ZETA CORPORATION

Biofouling Solutions for Industrial Fluid Systems

Zeta Rods® improve legionella control in steel mill cooling towers

June 2001, Bilbao, Vizcaya, Spain:

Nervacero steel mill is located near the city of Bilbao in the Basque territory of Vizcaya. The mill has an electric furnace with a feeder for the pre-heating of scrap metal, and a production capacity of one million tons of liquid steel per year. The mill produces billets of different geometries and corrugated round rods of different diameters for reinforcing concrete in construction[1]. The mill has five independent cooling systems:

- Circuit I: The primary cooling system has a total recirculation flow rate of 18,000 gpm servicing the furnace, and the air purifier. The tower has a 1million gallon hot water sump, and a 1 million gallon cool water sump.
- Circuit II: Provides cooling to the continuous casting process and has a recirculating flow rate of approximately 4,000 gpm.
- Circuit III: Provides cooling to the rolling mill process. It has a recirculating flow rate of 4,585 gpm.
- Circuit IV: Tempcore system. Provides high-pressure water to cool down the hot round rods with a recirculation flow rate of 4,850 gpm.
- Circuit V: The newest of the cooling systems was commissioned in the summer of 2001. It is an expansion of the Circuit I and provides cooling to the continuous casting process with a recirculation flow rate of 5,731 gpm.

Cooling tower make up water is sourced from a nearby river, and is of excellent quality.

The Problem

Given the high quality of the make up water, the Nervacero mill has never encountered scaling problems in their systems; instead, biofouling control has been the primary challenge. Tight federal and local regulations on legionella make biological control in cooling towers an issue of primary importance. Local authorities make routine inspections to industrial cooling towers in the

[1] Data obtained from Nervacero's website: www.Nervacero.com

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region looking for legionnella bacteria. Companies can receive warnings, high penalties or forced shut- downs if legionnella bacteria is found and not controlled.

Attempting to meet strict standards, Nervacero was treating their cooling water systems with a combination of a chemical biodispersant and sodium hypochlorite.

Chronology:

December 1999

By the end of 1999, in spite of the chemical treatment, Nervacero was still getting random positive readings for legionella in their cooling systems. The chemical supplier recommended doubling the dosage of the products to solve the problem. At that point, plant engineers at Nervacero decided to install the Zeta Rod System.

Jan 2000

Circuit IV Tempcore system was chosen for an evaluation. A Zeta Rod system consisting of eight Zeta Rods (model ZR24S) and two power supplies (model ZRPGM) was installed. Four of the Zeta Rods were installed in the hot water basin and the other four were installed in the cool water basin; each set utilized a common power supply.

April 2000

Zeta equipment was installed in late April of 2000.

July 2000

During the annual shut down, while doing some repair work to the structure of the cooling tower in circuit IV, the fill of the tower caught on fire. Nervacero installed temporary spray bars to remove some of the heat from the system, and combined water from circuit IV with the water of circuit III.

December 2000

Until the event in July, Nervacero recognized the Zeta Rod as having had a positive effect on bacteria control in circuit IV. Nervacero also recognized that the water in circuit IV was being diluted and mixed with that of circuit III, thereby preventing the Zeta Rod from doing its job. In December a Zeta Rod system consisting of eight ZR24S Zeta Rods and two power supplies was installed in circuit III (four electrodes in the cold water basin and four in the warm water basin).

April 2001

Based on results from circuits III & IV, Nervacero decided to install Zeta Rod systems into circuit I and into circuit II. Installation took place in April of 2001. Zeta Rod Systems consisted of eight ZR24S rods and two ZRPGM power supplies for circuit II, and sixteen ZR36S rods with two ZRPGM power supplies for circuit I. Electrodes were divided evenly between the cold water and warm water basins in each circuit.

June 2001

A new cooling system (circuit V) is commissioned at Nervacero and a Zeta Rod system consisting of six ZR24S Zeta Rods and two ZR36S Zeta Rods, powered by one ZRPGM power supply was installed prior to the start up date.

Conclusion

Nervacero was able to totally eliminate the addition of the chemical bio-dispersant and the consumption of Sodium Hypochlorite was reduced by approximately 50%. The mill has not had a positive test for Legionella bacteria since the implementation of the Zeta Rod systems.

Bacteria Counts Data

The following is the general bacteria data that was collected throughout the evaluation period. There are several sources of this data:

1. Data obtained on site using a HMB IV tester produced by Biotech International Inc. This instrument produces two numbers: a Biomass Readout (BMR) based on the oxygen generated from the reaction of any biomass (living and dead) with the reagents used by the instrument; and approximate bacteria count (cfu/ml) extrapolated from the BMR readout.
2. HACH total aerobic bacteria paddle testers
3. Plate counts conducted by a third party microbiology laboratory chosen by Nervacero.

	HMB IV				HACH		LAB		
DATE	BMR[2]	Cfu/ml[2]	BMR[3]	Cfu/ml[3]	TAB	Y&M	Y&M	TAB	Circuit
03-08-00[a]								$2x10^6$	IV
04-25-00[b]							0	0	IV
05-15-00							0	0	IV
05-18-00							6	$5.3x10^4$	IV
06-01-00[c]							0	58	IV
06-07-00	0.12	$1.1x10^4$	.025	$2.2x10^3$	0	0			IV
06-09-00	.13	$1.5x10^4$	.025	$3.0x10^3$					IV
06-10-00	.13	$1.5x10^4$	.025	$3.0x10^3$					IV
06-12-00[d]	.13	$1.5x10^4$	.025	$3.0x10^3$	0	0			IV
06-13-00	.31	$4.35x10^4$	.062	$8.7x10^3$					IV
06-14-00	.28	$3.6x10^4$	.056	$7.2x10^3$					IV
06-16-00	.26	$4.37x10^4$	.052	$8.7x10^3$					IV
06-19-00	.27	$3.3x10^4$	.054	$6.6x10^3$					IV
06-21-00							0	320	IV
	.27	$3.5x10^4$	.054	$7.0x10^3$			0	0	IV
	HMB IV				HACH		LAB		

[2] BMR & cfu's calculated before adjusting for Sodium Hypochlorite content in the water.

[3] Adjusted for hypochlorite content

DATE	BMR[4]	Cfu/ml[2]	BMR[5]	Cfu/ml[3]	TAB	Y&M	Y&M	TAB	Circuit
06-26-00[e]							0	$1x10^3$	IV
07-07-00[f]								12000	III
07-14-00								512	III
09-01-00								140	III
09-07-00	.28	$3.3x10^4$	.06	$3x10^3$					IV
09-14-01[g]								37000	III

Notes:

a. Performed biocide shock to the system
b. On 05-08-00 hypochlorite feed was reduced by 50%
c. On 05-23-00 hypochlorite was reduced to 20% of original rate
d. Biodispersant reduced to 25% of original rate
e. Test for legionella on circuit IV gave 0 cfu/ml. Biodispersant at this point had been completely removed.
f. During July 2000 circuit IV was down for maintenance, and it is when the fill burned down.
g. Biocide and biodispersant pumps failed on circuit III

[4] BMR & cfu's calculated before adjusting for Sodium Hypochlorite content in the water.

[5] Adjusted for hypochlorite content