Question 51: What is your best method for monitoring salt level in a diesel salt dryer? What are your current guidelines for salt usage and capacity? What are your best practices for loading and monitoring salt dryer performance?

ROBERTSON (AFPM)

We spell dryer in different ways because we could not come to a consensus on the proper spelling. [Laughter] We spent a lot of time discussing that at our meeting in August, so we will answer that question after we answer the real question. [Editor's Note: When referring to the unit (a noun), the word is spelled: "dryer." When the word is being used as an adjective, it should be written like this: "drier"; because if a unit is "drier" than another, it is "drier."]

MORELAND (Valero Energy Corporation)

We prefer not to use salt dryers in new ULSD designs. In recent ULSD designs, we will put in a vacuum dryer, or we will re-boil the stripper to meet the low water specs. If there are less stringent water specs, using a coalescer can be sufficient. One of our most recent new units will have a coalescer followed by a vacuum dryer.

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I want to talk about monitoring. I polled our hydrotreating network to get some answers for those who do use salt dryers. We have about four of them still operating at our plants. Most use rock salt for reloading during the run. One does use a mix of calcium and sodium chloride, which are loaded from the top. The salt levels are gauged from the top as often as once a week or as little as once a month, and just get loaded when needed. The brine is drained once or twice per shift, so it is part of a regular operator round. The main variables to monitor are salt carryover and high consumption of salt. The critical parameter is the operating temperature. Our typical guideline is less than 150°F; some operate less than 140°F to keep the solubility of water in diesel down.

McARTHUR (Phillips 66)

We have limited use of salt dryers. Actually, we have one in all of our refineries. So I had one person to ask these questions, too. [Laughter] In the past, we have basically used some predictive spreadsheets to predict when the next topping off would be necessary, and we found them to be a little cumbersome. Now we basically revert to changeouts whenever the haze starts to go off specification. The site will switch to the second dryer, put the first one offline, and then schedule maintenance on the out-of-service unit before it will be needed again. And like Andy mentioned, the key parameters are trying to monitor the temperature running in the dryer.

PEDERSEN (UOP LLC, A Honeywell Company)

We expect that a salt dryer will only reduce the temperature at which haze forms to about 25°F below the water saturation temperature at the operating temperature of the salt dryer, which translates to only about 30% removal of the water in the feed to the dryer. In those cases where it is required to provide haze-free diesel, a salt dryer does not do the job. Either a re-boiled stripper (so moisture is not introduced into the distillate product) or a vacuum dryer (as Andy indicated) is recommended. At UOP, we have not designed a salt dryer in several years because of the restrictions on the amount of moisture or haze in diesel products.

One other comment about operation of salt dryers: There is at least one experience where the refinery used utility water for washwater and found that it led to excessive biological growth and plugging of the dryer. Now they religiously use boiler feed water instead of the utility water.

DAVE FERGUSON (Tracerco)

Tracerco offers a service where a team comes onsite with a portable instrument that uses neutron radiation to “see” through the vessel wall. The principle of the Neutron Backscatter (NBS) device is that a source of high energy neutrons can sit in the head of the instrument with a detector of low energy neutrons and produce no signal. But when the head of the instrument is held against the exterior wall of a vessel containing hydrogen bearing molecules, most typically hydrocarbon vapor or liquid or water, then some of the high energy neutrons that pass through the wall will strike the proton in the nucleus of the hydrogen atoms. Because they are of almost the same mass, the reaction is a “billiard ball” collision. Some of the neutron’s energy is transferred to the hydrogen atom, and the low energy neutron bounces off.

Statistically, some of the low energy neutrons will pass back through the vessel wall and into the

detector, generating a signal. The strength of the signal generated is strictly dependent on the concentration of hydrogen atoms inside the vessel. In a vapor space, the hydrogen density will be low. In a hydrocarbon liquid, the density is high.

Molecules such as the salt in a salt dryer do not contain hydrogen atoms. When the NBS device is held against the wall of a salt dryer at an elevation above the salt bed, the vessel will be full of hydrocarbon liquid, producing a high signal. When the device is moved to an elevation where the salt bed is present, the signal is reduced because there is hydrocarbon liquid only in the spaces between the salt crystals.

The figure above shows the results of NBS scans of two salt dryers. A reading was taken with the NBS device at one-foot intervals starting at the top tangent line. The measurements from the 17-foot mark to the 12-foot mark on the A Dryer were all high signals. The rest of the readings on the A Dryer were much lower. The scan of the B Dryer found that all of the readings were similar to the lower readings from the A Dryer. The conclusion was the B Dryer was full of salt, but the top of the A Dryer salt bed was between the 11- and 12-foot elevations. Scans of two side-by-side dryers can generally be performed in no more than half a day onsite, with results presented before the crew departs.

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