

# Dissolved Ozone Measurement In Bottled Water

## Application Note AN-0112

### Background

Ozone ( $O_3$ ) is an unstable tri-atomic form of oxygen. It is a very strongly oxidizing gas that is injected into water to remove organics that may contribute color, odor or taste. Most importantly, ozone sanitizes the water, rapidly destroying any microbiological contamination. Dissolved ozone reverts back to harmless oxygen in a matter of minutes, depending on the temperature and pH of the water, so it must be generated and measured right next to the process. Ozone leaves virtually no harmful breakdown products.

Ozone generators operate by passing dry air or oxygen next to high voltage electrodes where a corona discharge converts some of the oxygen to ozone much as occurs in a lightning storm. That gas mixture is then contacted with the water, either in a tank diffusion system or in a pipe with venturi injector. Intimate contact is made to maximize the dissolution. There are newer generation techniques that can produce ozone directly in the water and reduce the possibility of atmospheric losses.

### Ozonation of Bottled Water

Bottled water is most commonly of two types: mineral water which comes from a natural source and is not altered significantly, and purified water which is treated with reverse osmosis and other steps to adjust the mineral content. Both must be sanitized with ultraviolet light or ozone.

Bottled water processing has embraced ozone as the best way to sanitize the system, the water, the bottle and its seal to achieve the longest possible

shelf life. For this, a dissolved ozone concentration measurement is made to assure an adequate level of sanitization has been achieved. The ozone sanitizes and then dissipates inside the bottle. The maximum ozone level allowed in the product water by the US FDA is 0.4 mg/L (ppm).

Higher levels of ozone can be injected upstream but excessive amounts are discouraged for several reasons. An excess of ozone requires venting and destruction to prevent escape to the atmosphere and resulting health hazards. Excess ozonation in mineral waters that contain bromides will oxidize them to bromate which is a suspected carcinogen. Bromate is limited to less than 10  $\mu\text{g/L}$  (ppb) by the US EPA for drinking water and by the FDA for bottled water. In addition, high ozone levels can cause deterioration of some polymer materials used in packaging.

### Dissolved Ozone Measurement

For the reasons given above, on-line monitoring and control of ozonation have become standard practice. Dissolved ozone instrumentation is available ranging from sophisticated high cost, maintenance-intensive equipment giving good performance, to low cost, less reliable equipment with flow sensitive readings. For measurements with excellent performance, high reliability and infrequent simple maintenance at reasonable cost, Mettler-Toledo Thornton offers dissolved ozone measurement in a choice of two multiparameter instrument platforms.

Ozone sensor #1. The ozone concentration is measured after the storage tank to ensure the proper concentration of ozone is achieved for effective disinfection action. It also assists in controlling the ozone dose required from the ozone generator.

Ozone sensor #2. Ozone is measured in this area to assure destruction of the ozone by the UV light and to confirm that the water utilized in production is sufficiently free of ozone at the points of use.

Ozone sensor #3. This post-use point measures the ozone concentration in the water used for production or during sanitization of the water system.

### Instrumentation

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### Single Point Measurements

For basic pharmaceutical water applications, the Mettler-Toledo Thornton 2000 provides two-channel measurements where one channel can monitor dissolved ozone and the other channel can measure conductivity. This is the most cost-effective choice if only one ozone measurement point is required.



### Multiparameter Measurements

To meet the requirement for multiple measurement points, the Mettler-Toledo Thornton 770MAX Analyzer/Transmitter can accept up to four sensors in any combination of ozone, TOC and conductivity, the latter two of which are required by US Pharmacopoeia and European Pharmacopoeia guidelines. For the four input channels, the 770MAX can also accommodate, dissolved oxygen, pH, ORP, flowrate, pressure and level measurements plus two additional channels of flowrate.



Pharmaceutical water production is a challenging measurement environment, and the 770MAX provides unequalled flexibility and value in satisfying pharmaceutical water measurement needs where multiple parameters and monitoring points are required.

For bottled water applications, Mettler-Toledo Thornton 2000 Instruments provide two-channel measurements where one channel can monitor dissolved ozone and the other channel can measure conductivity, pH or ORP. This is the most cost-effective choice if only one ozone measurement point is required.

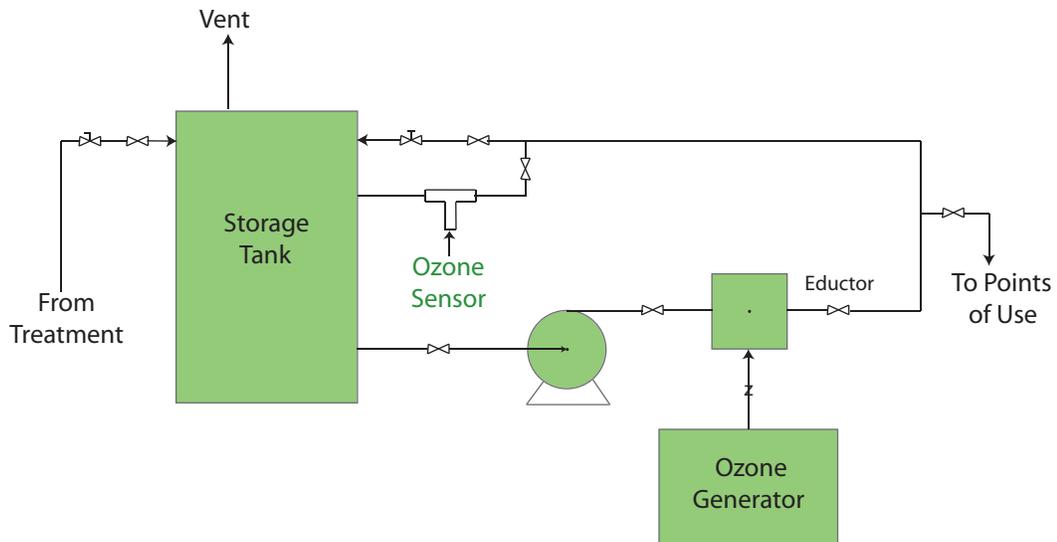


2000 Two-channel Instrument

Mettler-Toledo Thornton 770MAX Instruments can measure from four sensors in any combination of dissolved ozone, conductivity, flowrate, pH, ORP, dissolved oxygen, TOC, pressure and level plus two additional channels of flowrate. It provides unequalled flexibility and value in satisfying measurement needs where numerous parameters and/or measurement points are required.



770MAX Six-channel Instrument



Typical bottled water ozonation system

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