EIGA Safety Newsletter

Prepared by the Safety Advisory Group SAG NL 82/05/E

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1. Tanks damaged due to vacuum

Case 1

An oxygen buffer vessel was connected between the oxygen PSA plant (pressure swing adsorption) and the inlet of the oxygen compressor. The production capacity of the plant decreased but the compressor continued to run causing a vacuum in the tank and consequently the tank was destroyed.

Picture no1

The tank was designed for a min. pressure of 900 mbar(a). The installation was equipped with the following safety devices to prevent vacuum in the tank or to protect it from damage:

- The PSA plant had high and low outlet pressure switches and the vessel had a low pressure switch. These switches were connected to the same PLC (programmable logic controller) and on activation should stop the compressor. The PLC failed at the accident.
- The compressor had a low pressure switch on the inlet. The set minimum pressure was based on the protection of the compressor and was 0.15 bar(a) – much lower than the allowed minimum pressure in the vessel.
- The vessel had a bursting disc to protect against vacuum but the design bursting pressure of the disc was lower than the minimum allowed pressure of the tank.

Lessons learned are:

- Safety instrumented functions should be hard wired. If this is not feasible and PLC is used, the failure of the PLC shall be considered at the design risk assessment.
- During commissioning of a plant all safety critical functions (such as the bursting disc) should be checked for compliance with design specifications.
- The risk of tank implosion will be eliminated if the tank was designed for the pressure of 0 bar(a).

Case 2

A storage tank was going to be painted and therefore painting preparation included a scaffolding elevation as well as a protection with plastic covers of some parts of the tank, including the vent valve. The painters forgot to remove the plastic bag on the vent valve after painting. When liquid was withdrawn from the tank, the plastic cover was sucked into the vent pipe blocking the air flow and causing a vacuum in the tank. The tank then collapsed as can be seen on picture no. 2.

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For some, it is hard to believe that the plastic over the vent pipe is stronger than the steel tank under the vacuum conditions that are created when withdrawing product out of the tank. Seeing is believing!

Lessons learned are:

- Covering the vent pipe during tank painting is standard practice; leaving it covered when withdrawing product from the tank is not.

- This is an expensive, embarrassing mistake that is entirely preventable by adherence to good procedures and good communications between operations and maintenance.

- This sort of event nearly always results in total destruction of the tank. It is generally not cost effective to repair tanks with damage of this extent.

Picture no.2