CASE STUDY

Net Gas Cl Treaters within a UOP CCR, Oklahoma Refinery
Vari Zeo Replacing Pro Alumina Charge

This is a Refinery located in Oklahoma with a 1.42 MMSCFH UOP designed CCR. The focus of this study will be the Net Gas Chloride Treater, of which this refinery has one. The following is based on conditions within the CCR during two time periods;

a) 23 months of use with alumina material November 2009 until October 2011.
b) 6 months of use with CLS Vari Zeo October 2011 until April 2012.

For the purpose of this case study, we will evaluate the effects of each material on the CCR, as well as the costs associated with the use of each material. In order to remain consistent, we are evaluating one cycle length of each material.

November 2009 until October 2011

This Oklahoma Refinery was given the suggestion by UOP that they should stick to using promoted alumina within their Net Gas Cl Treater. It was explained to the engineers at this refinery that the system was designed for the use of alumina and any other materials could do more harm than good. This claim was backed up by the Head of Operations at that time.

During this 18 month period, the refinery continued to have consistent problems with the downstream plugging/fouling of burner tips in the Fuel Gas Unit. This was accompanied by a green “sludge” in their downstream components.

This material was kept online and not pinpointed as a cause of these problems due to the continued Draeger readings of 0.0ppmv at the exit of the treater. Upon further investigations, we found that no reading higher than 0.0ppmv had ever been found.

CLS visited the refinery in March of 2011 and explained that the origin of their problems was indeed the spent promoted alumina bed they currently had online. CLS was able to show the engineers the **Green Oils**, which were being produced within the alumina bed.

After several visits and a change in staff at the refinery, CLS was finally able to convince the new engineers and operations personnel that a change in Cl Removal material was necessary.

The discharging of this treater in October 2011 was burdensome and expensive. Due to the HCl -> RCl transformation process, and the creation of byproduct **Green Oil**, this material was very clumpy and difficult to remove. The discharge of alumina material requires that hot nitrogen be used in order to purge the vessel and lower the LEL’s to acceptable levels. This process was a time consuming and expensive one. The hot nitrogen must be used so that the adsorbed Cl's are not released and poison all untis downstream. If steam were used, the alumina would breakdown, release all Cl's and endanger all equipment and metallurgy it comes in contact with.

Once the purging was complete, the vessel had to be discharged of the spent alumina. This process was also a timely and expensive one. After discharging the material, the alumina must be disposed of as Hazardous waste. This too is a costly procedure. From start to finish, this entire procedure took over 4 weeks.

Completing the discharge allowed for the introduction of a new material.

October 2011 until April 2012

The installation of CLS' Total Chloride Removal System was quick and dry. No moisture was released downstream into the compressor and no time was wasted priming the material after loading. The bypass valve was carefully turned and the vessel was back online.

During the six months, the CLS Chloride Removal system successfully removed 100% of all species of Cl's, including the organic. The Vari-Zeo accomplished this with no side effects or formation of byproducts such as Green Oils.

The CLS Var-Zeo material performed as planned throughout the scheduled six month cycle length. This was followed by seven subsequent cycle lengths and the refinery is still using the CLS Systems today.

Two different costs are associated with the use of Aluminas versus the use of CLS Vari-Zeo. One is the easily calculable cost of changeouts and the auzilary costs associated with a change out. The second costs are a bit more difficult, but also more important. At the time of the initial switch from alumina to CLS Vari-Zeo, the refinery was experiencing constant shutdowns due to plugged burner tips and the necessity to replace corroded piping. This cost is one of spent capital and the loss of production.

The features/benefits of the CLS Vari Zeo system are as follows:

- No RCl formation
- No green oil formation
- Total Cl removal both HCl and RCl during 6 month cycle length
- Cost of fill for each bed = **$40,000.00**
- Vari Zeo can be **steamed** for 24 hours prior to discharge to achieve LEL. Cost of steaming is negligible.
- Unloading can be done by dumping via bottom schute within 2 days with catalyst handling cost of **$15,000.00**.
- Spent Vari Zeo after steaming is designated as **non hazardous** and can be landfilled as Class II industrial waste with a cost of < $0.05/lb = **$2,000.00**

Total cost of fill plus discharge, purging and disposal = **$57,000.00**.

The comparative experience with the promoted alumina system was as follows:

- RCl and green oil formation after 2 months online.
- Cost of fill for each bed = **$23,000.00**
- Pro alumina cannot be steamed. The lead bed was purged with hot nitrogen for 7 days at a cost of **$30,000.00**. LEL was not achieved.
- Unloading was done by vacuum discharge from the top manway within 3 days with catalyst handling cost of **$30,000.00**.
- Spent Pro alumina after is designated as **hazardous for benzene** and had to be landfilled at a cost of $0.35/lb = **$14,000.00**

Total cost of fill plus discharge, purging and disposal = **$97,000.00**.

Conclusion

Comparing the two capital costs associated with each changeout reveals a significant savings with CLS Vari-Zeo. This refinery saved approximately $40,000.00 in changeout costs alone. The capital saved over the past two years while using CLS material has not even been calculable. The reformer unit has not had a single shutdown due to corrosion or plugged burner tips.

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