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Strength Investigation of Liquefied Petroleum Gas Cylinders: Dynamic Loads

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Abstract : A large number of transportable LPG cylinders are manufactured annually for domestic use. These LPG cylinders are manufactured from mild steel and filled maximally with 12.5 kg liquefied gas under internal pressure of 0.6 N/mm^2 at a temperature of 50°C. Many millions of such LPG cylinders are in daily use mainly, for purposes of space heating, water heating, and cooking. Thereby, they are imposed to severe conditions leading to their failure. Each year not less than 5000 of these LPG cylinders fail, some of those failures cause damage and loss in lives and properties. In this work, LPG cylinders were investigated; Stress calculations and deformations under dynamic (impact) loadings were carried out to simulate the effects of such loads on the cylinders while in service. Analysis of the LPG cylinders was carried out using the finite element method; shell and cylindrical elements were used at the top, bottom, and in middle (weld region), permitting elastic-plastic analysis for a thin-walled LPG cylinder. Variables such as maximum stresses and maximum deflections under the effect of impact loading were investigated in this work. Results showed that the maximum stresses reach 680 MPa when dropped from 3m-height. The maximum radial deformation occurs at the cylinder's top in case of the top-position impact. This information should be useful for enhancing the strength of such cylinders and to for prolonging their service life.

Keywords : dynamic analysis, finite element method, impact load, LPG cylinders
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