JM

Root cause analysis nitric acid plants

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Root cause analysis (RCA) to identify problems in nitric acid production

Case study

A 925 mtpd medium pressure (MP) nitric acid plant had performance issues with low conversion efficiency and high levels of N_2O one month into a new gauze campaign. The initial conversion efficiency obtained with the JM gauze technology was between 1% to 1.5% higher compared to previous suppliers. However, the conversion efficiency started to decrease gradually from an initial average of 97% to 91% (see Figure 1) and the N_2O concentrations measured downstream of the gauzes increased from 400ppm to 1600ppm.

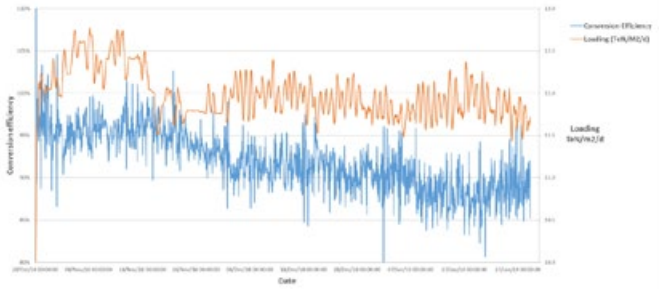


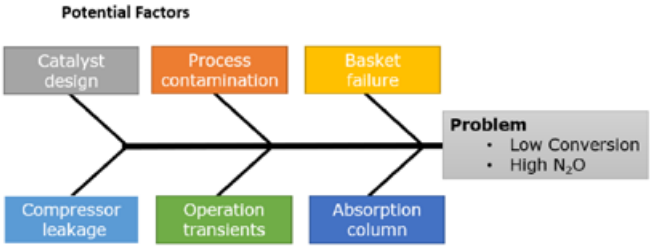
Figure 1: Conversion efficiency vs nitrogen loading (teN/m²/d)

As a result, a combined team of engineers from Johnson Matthey (JM) and the customer proceeded with a root cause analysis (RCA) to identify the cause of the problem and to prepare and implement the corrective actions to solve this issue. Well-structured RCA processes can greatly reduce or eliminate costly problems and minimise the impact to the producer – typically RCA's consider the following areas:

- Identification and description of the problem.
  - Typical questions to be answered: when?, where?, what?, which and how much/many?
- Selection of the team in charge of the RCA
- Identification of the potential hypothesis and reasons that have caused the problem
- Establish a workplan and strategy to rule out hypothesis
- Definition of steps to solve the problem with minimum impact

Identification of the main causes that originate the problem

The first thing when performing the cause identification exercise is to define the potential factors that can contribute to the problem. In this specific case and considering the low conversion and high N_2O level the main factors to considered were:



As part of the investigation JM used its proprietary kinetic model to simulate the performance of the gauzes and to determine the reaction profile within the catalytic pack that was used at the plant.

In this case it was required to stop production and open the ammonia oxidation burner to inspect the gauzes and the containment basket. To minimise any risk and to cover any potential issues related with gauze contamination and gauze damage, JM manufactured two emergency gauzes that were sent to the customer prior to the scheduled shutdown.

Once the burner was opened, there were clear indications of the reasons of the causes that originated the low conversion efficiency, the increase of N_2O emissions. The root cause being a basket failure. After basket repair, conversion efficiency and N_2O levels returned to the original values.

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1851JM/1221/1/ENR