

PURELAB flex

Real Time TOC System

Why do we monitor TOC?

Resistivity is well established as a good indicator of the level of inorganic ionic impurities in pure water. If the resistivity of water is greater than 17 MΩ-cm we can be sure that only a few parts-per-billion (ppb) of ions can be present. At a resistivity of 1 MΩ-cm ionic levels can be as high as 1000ppb.

In the same way, total organic carbon (TOC) is a useful universal indicator of the presence of organic impurities in water. By monitoring TOC on-line in real-time, we can be assured of the overall organic purity of the water.

The overall ionic and organic purity of the water can be confirmed by monitoring both resistivity and TOC. Logging these values facilitates the identification of trends and the detection of changes in system performance.

The limitations of monitoring TOC

In the same way that a resistivity monitor cannot specify the particular inorganic ions in the water, a TOC measurement cannot help us to define which specific organic impurities are present. Furthermore the relationship between the TOC and the equivalent concentrations of various organic

compounds will vary according to the percentage of carbon in each contaminant and the effect of other ions in the organic compound, such as chloride.

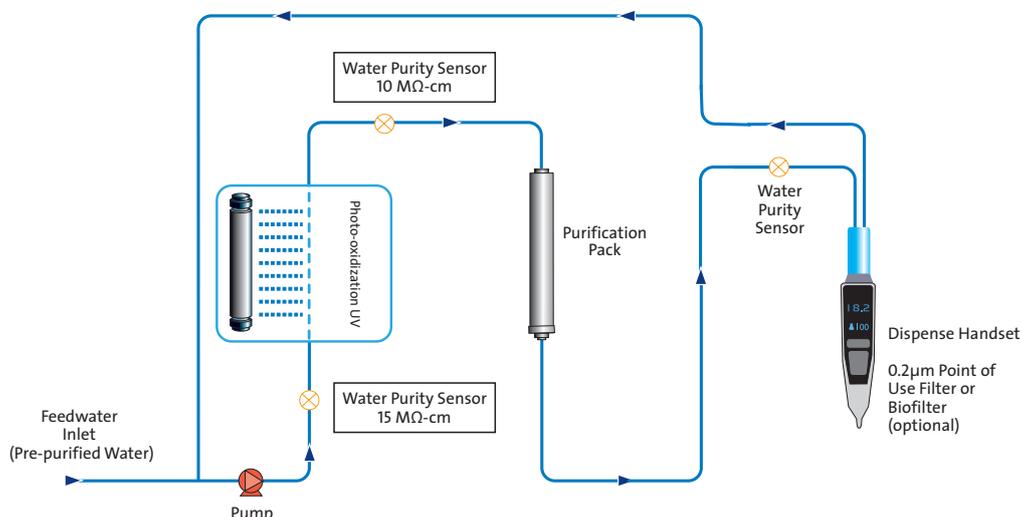
Sensitive analysis such as HPLC & GC-MS measures impurities down to ppb levels of contaminants. Ultra pure water is used to prepare samples and standards and as a component of the mobile phase in HPLC. Organic carbon compounds remaining in the water can therefore have a dramatic effect in the accuracy and sensitivity of these analyzers.

How is TOC monitored in the PURELAB flex?

In a basic on-line TOC monitor the water is measured for resistivity, oxidized and measured again. The TOC value is a function of the difference between the resistivity pre and post oxidation, as shown in Technology Note 7.

As water is dispensed from the PURELAB flex, the pre-purified feedwater is pumped through a chamber irradiated with high-energy UV light. The organic compounds in the water are oxidized to ionic species which cause the resistivity of the water to fall. By measuring the change in resistivity caused by the UV-photo-oxidation the TOC of the product water can be estimated. The organic ions produced are removed on the down-stream purification pack. The pack itself is kept clean by intermittent recirculation of highly purified water.

The oxidative efficiency of the UV lamp is monitored periodically to ensure the TOC is measured accurately. When the oxidative efficiency begins to change the TOC monitor recalibrates itself to ensure that the TOC continues to be measured accurately. When the efficiency falls below the recalibration adjustment levels, a UV replacement is indicated. This ensures that the UV lamp is changed at the right time.



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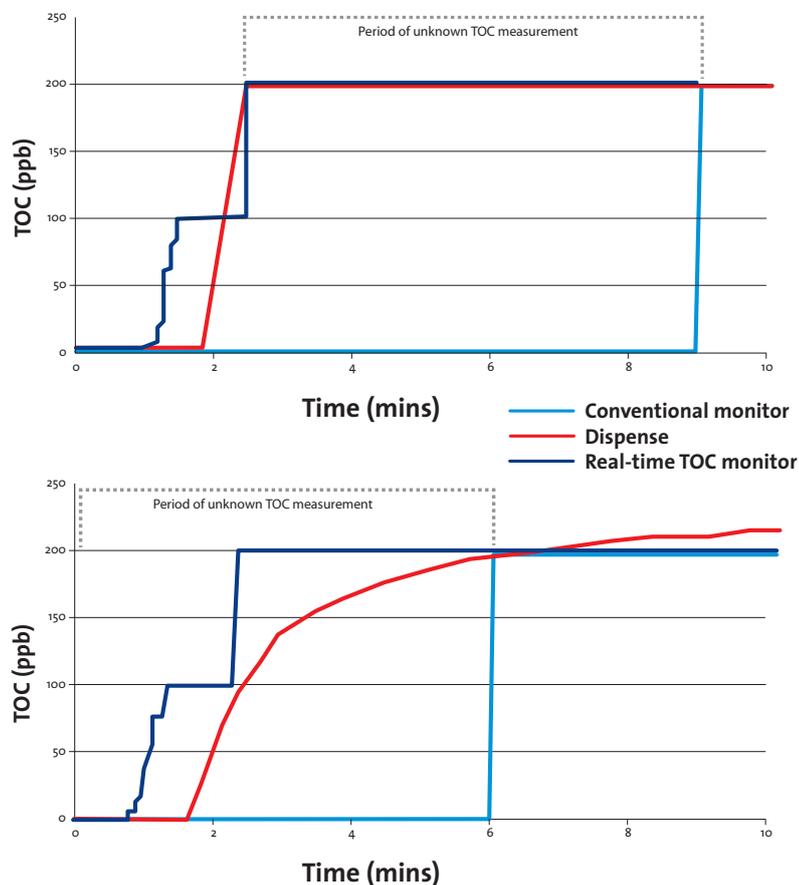
Advantages of real-time TOC monitoring

The main advantage of real-time TOC monitoring as used in the PURELAB flex is that the TOC reading you see is the TOC in the water you are dispensing. Conventional TOC monitors take a sample of water as it is being dispensed and oxidize it over a period of four to eight minutes before giving a result. During this time the TOC of your water is unknown and when you have a result you will have long since stopped dispensing water.

As illustrated in the figures, the red trace shows the actual TOC of the water being dispensed. A sudden change of TOC occurs. The light blue traces from conventional monitors show that they do not detect the change in TOC until many minutes later. The dark blue trace from the real-time monitor demonstrates its immediate response.

Technology Note 7 describes TOC monitoring of pure water in greater detail.

Advantages of Real-Time TOC Monitoring



The PURELAB flex will monitor TOC successfully as long as it is fed with water with resistivity greater than 5 M Ω -cm.

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