature Class T4 with temp range - 20°C to 40°C Casing protection Ip65 Probe installed direct into process line with measurement computer outside of classified zone



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