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## **Question 7: What is your experience with reusing molecular sieves in pressure swing adsorption hydrogen purification? What is your recommended inspection criteria for the molecular sieve to be reloaded?**

### **Brian Slemp (CITGO)**

CITGO has successfully reloaded the same PSA adsorbents multiple times in the same PSA skid.

We review operating history to ensure the system was not exposed to a significant amount of liquid water carry over. We monitor the hydrogen recovery from the PSA and ensure the system is operating within the design parameters to determine if the adsorbent is worth retaining. The material is carefully vacuumed from the vessel to minimize cross contamination of the layers. The adsorbent is screened with an inert system to minimize moisture adsorption and stored in a location protected from the elements in sealed metal containers.

### **Vern Mallett (UOP)**

The Molecular sieve adsorbent is routinely reused when vessels are unloaded for routine vessel inspection. The adsorbent must be screened, segregated from other adsorbent, and stored such that it is protected from exposure to ambient air. Typically, 15-20% fresh molecular sieve is required to make up for losses during the unloading/loading activities. A LOI (Loss on Ignition) test can be performed to test the molecular sieve activity. Finally, if the PSA unit was not meeting the design performance prior to the unloading, then reuse of the molecular sieve is not recommended

### **Dan Webb (Western Refining)**

We don't have any experience with these however I have heard from others in the industry that the mole sieves give relatively few problems. The mole sieve would likely only be dumped when the vessels are due for internal inspection. The alumina should be replaced as a precaution along with the activated carbon. as for the mole sieve material it would be intermixed with the other products due to the dumping procedure. The mole sieve and other components to a PSA vessel are fairly cheap and the cost of replacing them is likely not worth the risk of operational issues associated with not replacing them.

### **Randy Peterson (STRATCO)**

Oxygen is a major cause of monel denickelification. Oxygen can enter the circuit during loading operations. Care should be taken to avoid pressuring air contained within loading pipes/hoses into the unit. Whenever monel is overlayed on carbon steel, a "butter" layer of nickel should be laid down prior to the monel layer. This step reduces the potential of a poor-quality overlay. A corrosion problem has been reported with packed regenerators using monel rings. Due to distribution problems commonly associated with packing, portions of the packed beds run dry and hot. The monel tends to severely

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corrode under these conditions leaving only a copper residue. Although packed regenerators typically work well when first commissioned, trayed regenerators tend to have less corrosion over time as the trays are kept cool by the flowing liquid. Therefore, fixed valve trays are recommended in this service. Chase Homen (El Paso Refinery) We don't have any experience with these however I have heard from others in the industry that the mole sieves give relatively few problems. The mole sieve would likely only be dumped when the vessels are due for internal inspection. The alumina should be replaced as a precaution along with the activated carbon. as for the mole sieve material it would be intermixed with the other products due to the dumping procedure. The mole sieve and other components to a PSA vessel are fairly cheap and the cost of replacing them is likely not worth the risk of operational issues associated with not replacing them.

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