

Bulk Liquid Oxygen, Nitrogen and Argon Storage Tanks at Production Sites – Inspection Requirements

Introduction

Flat bottom storage tanks form an integral part of the production process of industrial gases. They are typically large volume tanks that contain mainly either liquid nitrogen or oxygen, though some are in argon service. Cryogenic flat bottom tanks consist of an inner tank and an outer jacket that are field constructed on an insulated foundation. The space between the inner and outer tanks is insulated, usually with expanded perlite.

Flat bottom cryogenic storage tanks have been in service for over fifty years in the industrial gases industry and have demonstrated satisfactory in-service performance. The global industrial gases industry including EIGA members have produced guidance on the design, manufacture and in-service inspection of flat bottom storage tanks, see EIGA Doc 127, *Bulk Liquid Oxygen, Nitrogen and Argon Storage Systems at Production Sites*.

Periodic inspection

The industrial gases industry does not carry out periodic internal inspection of bulk cryogenic storage tanks.

This policy has been established over many years, based on operating experience, the inherently stable and benign conditions within an operating cryogenic storage tank and an absence of the traditional failure mechanisms for such equipment including corrosion, erosion, fatigue.

An annual inspection should be carried out to guard against any degradation mechanisms developing and to confirm that the environment within the tank outer jacket is dry and inert and that there are no obvious indications of cryogenic and/or pressure leaks.

The practice of no periodic internal inspection of cryogenic storage tanks is supported by the arguments that:

- Cryogenic storage tank inner vessels are constructed from materials that are corrosion resistant. These materials retain their corrosion resistance at temperatures below ambient and experience shows that corrosion at cryogenic temperatures is negligible;
- The process fluids are dry, clean, non-corrosive, non-toxic and non-corrosive;
- Design and construction are carried out to well established and internationally recognised codes and standards. Designs take into account pressures, loadings, temperature changes and movements expected during normal running and during start-up and shutdown. The designs also take into account that inner tank and associated piping will be largely inaccessible within an outer jacket;
- The operating mode of cryogenic storage tanks is generally 'steady state' with few pressure and temperature variations;
- The materials used in the construction have high fracture toughness characteristics. The critical defect size, for the initiation of an unstable fracture, would allow a defect to be detected, well before the critical defect size is reached, from an increase in interspace pressure or from the presence of cold patches;

- The materials used in the construction have significantly enhanced yield and ultimate tensile strengths at their working temperature. For example, at cryogenic temperature the ultimate tensile strength of austenitic stainless steel is approximately twice that at ambient temperature.
- Internal inspections are sometimes performed on flat bottom tanks, when decommissioned and prior to scrapping. These inspections have never detected any problems that have led to a need to modify the policy of not carrying out periodic internal inspections.

EIGA has developed a publication that address plant integrity management and has a specific section on the external inspection of bulk cryogenic storage tanks, see EIGA Doc 190, *Plant Integrity Management*.

Regulatory survey for inspection of bulk liquid oxygen, nitrogen and argon storage tanks at production sites

EIGA has carried out a survey of its members who operate across Europe as well as those who operate in the United States, South Africa, Australia and Asia to understand if there are any regulatory requirements to carry out a periodic internal inspection of bulk liquid oxygen, nitrogen and argon storage tanks. In no case was there a regulatory requirement to carry out a periodic internal inspection of these tanks.

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