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OPERATIONAL HISTORY OF LIQUID HYDROGEN TANK WITH GLASS BUBBLES INSULATION

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Culminating years of extensive research and development, field demonstrations have proven glass bubbles to be a superior insulation material for spherical liquid hydrogen storage tanks. Six years of operational history has been accumulated on a spherical 218,000-liter liquid hydrogen (LH₂) storage tank with glass bubbles insulation in the evacuated annulus. Over this period of time the tank has been subjected to two complete LH₂ fillings and thermal cycles. Each load of LH₂ took approximately two years to boil away, representing an approximate 100% performance improvement over the original perlite powder insulation. No special maintenance was necessary and the tank sustained normal vacuum levels. Infrared imagery showed the outer surface temperatures to be uniform. The full-scale field application of glass bubbles insulation builds upon years of laboratory testing (compatibility, vacuum, vibration, structural, thermal performance) and custom 1000-liter tank testing with both liquid nitrogen and LH₂. To extend application of the technology to tanks of non-spherical geometry, analysis of a targeted application of glass bubbles insulation to a horizontal 830,000-liter LH₂ storage tank is presented. Also discussed is a survey of other vacuum-jacketed cryogenic tanks operating around the world with glass bubbles insulation.

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