

Case History Report

Operation of Cooling Systems with Soft Makeup Water and Zero Blowdown

CHR 02/05

Problem

A steel forging plant in Northwest Pennsylvania had their effluent limitations decreased during a routine discharge permit renewal. Past practice at the plant had been to simply discharge the blowdown directly to stream. The more restrictive effluent limits in the revised NPDES wastewater discharge permit would have required the plant to install an expensive treatment system to treat the blowdown to consistently meet the new effluent limits.

The discharged wastewater was produced during the manufacture of steel forgings by the cooling towers used to provide recirculated cooling water to air compressors, electrical induction furnaces, and hot steel forges. The wastewater consisted of cooling tower blowdown, cooling water discharged to storm sewer to control the level of dissolved hardness solids in the cooling water. Blowdown is required with typical water treatment chemistry programs to prevent the formation of hardness scale and remove insoluble solids from the cooling water system.

Solution

ProChemTech was requested to investigate the potential for operating the twelve (12) installed cooling tower systems with zero blowdown, thus eliminating any discharge of wastewater. Following an evaluation of the makeup water quality and plant cooling systems; a new water management program based on use of softened makeup water with appropriate water treatment chemistry, bypass filters, and chemical feed controls was designed. As softening the makeup water removed all scale forming minerals from the cooling towers, the major problem to be addressed was corrosion due to the use of soft water and the very high levels of dissolved salts resultant from zero blowdown operation of cooling towers. Using proprietary PCT SOFT™ water treatment chemistry eliminated this problem as it is designed to provide corrosion free operation of cooling towers at high dissolved solids levels while using 100% cation exchange softened makeup. Sidestream filtration was provided to control buildup of suspended solids in the cooling water, while the existing conductivity "feed and bleed" blowdown and chemical feed systems were replaced by ProChemTech makeup proportional chemical feed systems to insure accurate SOFT™ chemical inhibitor feed.

The zero blowdown water management program design was accepted and all twelve (12) of the cooling tower systems at the plant were converted to operate as "**zero discharge**" systems using a new central dual tank water softener, proprietary chemistry, bypass filtration, and chemical feed control technology provided by ProChemTech.

Results

Following conversion in December, 1992, the plant cooling tower systems were operated as zero blowdown units for the next eight (8) years with no scale, corrosion, deposition, or microbiological problems. Due to blowdown elimination, plant operating costs for water treatment chemicals and makeup water were **decreased by approximately 75% and 20%**, respectively.

The environmental problem was eliminated as the "zero blowdown" status of the cooling tower systems **meets all present and possible future discharge limits.**

The following table summarizes analytical data from four high cycle "zero discharge" cooling tower systems at this plant in April, 1993.

Parameter	Makeup*	CT#955	CT#365	CT#334	CT#381
pH su	7.60	9.65	9.68	9.36	9.03
total alkalinity mg/l	82	4000	4875	3600	1700
conductivity mmhos	375	42,600	25,000	18,000	8,000
iron mg/l	0.03	0.14	0.06	0.04	0.14
copper mg/l	< 0.02	0.15	0.14	0.03	0.03
chloride mg/l	62	4520	4650	2945	1150
sulfate mg/l	48	2550	3224	2020	881
dissolved solids mg/l	248	18,912	18,052	11,436	5,192
cycles on conductivity	-	113.6	66.7	48.0	21

* Note, makeup water is cation softened well water which has a hardness of 131 mg/l as CaCO₃.

Please note that the reported cycles show substantial variation between the various cooling tower systems as several design cooling towers are in use. The plant is presently equipped with Marley NC, BAC FXT, BAC V Series, and BAC Educator type cooling towers. Windage loss varies substantially between these different designs and accounts for the difference in the cycles obtained.

The plant was expanded due to increased production levels after start of our water management program, resulting in addition of several new cooling tower systems. As operation with softened water with no blowdown results in a high pH, very alkaline cooling water, "white rust", an accelerated form of galvanized metal corrosion was a concern. "White rust" corrosion in these new galvanized cooling towers was controlled by addition of our "**ZincGard**™" white rust inhibitor to the basic SOFT™ chemical treatment program.

The exclusive ProChemTech SOFT™ water chemistry had its beginnings in 1984, when softened makeup water was used to address severe scale problems on recirculating cooling tower systems providing cooling water to large, very high temperature glass melting furnaces. Application of the softened makeup water eliminated the scale problem, but caused a high corrosion rate problem. This corrosion problem lead directly to the development of the advanced corrosion control chemical technology used today in our soft makeup water management programs.

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