

The Application of Simplified Process Statistical Variance Techniques to Enhance the Detection of Filtration Integrity Loss

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Abstract:

Process monitoring for loss of filtration integrity is often performed using basic light scatter detection methods such as turbidity and particle counting. These methods monitor for the presence of particles in the filtration effluent (permeate). The industries where these parameters are most widely used include drinking water and ultra-pure water production. The recent upward trend in the application of membrane systems for drinking water production enhances the need for technologies with higher sensitivity and greater reliability because the loss of filtration integrity could directly impact human health.

Laser-based particle detection technologies, such as laser turbidity and particle counting are often utilized to monitor filtration processes. In addition to the raw measurement values, these technologies can often provide additional information regarding the performance of the filtration process. The baselines of filtrate or permeate product from a filtration system can be more highly characterized and the variability of the baseline itself can be quantified through the use of simplified statistical techniques.

The approach of baseline variability monitoring can be applied during filtration performance monitoring with the variability treated as a separate parameter. In the event of a fine integrity loss, the variability of the filtrate baseline will demonstrate a significant change relative to the baseline. This change is observed prior to the detection of the same particle event using conventional detection techniques.

The purpose of this presentation is to demonstrate how the baseline variability parameter can be applied to monitoring filtration processes for integrity loss. The basic approach utilizes a process, laser-based light scatter technology for monitoring the product leaving a filtration system. Research of this application is being performed to demonstrate the correlation between baseline variability and integrity loss within conventional dual media filtration, ultra-filtration, micro-filtration, and reverse osmosis filtration.

Preliminary results indicate that the application of baseline variability parameter can enhance the sensitivity for detecting a fine integrity loss beyond those basic detection methodologies that are typically applied. The sensitivity of this method is promising, with an improvement of between 1-2 orders of magnitude over the raw measurement values. This application is in the process of test on both membrane and conventional filtration systems in the drinking water industry.

This approach may add sensitivity to those detection methods that apply similar technologies and the application could be easily expanded into many different industries that utilize similar filtration practices.

Keywords: Process monitoring, integrity loss detection, light-scatter, baseline fluctuation