Fluorescent Dissolved Organic Matter (FDOM)
Monitoring with the LiquID Station

The LiquID Station

The LiquID Station from ZAPS Technologies (pictured below) is an innovative, optical instrument for continuous water quality monitoring. The automated online instrument analyzes a continuous flow-through stream from a pressurized water sample line using multi-spectral light and software algorithms, and uses no reagents nor produces any waste other than the original sample. This powerful analytical approach is called Hybrid Multispectral Analysis (HMA) and is unique to ZAPS Technologies. With HMA, the LiquID Station is capable of monitoring a wide range of water quality parameters in a number of different industry applications, including those relevant to municipal water and wastewater treatment, water reuse systems and industrial process control.

Total Organic Carbon (TOC) in water exists in many forms ranging from naturally occurring fulvic and humic acids derived from decaying plant debris to man-made compounds such as pesticides and fungicides. As a chemical class, most forms of organic carbon readily absorb ultraviolet light and their presence in water can be inferred by conventional *UVA/UVT measurement* (absorbance at 254nM).

Some of the compounds that contribute to the TOC pool also fluoresce. In the science literature, the fluorescent part of the TOC load is called *Fluorescent Dissolved Organic Matter*. FDOM is composed of both natural and man-made substances, but the complex cyclic molecules contained in fungicides, pesticides and herbicides tend to fluoresce far more brightly than the simpler, straight-chain natural substances found in plant debris.

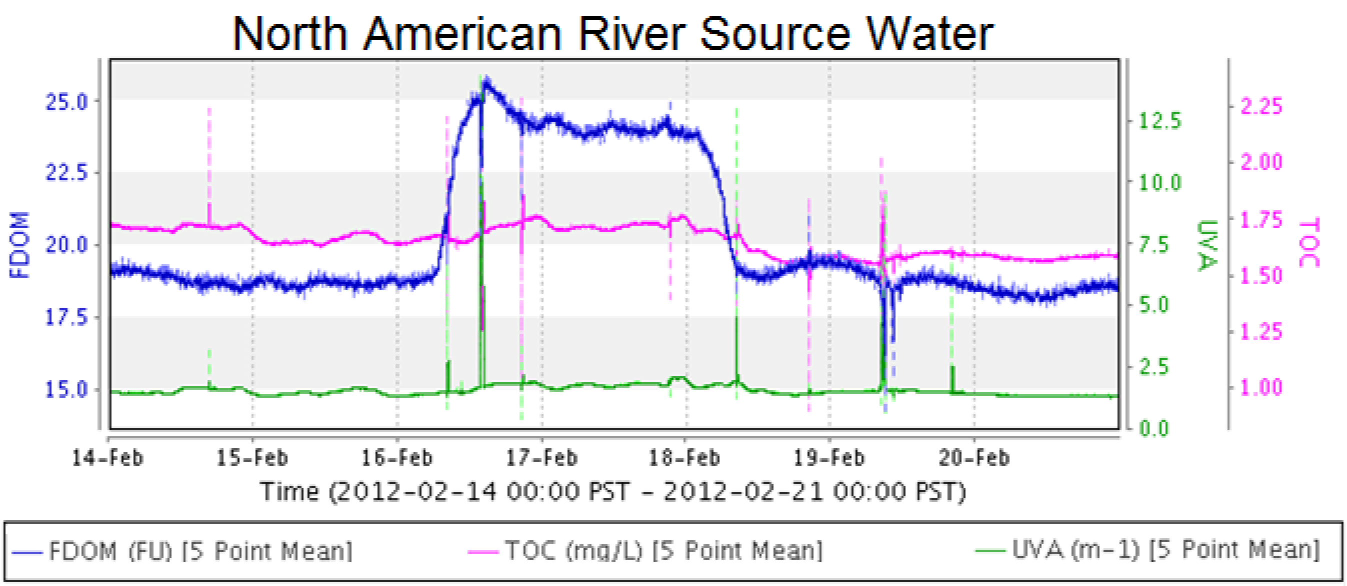
Such exotic cyclic chemicals normally exist in much lower concentrations (on the order of micrograms per liter) than TOC (mg/L) and therefore have a minimal effect on UV absorbance. Fluorescence measurements like FDOM are also more sensitive than absorption measurements of TOC. The combination of these two factors means that while the LiquID Station is extremely sensitive to changes in TOC (±10 µg/L), this level of detectability cannot compete with fluorescent compounds that can be detected at the sub-parts-per-billion level (<1 µg/L) .

Moreover, since the LiquID Station measures FDOM and TOC, it can also produce continuous records of another useful parameter called FTOC which is the ratio of FDOM to TOC. By measuring FTOC, the LiquID Station is able to present a view of how the percentage of man-made chemicals in the TOC mix varies with time. The TOC/FDOM/FTOC combination provides plant operators with a powerful event detection tool, as the following example illustrates.

Real-World FDOM Event Detection

A municipal drinking water treatment plant in the Pacific Northwest was troubled each spring by sudden upsets in the response of their water source to the plant's coagulant and disinfectant dosing schedules. The treatment plant operators originally monitored UVA in their source water in an attempt to get to the bottom of this problem but UVA failed to respond consistently to the bad water events. After installing a **Liqu**ID Station at the plant's intake, the operators were furnished for the first time with continuously-sampled and simultaneous measurements of not only UVA, but also TOC and FDOM.

The chart below is a screenshot from the user interface page that each **Liqu**ID Station provides via a secure web link. It was precisely this FDOM record that allowed plant operators to nail down the source of their plant issues. It all started to come together when previous FDOM anomalies detected by the plant's **Liqu**ID Station seemed to be related to water being pumped by the US Army Corps of Engineers into their source river from a nearby seasonal lake basin. Because the basin was being used in the summer for growing crops, its soil contained a variety of chemical residues which would leach into the rainwater that accumulated in the basin during the winter months. Then, when the dewatering pumps were turned on each spring, the lake basin water would appear in the plant's influent stream and interfere with their coagulant and disinfectant processes.



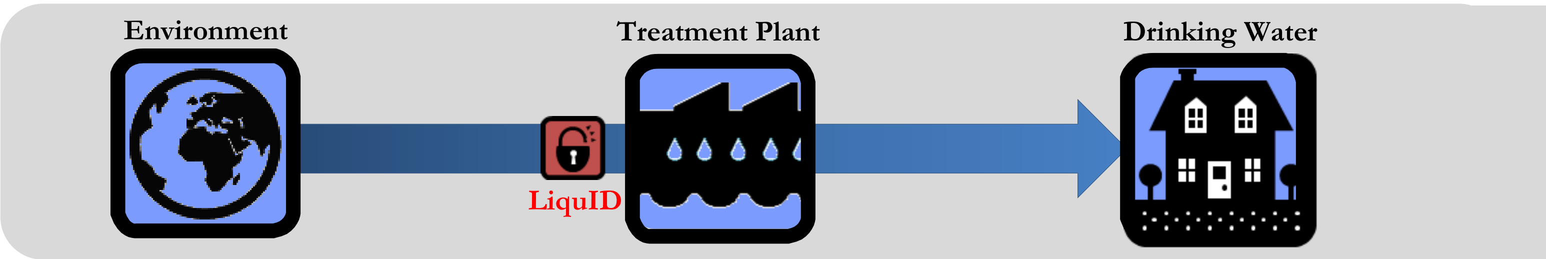
This screenshot is the actual record of an experiment that definitively linked the plant's problem with the pumping activity. To help resolve this issue, the Corps started pumping at a predetermined time. As shown in the screenshot, the FDOM channel (blue line) began a sudden rise late in the morning of February 16th, 2012. Taking the pipeline delivery time lag into account, this time corresponded exactly to when the pumps came on-line. Note that the UVA (green) and TOC (magenta) channels were essentially unaffected by the lake basin water, consistent with previous null results. Finally, late in the morning of February 18th, the pumps were taken off-line and the FDOM signal returned to its baseline level, thus confirming the link between pumping and disruption at the plant. In this way the differential response furnished by the **Liqu**ID Station solved a years-long mystery and enabled the municipal plant to more effectively and efficiently manage their processes.

LiquID™ How It Works

As illustrated in this example the **LiquID** Station's real-time measurements of FDOM and other key parameters provide drinking water and wastewater treatment plant operators with a unique problem solving tool that can furnish better understanding of their plant systems, better protection of human health and the environment, and opportunities for cost reduction via advanced process control. As shown in the rudimentary process diagram below, plants using a LiquID Station at their intake can choose to not take water into the plant when source water is of lower quality.

Immediately upon detection of a water contaminant the LiquID can warn water treatment plant control systems, activating water treatment processes, water diversion equipment, or shut down intake valves or pumps. When possible, such an avoidance tactic can provide a better quality product while saving the additional cost of enhanced treatment.

Contact **ZAPS** to learn how **LiquID** FDOM monitoring will benefit your application.



Contact ZAPS for More Information

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