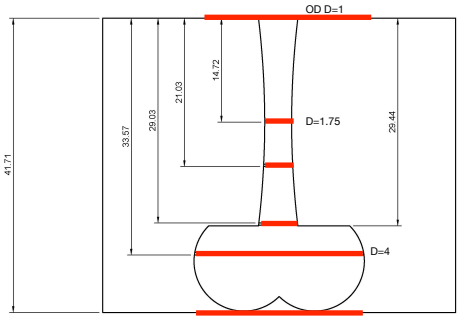
Advancement in Microwave Inspection of HDPE Allows Depth Interpretation

Microwave inspection of High Density Polyethylene has been available in the industry since the early 2000's, but it has only recently advanced to enable imaging of the fusion at various depths within the pipe wall. The innovation was made possible by the use of an advanced multi-frequency system, coupled with a first of its kind inspection antenna and sophisticated analysis software. Recent studies have shown accurate depth characterization of several zones within the fusion thickness. The software allows for both imaging and data analysis, including sizing, at each of the available layers.

The multi-frequency application is made available through the use of a laboratory quality microwave Vector Network Analyzer (VNA) that has been re-purposed for filed inspections. The use of the VNA provides a highly accurate and calibratable source of data to allow for good repeatability between inspections. The data is collected via the VNA by an encoded pipe scanner and then fed into the data acquisition software. The microwave data is collected over a range of microwave frequencies, typically from 6 GHz to 14 GHz, and the frequency range is subdivided into a user defined number of bins.

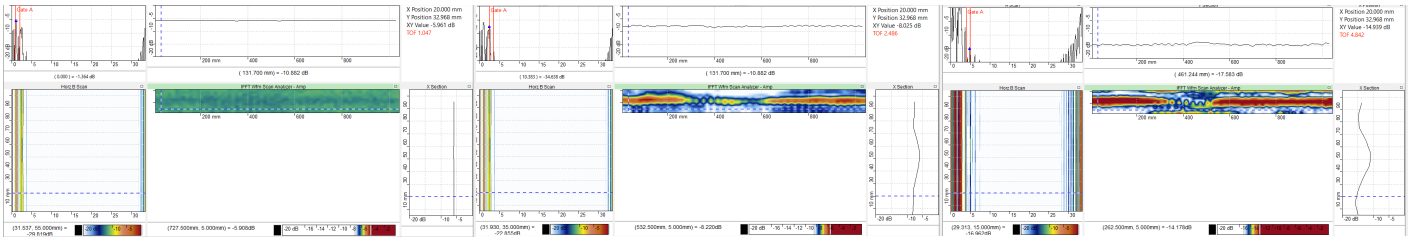


12 Inch SDR 11 Butt Fusion

The frequency range is then post-processed and transformed into the time domain, allowing the butt fusion cross section to be sub-divided into multiple depth zones, as shown. Each location (identified by the red line) is associated with a time delay and converted into depth via the known speed of light in the material. Unlike the speed of sound, the speed of light does not vary with temperature, making inspection possible in daylight.

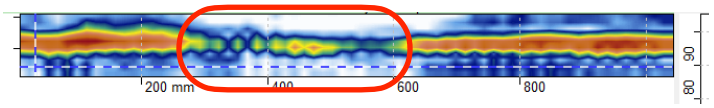
The butt fusion can then be imaged at each delay, making identification of flaws relatively simple. Three delays are shown for a fusion that has been contaminated with oil.

The software has been designed to portray the data in fashion familiar to UT operators, A scan upper left with data gate, C scan lower right, Horizontal B lower left, with data sections upper right and then far right



Delay = 1 (OD) Delay = 1.75 (Mid Fusion) Delay = 4 (Inner Bead)

lower. The C scan images the fusion circumferentially in the X axis and axially, fusion in the center, in the Y axis. The entire fusion circumference of 1020MM is shown with 50MM above and below the fusion, 100MM total.



The flawed region of the fusion is easily identified via the gap in the fusion zone at 300MM to 600MM, The image is at a depth of 14.72 MM below the OD surface in the fusion, which is directly in the center of the fusion. This location coincides exactly with the location of the oil contamination. This inspection took approximately 15 minutes, including set-up. Analysis and accept/reject is done within minutes of data acquisition. This system and methodology has also been used successfully on HDPE electrofusion inspection and GFRP inspection. The method will be incorporated into ASTM E3101 and E3102 in the upcoming months.

The system and training are available from Advanced Microwave Imaging (www.advancedmwimaging.com) located in Baton Rouge, Louisiana, USA. Contact Bob Stakenborghs (rjstak@advancedmwimaging.com) for more information.