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Identification of most resistant steel to corrosion in hydrogen present environments. New allowys comparison

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Gerdau is a steel producer with a broad product line sold on the five continents. Gerdau meets the needs of the civil construction, industrial, and agribusiness sectors. It is also a global leader in supplying special long steel for the automotive industry. Gerdau is highly motivated in the development of new alloys that would support energy applications such as oil&gas and other offshore industry.

On the other hand hydrogen embrittlement is a phenomenon appearing when a high strength metallic alloy under mechanical constraint or stress is exposed to an hydrogen loading. The hydrogen loading can come from an in situ generation: chemical or electrochemical reaction (e.g. cathodic protection), or can be generated during the transformation process of the material (e.g. welding, electroplating, pickling,Ł?Ł). This corrosion in hydrogen environments is a persistent problem for the design of structural materials in various industries such as offshore and gas & oil. The consequence of this phenomenon is an important degradation of the mechanical properties of the material, going from the appearance of blister to a dramatic brittle fracture. Such as important issue is also a concern to Gerdau that is commited to ensure suitable products for each industrial application.

Gerdau would like through H2FC project use HyMat facilities in order to test our new materials (X & Y...) with a conventional one (Z) in order to determine the most resistant one to corrosion in hydrogen environment applications. These procedures are not a standard in the company so the access to HyMat at Tecnalia will allow a higher knowledge of our products in terms of materials performance under hydrogen environments and the identification of the best material for energy industry. This will in return allow Gerdau to know the most durable and safest material for gas& oil and offshore applications.

Gerdau goal with the access to HyMat facilities is, as mentioned, the identification of most resistant steel to corrosion in hydrogen present environments. In order to do so Gerdau would like to test four materials (X, Y, ..Z) to hydrogen-induced cracking resistance under NACE TM0284 Standard and sulfide stress cracking resistance under NACE TM01777 Standard.

NACE TM0284 establishes a test method for evaluating the resistance of pipeline and pressure vessel plate steels to hydrogen induced cracking caused by hydrogen absorption from aqueous sulfide corrosion. This is important to Gerdau since natural gas & oil can contain low quantities of water that can contain gasses like hydrogen sulfide which makes it corrosive. This can cause blisters and crakings. This test allows in a short period of time the evaluation of the susceptibility of different steels to cracking due to hydrogen. This allows Gerdau to identify the best option and recommend it to our clients.

NACE TM0177 addresses the testing of metals for resistance to cracking failure under the combined action of tensile stress and corrosion in aqueous environments containing hydrogen sulfide (H2S). Sulfide Stress Cracking (SSC) of metals exposed to oilfield environments containing H2S was recognized as a materials failure problem by 1952. The presence of hydrogen together with external and/or internal tension causes a decrease in the mechanical properties of the material. Thus, this phenomenon entails the rupture of the material at lower tensions that would support under inert conditions. Therefore, Gerdau believes that this test can complement the results obtained by NACE TM0284 on the identification of the best available material for energy applications.