



# HOT HYDROGEN ATTACK (HHA)

## DETECTION AND MONITORING OF HOT HYDROGEN ATTACK DEGRADATION

The presence of hydrogen in industrial plants is a potential source of damage. High partial hydrogen pressure (higher than 30 bar) and high temperature (higher than 300 °C) can change the material characteristics negatively. This can be occurred majorly in fertilizer plants and refineries.

Hot Hydrogen Attack (HHA) is one such form of degradation which is due to the formation of Methane (CH<sub>4</sub>) by reaction with carbides in steel. HHA can occur either in the parent material or in the weld itself and manifests itself in several types of alloys.

The probability of HHA damage in plant is dependent on the partial hydrogen reasure and operating temperature. Methane formed by the reaction accumulates at internal voids on the grain boundaries, where at certain conditions the build-up can produce micro-cracks.

In the weld material this leads at the worst case to a leak before break situation but when the damage is in the parent material, the result can be catastrophic. The incubation time can be very long (more than 20~30 years) and the material degradation can lead to significant failure.

HHA can be detected in a number of ways but the reliability of some of the techniques is questionable. However advances in signal processing and imaging in the techniques described here lead to a far greater level of confidence in both the inspection results and the repeatability which is a great advantage for the monitoring of the damage.

SGS has developed a specific procedure and approach to identify and monitor HHA adequately.

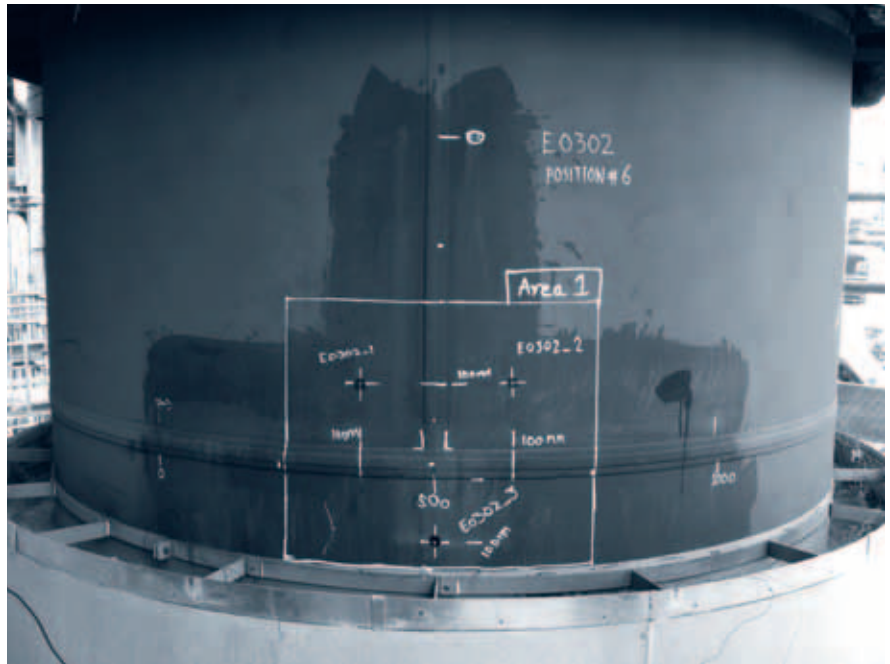
# DETECTION AND MONITORING USING **ADVANCED TECHNIQUES**

The methodology developed by SGS Industrial Services combines advanced signal processing and imaging of the results, utilizing advanced techniques like Time Of Flight Diffraction (TOFD), Automated Backscatter and Velocity Ratio measurements.

## **HHA INSPECTION AND MONITORING IN THE PARENT METAL**

To inspect a plant for possible presence of HHA an accurate inspection plan is made with the back scatter technique using the Corroscan utility, on the most critical areas i.e., at highest temperature and/or highest partial Hydrogen pressure).

In order to discriminate reliable between HHA and small inclusions and to verify the attack, additional measurements are taken with the velocity ratio technique.



## **HHA DETECTION AND MONITORING IN WELD MATERIAL**

The approach in the field would involve scanning of all welds for 100% (if accessible) with TOFD and manual or automated Pulse echo.

### **ADVANTAGES OF THIS APPROACH**

- The inspection has high reliability and reproducibility
- It is possible to detect attack at an early stage
- The progress of attack can be monitored in time
- Clear presentation of results is possible
- Examination is non-intrusive, resulting in cost and time savings
- All geometries can be examined
- All data are stored for easy and quick reference at any time in the future.

The need for reliable inspection techniques and the inherent accuracy of advanced ultrasonic techniques make the SGS Inspection approach the ideal

choice for a reliable inspection of HHA.

SGS operators have more than 20 years of experience in these HHA inspections which results in consistent performance and has resulted in the enormous cost savings in inspection of the assets.

### **SGS INDUSTRIAL SERVICES COMPETENCE CENTRE**

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