PARTICLE COUNTING AFTER RAPID SAND FILTERS

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At different locations PAMAS WaterViewer particle counters were installed to monitor the filtration process and influence of backwash. As a result was found, that the more sensitive particle counter reacts up to two hours earlier on problems to come, than the turbidimeter which are used as a standard. Again the automated sensor flushing unit of the PAMAS WaterViewer proved to keep the system running un-attended in presence of solved iron which tends to build up oxide layers, typically blocking optical instruments.

Rapid Sand Filter - example from Northern Europe

Rapid sand filters are very commonly used in many Europaean Countries in north-western neighbourhood of Germany.
Water highly contaminated with particles is filtered to remove most of the particle load. Depending on the water source the filters are re-flushed every few hours or some days.

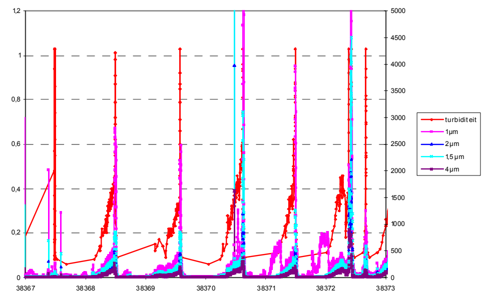


Fig. 1
Particles and Turbidity in the Filtrate
The example shows a filter typically being intended to be re-flushed every day. Then the filter started to behave strange, which led to the installation of the PAMAS WaterViewer particle counter.

In parallel to the particle number concentration, turbidity was measured. Comparison of the data shows a similar pattern for turbidity and particle counts.

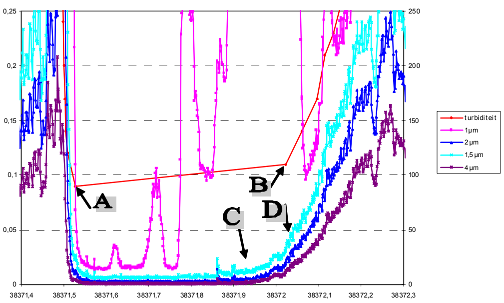


Fig. 2
When looking at the data at higher time resolution, the benefit of the particle counter becomes visible.
Turbidity data are too noisy, therefore only saved in case of a certain pre-defined difference.
When displaying these data, they are interpolated (marker A to marker B) - but at the control panel until "B" only the signal from "A" is displayed, as if there were no changes.
The particle counter therefore reacts approx. 2 hours earlier when comparing the rising particle counts from "C" to "D" by a factor of 2.

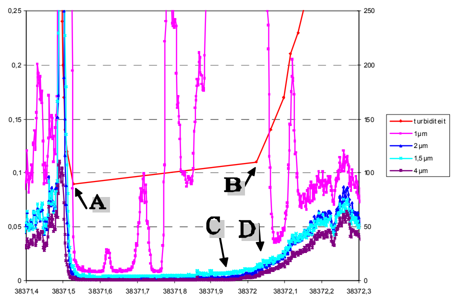
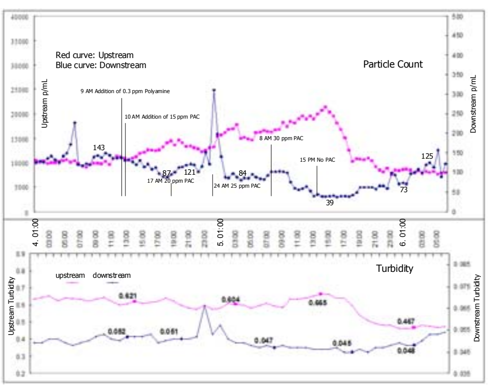


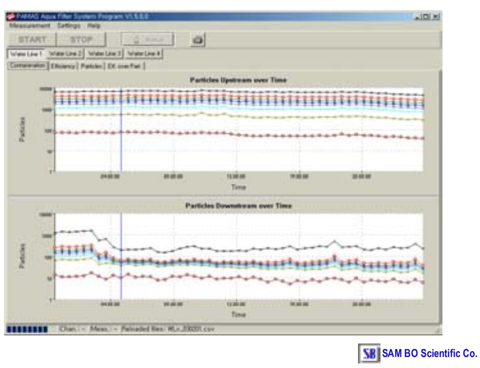
Fig. 3
In differential data, the effect is similar.

Further investigation is needed for the 1 micron particles.
One possible reason could be colloids from flocculant break-through.

Tap Water Filtration - South Korea

In South Korea particle counters delivered by PAMAS are used by many drinking water suppliers.
Besides checking the floc size in flocculation basins, they use the particle counter to control the filtration process for different types of filters. In the following, three different results from regular done measurements are presented.
The data were prepared by Sam Bo Scientific Co., who are the PAMAS distributor in South Korea and very experienced with all type of water application.





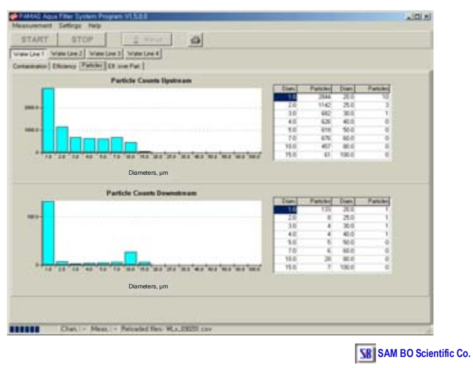


Fig. 4
Addition of Powdered Active Carbon (PAC), sometimes together with flocculant (Polyamine), often is used to support the filtration process. Especially small particles are more easily removed.

Shown is the effect of adding PAC and flocculant while measuring the particle number concentration in the raw water and in the filtrate (upstream and downstream).
In this case, the particle counter was installed in parallel to the turbidimeters for evaluation purpose.
The higher sensitivity and better signal-to-noise ratio is one reason why more and more particle counters are installed now.

The benefit of adding PAC is easily to be seen in the particle load of the filtrate, which goes down by a factor of 3 when adding PAC, and which rises again after ending the addition of PAC.
Turbidity signal only changes by some few percent in this case.

Fig. 5
Filter efficiency and the effect of backwashing the filter easily can be checked by comparing upstream (raw water) and downstream (filtrate) water quality.
Prior to the backwash, the filter had a removal rate of approx. 10, after the backwash and stabilization of the filtration process again, removal rate was approx. 100 (= only approx. 1% of the particles are passing the filter, 99% are removed).
While the raw water quality is more or less constant, the filter shows changing removal rate depending on time after backwash (new data are added to the graph from the right side).
Only one of four pairs of measured waterlines is shown.
Shown is cumulative data for 8 different particle sizes, from 1 to 15 micron.

Fig. 6
Having a more close look on the particle data sometimes reveals something special.
In this case, after a backwash, a peak at 10 micron particle size channel was found.
Further investigation proved Cyclotella spec., a species of algae (diatom), being the reason for that peak - a filter break-through.
If only cumulative data were checked, this effekt would not be that clearly visible.
Only particle counters give the possibility to get information on size distribution and particle number concentration.