



*Oil & Gas Technology**Equipments, Materials & Corrosion*

WINTECH GLOBAL is providing consultancy in the field of the Static Equipment technology including the Pressure Vessels, the Internal parts, the Materials and the Corrosion. Applications are performed for the account of companies involved in the Oil & Gas and Energy industries.

PREFACE

“Mini JIP”

Standard reliable testing procedure for 2¼Cr - 1Mo - V welding quality control & acceptance

INTRODUCTION

Various major vendors have reported cases of cracking in welds that happened during the fabrication of heavy wall pressure vessels. Intergranular cracking occurred during ISR or PWHT treatment in the weld zone of V-modified Low Alloyed Steel (2¼Cr1Mo¼V). This micro-cracking problem was associated with a RHC (Re-Heat Cracking) phenomenon. The troubleshooting study performed by Industeel on the same has been introduced to the Oil & Gas market during the API Meeting of April 2009. This investigation and expertise identified some unexpected impurity levels in the concerned welds as being the most probable cause of RHC. This has been established by correlating impurity levels and high temperature ductility measurement through Gleeble® Testing.



Scope

The scope of this "Mini-JIP" is focused on the way to make the industrial field confident regarding the use of 2 ¼Cr 1Mo V low alloyed steel as has been the case during this last decade. Based on initial Industeel laboratory results and conclusions, it has been decided to extrapolate the same aiming at building a standard reliable testing procedure for the industry that would avoid the RHC phenomenon during reactor fabrication.

By properly managing the quality control through specific and reliable standard procedures and specifications, the players would then recover the lost confidence and by the way the well-known and significant advantage of using the 2¼Cr1MoV low alloyed steel grade.

Proposition

This "Mini JIP" is complementary with the MPC JIP, as it is not dedicated to deep research on the root causes of the phenomenon, as the other wider JIP is intended to do.

Indeed, Mini-JIP is focused on the manufacturing quality control approach by also challenging with the urgency reported by the worldwide network of Oil & Gas industries.

As it has been demonstrated by Industeel with the K factor effect, the RHC phenomenon is clearly linked with both mechanical behaviour and chemistry analysis. The "Mini JIP" is therefore centred around two acting tasks that have to be led in parallel, that is to say one on the mechanical point of view and the other on the material chemistry point of view.

The effect of the two spheres of influence on the final weld is graphically visualized within the POSTER by an apple. One can imagine that the goodness and the visual aspect of an apple are related to many influencing factors (agricultural, environmental, etc.) acting on the quality of the fruit. In the same manner, to obtain a good, fine-looking and successful weld, all the factors have to be



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accurate: welding parameters, welder qualification, grain size, Heat Treatments, material behaviour, carbides precipitation and impurities level.

The RHC problem encountered by highly experienced and skilled workshops was not related to changes of well managed/controlled welding conditions and parameters. The RHC problem and induced micro-cracks after ISR/PWHT were clearly linked to impurities (*worm in the apple*) which were emerging from some of the welding flux.

The "Mini JIP" proposes to develop a standard and reliable Mechanical test (Gleeble test or equivalent) to assess the Reheat Cracking susceptibility of SA/A542grD and SA/A336gr22V Submerged Arc Welding (SAW) filler material. This will be related with a standard and reliable chemical analysis so as to obtain a specified and industrial impurity level ("K factor" or equivalent) through certified and standardized method for the analysis of impurities in the weld.

Goal & Deliverables

Once the procedures developed by "Mini JIP" will be validated from the three benchmarking laboratories as reliable Industrial and Standard Testing Procedures (ISTP), they will be incorporated in the API 934-A or other Industrial Recommended Practice as Standard reliable testing procedures for V-modified 2 ¼Cr - 1Mo - V :

- *ISTP 1 : chemical quality control (method and specification for chemistry analysis to insure welding components quality)*
- *ISTP 2 : welding quality acceptance (method and specification for mechanical test to perform HT ductility control)*

By applying the said ISTP(s), it will be achievable to restore performers' self-confidence and in this way avoid the RHC phenomenon all along fabrication phase.