Eddyfi Technologies
Beyond current

# HYDROGEN DAMAGE INSPECTION USING REAL-TIME TFM

| THE CHALLENGE | THE SOLUTION | THE BENEFITS |
|---|---|---|
| Detect step-wise HIC cracks and HTHA microcracking. | The use of real-time Total Focusing Method (TFM) in a PAUT portable flaw detector. | The TFM offers high-resolution images that allow the detection and characterization of both HIC and HTHA damage. |

**What is the Full Matrix Capture (FMC) and the Total Focusing Method (TFM)?**

According to the EN 16018:2011 European standard, the Full Matrix Capture (FMC) is a data-acquisition process for which each element of an array is successively used as a transmitter, while all the elements are used as receivers. The Total Focusing Method (TFM) is a reconstruction method that focuses the ultrasonic energy at every single pixels of a region of interest.

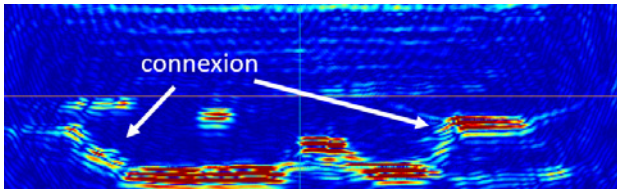
**The interest of using TFM for hydrogen damage (HIC / HTHA)**

**Hydrogen Induced Cracking (HIC)** is caused by blistering of a metal due to a high concentration of hydrogen. The blistering damage tends to form parallel to the surface. While the initial stage of HIC is not critical (individual cracking), it can become dangerous should HIC give rise to step-wise cracking that propagates into a weld or begins to go step-wise through the wall. **The aim is thus to detect potential connexions between the various cracks before catastrophic failure**. By nature, the FMC leads to a large beam spread and thus to energy sent into all directions making it a good technique to detect potential connexions between cracks.

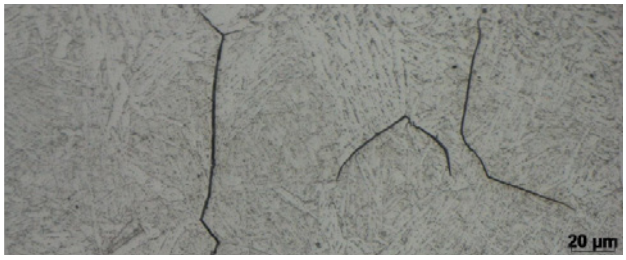
**High temperature hydrogen attack (HTHA)** is a form of damage observed in steels exposed to high pressure hydrogen at elevated temperatures. Damage occurs as hydrogen atoms diffuse into steels, react with carbon, form methane gas internally in the material, which results in decarburization and fissuring (micro-cracking). As defects are small (micro) it is quite difficult to detect them with conventional UT method; an analysis of the backscattered energy is usually performed. By focusing the ultrasonic energy to a small spot, the TFM is sensitive to these small defects. To see 300-micron size defects, probes frequency 5 to 10 MHz is used. With the TFM, an excellent resolution is obtained whatever the depth of the defects. Plus, it is real-time for field operations. The technique has been recently introduced by Oil & Gas companies and training centers as a mean to detect HTHA damage at an early stage.

**TFM offers high-resolution images that allow the detection and characterization of both HIC and HTHA damage**. The availability of portable equipment capable to perform real-time TFM offers a new tool to the NDT operator arsenal.

HIC




TFM imaging showing HIC connexions between cracks




HTHA cracks near the backwall

Detection of stage 1 HTHA ©BP Products North America