Case Study: Beverage Plant

Evaluation of ULR Chlorine Measurement Quality during Intermittent Flow, pre and post RO

Background

A major beverage company wanted to ensure that no excess chlorine went into the reverse osmosis (RO) system and that there was no chlorine in the post-RO water going into production. Source water is from the city tap dechlorinated by GAC before being filtered by RO. Demand-driven production flow and intermittent RO operation presented challenging conditions for the analyzer and complicated the data analysis. The target maximum residual chlorine amount in the RO permeate, set by the site, was 40 ppb.

Solution

The Hach Ultra-Low Range CL17sc was installed both before and after the RO skid. The post-RO measurement was more critical to product quality and was the focus of the test. Post RO measurements from the ULR CL17sc (colorimetry) were compared to measurements from the Hach DR1300 FL handheld ULR chlorine meter (fluorescence).

Results

Despite the demand-driven intermittent flow conditions, the data demonstrate that the dechlorination and RO processes are under control and excursions above the target chlorine limit (40 ppb) are infrequent and time-limited (1-2 ULR CL17sc measurement cycles). Spikes in chlorine concentration showed after the flow to the RO system was stopped and then restored and are likely caused by water accumulation in the lines and washing residual chlorine out of membranes (Figure 1).

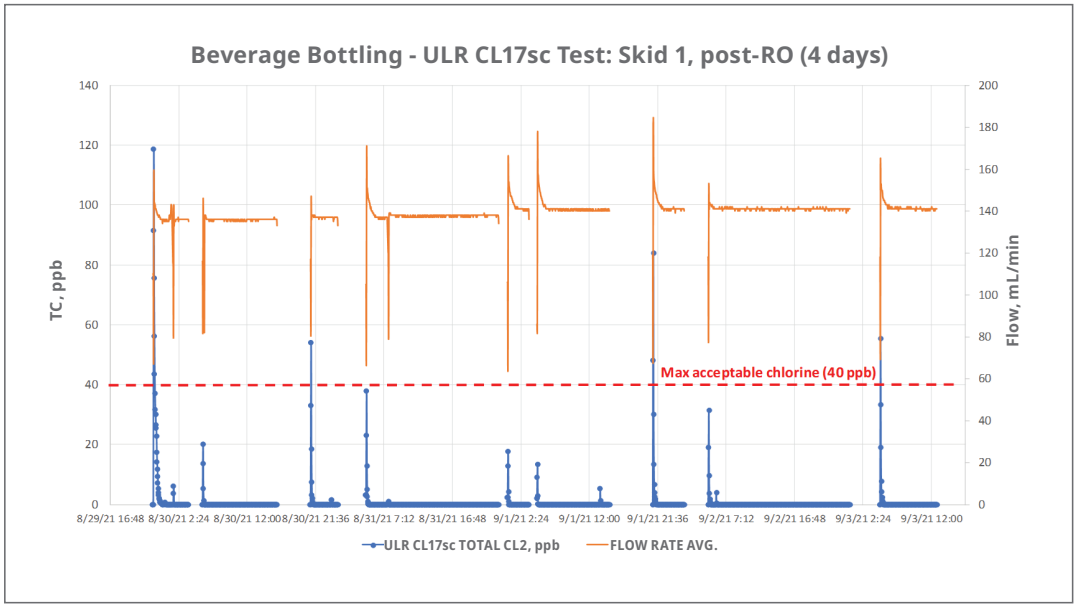

Figure 1. Part of the test with relatively consistent bottling plant operation, as indicated by the flow rate. Maximum chlorine concentration registered during this part of the test was 119 ppb.

Given the infrequent and short-lived nature of such events (2.5 – 5 min), the dilution rate of the elevated chlorine concentrations is significant due to combining effluent from all individual membrane cartridges in a pipe and/or holding/equalization tank prior to bottling, and as confirmed by the average residual. Therefore, the spikes can be ignored when correlated with restart of the RO skid operation. The shorter the periods of no-flow, the lower the observed spikes, so while it is still not detrimental for the membranes or the production water, this issue can be fully resolved by maintaining as continuous operation of the RO system as possible.

The ULR CL17sc measures total chlorine while the DR1300 FL can measure either free, or total chlorine, or bisulfite. The total chlorine measurements between the two instruments were compared (Figure 2), a free chlorine measurement was also taken on the DR1300 FL to confirm the species present in the finished water.

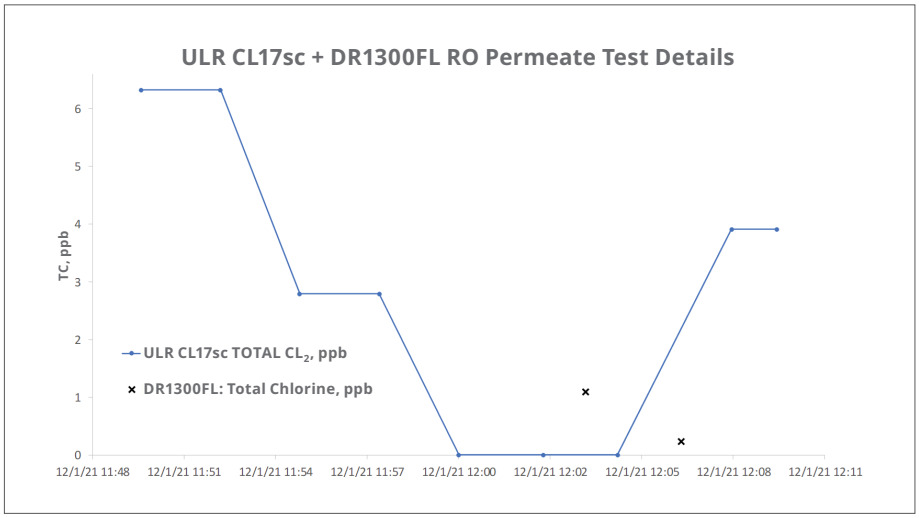

Figure 2. Last readings compared with the grab sample analysis: the difference is well within the sum of LOD's for the two instruments (see Table 1 below)

Table 1. Measurements from both analyzers (same sample, same time)

ULR CL17sc (LOD = 8 ppb)		DR1300 FL (LOD = 2.5 ppb)		
Date/Time	Total Chlorine, ppb	Grab Sample Date/Time	Total Chlorine, ppb	Free Chlorine, ppb
12/1/2021 12:02	0	12/1/2021 12:04	1.09	NA
12/1/2021 12:05	0	12/1/2021 12:07	0.23	NA
12/1/2021 12:10	3.91	12/1/2021 12:10	NA	0.00

The free chlorine test on the DR1300 FL confirmed the absence of this species, indicating a prevalence of chloramines in the water after dechlorination with GAC, which agrees with the general knowledge of such an application. The total chlorine verification test confirmed the accuracy of the ULR CL17sc with a more accurate fluorescent reference method.

The ULR CL17sc has LOD of 8 µg/L (ppb) and accuracy of ±5% or 10 ppb, whichever is greater. The CL17sc has LOD of 30 µg/L (ppb), and accuracy of ±5% or 40 µg/L (ppb), whichever is greater. Depending on your targeted chlorine level, specified LOD or accuracy yields actionable insights and provides confidence that you are below your residual target. Without such confidence tied to the right specifications, you may be breaching your target, putting your system at risk, or incurring additional cost by overfeeding dechlorinating chemicals.

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