

CASE STUDY
City of Enumclaw Wa
RH2 Engineers

By Mark Nelson, Force Flow

CHEMICAL DILUTION SYSTEM SAVES MONEY AND INCREASES SAFETY



Like buying orange juice and detergents, water treatment chemicals are almost always less expensive to purchase in higher concentrations. Unfortunately, feeding high strength chemicals into process water can create problems for the water treatment operator. These problems may stem from things like extremely low feed rates, chemical off-gassing, hard process water and safety or regulatory concerns in handling high strength chemicals. An innovative engineer and a determined Northwestern city set out to solve these problems with a chemical dilution system that met both their budget and design criteria.

Safety & maintenance concerns with high strength caustic

Early in 2001, the City of Enumclaw, WA hired RH2 Engineers in Bothel, WA to design a pH control system for their main water treatment plant. Project engineer Dan Mahlum was given the task of creating a safe, reliable and cost effective caustic (sodium hydroxide) feed system for the city. Having designed caustic feed systems in the past, RH2 knew that chemical suppliers typically deliver caustic in the range of 25-49% strength chemical. Although it is far more cost effective to purchase this chemical in these higher strengths, RH2 and the City of Enumclaw had some safety concerns about operating and servicing a chemical feed system with high strength caustic. In addition, RH2 felt that high strength caustic could cause feeding problems because it freezes at temperatures below 55 degrees, and scaling could be an issue at the process injection point due to the hardness of the process water. It was therefore decided to feed low strength caustic in the range of 5-10% strength.

Buy chemicals, not water

In order to feed low strength caustic, the city had three

choices: (1) purchase low strength caustic which is mostly water (2) manually dilute high strength caustic when it arrives on site or (3) devise an automated chemical dilution system to reduce the caustic strength on site. Option 1 was quickly disregarded when the City realized that purchasing pre-diluted chemical would be far too costly due to the transportation costs in shipping a product that is mostly water. In addition, many chemical companies are reluctant to dilute raw caustic due to the exothermic reaction that takes place when mixing caustic and water. Option 2 (manual dilution) was disregarded because it was labor intensive, could potentially produce inconsistent results, and would further expose operators to the dangers of high strength caustic. It was therefore decided to go with an automated dilution system.

Weight based batching system

Having used weighing systems to monitor chemical tanks in the past, RH2 Engineers knew that a weight based system would be extremely accurate and reliable. They therefore contacted Force Flow Inc in Concord CA in regards to providing a weighing system and controller that would allow caustic and water to be automatically batched into a

dilution tank by weight. Among the most important design criteria were (1) The ability to accommodate different starting and ending solution strengths, (2) System accountability through inventory control and process alarms (3) Accuracy and consistency of the diluted chemical strength and (4) Safety & Redundancy in the event that the dilution system should fail.



Any strength at the touch of a button

With prior experience in designing dilution systems, Force Flow was able to accommodate all of the City's needs through some minor changes to existing hardware and software. Force Flow's Merlin Dilution Controller automatically calculates the necessary amounts of water and caustic based on the chosen

beginning and ending chemical strengths. The system was designed for the operator to easily accommodate different "neat" (beginning) caustic strengths at will. If the City of Enumclaw changes chemical suppliers or if their current supplier changes the strength delivered, they can easily accommodate this at the touch of a button. Additionally, it is just as easy to change the diluted (ending) strength of the caustic. If process conditions change or if the city needs to fine tune what strength is easiest to feed to their water stream, they can do so at the touch of a button. Another benefit to this flexibility is the fact that the city can keep the metering pumps operating in their "optimum" range simply by adjusting the chemical strength.

Inventory control & process alarms

Because the Department of Health requires the City of Enumclaw to track their caustic usage and compare it to their water flow, detailed accounting of chemical usage was extremely important. By tracking nine different variables such as chemical usage, feed rates and remaining chemical quantities, the Merlin dilution controller is able to give the City of Enumclaw a full accounting of their chemical feed and dilution process. In addition, by tracking throughput and using

timers to track the dilution process, six different process alarms give operators early warning of potential problems with their caustic feed system. Remote monitoring of chemical feed rates and remaining chemical supplies is accomplished through 4-20ma signals.



Redundancy

Because this plant is the sole source of the city's water supply, RH2 wanted a fully redundant and fail safe system that would allow continuous operation in the event that a failure occurred. The answer to this was found in using two separate dilution systems, each with separate controllers. An auto switchover valve was used

to alternate between each of the two systems. If one bank ever is down for maintenance, the system can be diverted to the working system until repairs can be made. This redundancy paid off for the City of Enumclaw in the first few months while they worked through some programming and hardware bugs.

Conclusion

The city of Enumclaw's concerns about operator contact with high strength caustic, and potential maintenance problems due to scaling and crystallization were alleviated through feeding a low strength caustic solution. By devising an automated onsite chemical dilution system, the city was able to avoid the cost of purchasing pre-diluted chemical, eliminate the labor and safety concerns that manual dilution would demand, and integrate inventory control and process alarms to make their system safe and reliable for many years to come.

Mark Nelson is a process sales engineer for Force Flow Inc in Concord CA. For more information on this case study or other chemical dilution systems, he can be contacted at 800-893-6723 or mark@forceflow.com.