Ice Cream Plant Recycles Process Water as Boiler Feedwater and Saves $47,307

NALCO Water
An Ecolab Company

CASE STUDY – FOOD & BEVERAGE

CH-1720

SITUATION

Following Nalco Water's Six Service Standard approach of conducting routine monthly service calls, the sales engineer determined that the plant's condensate quality was inconsistent over time. The observed intermittent condensate hardness spikes with a monthly average 7 ppm indicated a problem that required further investigation which the sales engineer knew from Nalco Water's Boiler Best Practices and the ASME (American Society of Mechanical Engineers) Guidelines. Figure 1 illustrates the range of condensate hardness spikes in the ice cream plant. High level condensate hardness results in boiler scale and a loss in fuel efficiency. Even more importantly, it has the potential to cause an unscheduled boiler shutdown impacting production and cost of operation.

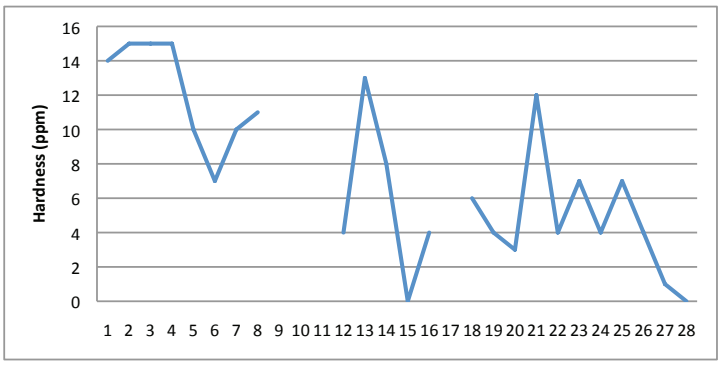

Figure 1 – *Process Condensate Hardness Levels Over Time*

Customer Impact	eROI℠	Economic Results
11 million gallons of water saved	WATER	Savings of $41,462/year
14,072 MMBTU of energy saved annually	ENERGY	Savings of $25,714/year
CO_2 emissions reduction of 351 tons/year	AIR	

eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.

(Continued on Reverse Side)

At this southern ice cream processing plant, the sales engineer and his customer began to investigate this high level of condensate hardness so an action plan could be developed to address the problem. This boiler house has three boilers; Johnston fire tube boilers, operating at 125 psig to produce on average 21,000 lbs. per hour of steam for 24 hours, 7 days a week. These boilers used approximately 205,513 MMBTU of natural gas as the fuel source with an average fuel cost of $3.90 per million BTU. The boiler pretreatment consisted of sodium zeolite softeners which were consistently producing low hardness makeup water along with a well-functioning deaerator. Since there was 88% condensate return or approximately 55,000 gallons, the feedwater quality was highly variable.

SOLUTION

The local operator worked with Nalco Water to track all the condensate streams coming into the main condensate receiver in the boiler house. They discovered that, due to sustainability efforts to reuse and recycle water within the plant, a decision had been made to connect all of the process water to be returned to one of the two main condensate receivers in the boiler house.

According to the ASME guidelines, fire tube boilers operating under 300 psig require feedwater hardness to be less than 1 ppm. If the process condensate hardness level is so high that when it is blended with the NaZe boiler makeup water it results in high feedwater hardness levels of greater than 1 ppm, the process condensate either needs to be dump or polished. Since the feedwater hardness level is frequently higher than 1 ppm ASME guideline, the local Nalco Water sales engineer recommended that the plant install a condensate polisher. The condensate polisher would allow this plant to consistently recycle 30,831 gallons per day or approximately ~257,136 lbs per day of process water back to the boilers taking the current boiler cycles from 18 up to 50. As a result, the plant would enjoy savings of $48,200 in energy, water and sewer costs associated with boiler blow down. The cost of the condensate polisher was $35,000.

Nalco Water also informed the plant management team to expect to see boiler scale when the boilers are taken offline for annual inspection.

Energy Loss Due to Scale Deposits*

Scale Thickness, inches	Fuel Loss, % of Total Use		
	Scale Type		
	"Normal"	High Iron	Iron Plus Silica
1/64	1.0	1.6	3.5
1/32	2.0	3.1	7.0
3/64	3.0	4.7	-
1/16	3.9	6.2	-

Note 1: "Normal" scale is usually encountered in low-pressure applications. The high iron and iron plus silica scale composition results from high-pressure service conditions.

Note 2: These energy losses are for firetube boilers that are not equipped with stack gas heat recovery equipment such as feedwater economizers or combustion air preheaters.

As expected, when the boilers came down for their annual inspection, there was fresh 1/16" boiler scale from the incoming hardness. According to the Department of Energy, fire tube boilers with 1/16" see a 3.9% reduction in boiler efficiency.

Based on an annual fuel usage of 205,513 MMBTU with the average fuel cost of $3.90/MMBTU, a 3.9% loss in boiler efficiency costs approximately $31,258 in fuel. Since the boilers ran for approximately six months with this intermittent hardness issue, the boiler efficiency costs should be half the annual cost - $15,629. The local Nalco Water sales engineer recommended an acid cleaning prior to the boilers being returned to service in order to recovery the boiler efficiency loss and ultimately to protect the boilers from future boiler failure due to long term overheating associated with boiler scale. The cost of the boiler acid clean was $1500.

RESULTS

Through consistently applying the Nalco Water Six Service Standards along with understanding Boiler Best Practices and the ASME guidelines, this local Nalco Water sales engineer was able to identify a serious problem and put a plan in place to address the feedwater hardness contamination issue associated with reusing process water as boiler feedwater. This customer was able to save approximately 11 million gallons of boiler make up water with an annual cost savings of $19,978) by recycling their process water as boiler feedwater. The total savings of $83,807 minus the cost to capture these savings ($36,500) gives the customer a net savings of $47,307. Nalco Water was able to optimize this plant's total cost of operation along with providing better asset reliability and help the plant achieve their sustainability objective of plant water usage reduction.

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