Safety Information

Prepared by the Safety Advisory Council, SAC

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The Risk of Generating Static Electricity When Using CO_2 as an Inerting Gas

The Safety Advisory Council, SAC, 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 SAC recommends adopting the following measures:

- Strictly forbid the use of portable CO_2 extinguishers for inerting any tanks or equipment containing flammable or explosive materials.

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- When CO_2 (gas, liquid, solid, or dry ice) is used for inerting, proper precautions must be taken to mitigate the risk of static electricity, such as ensuring electrical continuity.

- The design and application of CO_2 systems for inerting should follow recognized design codes, such as:
  - NFPA 12 – Standard on Carbon Dioxide Extinguishing Systems (USA)
  - ISO 6183 – Fire protection equipment – Carbon dioxide systems for use in fire protection – Performance and design requirements (International)
  - EN 12094 series – Fixed firefighting systems – Components for gas extinguishing systems (Europe)
  - BS 5306-4 – Fire extinguishing installations and equipment on premises – Code of practice for carbon dioxide systems (UK)

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