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THE CONTROL OF SCALE AND CORROSION IN WATER SYSTEMS USING MAGNETIC FIELDS

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TREATMENT IN AN AIR CONDITIONER CONDENSER

A magnetic unit was installed in the condenser inlet line of a 300 ton air conditioner. The measured flow of 1100 gpm was close to the optimum rated flow 1200 gpm for this unit. The following parameters were recorded three times per day: current consumption, temperature differential of the condenser water and the compressor bearing temperature.

Initial inspection of the condenser prior to installation of the magnetic unit revealed 1 mm coating of very hard calcium carbonate scale. This condenser had been running many years without any chemical treatment. After three months operation with the magnetic unit, the condenser was opened again. The scale in the tubes was noticeably thinner and softer. The condenser was closed and mild steel corrosion coupons were put in the condenser water of this air conditioner and in an identical one nearby that was using untreated water. After three more months the condenser was opened again. The character of the scale had altered significantly. The most important change was in its hardness. The scale was considerably softened. The close up photo of the condenser tubes shows two tubes where the scale was wiped out with a finger. The scale could have easily been wiped out of all the tubes with a soft brush. The corrosion rates are expected to be high because of the high chloride concentrations (Table 1). It is actually like a dilute sea water. However, the treated tower showed a corrosion rate of 0.206 mm/year (8.1 mpy), which is well within the customary accepted limits of .076 to 0.254 mm/year (3 to 10 mpy). On the other hand, the corrosion in the untreated tower was .4 37 m m / year (17.2 mpy) which is almost twice as high as the acceptable limit. This reduced corrosion in the treated tower is shown in Figure 3. The corrosion coupon on the top was in the untreated water and shows much more corrosion visually. The reduction in corrosion was also evident by the color of the scale, which changed from rust color to white, due to reduction in formation of the iron oxide.

During the first six months of operations, the current decreased from 145 to 125 amperes, the bearing temperature decreased from 142 to 132^{O}F (61.1 to 55.7^{O}C), and the condenser water temperature differential increased from a range of 2 to 4^{O}F (1.1 to 2.2^{O}C), to a range of 4 to 6^{O}F (2.2 to 3.3^{O}C). These improvements in performance are even more significant when it is realized that the test started in December, and that the cooling load actually increased from its annual minimum to near its maximum.

The annual savings in electrical power were estimated to be about $7,000. The cycles of concentration was increased from 1.8 to 12 cycles which resulted in an estimated annual savings of $5,376 in water and sewer charges. The total measurable annual savings were $12,376. The lower current consumption and lower bearing temperatures indicate that there will be less wear on the compressor. This results in additional savings though it is not possible to estimate the amount.

It is interesting to note that the tower had been running at 1.1 to 1.8 cycles concentration for five months prior to the installation of the magnetic unit. It is a commonly accepted notion that the scale should have dissolved during that time, but it was still thick and hard as concrete. On the other hand, after three months with the magnetic treatment at the similarly low cycles, the scale was much softer and thinner. In addition, the air conditioner was run at higher cycles (from 5 to 33) for the next three months with the magnetic treatment. Again, it is commonly accepted that more scale should have formed during this period, while actually it continued to be removed. Towards the end of the test period in June the magnetic unit was operating very close to its optimum conditions. It was operating at 1100 gpm and 2855 ppm TDS, while optimum is 1200 gpm and 2500 ppm TDS.

Note that with magnetic fluid conditioning (MFC) the number of cycles at which the air-conditioning system operates can be very significantly increased.