BLAST FURNACE GAS SCRUBBER COOLING WATER SYSTEM CLEAN AFTER 9 YEARS NEGLIGIBLE CORROSION/SCALE

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ABSTRACT

This report details two successful and unprecedented tests of HYDROLATOR'S application of a proprietary intense magnetic field to produce an electric charge in a blast furnace cooling water system to control corrosion, fouling, energy waste, and plant deterioration. At the same time, an improvement in drop out rate has been reported along with clarification of the cooling water and an improvement in the de-watering process. Finally, environmental impact is lessened because no chemicals are used except ph control and, without chemicals, the attendant high cost is avoided.

HYDROLATOR'S HISTORY

Since 1986, I've worked with a steel company to demonstrate my technology in a variety of applications. The first provided de-scaling relief for 2 hot lime slaker systems which previously required extensive and expensive clean out of piping and storage tanks which fouled heavily with lime scale. The results of installing HYDROLATOR's electric water treatment system were to provide immediate cost relief and man hours savings. The system ran scale free until the company switched to bag lime in 1989. In late 1990, 1 was invited to demonstrate again, this time on the recirculating ammonia liquor recirculating primary cooling and flushing systems Serving the coke oven batteries. Again, a dramatic improvement was seen in these operations (see Technical Bulletin, "Elimination of Naphthalene Fouling in Coke Oven Process" 12/1/91). The following report details two tests of my technology on a blast furnace gas scrubber cooling water system.

BACKGROUND BLAST FURNACE GAS SCRUBBER SYSTEM

Under chemical treatment, this system had suffered from high corrosion and fouling in the past causing down time for repair and cleaning of the cooling towers. Some of the mist eliminator sections had collapsed onto the tower floor; some steel louvre supports disintegrated to the touch and, because of heavy fouling in the distribution mains and nozzles, the more efficient Marley down spray nozzle system was abandoned early due to plugging by scale, and larger and less efficient nozzles were installed to deal with tower fouling under chemical treatment. This, in turn, resulted in increase in cooling tower fan energy use in both cooling towers. Further, increased pump pressure had from time to time raised costs of energy and pump maintenance. These flow restrictions had also forced use of additional pumping to increase pressure to the cooling tower, also increasing operating costs. In addition, chemical residues had added to waste treatment load and EPA compliance concerns. Since 1990, grab sample corrosion readings using a Rohrback Casasco Corrater #9000 ranged from 10 mpy to 50 mpy with averages around 15 mpy. This average data for general corrosion and pitting correlated with the customer's knowledge of corrosion levels known to exist over the years. At one point (1991) a 50 mpy spike or excursion reported by HYDROLATOR alerted operators to a chemical feed problem which was corrected.

JUNE 21 TO JULY 17; 1993 - HYDROLATOR'S FIRST TEST -

Based on my successful track record at this site, HYDROLATOR was invited to test on the 10,000 gpm, 3.5 million gallon gas scrubber cooling water system which de-waters 60-70 tons of blast furnace emission daily. On June 21, 1993, HYDROLATOR installed a window sill array of magnetic racks in the cooling tower exiting water stream to test for control of this system, utilizing the most powerful and concentrated magnetic field ever designed for industrial use. All chemicals previously fed except sulfuric acid for ph control were cut off. On July 15, 1993, Corrater samples (12 readings) averaged 12.4 (general corrosion) and 5.58 for pitting (index value only) indicating a down trend despite very active descaling and dissolution of chemically bound scale which can keep corrosion values elevated during early stages of system clean up. By July 17; corrosion readings were averaged to 2.2 mpy (general) 1.4 pitting, indicating excellent level of corrosion control. Heavy descaling was observed during the HYDROLATOR test, thickeners became overloaded on two occasions, but these "crud bursts" did not foul cooling towers as was previously feared. Cooling tower pump pressure remained within spec and system operation was not otherwise adversely affected. Under chemical treatment, settled sludge had a darker, gummy feel and 1.03 to 1.1 SPG. During HYDROLATOR's test, sludge was observed to have a "drier" or cleaner feel to it. When a bucket of this sludge was poured onto a hard surface, it "de-watered instantly, like beach sand." Color was lighter and density increased to 1.3 to 1.4 SPG. Underflow dropped from 80-85 gpm to 65 gpm, but pumps were unaffected as sludge was loose and flowed easily. Some sedimentary fouling did occur in transport piping during the test, but this was to be corrected later by increasing flow rate through a beefed up transport piping and pumping upgrade. Although suspended solids actually increased to 60-70 ppm, the water appeared to be clearer than with chemical treatment at 30 ppm, giving rise to speculation that lighter particles (up to 40 microns) were making up most of the loading. NOTE: 40 microns is considered by the filtration industry to be the smallest particle size visible to the eye and, according to Bischoffs Canadian expert, "loading by the smaller particles would not abrade the Bischoff Venturi System.."

JULY 17 - 20, 1993 -THE "NO TREATMENT" TEST

On September 14, 1994, a corrosion excursion was measured at 30 mpy indicating temporary loss of CHEMICAL control. Former level of high turbidity was observed: water became black and larger particles again showed up in samples. Corrosion grab samples averaged 20 mpy and higher until June 20, 1994. Just prior to June 21, 1994, samples of fouling scale were removed from cooling tower #12. This deposit was identified as causing decreased flow from early 1994 when additional pumping was required to keep the furnace cooling circuit on line. The difference between the 1993 and 1994 tests is that the 1993 scale did not appear to be in as great a volume as the 1994 scale. Also, the scale samples retrieved revealed thicker, more brittle, but lighter weight formation than the 1993 species and had the feeling of dry toast In fact, the fouling deposit build-up measured in places up to 1 ½"! The back section of #2 cooling tower had plugged shut and the plant went to near trip condition in May, 1994. For two weeks in early June, 1994, the chemical vendor attempted to descale the system, but to no avail. At this time, HYDROLATOR was asked to reinstall. The purchase order read "current situation critical with scale build up, - (HYDROLATOR) needed to resolve(problem)." As for corrosion control under chemical treatment, grab sample data taken with the Corrater 9000 since early 1990 confirmed 15 mpy average base line under the former chemical vendor and 20 mpy between October 1993 and June 1994 under the then current vendor. Both treatment programs also evidenced excursions above 50 mpy which I reported. Some of these readings were witnessed over this period which verified accuracy of my grab sample data when compared with drinking water corrosion rates. All of these readings confirmed high corrosion levels under chemical treatment. Yet, reports from the chemical vendor did not admit to these high levels. In May of 1994, the customer installed his own Corraters on both the cooling and re-cycle circuits and confirmed my grab sample data.

JUNE 21, 1994 TO MARCH 15, 1995 - HYDROLATOR RE-INSTALLED (2ND TEST)

On June 21, 1994 at 7AM, HYDROLATOR's began the seemingly impossible task of simultaneously de-scaling and reducing the high corrosion rates from chemical treatment base line of 20 mpy down to a safe operating range. It took only 10 days from start to bring the scrubber water back into the safe operating range (3 mpy or less) measured during the one month HYDROLATOR test in 1993. A low of.2 MPY was recorded in the cooling circuit within the first month of HYDROLATOR operation! Incredibly, with a Corrater also installed on the re-cycle loop, this data showed reduced corrosion also even though the re-cycle system cross connects to the cooling loop by only 25-30%. This data shows that the HYDROLATOR effect was being felt by the re-cycle loop! At this same time, within 2 weeks of re-installing, clean sections of wall surfaces emerged and the scale formation became softer, wetter and heavier to the touch. In a short time, pump pressures came down and flow increased, thereby avoiding shutdown. To challenge HYDROLATOR'S capability further, the furnace went to high wind on August 10, 1994. Given the fouled condition of the cooling water system in early June, the consensus is that without HYDROLATOR'S demonstrated de-scaling capability, production would have been in trouble. In fact, whereas 7 pumps were required in early June 1994 due to the heavily fouled plant, operators found that the flow rates increased and pumping had to be reduced because of "too much flow to the scrubber." As of March 27, 1995, only 4 of the original 7 were in use. Upon opening the scrubber on 9-13-94, surfaces were "cleaner than previously seen"; also the gas main to the company's power station fire box and the goggle valve were much cleaner than on prior inspections indicating that the HYDROLATOR process apparently does a better job of gas scrubbing than that done by chemicals. The cold well, usually partially filled with sediment, cleaned out entirely during this period. Also, #2 cooling tower rear section nozzles which were blocked with scale were flowing within weeks of HYDROLATOR reinstallation. By this time, both cooling towers were showing about 50% of the interior surfaces bare to metal and the original partition and wall surfaces had never been seen since construction! Of the remaining 50%, the scale still clinging was of thinner dimension averaging ½ to ¾ inches overall. Finally, the weirs cleaned up some months into the test. Shortly after reinstallation, a dramatic change occurred in the TSS profile. Larger suspended particles which were observed in water samples before June 1993 and June 1994 under both chemical treatment programs disappeared from HYDROLATOR samples and therefore did not contribute to loading and system damage from particle abrasion. Although turbidity spiked over 100 ppm during HYDROLATOR clean up in 1994, only particles under 40 microns appeared to be loading the water. Months into the HYDROLATOR re-test, record setting reports of single digit ppm solids loading were seen and water was clear enough on better operating days that one could sec down three feet into the cold well!

MARCH 15, 1995 TO PRESENT

The under-thickener sludge transport had been upgraded in early 1994 from one pipe to a two pipe system with a concentrator/thickener added to improve production and water quality. To torture test the three treatment modes, the single pipe system was put on line for 6 of the 9 months of the 1994-1995 HYDROLATOR test, 4 days only of the no-treat test and at least 14 weeks of the present chemical test. The results of these tests follow:

1995 RESULTS - SINGLE PIPE TEST - CORROSION

For the HYDROLATOR 9 month test, independent lab results for electrode coupons averaged 3 MPY for clarified and 7 MPY for re-cycle water at 6.5 ph. (Ref: Metal Samples Co., Inc.). These data correlated closely with customer electronic data (in-line probe) and HYDROLATOR grab samples, but not with chemical vendor coupon results! During the no treatment test at 6.5 ph, spikes of 70 MPY + were noted indicating no corrosion control. Historical chemical corrosion data at this site show wide fluctuations in electronic recordings averaging in the 15-20 MPY range at 6.5 ph. The chemical vendor requested and got a change in ph to 7.0. At this level, corrosion rates dropped predictably since most chemical treatment programs perform best between 7 and 9 ph. Conclusion -Independent lab and customer data demonstrate HYDROLATOR's superior ability over chemical treatment to control corrosion even under extreme changes in ph, solids loading and short term interruptions of flow through the HYDROLATOR system.

SOLIDS LOADING

Spikes of 600 PPM were recorded when a polymer pump was off line during the latest chemical test showing considerably wider swings in TSS under chemical treatment. Conversely, HYDROLATOR controlled water has been reported to be clearer than when chemically treated, and spikes to 100 PPM were infrequent. Conclusion - The greater bulk water voltage induced by HYDROLATOR's intense field apparently is able to dampen or smooth out swings in operation and achieve better solids control.

FOULANT CONTROL
An inspection and snapshots inside of the 24' clarified water transport pipe on 7/31/95 showed cleaned surfaces; also, the scrubber, weirs and cooling towers showed marked improvement in scale control over the 9 month test as reported previously. By contrast, the scrubber water system was badly fouled under chemical treatment (see previous statements). Conclusion - As was the case with the de-scaling of the lime and coke oven liquor systems, HYDROLATOR controlled systems tend to stay cleaner permanently.

A QUOTE FROM MY CUSTOMER:
For over three years our company has been using the (HYDROLATOR technology) in our Blast Furnace cooling water system without the addition of any major corrosion/scale control chemicals. Only acid and base for pH adjustment have been added over this time. Indications are that no scale is forming in this system and the corrosion rate is low. In fact, this system has apparently descaled over this time due to the HYDROLATOR technology. As a result, significant savings in chemical and pumping costs are being realized..."

GENERAL CONCLUSIONS
Given the above stated facts, HYDROLATOR technology has proven its worth from the data produced and has demonstrated to the customer that it can:

- Descale chemical caused or natural fouling deposits and prevent new formations.
- Improve heat rejection in cooling tower systems.
- Reduce electrical energy Consumption (fans, pumps).
- Increase life of plant by preventing corrosion.
- Reduce maintenance costs due to corrosion/fouling.
- Eliminate risk to employees handling chemicals.
- Increase stability and reliability of operating system (no chemical caused excursions).
- Contribute to a cleaner environment.
- Reduce TSS, especially larger particles which contribute to erosion/corrosion.
- Keep gas scrubber, pipes, vessels clean.
- Clean out cold/hot wells.

For further information - call Ted Light (410) 352-5524