



## Reverse Osmosis Reject Water in Beverage Production

# Online Total Nitrogen analysis of Reverse Osmosis Reject Water Reduces Permit Compliance Expense by \$350,000 Annually at Beverage Bottling Plant

### The Problem

A beverage production plant operated by a leading contract bottler in the northeastern United States was struggling with the high cost of permit compliance related to Total Nitrogen limits in their effluent.

The facility's reverse osmosis (RO) treatment concentrated nitrogen in the RO reject stream. To stay compliant the plant hauled off accumulated reject water on a daily basis to an advanced treatment facility 9 miles away to avoid discharging directly to the local public works. However, the influent nitrogen concentration in city make-up water varied considerably on a seasonal basis, leading facility operators to question how often reject haul-offs were truly necessary to stay within compliance.

### The Solution

A Hach EZ colorimetric Total Nitrogen analyzer was installed in line with the reverse osmosis reject stream. Following commissioning, the analyzer provided operators with total nitrogen concentration values every 30 minutes.

Automation was configured such that when the nitrogen value was below the permit limit the RO reject would be reliably directed to discharge. When nitrogen exceeded the permit limit a relay triggered an automated valve to divert the reject into a calamity tank for haul-off and advanced treatment. The nitrogen analyzer uptime was maximized through strong customer ownership and partnership with the Hach sales and service organizations and the collective desire to protect the community and the environment.



### The Results



Annual reject haul-off volume projected to be reduced by **18M gallons** based on seasonal variability of elevated nitrogen content.



Annualized cost savings of the reduction in daily wastewater haul-off loads projected to be **\$300,000**.



Saved over **\$50,000 annually** in permit non-compliance fines and surcharges associated with effluent nitrogen concentration.

### Background

The vast majority of 10,000 bottling facilities in North America employ multiple stage reverse osmosis treatment to ensure consistent high quality ingredient water is available for finished beverage production.

While incoming city-makeup water treatment reliably provides water with nitrogen content below the requirement for a drinking water standard, seasonal variability of nitrogen nonetheless persists primarily due to the impact of agricultural fertilizer presence in runoff during warmer months.

When trace amounts are concentrated as part of reverse osmosis reject, the resulting stream can result in total nitrogen loading above what a local public works can readily accept in large volumes and remain biologically balanced. Until such technology is widely adopted the nearest wastewater treatment facility capable of advanced nutrient removal may require over-the-road hauling.

### Challenge

The plant withdrew 300,000 gallons of city make-up per day, with approximately one-third of the volume rejected by reverse osmosis. The site had limited on-site storage capacity for wastewater, resulting in a daily operation to transfer the tank volume into a tanker operated by a licensed hazardous waste transportation operator at a cost of \$1,200 per day. Any deviations in the tanker haul-off schedule ran a high risk of either a production disruption or a discharge permit violation.

The site is permitted for a limit of 10 ppm daily average of Total Nitrogen from the reverse osmosis reject water. While the site operated a wastewater pretreatment system (mixed liquor / activated sludge) it did not effectively remove nitrogen from the reject stream, leaving permit compliance at risk. The site environmental compliance staff cited the annualized historical fines associated with permitted nitrogen level exceedances to be between \$30,000-\$50,000 dollars or more.

## Setup

The plant reached out to the local Hach representative with which they had existing partnerships on laboratory and other wastewater monitoring solutions such as chemistries and autosamplers. The Hach representative worked with the plant staff to define the problem and bring in additional resources to design solutions for the Total Nitrogen monitoring requirement.

The plant installed the Hach EZ Total Nitrogen analyzer to sample the reverse osmosis reject stream, upstream of a three-way automated valve. The signal output of the analyzer was connected to a logic controller programmed to operate the valve based on the measured nitrogen value. If the value was above the permit limit the valve would divert flow to the calamity tank. If the value was below the permit limit the valve diverted flow to the onsite wastewater treatment and ultimately to the public works.

The facility also employed Hach Field Service Partnership to commission, optimize, periodically calibrate and maintain the instrument on-site. During initial observation following commissioning the team addressed salt accumulation in the digestion vessel by adding a cleaning cycle to limit frequent cleaning which would otherwise be necessary to ensure instrument uptime. This additional step resulted in a low maintenance burden consisting only of reagent replenishment.

While there are several analytical techniques to monitor Total Nitrogen it was critical in this circumstance to select one which could be validated with offline and outside laboratory analysis. The EZ employs a colorimetric measurement at 546 nm using hydrazine reduction and N-(1-Naphthyl)ethylenediamine dihydrochloride (NEDD) color solution after persulfate digestion in alkaline medium, which conforms with American Public Health Association (APHA) Method 4500-N Standard Methods for the Examination of Water and Wastewater. In this method the determination of the total nitrogen concentration in water is based on the reaction of nitrate with color reagent in an acidic medium to form an intense, blue-colored complex. With the obtained absorbance values, the total nitrogen concentration is calculated according to Beer's Law (light absorption is directly proportional to path length and concentration of the solution). Ultimately the method is a true digestion which can be validated with offline and outside laboratory analysis.



Figure 1. Hach EZ sc analyzer

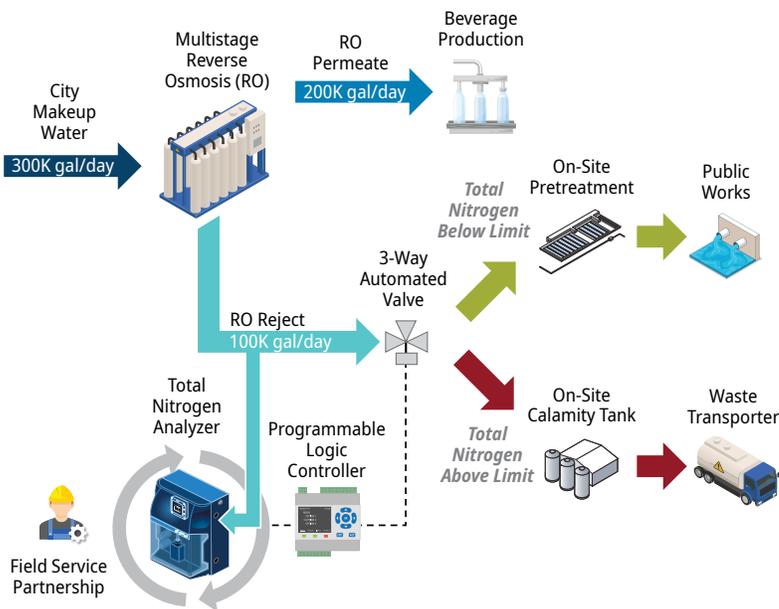


Figure 2. Installation diagram

## Results

Following analyzer commissioning, the plant was able to immediately reduce the reject volume sent to the calamity tank after communicating measured values with the local permit regulator. Annual reject haul-off volume projected to be reduced from 36M to 18M gallons, based on seasonal variability of elevated nitrogen content.

Annual cost savings of the reduction in daily wastewater haul-off loads projected to be \$300,000 assuming direct discharge is permissible for six months of a full year.

Additionally, the plant was able to avoid risk of future penalties and surcharge payments associated with permit exceedance events related to effluent nitrogen concentration. In the 12 months prior to the analyzer's installation this amount was approximately \$50,000 and historically ranged between \$30,000 and \$50,000 per year.

## Perspectives

Managing accumulated contaminants in RO reject streams can be burdensome if local wastewater facilities are not able to readily accept the streams. Real-time monitoring of streams using validated and verifiable analytical techniques can provide the RO operator additional flexibility for managing RO reject compliance in the most cost-effective manner.



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DOC043.53.30860.Oct25