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# MFI™ for Particle Removal Characterization

Particle removal is a critical component of drinking water treatment, involving many complex processes such as coagulation, flocculation, sedimentation, flotation, and filtration. Optimizing the particle removal process involves understanding the relationship between treatment system operational parameters, particle population characteristics, and the degree to which particles have been removed. Conventional techniques for characterizing particles and measuring particle removal involve use of a turbidity meter and/or laser particle counter. These measurement techniques are indirect, provide limited insight into the particle characteristics, and are insensitive to subtle changes in the particle population.

MFI™ is a new technique which employs digital imaging of a flowing sample stream to measure the size, shape, and concentration of suspended particulates. A single 5 minute sample run provides size and shape statistics on 100,000's of particles. This rapid and comprehensive analysis can highlight significant changes to raw water, characterize floc formation and settling properties, and measure filter performance.

## The MFI™ Advantage

**Material and Shape Independence:** Unlike many indirect particle size measurement technologies, the direct, pixel based imaging technique employed in MFI makes no assumptions of particle size or shape. Particle sizes from 0.75µm to 400µm are readily accommodated.

**Concentration Measurement:** MFI™ instruments provide sensitive detection, counting, and sizing of each individual particle present in each image frame. Each frame represents an accurately known volume of sample, permitting direct measurement of particle concentration.

**Selective Image Capture:** The selective image capture feature in MFI™ allows a user to store images of any particles detected during the run. These images serve to confirm numerical results and are invaluable for process control, quality control and diagnosis and troubleshooting.

**Comprehensive Morphological Analysis:** Stored images can be analyzed using the MFI™ morphological analysis module, providing measurement of ECD, Feret's diameter, area, perimeter, circularity and transparency. Results are conveniently presented in the form of histograms or scatterplots.

**Time-Resolved Sampling:** MFI™ systems will time-stamp each image, and produce trend charts of particles size distribution parameters (mean, mode, count, and concentration). The integration interval can be adjusted to accommodate the rate of change to the particle population, and the run duration can extend to 24hrs.

**Speed and Convenience:** MFI™ analyzers are easy to operate and analyze multiple image frames per second providing a full population analysis in less than 5 minutes.

**Direct Observation**: During analysis, image frames are displayed providing immediate visual feedback on the nature of a particle population.

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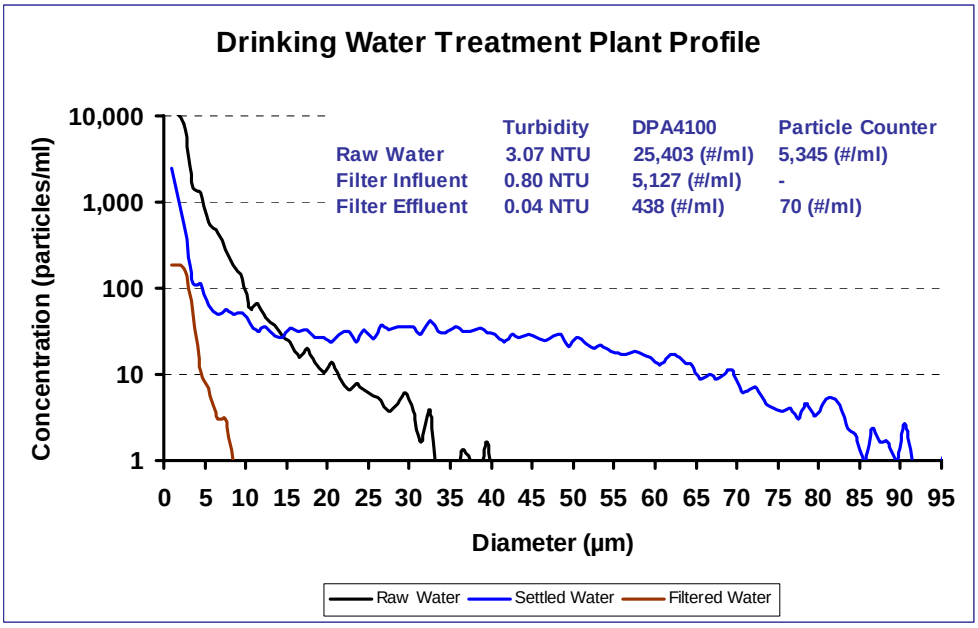
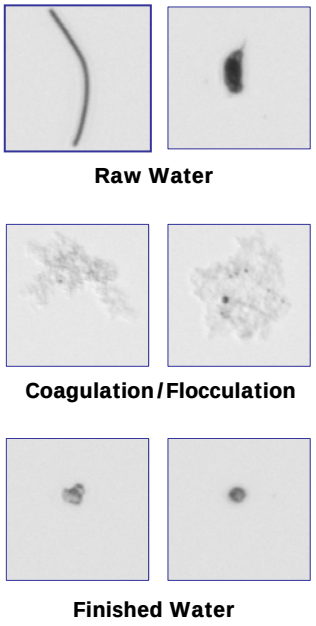
## MFI™ Sizing, Counting, and Morphological Analysis

The charts and images below are an example of the DPA4100 MFI™ analysis of raw water, filter influent (after coagulation, flocculation, and sedimentation), and filter effluent. The quantity of particles per ml at each stage may be measured directly, and images can be stored providing additional insight into the dynamics of particle formation/removal.




## MFI™ Morphology Analysis

In addition to measuring the size and concentration of outlier particles, MFI™ can measure the morphological characteristics of the suspended particulate (equivalent circular diameter, Feret's diameter, area, perimeter, circularity, and transparency) using the captured images. Powerful software tools including variable thresholding, histograms, scatter plots, and fully exportable data sets permit comprehensive comparisons across samples and more advanced particulate diagnostics.

## Summary

MFI™ instruments provide highly sensitive detection, counting, and sizing of each individual particle combined with an automatic image capture and shape analysis capability. These features provide further insight into the nature and origin of the suspended particulates, and can be used to fully characterize and optimize the particle removal process.