Controlled Shot Peening Reduces or Eliminates Stress Corrosion Cracking

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ABSTRACT Controlled Shot Peening (CSP) is a cost effective technique to reduce and/or eliminate stress corrosion cracking (SCC) failures which cost industry millions of dollars. Cases are shown.

Key Words: Shot Peening, Stress Corrosion

Case I

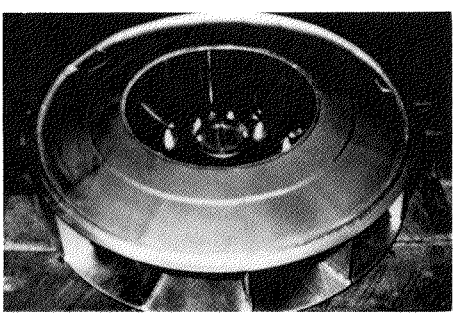

Fig. 1. Hastelloy Blower Wheel

Problem: A Hastelloy Blower Wheel used in hot nitrogen (300°F) failed in less than six months.

Treatment: Automatic Controlled Shot Peening with 170 shot to an intensity of 10A-14A followed by glass bead peening for decontamination. Coverage 200%.

Control: Almen strip for intensity, PEENSCAN* for coverage.

Result: No Failure after three years.

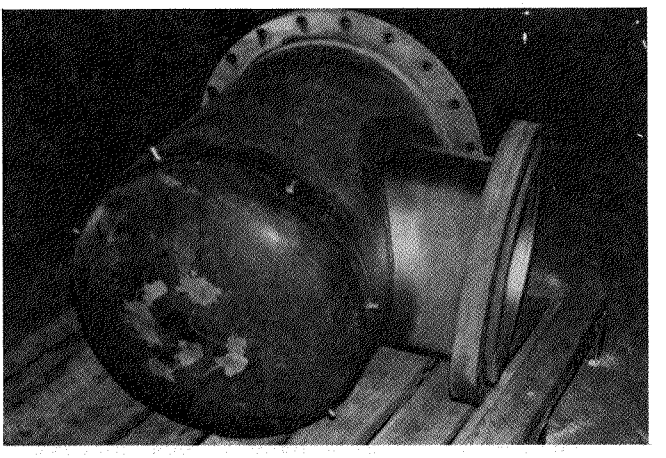

Fig. 2. Reboiler Head

Problem: Hastelloy B-2 reboiler heads used in water containing chlorides failed after eight months in the formed dome and the heat affected zones (welded).

Treatment: Peened with 230 shot to an intensity of 12A-14A followed by glass peening for decontamination. Coverage 200%.

Control: Manually peened with PEENSCAN * control.

Result: No failure after two years.

Case III

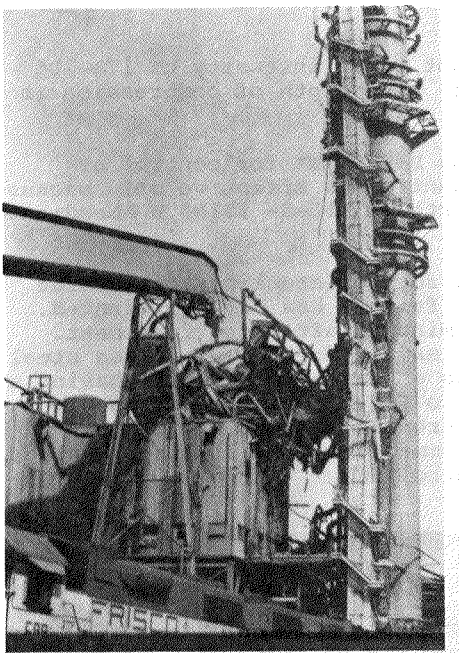

Fig. 3.

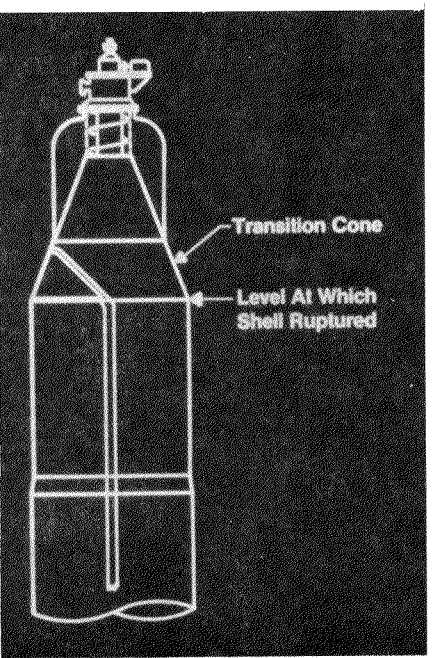

Fig. 3a.
Mill Continuous Digester

Problem: Catastrophic failure due to SCC in a continuous digester over 200' high and thirty plus feet in diameter made of A-212B-1 3/4" thick steel led to the discovery of SCC in over forty percent of the units in use of its type and manufacture. Welds with and without stress relief showed cracks when inspected with Wet Fluorescent Magnetic Particle method. Strong caustic solutions containing many aggressive compounds especially sulfides and sulfites are felt to be especially detrimental in the environment of temperatures exceeding 200°F and pressures of 150 psi. A permanent one time fix is sought by the industry but in the meantime shot peening is controlling SCC in twenty digesters.

The need for very careful preparation was learned when less than perfect results were obtained because of short cuts taken such as failure to grind welds smooth after repair and proper care not taken with the WFMP inspection. These errors coupled with poor grinding technique causes flaws to go undetected and unrepaired. The environment to perform all operations is poor at best, and all work is done under severe time constraints because digester down-time cost can be $25,000 per hour. It is therefore necessary to accept that we must often repeat the

procedure one or two more times at yearly intervals before getting a "clean digester", i.e. free of indications of any cracking upon WFMP inspection.

Treatment: Peened with 230 shot to an intensity of 17A-20A using 230 shot. Coverage 100%. The depth of compression is estimated to be .020".

Control: Manually peened using PEENSCAN* for control of coverage. The use of manual control is effective only because of coverage controls as set forth in MIL-S- 13165 B Amendment 2.

Result: Some digesters show no further cracking after three years. Danger of catastrophic failure has been eliminated. In some cases cracking was eliminated after one treatment. Shot peening is cost effective as compared to stainless steel weld overlay which still leaves a heat affected zone having a tensile stressed area subject to SCC. Because shot peening eliminates the danger of catastrophic failure savings of $50,000 per year per unit are immediately available by using Controlled Shot Peening to control SCC.

Case IV

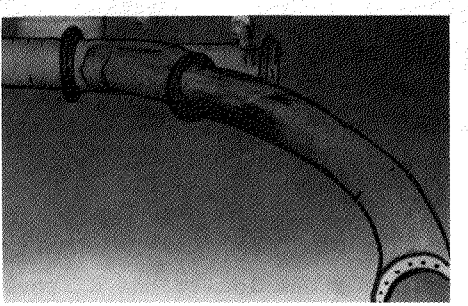

Fig. 4 Stainless Steel Spool

Problem: 304 stainless steel flanged pipe sections failed to SCC after exposure to sour water containing heavy sulfur and chloride contamination. Carbon steel failed in 1-1½ years. Unpeened stainless steel spools failed in less than one year.

Treatment: Entire inside of spools and exterior welds peened using automatic control; shot size 230, intensity 010A-014A. Coverage 100%. Spools glass peened with glass shot for decontamination.

Control: Almen strip for intensity, PEENSCAN* for coverage.

Results: No failure after four years.

Case V

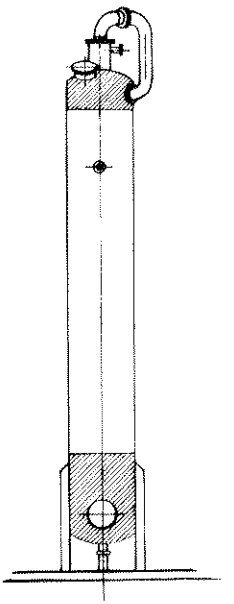

Fig. 5. Stripping Column

Problem: A stainless steel slurry stripping column failed to SCC in top and bottom sections due to chlorides and tensile stresses resulting from welding and forming during manufacture.

Treatment: Tank interior bottom and top ends shot peened with 170 shot to intensity .012A-014A, followed by glass peening for decontamination. Coverage 200%.

Results: No failure after two years of service.