Technologie-orientierte Partikel-, Analysen- und Sensortechnik
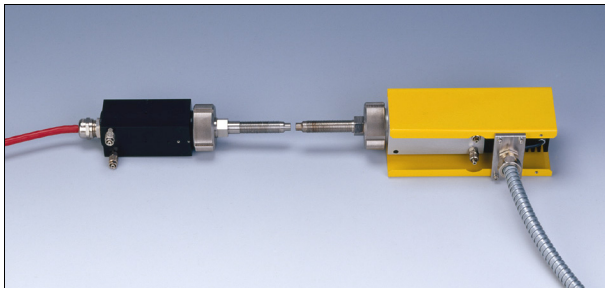
| Polymer Melt Particle Sensor | PMP 694 |

Polymer Melt Particle Sensor PMP 694

The Polymer Melt Particle Sensors of series PMP 694 have been developed for online and inline monitoring of particle situation as well as for performing purity analysis with high sensitivity and resolution.
With single particle counting a common method is used and applied to a new demanding measuring task in industrial environment, especially polymer processing.

Measuring Method

Particle sizing methods based on single particle counting classify a physically measurable quantity according to particle size independently and under no assumptions. Such methods provide high sensibility and accuracy combined with very quick response of a particle system analysis.
Single particle detecting sensors of series PMP base on light extinction method and have been especially developed for measurements under industrial conditions in flowing transparent polymer melts or similar fluids. Process conditions are characterised by temperatures up to 290°C, pressures up to 150 bar and high viscous materials.
The Polymer Melt Particle Sensors can easily and directly be adapted to extruders and other machines via common screw threads (½"- 20UNF) by means of screw in adapters.

Special Advantages

- Online measuring method
- Fast, touch free optical measuring method
- Low dependency on particle material
- Measurements under extreme conditions (up to 290°C and 150bar) direct in flowing, transparent melts
- Standard sensor port ½"-20UNF, other dimensions on customer request
- Can be adapted to different extruders and polymer processing machines
- Robust Industrial design
- User-friendly Windows compatible control software PMPWin

Applications

- Measurement of particle sizes as well as concentrations in transparent fluids
- Monitoring of production processes
- Continuous pureness analysis (gas bubbles, fish eyes, black specks, …)
- Detection of homogeneity fluctuations
- Determination of optimal extruder configuration or extrusion conditions
- Reception and outgoing control
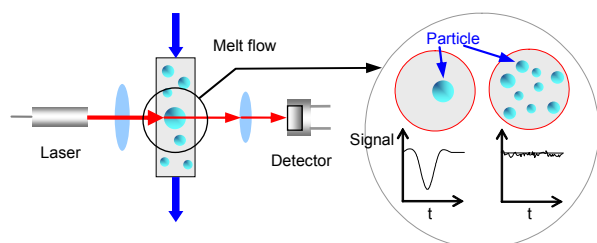
Optical Principle

Operating Principle

For the PMP 694, the physical effect is used where an illuminated particle will cause a definite light extinction (blockage) corresponding to its cross section and size, respectively. For this, the particle system continuously streams through a sensing zone, inside the process line or a measuring cell
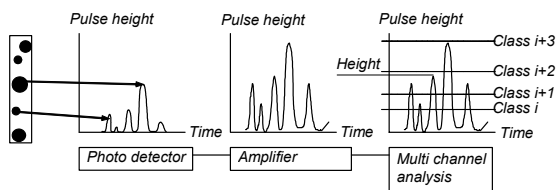
Signal analysis

Polymer Melt Particle Sensors series PMP 694 consist of two main components: optical sensor unit, signal acquisition unit. Essential parts of the optical sensor unit are photodetector, diode laser and optical components like lenses.
Particle concentration and measuring volume must be in such a relation that with high probability, the sensing zone contains only one particle at any time. For process control of material purity it is advantageous to illuminate as much measuring volume as possible. To these purposes suit special optics. It must be pointed out that the more the measuring volume increases the worse is resolution for fine particles.
Electrical pulses of the photo detector caused by single particles are amplified and classified by their height into different channels.
In the measuring software thresholds representing different size channels can be freely set up, relative or absolute in terms of the basic signal. Per threshold an upper limit of the counting rate is selectable. With these two tools different material qualities are definable and distinguishable.

Examples of Applications

Particulate impurities (Black spots, fish eyes, gas bubbles, etc.) in polymer melts can influence besides optical (transparency) also other product properties such as impact resistance, isolation properties, inflation capability of blown films, etc..

Therefore the online detection of such impurities by means of process sensors of series PMP 694 can significantly reduce output of non-specification grade batch. Furthermore they can enhance the process understanding.
Several applications have been already realised because of a big variety of influencing factors: process conditions, accessibility to the process and measuring tasks. That led to different connection designs: online via bypass, inline via line adapter, inline via slit dye adapter.

Prevalent in polymer processing is the problem of fish eyes with their different origins. They can be detected depending on application from size of 20µm up to 500µm. For classification reasons of melt quality in control software PMPWin the user can freely define their maximum allowed number concentration per size threshold.
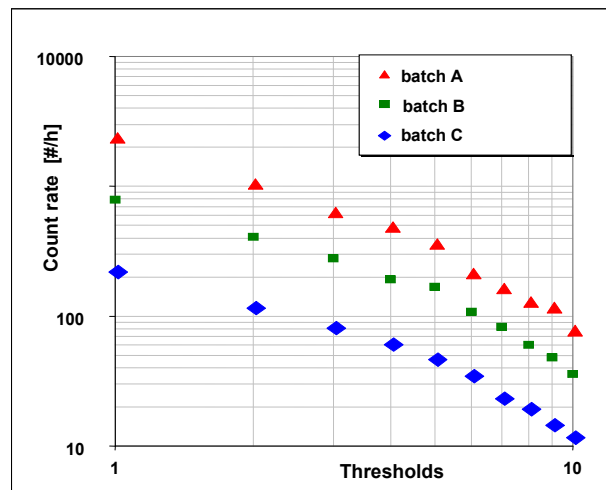
Differences between PE-batches (caused by different gel concentrations) measured as count rates at 10 thresholds
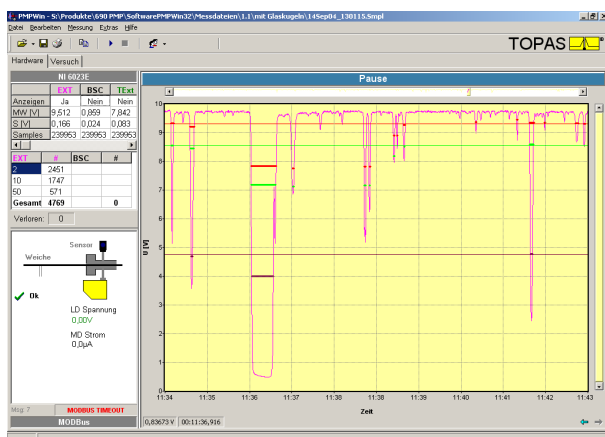
Topas Particle Analysis Software PMPWin

Based on practical knowledge Topas developed for sensor series PMP 694 the user-friendly and capable control and analysis software PMPWin. It enables easy and fast execution of a measurement but has also some degrees of freedom for experienced users, e.g. free determination of thresholds, administration of user profiles.

PMPWin works on a signal unit with integrated industry standard PC, display, and signal-I/O-card.

Signal unit with robust industry-standard PC, display, detector and alarm ports, Laser control, (heating optional)

Substantial Features of the Software PMPWin

- User interface under Windows 2000/XP
- Realtime signal analysis of raw data and output via display or file
- User-definable thresholds (failure limits)
- Particle size classes assignable
- User-definable count rate limits for each threshold
- Integrated user administration with graded rights
- Measuring progress definable: integration time, time resolution
- Wide range of data recording functions (data log function, raw data recording, minutes function)
- Sensor function test: activation of an alarm output
- Parameterisation and activation of an alarm output for the case of exceeding of count rate limits
- Graphical display of progression of count rates for activated thresholds, failure situation and alarm output status
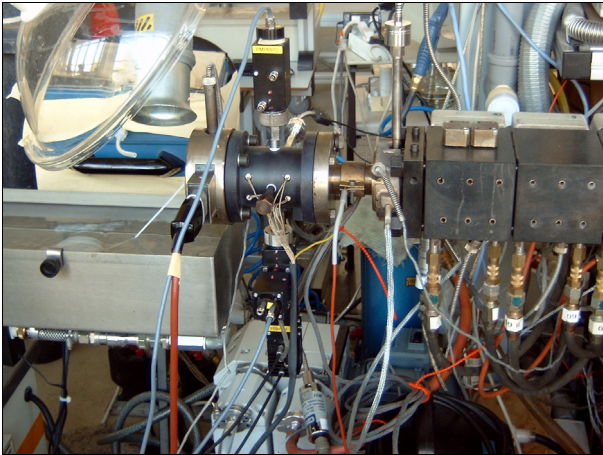- Graphical output of count rate trend over last 5 minutes

Raw data representation in software PMPWin
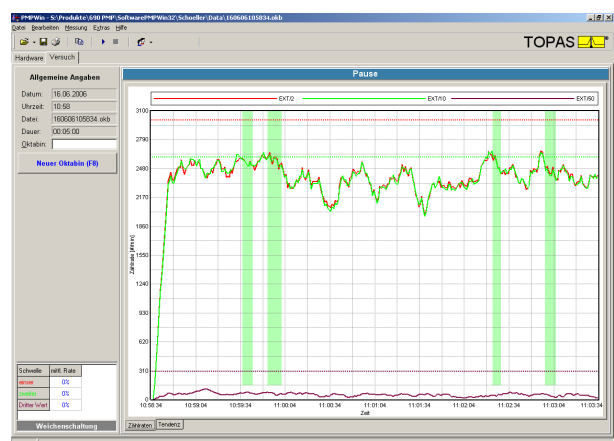
Measuring data trend of count rates of selected thresholds, off-spec count rates are underlaid

Industrial Application Example

PMP 694 (middle of picture) mounted inline to line adapter of twin screw extruder

In case of adverse process conditions (screw speed, mass flow, temperature) or as a result of start up periods and batch changes it can happen that few granules melt on only incomplete or pyrolyse (black spots).
By use of PMP Sensors such situations can be made out and correcting action can be taken, for instance switching of a good/bad valve, changing of process conditions.

≈150μm
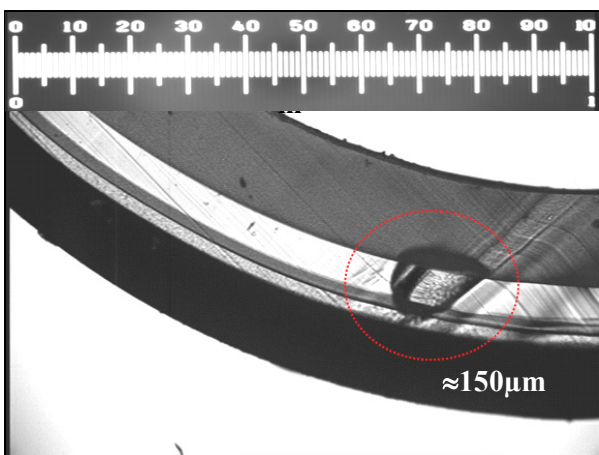
Light optical microscope image of a particle in an extruded multi layer pipe – worse fracture behaviour

Technical Data

Measuring size range	20 to 500 μm
Concentration range	max. 150 particles/cm³
Cross section of measuring beam	400 x 200 μm², custom-designed
Light source	30mW laser diode, 660 nm
Particle size classes	Custom-designed
Software	Data acquisition and control software PMPWin
Interfaces	LAN, USB
Power supply	110…230 VAC, 47…63 Hz
Dimensions of signal unit: w x d x h	$450 \times 320 \times 450$ mm³
Weight of signal unit	15 kg

Literature

[1] Patent-registration DE 35 17 099 A1
[2] M. Stephan et al: Realtime Process and Quality Control in Polymer Extrusion – Detection and Sizing of Particulate Inhomogeneities in Flowing Polymer Melts, Antec, 16.-20.5.2004, Chicago
[3] M. Stephan et al: Realtime detection of particulate heterogeneities in polymer extrusion processes using microphotometric measuring method. Plastics, Rubber and Composites, 2006, vol 35, no. 10, p. 432-438

QMS certified to DIN EN ISO 9001

TÜV SÜD
ISO 9001

12 100 11908 TMS

For more information please visit our website at www.topas-gmbh.de

Specifications are subject to change without notice.

© Copyright 2015 Topas GmbH.

TOPAS-GMBH.DE

PARTICLE UNDER CONTROL