EIGA Safety Newsletter

Prepared by the Safety Advisory Group

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The risk of generating static electricity when using CO_2 as an inerting agent

The Safety Advisory Group, SAG, has been informed of several fatal accidents caused by explosions which occurred while using CO_2 during inerting equipment and storage tanks that had previously contained flammable materials. In most cases the flammable materials were liquids or gases but dust explosions may also be triggered by the same cause.

Examples of fatalities:

- Two navy firemen were killed in an explosion while attempting to inert an 18,9 m^3 Jet Fuel tank by use of portable CO_2 fire extinguisher.
- Four persons were killed in an explosion on board the tanker Alva Cape while inerting naphtha tanks using CO_2 cylinders.
- Twenty nine persons were killed in an explosion while witnessing the demonstration of a newly installed CO_2 fire-extinguishing system for a partially filled 5000 m^3 jet fuel tank, in Bitburg, Germany.

Subsequent investigations have shown that, during the inerting process, static charges of several tens of kV were generated and accumulated at the end of the piping connected to the tank. Voltage of this nature is sufficient to produce sparks which act as points of ignition for the flammable mixtures.

When liquid CO_2 expands up to absolute pressures of less than approximately 5 bars, the result is the formation of small particles of solid CO_2 (dry ice). As the two-phase solid/gas flows through the piping, static charges are produced by the particles rubbing against other particles, between themselves, piping and equipment. Subsequently, these charges accumulate in the zones that are not earthed/grounded at the end of the pipelines, most often in valves and nozzles. The sizes of these fields, as determined by experiments, can reach values of between 50 and 180 kV/m. Similarly, static electricity can be generated by the dry ice particles after they leave the discharge nozzle. The pressure and impurities in the CO_2, equipment materials in transfer line hoses, etc. all influence the generation of static electricity.

In the case of the extinguishers, the material used in the diffusing nozzles plays an important role in the size of the electrostatic field created. In fact, the field is significantly larger if these release nozzles are made of dielectric material, as is the case for most extinguishers. The field strength can, in some circumstances, be reduced by a factor of 100 if earthed/grounded metallic gas type nozzles are used instead of dielectric nozzles.

In any case, bearing in mind the fact that each installation must be submitted to a complete risk assessment, the SAG recommends adopting the following measures:

- Strictly forbid the use of portable CO_2 extinguishers for inerting any tanks/equipment containing flammable or explosive materials.
- Never use liquid CO_2 directly for inerting containers, tanks or equipment containing flammable or explosive materials.
- When CO_2 gas is used for inerting, proper precautions have to be taken regarding the formation of static electricity (such as ensuring electrical continuity).

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Treatment of cylinders and containers in scrap yards

A serious accident occurred in a scrap yard while two workers started cutting up an LPG cylinder with an electric saw. The cylinder exploded, causing serious burn injuries to both workers and one of them died later.

At the subsequent investigation, the employees declared that it has been a common practice to use saws or other tools to cut cylinders, even when they contained a gas.

Obviously, these circumstances are extremely dangerous and not in line with any member company standard. To avoid recurrence, SAG recommends the following.

Gas companies and cylinder owners

- Cylinders must be emptied, inerted and rendered useless by cutting a hole, destroying neck threads, etc. preferably at the gas company site. If this is done at a site of a contracted company, the member company must ensure that the transport and the actual work is done in a proper way.

- The work must be risk assessed and done in a safe and environmentally sound way. Consider the possible creation of hazardous wastes and its disposal.

- Acetylene cylinders must not be sent to scrap yards. They contain acetone (or DMF) and a porous mass, sometimes with a few percent of asbestos. The cylinders must be treated in installations specially authorised to carry out this process.

- Salesmen dealing with scrap yards, agents and distributors should be informed of the proper scrapping methods.

- Records should be kept of the cylinder and container numbers retired from service.

- The member company should ensure that the scrapping company has received appropriate training and information about the risks according to this Newsletter.

Scrap yards

- Scrap yards and other companies who might scrap cylinders should be urged neither to accept nor to destroy cylinders and containers that may contain residual gas. It is important to emphasise that all cylinders with mounted valve should be considered as containing residual gas, despite appearing to be empty.

References

EN 1968, Transportable gas cylinders – Periodic inspection and testing of seamless steel gas cylinders
EN 1802, Transportable gas cylinders – Periodic inspection and testing of seamless aluminium alloy gas cylinders
EN 1803, Transportable gas cylinders – Periodic inspection and testing of welded carbon steel gas cylinders
EIGA Doc. 5/00 – Guidelines for the management of waste acetylene cylinders