BALANCED MATERIAL SELECTION APPROACH OF 316 STAINLESS STEEL FOR HIGH PRESSURE HYDROGEN SYSTEMS

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High pressure hydrogen imposes challenges to materials of construction for hydrogen storage and delivery systems. There are several types of mechanical property degradations in materials when in contact with high pressure hydrogen. Some impact material performance more than the other. Different materials also respond to hydrogen exposure differently. Austenitic stainless steels, particularly, 316 stainless steel, has been studied extensively from different property perspective for its suitableness to these applications. Owing to its intrinsic high ductility and its mild mechanical property deterioration when exposed to high pressure hydrogen, 316 stainless steel is one of the favored materials for hydrogen system construction. Industrial standard 316 stainless steel, such as AISI 316, can have chemical composition varying in specified range. Property changes of 316 stainless steel in hydrogen have been shown to be closely related to the specific chemical composition of the material. Certain alloy elements are noticeably helpful in enhancing this alloy's resistance to hydrogen induced property deterioration. Nickel, chromium, and manganese, etc. are all shown to be beneficial. Higher contents of these alloy elements in 316 stainless steels could resulted in higher resistances to property degradation, and possibly longer component service life, in hydrogen. It should also be realized that the cost of 316 stainless steel fluctuates depending on the contents of these alloy elements and the quality of the material. Engineering designs require consideration of both technical efficacy and economic impact. In depth analyses of these effects and factors suggested that a material selection approach balanced with engineering needs, technical excellency and economic consideration can be achieved.