Fact Sheet

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WCWC Walkerton Clean Water Centre
An agency of the Government of Ontario
CWAE Centre de Walkerton pour l'assainissement de l'eau
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Application of Continuous Particle Monitoring Technologies

Key Words: Particles, Particle Counting, Particle Monitoring, Turbidity

What Are Particles?

Particles present in water range in sizes from very small molecules (e.g. metal ions) to large particulate (e.g. sand). Particles can be formed from inorganic, organic and microbiological sources.

Inorganic particles are mainly from the natural weathering process and may include clay, silt mineral fragments, and natural precipitants (e.g. calcium carbonate, manganese dioxide, iron oxide).

Organic particles include natural organic matter (decomposed plant and animal debris), organic macromolecules, and living or dead microorganisms (bacteria, algae, cyanobacteria, zooplankton, and protozoa).

The distinction between particles and dissolved matter is vague. Operationally, the dissolved and particulate matter can be separated using a membrane filter of 0.45 µm pore size. Materials that pass through are considered as 'dissolved', and materials retained by the filter are defined as 'particulate'.

Continuous Particle Monitoring Technologies

Particles can be measured in different ways. A particle counter monitors the number of particles and sort them by size, while a turbidimeter measures the cloudiness (i.e. turbidity) of water caused mainly by the presence of particles and other impurities. The correlation of turbidity and particle counts has not been established, but both of them provide valuable water quality information.

How do Particles Affect Water?

Table 1. Implications of particles on water quality, treatment and distribution

Water Quality Implications	Water Treatment & Distribution Implications
• Affect the aesthetical quality of drinking water, reduce clarity and cause taste & odour problems • Affect pH, alkalinity and zeta potential • Provides source of nutrients for microorganisms • Provides source of metals and metal oxides • Provides potential sources of toxins	• Influence coagulation, flocculation, sedimentation design and operation • Shield pathogens from disinfection • Increase disinfectant demand • Cause membrane filtration fouling • Reduce filter run-time and clog filters • Influence biological growth (biofilm)

Standard & Laser Turbidimeters

Of all the continuous particle monitoring technologies available, turbidimeters are the most common because turbidity is a regulated parameter. Standard turbidimeters measure the scattering of light using an incident light beam. Another option to measure turbidity is a laser turbidimeter, which has a higher sensitivity than standard turbidimeters. A laser turbidimeter can be useful when high sensitivity is needed (e.g. monitoring treated water from membrane filtration and monitoring the early end-of-run filter breakthrough).

Particle Counter

Drinking water guidelines for particle counting have not been established. A particle counter quantifies the number of particles in water (> 2 µm) sorted by particle size. Particle counters typically show higher sensitivity than standard turbidimeters at low turbidity levels, and can provide an early warning sign of turbidity breakthrough. Particle counts may also be used in ultrafiltration membrane monitoring.

Particle Monitor

A particle monitor measures the relative clarity of a sample expressed as Particle Index (PI). PI indicates the relative clarity of water quality, and increases when impurities increase. Guidelines for PI have not been established; therefore utilities have to develop onsite baseline levels. PI does not have the ability to discriminate either particle size or number.

Applications

Monitoring particles is a good way to provide information about raw water quality. Suspended particle loading entering the treatment plant can indicate and predict coagulant dosage adjustments. Particle monitoring of the clarifier can also provide early warnings of incorrect coagulant dosages and process efficiency. Monitoring the filter backwash curve can be useful to determine the effectiveness of backwashing procedures and the readiness of a filter for service. Particle monitoring of filtered water can ensure correct operation of the filters and detect the breakthrough of particles that might not be detected by turbidity monitoring.

Table 2. Four different types of continuous monitors

	Standard Turbidimeter	Laser Nephelometer	Particle Counter	Particle Monitor
Parameter Monitored	Turbidity	Turbidity	Particle count and size	Particle index*
Parameter Regulated	Yes	Yes	No (have to develop a baseline)	No (have to develop a baseline)
Range	0 – 1000 NTU	0 – 5 NTU	Particle size > 2 µm	Particle size > 2 µm
Method of Detection	Light scatter at 90° relative to the incident light beam	Light scatter at 90°, strong laser light source with sensitive detector	Various models: light obscuration, light scatter, or electrical resistance	Light obscuration and reduction in the intensity of a narrow light beam

* Particle index is a relative measure of the clarity of water sample

References

Hargesheimer, E. E., McTigue, N. E., Lewis, C. M. (2000) Fundamentals of Drinking Water Particle Counting. AWWA Research Foundation report.

Hargesheimer, E. E., Lewis, C. M. (1995) A Practical Guide to On-line Particle Counting. AWWA Research Foundation report.

For More Information

For further information and resources on drinking water research and water operator training programs, please visit our website.www.wcwc.ca

Walkerton Clean Water Centre
20 Ontario Road
Walkerton, ON, N0G 2V0
519-881-2003