



List of the steel grades to be investigated

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1. Introduction

At the proposal stage, the Hystories project partners decided that the following 4 materials should be fully characterized and H₂ tested (in different atmospheres and with various additions of electrolyte) during the Hystories project (Table 1).

Table 1: Materials to be investigated with full characterization and investigation under all test conditions according to Hystories proposal

Material	Microstructure	Specified Minimum Yield Strength (SMYS) [MPa]
K55	ferrite + pearlite	380
L80	tempered martensite	550
P110	tempered martensite	760
K55 welded grade	ferrite + pearlite	380

2. Selection of steel grades

In January and February 2021, several meetings with the Advisory Board of Hystories, in particular with Vallourec Mannesmann, took place to refine the test matrix with regard to more materials. Especially Advisory Board members (e.g. Italgas) noted that not only the planned materials from Table 1 are of interest but also several others. Therefore, it was decided to extend the number of investigated materials to other relevant materials for gas storage.

In addition, it was recommended by representatives of Vallourec that some materials shall be tested with more severe surface conditions since corrosive attack during service will cause pits and surface roughening, which will result in notching and finally in higher stresses. Two surface conditions were chosen to investigate this issue:

- A defined pre-corrosion step shall be done for some materials before starting the high pressure autoclave testing.
- Specimens with circumferential V-notches according to ASTM F519-13 will be tested to investigate a maximum notching effect with a notch radius of 10 μm .

Currently it is believed that (hopefully) not many or even none of the specimens would crack under the even most severe testing conditions. To be sure that the testing facility in principle can initiate cracks, it was agreed that in a first test a quenched material will be tested, which shall crack even when loaded with a smooth surface without any notch.

Consequently, the following materials will be tested during the project.

As a pre-test to proof that crack initiation with the given equipment is possible (despite the fact that very few cracks or even no cracks are expected) a hardened material according to Table 2 will be investigated.

Table 2: Material to initiate Hydrogen Induced Stress Corrosion Cracking (HISCC)

Material	Microstructure	SMYS [MPa]
hardened grade	martensite	> 1500

In contradiction to Table 1 the full characterization will be done with 3 materials instead of 4. The materials are shown in Table 2.

Table 3: Materials to be fully characterized and investigated under all test conditions according to Deliverable D4.1

Material	Microstructure	SMYS [MPa]
K55	ferrite + pearlite	380
L80	tempered martensite	550
K55 welded grade	ferrite + pearlite	380

In addition to the proposal the following materials will be investigated in autoclave tests under most severe conditions (Table 4).

Table 4 Materials to be investigated under the most severe conditions according to Deliverable D4.1

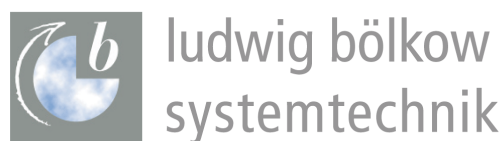
Material	Microstructure	SMYS [MPa]
P110	tempered martensite	760
13% Cr	martensite	550
2205	ferrite + austenite	approx. 400
Incoloy 625	austenite	approx. 600

The following notched specimens will be investigated under the most severe testing conditions (Table 4).

Table 4: grades that will be tested in the most severe conditions

Material	Type of notch to increase surface roughness
K55	pre-corroded
L80	pre-corroded
K55 welded grade	pre-corroded
K55	V-notch according to ASTM F519-13
L80	V-notch according to ASTM F519-13
K55 welded grade	V-notch according to ASTM F519-13

Hystories project consortium



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