

Where does CSC end up in the refinery?

There are products to trace to get the full picture: unreacted CSC, CSC*Cl, and the decomposition products (primarily trimethylamine). CSC and CSC*Cl partitions heavily to the water phase. REACH registration data gives the following octanol/water distribution:

- Active: octanol/water = 0.0053
- Salt: octanol/water = 0.00017

Trimethylamine will also be captured in the water phase where sufficient contact is made. Any remaining trimethylamine will travel with the rest of the vapor.

In dry systems:

- Below 580°F, CSC*Cl will travel with the hydrocarbon phase (decomposing above that).
- Between 210 and 300°F, the CSC can aerosolize, primarily carried by the vapor phase unless flow is obstructed by contact with fluid or equipment, (trays, de-mister pads for example). In the absence of an aerosol formation, the unreacted product will follow the hydrocarbon liquid phase until it contacts either water or a chloride salt) decomposing over time above 300°F.
- Below 210°F, CSC will travel with the water phase.

What does a typical CSC delivery system look like?

The general delivery system is similar to what you will find with other additive injections. The product is stored in totes or bulk tanks, moved with a chemical pump, and injected through a quill.

In a Crude OVHD system with water wash, do you inject chemical neat or do you inject in the water?

Typically, if the water wash is adequate to depress overhead temperature below the dewpoint, salt formation is not an issue. Salting usually occurs where there is no free water present, (ie tower trays, heat exchangers above 250°F, HDS effluent exchangers, overhead exchangers upstream of the dew point, or prior to the water wash).

If you are seeing salt formation downstream of the water wash, it is either too low a flow of water, or poor distribution of the water leaving unwashed portions of the heat exchangers. If this is the case, then injection of the chemistry with the corrosion inhibitor, or separate from the water wash may be a better alternative. Each case should be evaluated independently prior to starting a treatment program.

What are the effect of CSC on the waste water treatment plant? Does this process cause increased COD loading for Wastewater downstream?

The CSC salt itself is readily biodegradable, as noted in an extensive toxicology report for Global CAS registration. Quaternary ammonium cations (QAC) are known however, to inhibit bacterial activity. General thresholds for QACs include 20-25 mg/L QAC for inhibition of heterotrophic, floc forming bacteria and 2-5 mg/L QAC for inhibition of nitrifying bacteria. Concentration should be low by the time water streams are combined and the CSC reaches the WWTP, so a minimal impact is expected. No negative impacts have been seen in our applications. With a lower tolerable threshold for nitrifying bacteria, WWTP performance should include a monitoring program for any new trial.

A simple mass balance calculation will determine the levels in the waste water compared to the levels in the overhead water leaving the process unit.

Can the reacted CSC cause problems at the top trays of an FCCU main fractionator if it is injected in the reflux line?

No, the CSC salt (reacted CSC) is non-corrosive compared to other salts (typically <2.0 mpy) and mobile. It will move down the fractionator until it is removed in the first liquid draw tray. Assuming this tray is not a total liquid draw a portion of the salt will continue down the tower and decompose.

Has CSC been used in non-refinery, or upstream of a refinery operation? What were the pre-CSC chloride concentrations in the applied streams?

Not that I'm aware of. The primary benefit of the CSC chemistry is the ability to clean the system online and maintain it. Upstream of the refinery, where this ability is less crucial, the relatively high chloride concentrations prior to desalting make the use of CSC economically inefficient.

At what temperature do CSC*Cl salts precipitate?

The CSC*Cl salt only exist in the solid and aqueous form. It will decompose before it boils, melts or sublimates.

Do overhead drums run in a high pH mode with this application? What are the pH ranges where this application is in use?

In the situation where CSC is used to clean up a salt fouled system, a increase in pH would be expected. The base shift associated with CSC will replace the ammonia or amine, allowing it to eventually end up in the overhead water. If no additional acids (chloride, sulfide, or organic carboxylic acids) are available to react with these bases, then the pH will be elevated.

When used continuously as a neutralizer replacement, a higher pH control may be needed depending on the acid base balance in the overhead.

For example, if the product is used to control overhead pH, and a spike of amines enter the system as a result of an H₂S scavenger added in the oil field, these amines can end up in the overhead system, increasing the pH. If that is the case, the last thing that operations should do is reduce the CSC to bring the pH back in range. This will allow for the amine salt of the scavenger to deposit on the overhead line and/or exchangers, recreating the original problem of salt fouling. This scenario happens in crude units that have good salt removal, low chlorides and low organic acids in the overhead.

Most systems will have enough strong and weak acids, and are sufficiently buffered that a pH control range of 6.5-7.0 is easily maintained. Overcoming this issue is usually addressed by setting a minimum injection of CSC, regardless of the pH excursion. In other words, never turn the chemical off because the pH has exceeded the upper pH control limit.

How does Athlon ensure best contact between CSC and vapor?

Contact is most efficient with solid and liquid phases for most applications, with vapor contact being effective at tower tray valves. At temperatures above 200°F, aerosolization of the CSC chemistry can facilitate vapor contact as well, but is limited to the travel distance of those aerosol droplets.

Does CSC have any effect on reformer catalyst life?

The CSC leaving the upstream processing units, either as product or as a salt, will partition to the water phase and be removed with any water draw prior to the reformer. Treating the naphtha in the hydrodesulfurization unit will convert any CSC or its chloride salt to ammonia, water and HCl in the reactor similar to any nitrogen compounds native to the hydrocarbon stream. These byproducts will be removed in the low pressure separator water boot. In the rare situations where there is no HDS unit in front of the reformer, the negative impact would be associated with the nitrogen found in the product. Treatment in a reformer to prevent ammonium chloride deposition or corrosion from HCl is done downstream of the reactor and feed effluent exchanges with the salt removed in the separator water draw boot if available or it will leave with the debutanizer bottoms stream and drawn off with the water in tankage. These salts will not negatively impact NACE spindle test.

What are the decomposition products if the CSC*Cl salt hits temps over 580 F before it can be removed from the system?

The CSC*Cl salt will decompose at 580°F to produce trimethylamine and glycol (as the unreacted CSC does). The chloride will ascend the tower and the TMA, which is highly volatile and does not form a salt above the water dew point will condense in the overhead.

We have a wide swing in crude blends buying spot crudes where available. Do we need to increase the testing each time blends are changed?

No. The frequent testing of process streams during trial is to ensure application effectiveness and efficiency. Once that process is stable- as long as the established key performance indicators continue to be met- there is no need to increase testing. With that said, if you have a blend of particular concern and want to ramp up testing we can assist with that.