ChemTreat®

CASE HISTORY

#10-027

# Southeast Power Plant Manganese Deposition Control

## History:

A power plant located in the southeast was experiencing manganese deposition on their stainless steel plate and frame heat exchangers. The deposition eventually caused failure to both heat exchangers shutting the plant down until a replacement could be appropriated.

Steps forward:

1. Conduct root cause analysis
2. Determine path forward to prevent reoccurance
3. Establish monitoring parameters to ensure asset protection

Figure 1 shows the general layout of the cooling system at the power plant. The auxiliary cooling heat exchangers developed leaks because of stainless steel plate pitting.

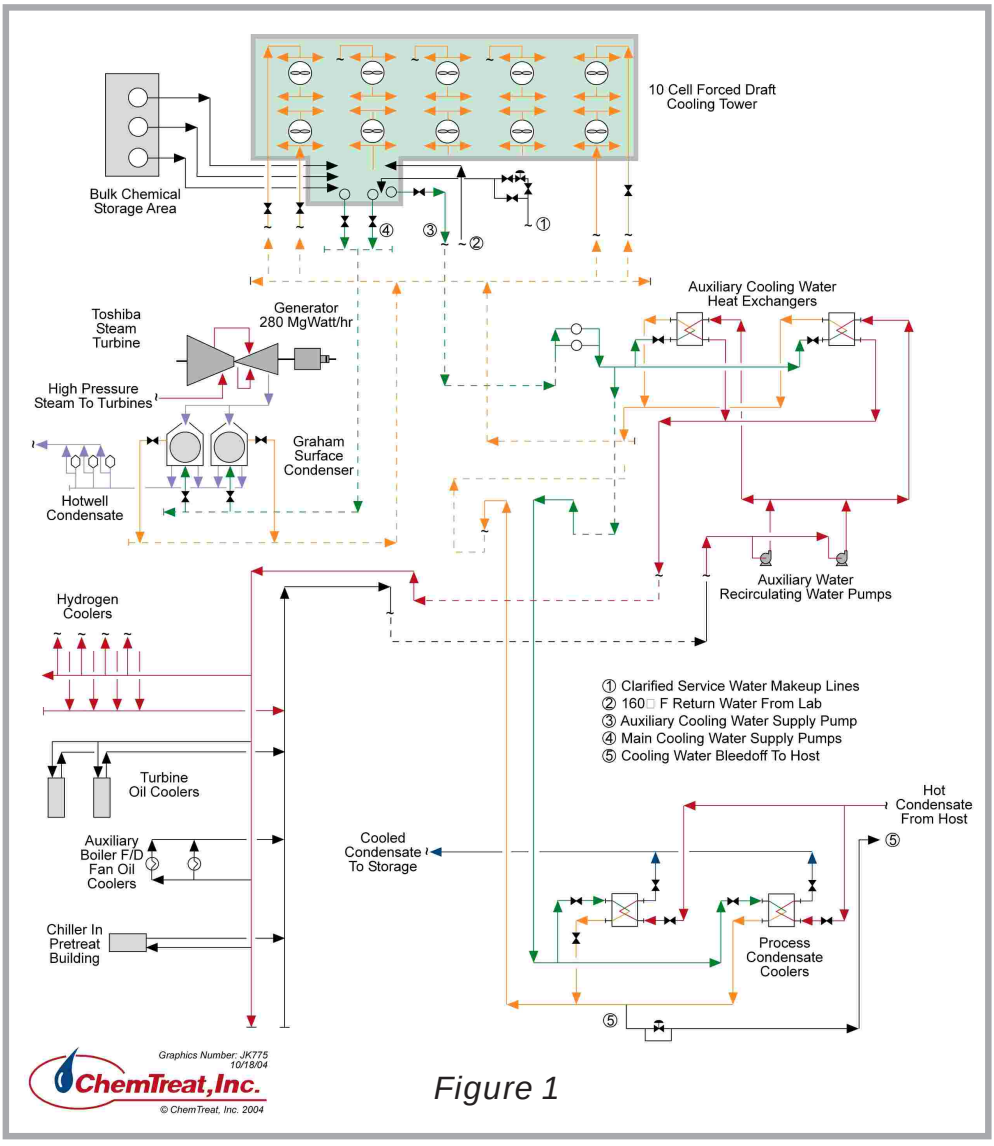



*Figure 1*

## Makeup Water:

The makeup water is from a surface water source which depending on rain events, has manganese concentrations over 50 ppb. This water is used as makeup to the cooling tower where the manganese concentrates as the water is cycled up.

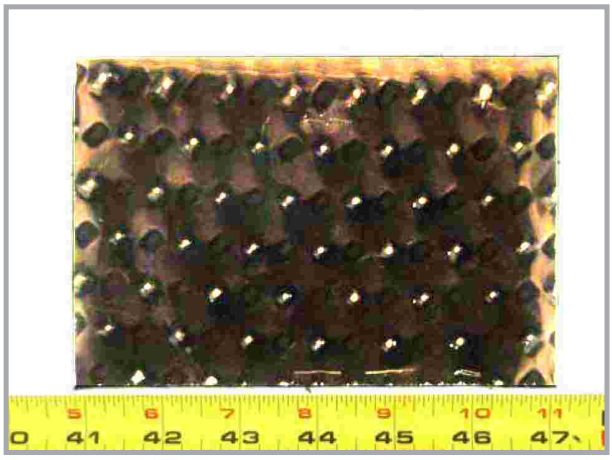
## Cooling Tower:

Manganese, unless properly treated, can deposit on the surfaces of plant components causing heat exchange inefficiency and corrosion by different mechanisms. Chloride pitting can occur under the deposits and/or ennoblement can occur directly because of the manganese deposition. Ennoblement of the stainless steel is caused by oxidation of the manganese which creates cathodic and anodic cells to form destroying the passivated layer and therefore corrosion occurs.

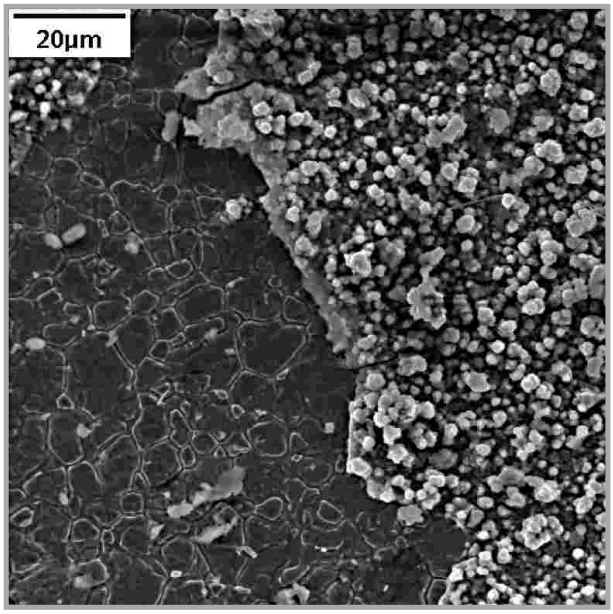
## Pitting:

Pitting initiated at the heavily deposited side. No evidence of pit initiation on the closed cooling side of the plate. Pitting exhibited steep walls and undercut cavities. The microstructure consists of infrequent elongated delta ferrite stringers in an equiaxed austenite matrix. Preferential attack of elongated delta ferrite stringers was not apparent. Infrequent patches of deformation bands indicate some work hardening during the plate-forming process. The microstructure is consistent with an annealed and subsequently cold worked austenitic stainless steel.

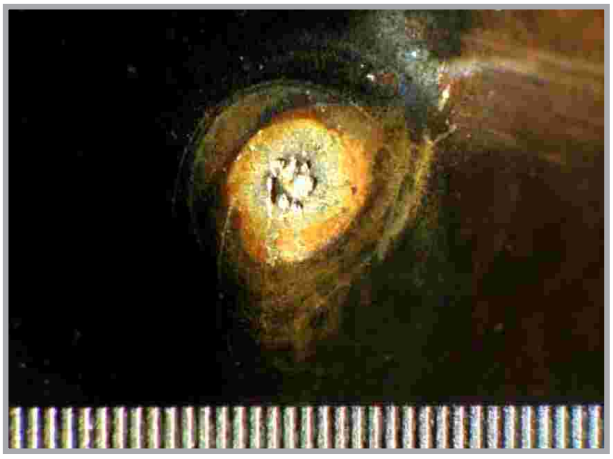
Deposits on the cooling tower side of the plates contain as much as 28% manganese. The relatively high manganese content of the deposits suggests that pitting was most likely promoted by deposition of cathodic manganese containing oxides. Chloride pitting did not appear to be the result of the material defects. Chlorides were not detected within or outside of the pits.



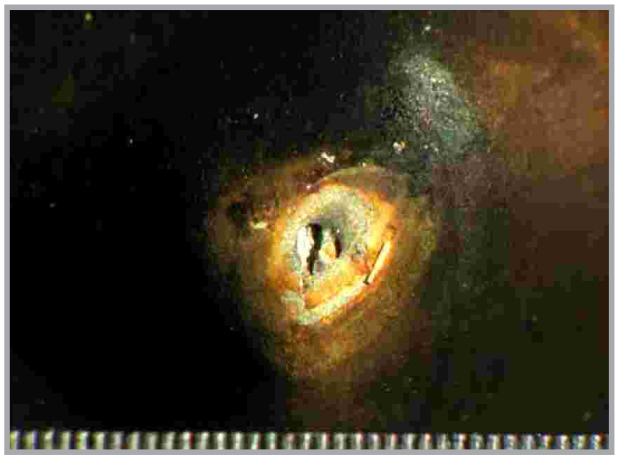

*Heavily Deposited Plate, 0.41X*




*Heavily Deposited Plate, 830X*

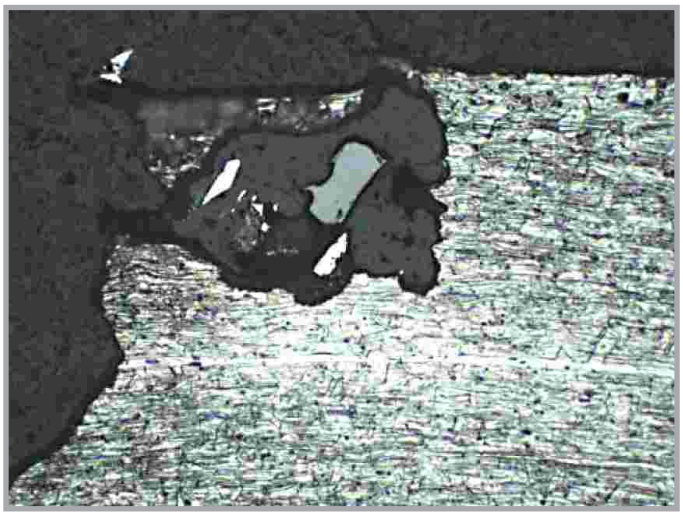


*Representative Pits, 9.0X*

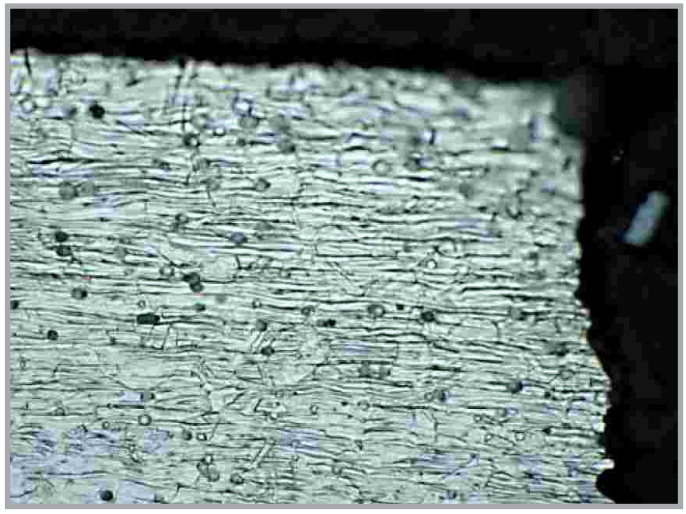


*Representative Pits, 9.0X*

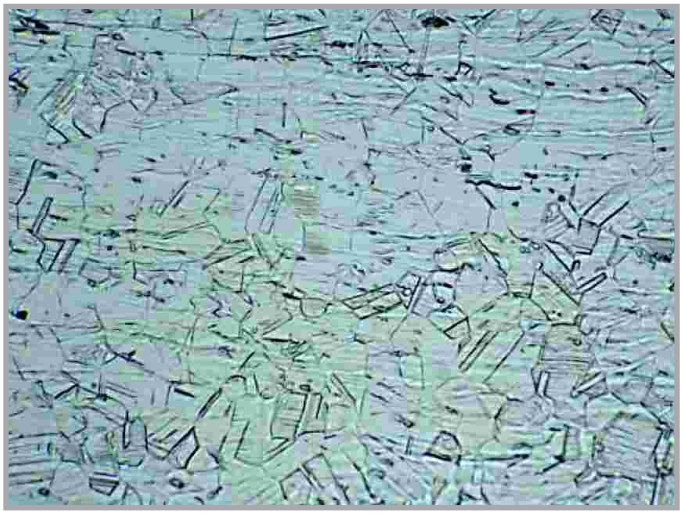
*Representative Pit, 40X*



*Undercut Portion of Pit, 80X*



*Edge of Pit, 40X*



*Mid-Wall Microstructure, 320X*

## Path Forward:

An effective chemical program is needed that will prevent manganese deposition from occurring and protect plant assets. ChemTreat's high performance polymer and scale inhibior package has shown excellent efficacy of inhibiting manganese deposition in other facilities with known manganese deposition. A program was initiated utilizing this technology and three years later, there have been zero failures.

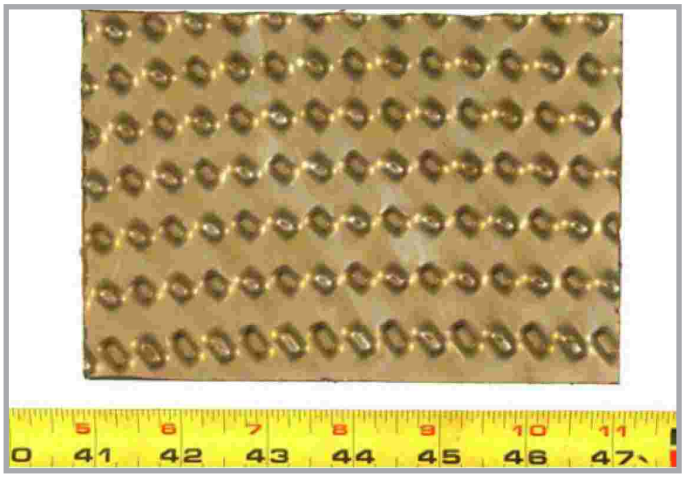



*Plate Cleaned With* ***ChemTreat Program***

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5640 Cox Road / Glen Allen, Virginia 23060
www.chemtreat.com

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