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**Question 51: Reforming unit stabilizer column top trays and overhead condensers can experience fouling with ammonium chloride salts, which are commonly removed by online water washing of the column overhead. What practices do you employ to reduce the risk of rapid corrosion and the potential failure associated with this fouling and subsequent water washing procedure?**

FERNANDEZ (Jacobs Consultancy Group)

Ammonium chloride salts are a common problem in both naphtha reforming and naphtha hydrotreating units. This has been discussed several times in previous NPRA Q&A panels. The problem tends to be the reactor effluent condenser; the inlet to the recycle gas compressor; and the position of the product stabilizer. We'll talk here mostly about the product stabilizer issues.

A quick review of the basics is important to understand where they come from and the origins of these salts. Ammonium chloride salts are formed because of the presence of both ammonia, hydrogen chloride, and hydrogen in the reactor effluent stream. These two combine to form the salt and precipitate. A relevant number to remember is how little nitrogen in the feed you need to have in order to have the potential of making very large amounts of salt. If you have a 20,000 BPD semi-region or CCR naphtha-reforming unit, and the feed to the unit has .5 wt ppm nitrogen, that nitrogen has a potential to convert itself in 4700 pounds of ammonium chloride salt. And if you think about this, that's about 100 sacks of 50 pounds of salt. So it is a large amount of salts that can accumulate. An often-misconceived idea comes from the fact that these only deposit in cold sections of the unit.

As this chart shows, you can have precipitation in very warm sections of the unit, up to 300° F. It all depends on what is the concentration of both the ammonia and the hydrogen chloride. The biggest concern about these deposits is not only the nuisance of having things plugged inside your units, but also the facts that these salts are very hygroscopic; they absorb water; and the water that pools around these salts tends to form a very acidic and corrosive solution. And if you leave it behind, you will have a great potential for under-acid corrosion in the areas where you have these deposits.

In order to prevent the formation of ammonia chloride, we think the first medicine is always to avoid it: Don't have it there. What you need to look at are the sources. Obviously, you cannot completely eliminate the hydrogen chloride from your system. It's part of the reforming catalysis, so you will always have hydrogen chloride coming out in the reactor. What you can try to do is avoid the ingress of nitrogen and the feed to the unit.

When you talk with most licensors, they recommend that you have less than .5 wt ppm nitrogen in the feed-to-reforming unit. We think that that is the basic—what we would call basic standard of care. We would recommend going lower. We know several refining customers that actually have a standard that

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says that the nitrogen feed should be lower than .2, and we would encourage everyone to try to meet this standard at least. We realize that's pretty easy to say when you're processing straight-run naphthas from sweet crudes, but it might not be possible to do when what you're processing is thermally-cracked naphthas, coker naphthas, and the like.

There are some occasions that you really cannot avoid the nitrogen coming in the units. You then have to go to the second line of defense, which is looking at what else you can do to avoid the formation. There are two techniques that have been used to avoid the formation of ammonium chloride salts in the stabilizer, and they come by trying to scavenge the chlorides coming out of the reactor before they get to the product stabilizer. The most common system used is to—[end of Side \_\_, Tape \_\_]

#### UNIDENTIFIED SPEAKER

We might have been the ones who submitted this question. It's a two-parter, so I'll address them both. One of our refineries that has a sulfuric acid alkylation unit is currently not operating the system under a vacuum. We were interested in doing this because between runs, if you want to get more out of your compressor and your section piping isn't big enough, then that's the next option. I was hoping to get a test run in before the meeting, but we didn't get a chance to do that. As far as the bottleneck and refrigeration section, we've installed the larger driver and refrigeration compressor, added compressor discharge cooling, optimized the refrigerant composition, and installed the larger effluent recycle pumps.

#### HAZLE (NPRA)

Clever.

#### HATZEL (Tesoro)

Tesoro has no experience running less than atmospheric with this compressor, but some suggested aids were to use chillers to cool the refrigerant or the depropanizer bottoms recycle stream. Also mentioned were just lowering the contact temperature with the aid of a chiller as well. Then the usual kind of de-bottlenecking approaches can replace suction, specifically, but potentially also discharge lines that are around the compressor. Can you increase the capacity of the compressor to move the refrigerant around?

#### HAZLE (NPRA)

Those are the panel responses. Has anyone in here tried to run a compressor at negative suction pressure? Any other questions on this topic? We'll go on to Question 52.

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