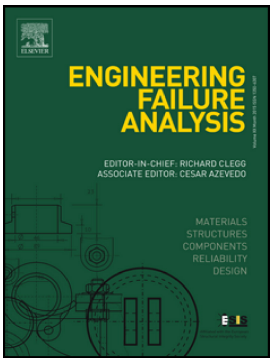

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Urbi Pal, Goutam Mukhopadhyay, Sandip Bhattacharya

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Failure Analysis of an Exploded CO_2 Gas Cylinder

Urbi Pal*, Goutam Mukhopadhyay, Sandip Bhattacharya

Failure Analysis and Plant Metallurgical Inspection Group,
R&D and Scientific Services,
Tata Steel, Jamshedpur 831001, India.

Abstract

This paper presents the analysis and subsequent recommendations towards prevention of failure in an IS 7285 type 2 cylinder which is seamless gas cylinder grade steel. The region of fracture showed the presence of an oxidized zone in the inner walls of the CO_2 gas cylinder along with a fresh surface. Visual observation showed presence of multiple small cracks at the inner surface. Microstructural examination with optical and scanning electron microscopes revealed that the cracks were associated with scale indicating their pre-existence. A decarburized layer was also observed at the inner surface. The stress intensity factor (K_{1C}) estimated at the crack tip upon consideration of the pressure inside the cylinder surpassed the fracture toughness of the material. Exposure to direct sunlight elevated the temperature of the CO_2 gas wherein it behaved as a supercritical fluid occupying the entire volume of the cylinder with a pressure higher than ambient. At a particular density, above 48 – 54^o C, this pressure increased abruptly, beyond the limit offered by the pressure valve resulting in explosion. Periodic checking of pressure valves and proper quality assurance system enabled by NDT techniques were recommended for the prevention of such catastrophic failures.

Keywords: Failure analysis; Fracture toughness; P – T diagram

Corresponding author: email – urbi.pal@tatasteel.com