# Quality Control of Potable Water through Automatic Particle Counting

## Faster and more differentiated than Turbidimetry

The German company PAMAS develops, manufactures and distributes Automatic Particle Counters for fluid cleanliness control, e.g. of hydraulic or lubricating oil, fuel, pharmaceutical liquids like infusion solutions, WFI (Water for Injection) and process water. For dedicated water applications, PAMAS offers both portable and online measuring instruments. Portable instruments for water applications are the particle counters of the PAMAS S4031 product series. For online measurement of water, the PAMAS product range provides the PAMAS WaterViewer fulfilling the specific requirements for water quality control: This online particle counter is the ideal instrument for the analysis of potable water, process water, purified waste water or raw water. The PAMAS WaterViewer has been tried and tested for water applications throughout Europe for many years and has become the trusted measuring instrument for use in water treatment plants and water distribution networks. PAMAS Automatic Particle Counters (APCs) deliver faster and more accurate measuring results than turbidimeters or nephelometers. They also provide a more sensitive, differentiated measuring result: Beyond the collective amount of particles, an APC detects, counts and measures each and every single particle. In an online environment, the trending of these results shows much more interesting events. (**Figure 1**)

There are various existing methods to determine whether water is clean and free from particulate contamination. In water treatment systems, both particle counters and turbidimeters or nephelometers are used for water quality control. Turbidimeters and nephelometers measure the collective amount of solid contaminants in liquids. The more turbid a liquid is, the higher the measuring value will be. Contrary to this, Automatic Particle Counters do not measure the collective amount of solid particles, they analyse size and quantity of each single particle which is part of that population in the online sample flow. The knowledge of the particle sizes is of paramount importance in water applications, as it helps to quickly identify certain types of bacteria or even a failure in the system (e. g. break-through of a membrane filter in case of an above average number of large sized particles). The Automatic Particle Counter thus gives more versatile and significant results than a turbidimeter.


**Figure 1**: The PAMAS WaterViewer is designed for continuous water quality control. The instrument measures online during operation. For many years, this analysing system is being successfully used for the cleanliness control of potable water, process water, waste water or raw water. (Picture: PAMAS)

PAMAS, located close to Stuttgart in Germany, specialises in liquid particle counters. The company develops, manufactures and distributes Automatic Particle Counters, designed for fluid cleanliness control. The extensive PAMAS product range provides more than 20 different particle counting models for multiple applications. Besides the most widely used models, which are applied in contamination control of hydraulic fluids, fuel and insulation liquids there are more specialised models for the determination of filter efficiency (beta-ratio analysis) and parts cleaning. Fluid cleanliness control in the pharmaceutical industry and water quality control in water treatment plants are other applications within the extensive uses of Automatic Particle Counters.

One instrument of the PAMAS product range especially designed for water applications is the PAMAS WaterViewer. This unit takes measurements online and is installed as a fixed stationary instrument for water condition monitoring. The system is used for the cleanliness control of potable water, raw water and purified waste water or process water. For condition monitoring, the PAMAS WaterViewer may be connected to up to 32 measuring points. With the aid of microprocessor controlled valves, it is easy to change between measuring points and bypass connections. The PAMAS WaterViewer may be fitted optionally with an automatic Sensor Flushing Unit, the PAMAS SFU. This attachment will automatically remove mineral deposits (e. g. manganese, calcium, iron oxide, etc.) from the optical cell windows which may otherwise diminish the laser

light beam. The instrument stays in action round the clock without anyone having to take care of it. The instrument configuration can be set up according to the customer's requirements: Depending on the user-specific application, the PAMAS WaterViewer may be equipped with different particle sensors with different sensor specifications. The sensor PAMAS HCB-LD-25/25 for example, analyses particle sizes between 1 and 200 µm. (**Figure 2**)

## Application example

The PAMAS WaterViewer has been tried, tested and trusted for many years and considered by many users as an accurate and reliable measuring instrument for water applications. It was screened and chosen by the Dutch KWR Research Institute (former KIWA) in 2005. Since then, a multitude of existing publications and scientific papers prove that the PAMAS WaterViewer is used for scientific research at many universities in Europe (e. g. at the Technical University Delft in the Netherlands, at the University of Lorraine in France and at the University of Kuopio in Finland). As an example, the PAMAS WaterViewer helped to identify relevant factors for the ideal construction of water distribution pipeline systems and the most efficient filtration speed required in pool water treatment.

One typical application example is the use of the PAMAS WaterViewer for water quality control in water treatment plants. In a scientific study, the University of Lorraine in Nancy/France made a research on "Particle Counting for early detection of contaminants in drinking water". The results of this study were then presented at the WCEC5 conference (Water Contamination Emergencies – Managing the Threats) in Mülheim an der Ruhr in Germany in November 2012. Based on measurements of a real application at the city waterworks of Nancy in France, the study provided evidence on the benefits of the PAMAS WaterViewer for water quality control. (**Figure 3**)

## Scientific research in water treatment plant by University of Lorraine

Particles were counted in three different online measurements: Under stable and

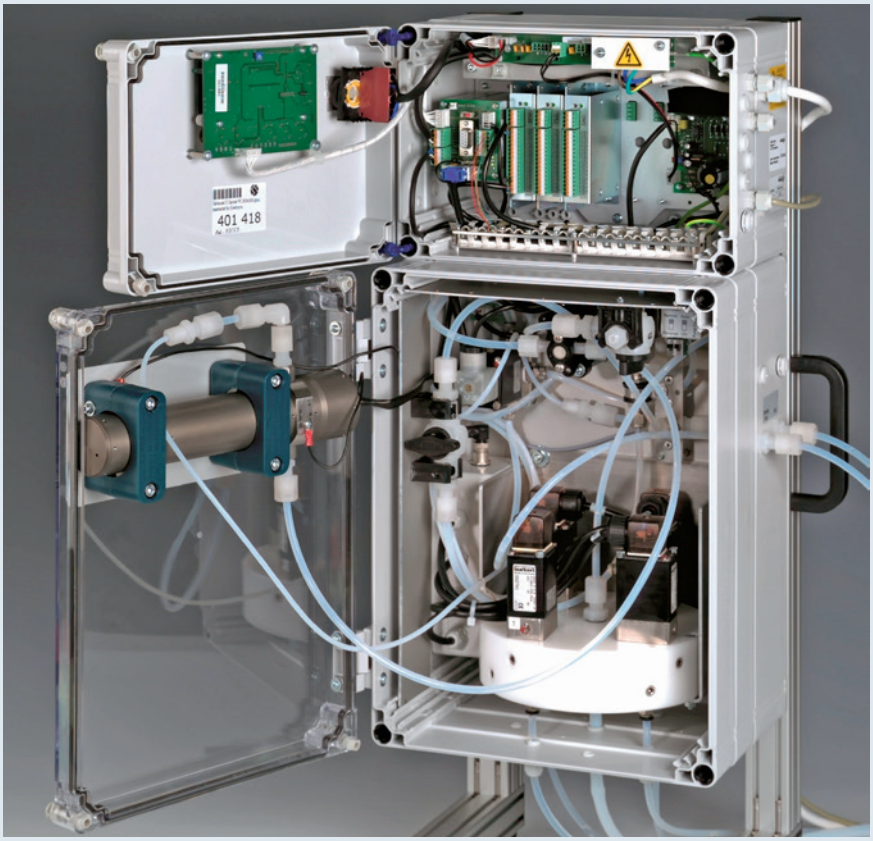


**Figure 2**: The PAMAS WaterViewer is an automatic particle counting system designed for water applications. The instrument has been tried, tested and trusted for particle analysis of potable water, raw water, process water and waste water. For continuous condition monitoring, the measurement is performed online during operation. The online particle counter gives instantaneously alerts if pre-defined limits are exceeded. With the aid of the optional Multiplexer unit, the PAMAS WaterViewer may be connected to up to 32 measuring points and thus is able to monitor up to 32 waterlines. (Picture: PAMAS)


**Figure 3**: Use of PAMAS WaterViewer at the water treatment plant of the city of Nancy in France

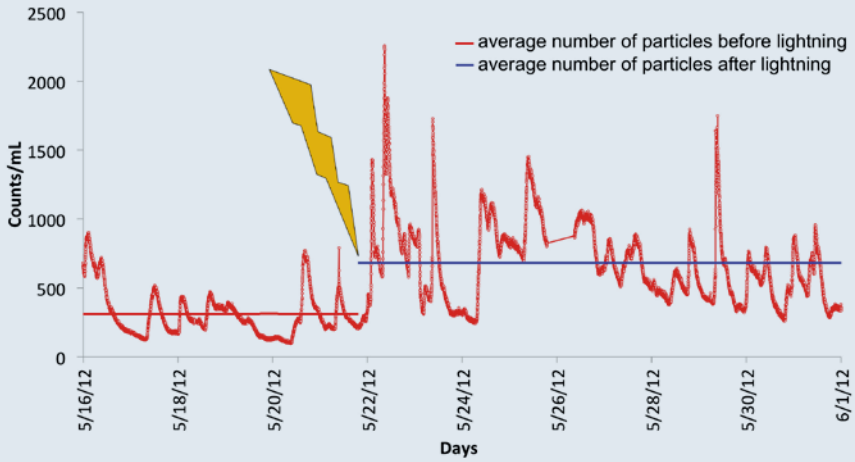


**Figure 4**: The measuring results of the PAMAS WaterViewer clearly showed that the average number of particles per millilitre was seriously increased due to the lightning event and the changes in water production and distribution

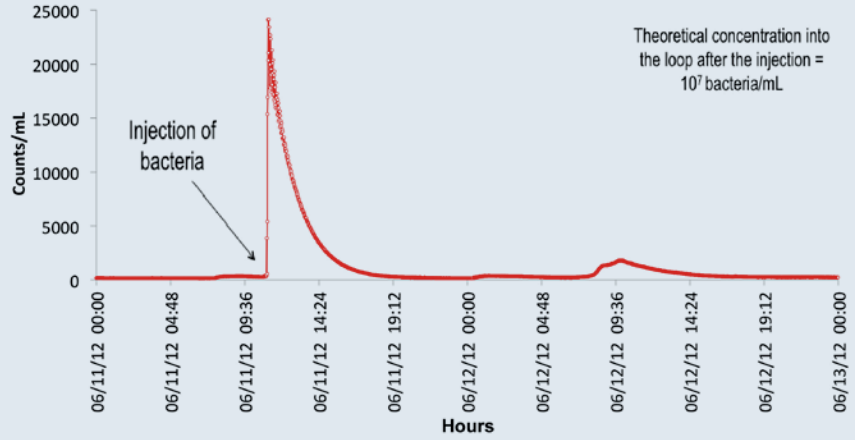


**Figure 5**: The injected bacteria suspension was visible in the particle counts only during the first hour after injection. Due to sedimentation and dilution, the particle concentration decreased very soon

normal conditions, the PAMAS WaterViewer measured a mean number of 310 P/ml in the specific interval of particle sizes between 1 to 15 µm.

In a second step, the particle concentration was analysed after a major raining event. During a thunderstorm, a lightning stroke into the water treatment plant of the city of Nance and seriously affected the plant operation. The water production was stopped for several hours and water had to be taken out of highly chlorinated security reservoirs. When analysing the water coming out of these reservoirs, the PAMAS WaterViewer counted between 801 P/ml and up to 2300 P/ml for the particle size range between 1 and 15 µm. (**Figure 4**)

During the third experimental step of analysis, the water was contaminated by injecting a bacteria suspension into an isolated loop circuit, in order to examine the effects on water quality. During the first hours after injection, more than 20.000 P/ml were counted. The graph of online measurements however shows that the particle concentration decreased within few hours after injection. The authors of this study attribute this fast decrease of particles to sedimentation and dilution processes. (**Figure 5**)

The analysis in the water treatment plant of Nancy gave evidence on the fact that the PAMAS WaterViewer is an ideal instrument for the early detection and warning of contaminants in drinking water. The online particle counter instantaneously gives alert in case of drastic changes in the measuring results and immediately informs about exceeding particle contamination.

## Conclusion

The water application example shows how and for what purpose the PAMAS WaterViewer is used in today's application practice. The PAMAS WaterViewer online particle counter proved to be the ideal instrument for water quality verification and water cleanliness control. Numerous users appreciate the particle counter's measuring accuracy and reliability. In real world practice, the PAMAS WaterViewer is applied for particle counting of process water, pool water, raw water, treated water and mainly for drinking water.
Furthermore, the PAMAS WaterViewer is also tried and trusted as measuring instrument for scientific research, since it was used for the study on drinking water treatment at the French University of Lorraine.

### References

[1] *Pollmann, P.; Colon, E.; Gosselin, F.; Block, J.-C.*: Particle Counting for Early Detection of Contaminants in Drinking Water. Published in: Water Contamination Emergencies – Managing the Threats, edited by K. Clive Thompson, Ulrich Borchers and John Gray. Conference book to Water Contamination Emergencies: Managing the Threats, IWW Water Centre, Mülheim an der Ruhr, Germany, 19th–21st November 2012, pp. 340–345.

### Author

Sandra Suresh
PAMAS Partikelmess- und Analysesysteme GmbH
Dieselstraße 10
71277 Rutesheim
Germany
www.pamas.de