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MEXEL® 432 CASE STUDY - GEOTHERMAL POWER GENERATION

The company SOCOMINE operates a geothermal power station in eastern France near Soultz-sous-Forêt. Concerns about corrosion of the drill pipe caused them to begin testing Mexel® 432 late in 1994. In the initial tests, it was determined that Mexel 432 reduced metal loss on a carbon steel test ring to 0.03 grams (starting weight was 79.853 grams) over 262 hours, i.e. negligible corrosion rate. Socomine has been treating the main flow with Mexel 432 since then.

The working 'fluid' is 9000 gpm of brine at temperatures from 60ºC. to 140ºC. Dissolved minerals average about 100 grams/liter, i.e. 10%. Dissolved oxygen is essentially zero. Chloride ion concentration ranges from 40 to 53 grams/liter, and the pH is less than 5.0.

Because of the severe conditions, Socomine treats with a continuous dosage of 4 ppm of Mexel® 432. The operators do not want to risk corrosion or a shut-down, so they have not attempted to determine if a lower dosage rate or intermittent dosage might be adequate.

Following extensive monitoring during a production run in 1997, it was observed that there was negligible corrosion of piping and equipment made of carbon steel, Hastelloy G, Uranus B6, and 316L stainless steel. Low corrosion rates were confirmed by measurement of corrosion coupons. When equipment was dissembled for inspection, it was noted that the lack of corrosion made it very easy to take the equipment apart and remove the pumps.

The only corrosion noted occurred on certain elements made of galvanized steel.
Performance was not consistent, as some galvanized components were uncorroded and others exhibited 'massive localized' corrosion of the zinc. In all cases, there was no corrosion of the underlying steel.

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MEXEL® 432 CASE STUDY - OIL FIELD REINJECTION WATER

In the Villeperdue Field east of Paris, pressure is maintained by reinjecting process water that has been topped off by 132,000 gallons per day (92 gpm) of tertiary water from a production well. This water is distributed via fiberglass piping to 4 injection wells within a 2 mile radius. Ever since they began using tertiary water, they have constant problems with bacteria identified as AERO and SRB, i.e. aerobic bacteria and sulfate-reducing bacteria.

Apparently, the piping was contaminated earlier while transporting process water and now continuously reinfects the well water.

They ran a trial with Mexel® 432, comparing it to their current treatment (Bactiram 449, a powerful, non-biodegradable biocide made by CECA Division of Elf Atochem). They injected Mexel into the discharge of the production well at 10ppm continuously for one week, and then reduced dosage to 5 ppm. Test results showed Mexel to be totally effective in dispersing colonies of SRB and more effective than the competitor in dispersing colonies of AERO. Their treatment costs were reduced to 25% of what they had been paying, and they gain environmentally because they now inject a biodegradable material.

The company running the field is COPAREX CHAMPAGNE. Their production office is in Montmirail, about 50 miles east of Paris. Coparex's headquarters is located in Issy-les-Moulineaux, a close-in suburb of Paris.

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Site	Bacteria	2/94	8/94	2/95
004	SRB	10^{2}	10^{2}	0
004	AERO	10^ 4	10^{3}	10
RO4	SRB	10^{3}	10^{2}	0
RO4	AERO	10^ 6	10^ 4	10^{3}
NO1	SRB	10^{3}	10^{3}	0
NO1	AERO	10^{3}	10^{3}	10^{3}
L52	SRB	-	10^{1}	10^ 4 *
L52	AERO	-	10^{3}	10^{3} *

*Since these measurements, dosing regime has been altered to reduce the relatively higher counts reported at Site L52.

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MEXEL® 432 CASE STUDY - COOLING TOWER WITH SEVERE BIOFOULING

BACKGROUND:

An orange juice concentration plant in Florida experienced severe accumulation of biofouling in the cooling tower system serving a taste evaporator. The vacuum is provided by steam ejectors and barometric condensers, and carry-over of nutrients from the evaporators enters the cooling water system via the barometric condenser. Treatment with chlorine and bromine had not been effective; treatment with chlorine dioxide had been somewhat effective, but costs were high due to the high demand of oxygen in the cooling tower system.

TREATMENT:

The cooling water system has a circulation rate of 4800 gpm and a hold-up of 28,000 gallons. Daily dosage was at a rate of 4 ppm (based on the circulation rate) for 20 minutes, at which time the system concentration approached 16 ppm based on the total system volume.

RESULTS:

Within a few hours of the initial treatment, large clumps of biomass had been dislodged from the tower internals and were floating in the basis. After three weeks of treatment, an estimated 75% of the biofouling in the cooling tower had been dispersed; at that point, an equilibrium seemed to be established where the rate of growth of biofouling was equal to the rate of dispersion. It was also noted that the remaining deposits had been loosened such that they were easier to remove by manual cleaning.

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MEXEL® 432 CASE STUDY - FUJIAN REFINERY

BACKGROUND:

A refinery in Fujian Province of China has several cooling tower systems. They suffer from corrosion due to the low pH and very low dissolved mineral content of the make-up water.

On the tower initially treated, system flow is 11,000 gpm and total system hold up is estimated to be 265,000 gallons.

TREATMENT:

The primary goal of this treatment was corrosion control. A secondary goal is improvement of heat transfer rates.

Treatment began on 19 November 1998. Intended dosage rate was 4 ppm (based on circulation rate) for 24 minutes, twice per day. This makes a concentration of 8 ppm based on total system holdup. The dosage on the first day was higher, slightly more than 10 ppm.

RESULTS:

Measurements of corrosion coupons and electrical measurements of pitting potential show that the corrosion of the system is reduced to levels that are well below allowable levels.

When Mexel® 432 concentration exceeds 7.5 ppm there is no algae seen in the top of the tower. When Mexel® 432 concentration was reduced to 4 ppm, the algae returned.
During the first few treatments some foam was formed, due to soft water and the presence of fouling and iron oxide sludge in the system. It had brown scum on the surface, indicating that Mexel® 432 was cleaning fouling out of the system. The foam has almost disappeared as the system fouling has been cleaned out by the Mexel® 432.

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MEXEL® 432 CASE STUDY - SAMIR REFINERY

BACKGROUND:

A small refinery (crude unit) near Mohammedia, Morocco uses sea water for cooling with tubular heat exchangers and plate heat exchangers. The circuit for this case has about 2500 square meters (27,000 square feet) of wetted surface.
Materials of construction include ABS, steel, 316L stainless steel, cupronickel, and cast iron. Water flow rate is 8000 M³/hour (35,000 GPM). Fouling species is primarily black mussels.

The system had been treated with chlorine and Acti-Brom, but treatment had been stopped 4 months earlier due to poor results (persistent infestations, corrosion, cost). At the onset of treatment with Mexel® 432, the inlet water piping was lined with 6 cm. (2.36") of mussels.

TREATMENT:

The primary goal of this treatment was rapid kill, dispersion of existing deposits, and prevention of new deposits. The secondary goal was corrosion control.

Treatment began February 18, 1997. Initial dosage was 6 ppm for one hour (48 kg, or 106 pounds) injected daily for 9 days. Subsequent dosage was 2.5 ppm for 30 minutes (10 kg., or 22 pounds) per day.

RESULTS:

Inspection of the inlet water piping on March 31, 1997 showed a complete absence of mussels. Sloughing of deposits had been sufficiently gradual that operations were not impeded by the shells.

Inspection of a condenser water box on April 11, 1997 showed the tubes, tube sheet and water box cover to be completely clean. The only deposits remaining consisted of some

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MEXEL® 432 CASE STUDY - OFFSHORE PLATFORMS

BACKGROUND:

ELF-PETROLAND, a subsidiary of Elf-Aquitaine, operates 17 platforms in Dutch offshore waters in the North Sea. These are un-manned platforms that collect natural gas, pre-treat it, and compress it for transport to on-shore facilities. The automatic systems of these platforms, particularly the fire protection systems, are inspected every 14 days.
Sea water enters these platforms through permanently submerged risers which vary in diameter from 30-40". Each riser has a steel grid at the bottom. There is one submerged pump (plus an installed spare) delivering 50 gpm for the heat exchangers, and a submerged fire protection pump (plus an installed spare) that delivers 1750 gpm. All pumps are 316L stainless steel.
Previous treatment had been with sodium hypochlorite plus a product called "Toxion", but they had three problems: (1) build-up of mussels on the steel grid, blocking water flow; (2) corrosion (pitting) of the fire protection pumps; and, (3) accumulation of a very dense, hard scale (they called it 'concrete') up to 1 cm. thickness on piping surfaces. The reduction in effective pipe diameter was threatening the entire fire protection system, and they had no way of replacing the piping.
Treatment with Mexel began with a daily dosage of 10 ppm for 2 hours per day dripped into the riser. In addition, there is a separate dosage of the fire protection system once every two weeks. During the inspection, the fire protection system is run for two hours. They dose Mexel® 432 for 15 minutes at a rate of 10 ppm.

RESULTS:

The bottom grid is clean with no accumulation of mussels. There is no more pitting of the fire protection pumps. The treatment gradually dispersed the hard scale so that the full usable diameter of piping has been restored.

CHRONOLOGY:

Discussions with Dutch environmental authorities began in late 1994; after 6 months of testing and debate, the authorities approved Mexel for this usage. Tests on the first platform began in 1995, and by the end of 1996 Elf Petroland decided to standardize on Mexel® 432.During the next two years, all remaining platforms were retrofitted.

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MEXEL® 432 CASE STUDY - COMPRESSOR INTERCOOLER EXCHANGERS

A large refinery at Pernis, on the harbor near Rotterdam in the Netherlands, experienced problems with fouling and diminished performance of some large air compression equipment. They tested Mexel® 432 on a full-scale trial.
Each compressor unit consists of a 2-stage compressor plus 4 heat exchangers (oil cooler, regeneration cooler, gas intermediate cooler and gas final cooler).

The first two operate at moderately high temperatures (80 -95ºC for the oil); the interpass cooler receives compressed air at 200 - 250ºC and must cool it to well below 50ºC, and the final cooler has an inlet temperature of 200 - 270ºC and must cool it down to 30 - 40ºC. The gas heat exchangers are high alloy U-tube bundles hanging in the compressed air channel, with concurrent water flow. The cooling water is drawn from the harbor, varying (with tide, wind, river flow, etc.) from mostly fresh water from the Rhine River to mostly sea water from the North Sea, along with the dissolved and suspended solids expected in a major seaport.

Prior to treatment with Mexel 432, the heat exchanger had to be taken apart and cleaned at least once every 6 months. Inspection showed that the colder sections of the circuit had accumulations of mussels and other biological growth. Many tubes in the hottest elements were plugged with scale and macro fouling deposits, and severe corrosion necessitated replacement of the first 2 or 3 bundles.
Treatment with Mexel began in January, 1997. Mexel® 432 was dosed into the circulating water at the rate of 7 ppm for 15 minutes per day. The unit operated continuously until February, 1998 when it was taken down for inspection. No fouling was expected, as there had been no gradual rise in gas outlet temperatures during the year; it had not been necessary to increase water flow to hold the design discharge temperatures. All heat exchangers were found to be clean, with no corrosion.

CONCLUSIONS:

The unit was returned to service without any further cleaning, and the other air compressor units on the site will be treated with Mexel® 432.

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