

Ultrasonic testing technique for corrosion and defect of self-propagating ceramic composite steel tube

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Ceramics are electrically insulating, non-magnetic, anisotropic materials with high noise and significant sound attenuation, the production process of self-propagating ceramic composite steel pipes primarily relies on manual inspection using endoscopes. This method can only detect obvious defects on the inner surface by the naked eye, resulting in a low detection rate and a waste of resources. Through an analysis of UT (NDT) self-propagating ceramic composite steel pipes, it has been found that UT can detect defects such as incomplete bonding of the ceramic layer during manufacturing, cracks caused by delayed stress release during heat treatment, and corrosion pits with diameters greater than 0.5mm that occur during use. It can also provide visual representation of the defect locations, creating more intuitive images. To address this, we have developed three visualization UT techniques: portable phased array, immersion-focused C-scan, and pipeline crawling robot. We have also developed corresponding equipment and systems. Through experimental validation and analysis, we have found that these three methods are suitable for different application scenarios, meeting various testing requirements. Portable phased array is suitable for on-site manual testing, immersion-focused C-scan is ideal for laboratory research and analysis, and the magnetic-adhesion pipeline crawling robot offers the best balance in terms of efficiency and testing accuracy.