Case Study

# TOC Monitoring in Non Dairy Milk Alternative Applications

## Problem

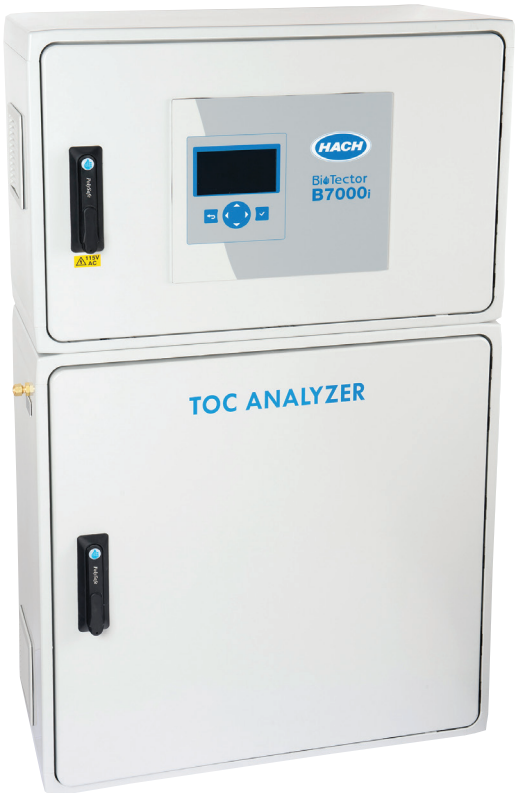
In our forever changing world, we are often challenged with new applications for our current technologies. In this case monitoring organics (TOC) in process water for product quality or process control in a changing product environment. We currently monitor TOC in milk-based products. In this application the use of TOC analysis to monitor Plant- based, milk alternative products for product quality , process control and efficiency, lost product, and wastewater plant loading. How will the instrument perform with these different types of products, how do they affect the performance of the instrumentation?

## Solution

Hach's BioTector B7000i-Dairy TOC analyzer has been used for monitoring TOC in milk product manufacturing for many years with great success. The use of these instruments to monitor TOC in non- dairy milk alternatives has great potential as seen in the data below.

## Benefits

BioTector's use to monitor for TOC levels in different water processes within a plant can lead to better process control, minimize lost product, wastewater plant loading, and asset protection, all lead to a huge benefit in product quality, process control, cost control and profit.




## Background

Three different types of plant based non-Dairy products were tested, Almond Milk, Oat Milk, and Oat Milk Non-Dairy Creamer. Each product will be tested for ability to oxidize, repeatability, and operational needs.

Products will be mixed at 4 different concentrations in ultra-pure water. 1mL per 1000mL, 5mL per 1000mL, 10mL per 1000mL, 100mL per 1000mL.

Each concentration of sample was analyzed using a Hach BioTector B7000i TOC analyzer.

To summarize:

All three products worked great with the BioTector Two-Stage Advanced Oxidation process.

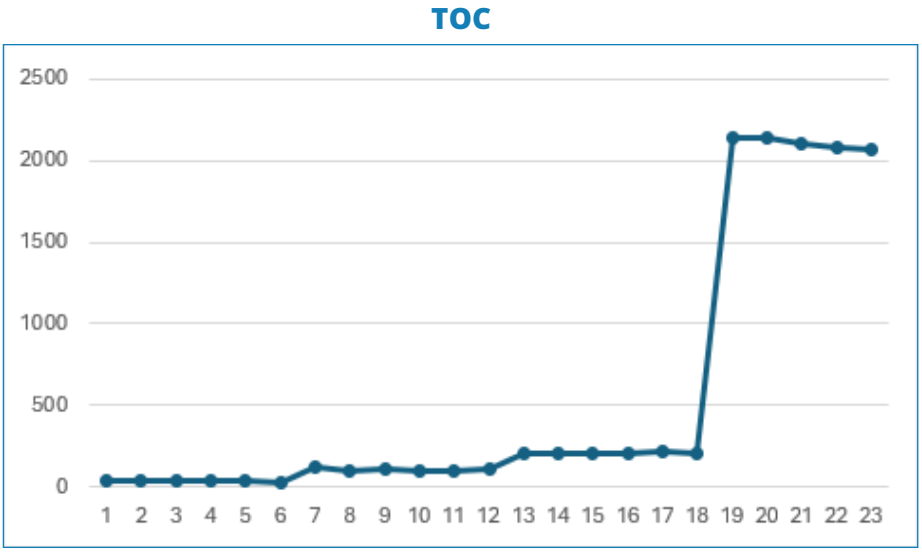
1. We mixed the following concentrations to ultra-pure water from a Millipore system in the lab.
2. The following concentrations were added of each product.

| Product | Water to bring total volume to 1000mL |
|---|---|
| 1mL | 1000mL |
| 5mL | 1000mL |
| 10mL | 1000mL |
| 100mL | 1000mL |

   Oat Non Dairy Creamer was ran in range 2 and range 3 based on results of high concentration sample.
3. After some challenges with settling of product a mixing plate was added to keep solution homogenized (this is a very important step), otherwise variations in readings were apparent.

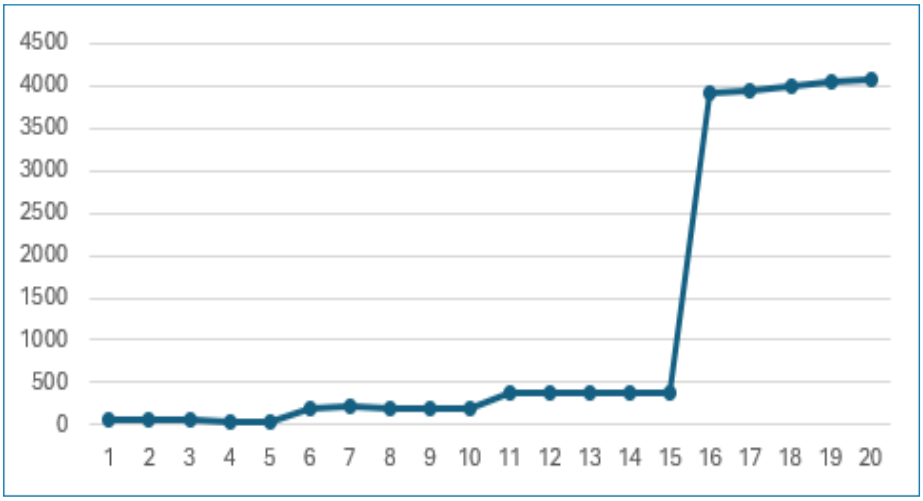
## Almond Milk Results

| TIME | TIC | TOC | Concentration |
|---|---|---|---|
| 10:18:41 | 1.6 | 30.2 | 1mL /mix |
| 10:25:39 | 1.4 | 31.4 | |
| 10:32:36 | 1.3 | 31.3 | |
| 10:39:33 | 1.2 | 32.9 | |
| 10:46:31 | 1.2 | 31.7 | |
| 10:53:28 | 1 | 26.5 | |
| 12:25:02 | 2.7 | 119.1 | 5mL/mix |
| 12:32:00 | 2.5 | 99.8 | |
| 12:38 | 2.4 | 106.7 | |
| 12:45:54 | 2.4 | 97.6 | |
| 12:52:51 | 2.3 | 98.5 | |
| 12:59:49 | 2.5 | 106.7 | |
| 11:10:31 | 6.6 | 205.6 | 10mL/mix |
| 11:17:37 | 6.3 | 201.3 | |
| 11:24:41 | 6 | 203.2 | |
| 11:31:45 | 5.5 | 199.9 | |
| 11:38:37 | 5.4 | 213.1 | |
| 11:45:50 | 5.4 | 207 | |
| | 72.4 | 2135.3 | 100mL/mix |
| | 51.4 | 2135.1 | |
| | 51.2 | 2101.6 | |
| | 50.8 | 2083.7 | |
| | 51.5 | 2066.8 | |



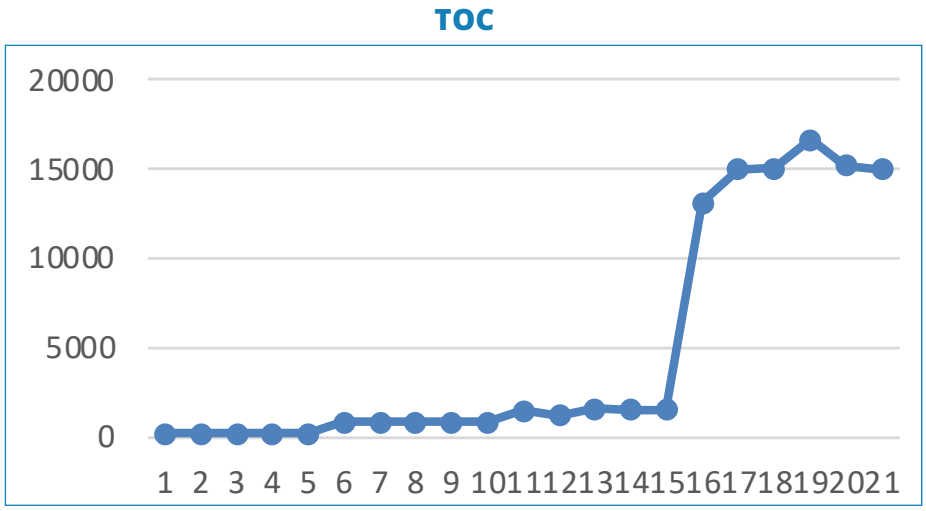

## Oat Milk Results

| TIME | TIC | TOC | Concentration |
|---|---|---|---|
| 9:16:36 | 1.3 | 62.6 | 1mL/mix |
| 9:23:33 | 1.4 | 60.6 | |
| 9:30:30 | 1.3 | 54.9 | |
| 9:37:28 | 1 | 41.5 | |
| 9:44:25 | 1.1 | 43.5 | |
| 11:08:33 | 2.3 | 193.6 | 5mL/mix |
| 11:15:30 | 2.6 | 212.8 | |
| 11:23:32 | 2.7 | 185.4 | |
| 11:30:29 | 2.2 | 200.5 | |
| 11:37:26 | 2.3 | 197.2 | |
| 12:04:44 | 4 | 378.2 | 10mL/mix |
| 12:11:45 | 5.3 | 384.2 | |
| 12:18:55 | 5.2 | 383.4 | |
| 12:25:58 | 5.7 | 386 | |
| 12:57:53 | 5.4 | 378.9 | |
| 13:32:36 | 49.1 | 3908.2 | 100mLmix |
| 13:42:25 | 39.9 | 3936.8 | |
| 13:50:59 | 54.2 | 3988.2 | |
| 13:59:52 | 55.5 | 4045.2 | |
| 14:08:57 | 55.6 | 4082.5 | |



## Oat Milk Non Dairy Creamer Results

| TIME | TIC | TOC | Concentration | |
|---|---|---|---|---|
| 10:09:30 | 6.6 | 196.7 | 1mL/1000 | R-2 |
| 10:16:37 | 6.7 | 195.8 | | |
| 10:23:44 | 7.3 | 194.5 | | |
| 10:30:54 | 7.1 | 191.3 | | |
| 10:37:59 | 6.9 | 189.2 | | |
| 11:20:18 | 10.6 | 847.8 | 5mL/1000 | R-2 |
| 11:27:52 | 11.4 | 852.9 | | |
| 11:35:21 | 11.7 | 861.3 | | |
| 11:43:40 | 12.2 | 863.8 | | |
| 11:51:08 | 12.7 | 854.4 | | |
| 12:28:40 | 7.8 | 1494.4 | 10mL/1000 | R-3 |
| 12:35:38 | 11.3 | 1207.7 | | |
| 12:42:37 | 7.5 | 1562.8 | | |
| 12:49:35 | 6.4 | 1541.6 | | |
| 12:56:34 | 6.4 | 1545.8 | | |
| 13:15:57 | 20.3 | 13143.3 | 100mL/1000 | |
| 13:23:38 | 37.2 | 14993 | | |
| 13:32:25 | 47.4 | 15026.8 | | |
| 13:40:11 | 30.5 | 16658.3 | | |
| 13:47:53 | 73.6 | 15213.9 | | |
| 13:55:39 | 29.9 | 14986.6 | | |




As seen above the 10% concentrated sample of Oat Milk Creamer analysis values were above 15000mg/L of carbon at this level, maximum range of the

I also wanted to test the need for a BioTector Dairy analyzer in this application for the reverse wash due to it being very acidic. Dairy milk can have a curdling affect and coat the inside of the tubing causing cross contamination and or failure of the instrument. The Dairy instrument uses base as a solution to rinse with, causing the product to liquify and flush away. I took 10 mL of product and added 2.5 mL of BioTector acid reagent into the product. Resulted in immediate curdling of the Almond milk and a bit slower but same reaction for oat milk

At the right, you will see the beakers marked with A and B , acid and base mixed with both products. The acid had harsh affects and curdling with both products. Therefor a Dairy analyzer would be a must for this application.

This application will be a great one for the BioTector B7000i Dairy analyzer, caution must be taken to assure good mixing of the sample. We don't offer or have mixers for our sampling systems that we offer currently. With the use of a Venturi sampler this should not be a problem but should be watched. This should be accomplished in the movement of the product in water in the pipe system or in waste channel. Slow moving or still waste streams could show signs of erratic measurements due to settling of product. In a waste stream with multiple products, product loss calculations would not be a viable option.

Milk curdling when mixed with acid

Base solution added resulting in no curdling

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