A computational platform is developed in the Modelica® language within the DymolaTM environment to provide a tool for the design and performance comparison of on-board hydrogen storage systems. The platform has been coupled with an open source library for hydrogen fueling stations to investigate the vehicular tank within the frame of a complete refueling system. The two technologies that are integrated in the platform are solid-state hydrogen storage in the form of metal hydrides and compressed gas systems. In this work the computational platform is used to compare the storage performance of two tank designs based on the tubular tank configuration with Ti1.1CrMn as the absorbing alloy. Results show that a shell and tube layout with metal hydride tubes of 2 mm inner diameter achieves the desired refueling time of 3 min and store a maximum of 3.1 kg of hydrogen in a 126 L tank, corresponding to a storage capacity four times larger than a tube-in-tube solution of the same size. The volumetric and gravimetric densities of the shell and tube are 2.46% and 1.25% respectively. The dehydriding ability of this solution is proven to withstand intense discharging conditions.