



Significant of Successful cleaning & descaling:

Cleaning and descaling of equipments is major concern by industries. It is observed that generally deposit is accrued in heat transfer surfaces of boilers, heat exchanger, condensers, process equipment such as calendria vessels, reactor, limped coil etc. Deposit is exists in system due to failure of pre treatment or internal water treatment infect some time process contaminant and other than water born deposit may causes deposit. Calcium and magnesium salts exhibit inverse solubility. As the water temperature rises their solubility reduces, at a temperature of 70'C and above they come out of solution and begin to deposit. Iron deposit exist in system due to carry forward corrosion product in system from make up or feed water or system it self corroded due to negligence of corrosion protection action(Corrosion inhibitor). The major constitute of deposit are as below:

Magnetite (Fe₃O₄)

A smooth black tenacious, dense magnetite layer normally grows on waterside surfaces. It's indicated good corrosion protection as it forms in low oxygen levels and is susceptible to acidic attack.

Hematite (Fe₂O₃)

Hematite is favors at low temperatures and high oxygen levels can be red and is a binding agent and tends to hold over materials in deposition. This is an indication of active corrosion stirring within the equipment or make up /feed system.

Other metals

Copper and Copper oxide is deposited by direct exchange with iron or by reduction of copper oxide by during corrosion. Reddish stains of copper are common at or near areas of caustic corrosion. Copper Oxide appears as a black deposit. It is considered very hydrogen evolved serious corrosion risk because of the initiation of galvanic corrosion mechanisms.

Copper oxide formed in system conditions is black and non- metallic.



SALTS :-

(CaCO_3 , CaSO_4 , MgPO_4 , MgSiO_2 , SiO_2 , Hydroxy apatite $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ etc.)

The deposition of salts depends on their solubility. The salts having less solubility deposit first. CaCO_3 Calcium carbonate-effervesces when exposed to HCl acid. CaSO_4 is slightly less friable than CaCO_3 . Magnesium Phosphate-Tenacious binder, discoloured by contaminants while Silicates are insoluble except in fluorinated compounds i.e. Analcite. Calcium phosphate-(hydroxyapatite) $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ is found in system using the phosphate treatment method this is a tan/cream deposit. This is generally associated with overdosing but can occur where insufficient dispersing agent reduces the effects of blow down in boiler or polymer less cooling water treatment Programme.

Prior to any descaling following parameter should be consider:

1. Deposit loading
2. Scale Analysis test
3. Description or visual observation report.
4. Jar Test (Solubility test)
5. Availability of time, System substitute, Availability of mechanical devices etc.



1. **Deposit Loading:** - Deposit loading can be determining. Deposit loading is a weight of deposit material per equipment surface area unit. It is generally expressed as mg/cm² or gm/ft². This test gives us idea to judge require quantity de scaling chemicals.
2. **Scale analysis Test:** - This test is very important and success of cleaning is depending on it. In this test major constitute of deposit and their approximate percentages can determine which is important to select descaling chemicals and their quantity.
3. **Description and Visual Observation report:** A report from plant person is also very important which may consist date of observation, thickness of deposit, appearance of deposit, whether deposit is uniform or higher in specific area.
4. **Jar test (Solubility Test):** - Jar test is done by selected de scaling chemicals and their quantity at specific temperature to evaluate how many % can be dissolve by specified descaling quantity. In solubility test, loose deposit in the beaker may treat differently with the solvent than the deposit on a metal surface such as a heat exchanger tube. Jar test are usually sufficient to indicate which de-scaling chemicals will work to descale the system & which is best. Laboratory usually required minimum sample sizes. Typical size for a loose deposit sample is 30 gm when selecting a tube sample ASTM 3483 specified tube length 2 fit while NACE recommended 3 fits.
5. **Availability of time, System substitute, Availability of mechanical devices etc.:** - Descaling time, availability of substitute system, water availability, proper availability of mechanical devices such as pumps with desired flow rate, hose pipe etc. should be arrange prior to descaling. It is observed that some pump with desired flow rate is not available. Many cases electricity or desired water is not available on site during the time of descaling.



Common reasons for Failure:-

Even with Laboratory testing good engineer & execution there are still cases where the procedures fail to remove all the deposition some reasons that have been identified as causing such failures are

- A. Sample was not representative of the deposits in the system.
This is common because sample was too old.
 - a.) System deposit had grown thickens after collection of sample in system.
 - b.) Composition had change drastically or the sample may have taken from low deposit area of the system.
- B. Slought off of the metal. In the system the solvent mostly remove the deposits from only the waterside, stopping when it reaches the layer it can not dissolve or disintegrate.
- C. The solvent did not uniformly circulate in to all areas of the system.
- D. The laboratories did not report Layers in the deposits there. Oil lacking in to the system may results in carbon layer in the deposit. Incursion of plant water on black liquor may leave layers high in silica CaSO_4 or BaSO_4 . Laboratory solubility test may fail to detect this as a problem when the solvent eats out under a layer from the edges of the tube pieces in the beaker and the insoluble material

Conclusion:

For Successful cleaning of System the following should be consider:-

- 1] Details boiler water analysis
- 2] Proper procedure development
- 3] Prevention of Loss for of personal & technical aspects.
- 4] Mechanical preparation & implementation
- 5] Trained & experience person for with process understating



Deposit	Altret Solution	Normal Temp. °C (°F)	Construction Material Incompatibilities
Magnetite, (Fe ₃ O ₄)	Altret 600	50 – 65	Austenitic stainless steels, Incolony 800, soft metals
Magnetite, (Fe ₃ O ₄)	Altret 601& Altret 607	65 – 150	Soft metals
Copper oxide CuO	Altret 600 along with Altret 610 Copper corrosion inhibitor	50 – 65	Copper alloys, austenitic Stainless steels, Incolony 800, soft metals
Copper metal + oxide	Altret 607	50 – 65	Copper alloys, Soft metals
Water scale, mainly Calcium carbonate CaCO ₃	Altret 600 / Altret 602-Alkaline	50 – 65	Austenitic stainless steels Incolony 800, soft metals
Carbon, C	Concern APCL	95	Soft metals
Silica, SiO ₂ , or high silica water scale	Altret 601 along with Altret 600	50-65	Titanium, zirconium, stainless steels, Incolony 800, soft metals
Calcium sulfate, CaSO ₄	Proprietary gypsum solvent Concern APCL	Varies widely	Depends on choice of acid