Particle Counters after Membranes

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I. Membranes used in Waste Water Processing

During a six-week test period, a PAMAS WaterViewer particle counter was used to permanently monitor the filtrate of a membrane unit for waste water processing. Findings made proved the advantages expected from the highly sensitive method of particle counting. Using the particle counter gives good information about the filtration process. The automated sensor flushing keeps the system running unattended even in case of iron oxides, manganese oxide, or micro organisms, all of them possibly blocking optical instruments.

Measuring equipment

The PAMAS WaterViewer, a particle counting system for multiple measurement points, is designed as permanently running system with automated sensor flushing SFU. A GSM-phone sends a SMS in case of overriding preset limits for the filtered tap-, process-, or waste water.


WaterViewer

Sensitivity

A single spherical particle of 1 micron in diameter has a volume of $5.236*10^{-13}$ ml. 100 particles of 10 micron found in 100 ml of sample are approx. 0.5 ppb.

Membrane Bio reactors

Membrane Bio reactors (C-MEM™) are a new trend in waste water processing. Separation of activated sludge and cleaned effluent happens by membrane filtration instead of sedimentation. As integrity check the WaterViewer is permanently measuring the effluent to guarantee for water quality.

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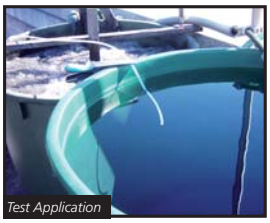
Test Application


Waste Water Processing Plant of RHV Salzburg PA)


Submersed C-MEM™ Module

C-MEM™ technology uses hollow fibres that are fixed to carrier cartridges and combined to modules having approx. 200 m² membrane surface. They are submersed in the activation basin. The filtrate is permanently checked by particle counting, measured data are integrated to the centralized control system.

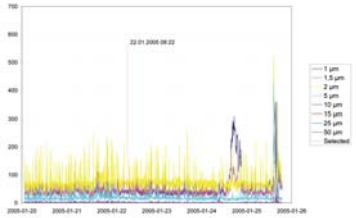

Fig. 1
Shown is a sequence of measurements. The "noisy" look is coming from frequent timed re-flushing of the membranes. The graph shows differential data, making "events" visible at first glance.

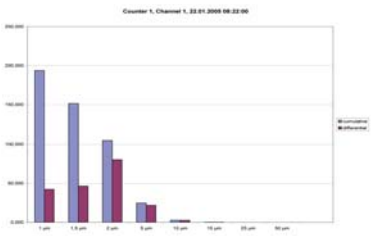

Fig.2
Typical size distribution for this installation. The 2 micron particles are nearly twice the number of the smaller 1 or 1.5 micron ones. This may come from the frequent re-flushes or from "contamination" of the effluent with micro-organisms.

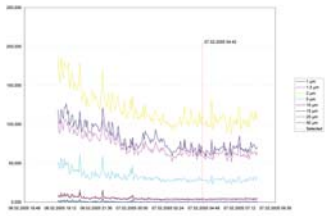

Fig. 3
Addition of Powdered Active Carbon helps to remove particles. After ending the measurements, the membrane was undergoing an intensive cleaning. The graph shows differential data.

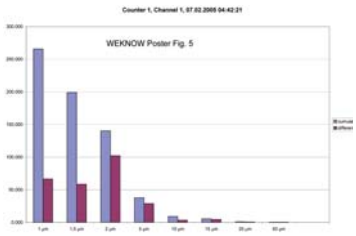

Fig. 4
When comparing to Fig. 2, the reason for need of intensive membrane cleaning can be seen – particles bigger than 15 micron show up.

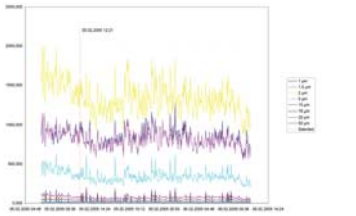

Fig. 5
Besides higher concentration level bigger particles show up, too (compared to Fig. 3).

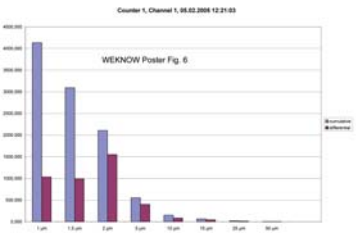

Fig. 6
Typical pattern, similar to Fig. 2, but at a level of one magnitude higher. Reason: Measurement of second membrane unit, with some few defective fibres (destroyed for test purpose).

II. Membranes used in Process Water Filtration

Back-flushing and normal operation can be identfied by the particle number concentration pattern for the different particle sizes. The PAMAS WaterViewer particle counter is sensitive even for single particles passing the sensor. Therefore it can be used as an easy-to-use tool for permanent monitoring of the process. This information can be used to optimize the filtration process, saving energy, time, and money.

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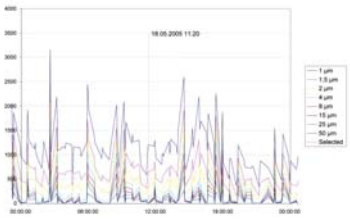

Fig. 7
Sand Filter filtrate
The process water needed in a production facility as coolant for glass-fibre production is cleaned by a three-step process. The used ground water first passes a sand filter, then a reverse osmosis (RO) membrane system to remove particles and solved components. Third step is a resin-based ion-exchanger.

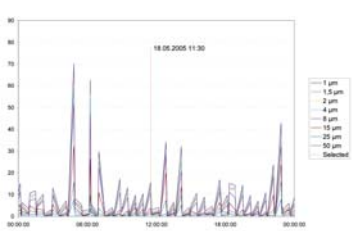

Fig. 8
Particles found in the water after the ion-exchanger. Compared to Fig. 7, number concentration of particles is reduced by approx. 100 (two magnitudes). RO removes all the particles bigger than 0.1 micron, passing the sand filter. Graph shows differential data.

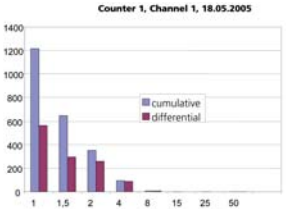

Fig. 9
Typical size distribution after a sand filter running in good condition. Changes in the filtration process do not only have an effect on total number of particles passing the filter. Very often a different size distribution pattern shows up. While it is not possible to define a „good condition" without knowing the filter system, the particle counter is very sensitive to changes, making them visible to the user (compare to Fig. 1), especially when displaying the data in differential mode. This helps to run the filter system effective.

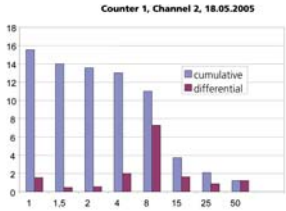

Fig. 10
Particles bigger than 8 micron show up.The particle counter proves that there is a contamination of the water coming from water treatment. Particle sizes that are not seen in that concentration after the sand filter, are a hint that wear of the ion-exchanger resins or the chemicals used for regeneration of RO membranes or ionexchanger at the end are contaminating the water. The particle volume coming from the 50, 25, and15 micron particles is even bigger than the particle volume in total after the sand filter (compare to Fig. 9).