LIBRARY SEARCH ON HOOK CRACKS IN ERW PIPES

Number of references: 8

1) **Non-Destructive Evaluation of Low-frequency Electric Resistance Welded (ERW) Pipe Utilizing Ultrasonic In-Line Inspection Technology.** Rick Meade. ECNDT 2006 - Tu.4.1.4

As a result of recent studies concerning low-frequency ERW pipe and its susceptibility to long seam failures, a Pipeline Company chose to incorporate ERW long seam assessment into their integrity management program. A 94 mile crude oil pipeline section constructed of 1948 vintage 10" low-frequency ERW pipe was recently inspected utilizing a LineExplorer UC in-line inspection (ILI) tool. This new generation of ultrasonic crack detection tool is a part of Tuboscope Pipeline Service's new fleet of ultrasonic in-line inspections tools which were built and developed by NDT Systems and Services AG. This paper will describe the logistics of the ILI survey and verification of ILI results.

2) **Influencia de las condiciones de proceso de colada contínua en la aparición de fisuras tipo "hook cracks" en tubos soldados ERW.** Luis E. Dutari, Juan C. Basone. 15º Seminario de Acería del IAS, San Nicolás, Argentina, Noviembre 2005.

Acindar S.A., conocido fabricante argentino de alambrones, alambres y barras de acero para la industria, el agro y la construcción, es además fabricante de tubos de acero con costura por el proceso ERW, para conducción de fluidos y usos estructurales. En el caso particular de los tubos para conducción de fluidos, se trata de tubos para la conducción de petróleo, gas y agua, producidos en la planta de tubos de Villa Constitución, Provincia de Santa Fe. Específicamente, los tubos para conducción de petróleo se fabrican en la gama de 2-3/8" hasta 4-1/2" de diámetro exterior, empleándose como materia prima fleje laminado en caliente en el laminador combinado de barras y fleje (Laminador #1), que a su vez emplea mini-slabs de colada continua producidos en la acería eléctrica. Estos tubos, fabricados según normas API deben satisfacer las exigencias de la norma para garantizar la integridad de la unión soldada, que consisten en ensayos de aplastamiento y control por ensayos no destructivos de la misma. En el presente trabajo se describe el fenómeno del defecto llamado "hook cracks" en los tubos y las medidas que se tomaron en el proceso de colada continua para solucionarlo.

3) **Phased Array Technology for Automated Pipeline Inspection**. J Bosch, A Hugger, J Franz S Falter, Y Oberdörfer. Business briefing: exploration & production: The Oil & Gas Review 2004.

Pipeline operators face many threats to the integrity of pipelines. Sophisticated non-destructive testing technologies and measuring devices are being used for diagnosing the pipeline condition, e.g. for detecting cracks and metal loss defects. For older pipelines especially, hydrotesting is no longer accepted as an alternative to defect monitoring using non-destructive testing devices like ultrasonic inspection tools. However, until now, different inspection tools with suitable sensor arrangements are required for the different measurement tasks resulting in high mobilisation cost and loss of pipeline throughput. Quite often, a further problem is that the data recorded with different inspection tools need to be correlated. Otherwise, indications of defects present in the data sets of different inspection runs at same locations may be overlooked or not considered correctly. For these reasons, GE Energy started the development of a new ultrasonic inspection system based on phased array technology. The main advantage of this technology is that the aperture, shape and direction of the ultrasound beam can be controlled by the electronics.

4) **Dealing with low-frequency-welded ERW pipe and flash welded pipe with respect to hca-related integrity assessments.** John F. Kiefner. ETCE 2002, ASME Engineering Technology Conference on Energy, February 2002, Houston, Texas

The new regulations, Part 195 Section 195.452, require that special integrity assessments be made to address potential seam-defect problems in low-frequency-welded ERW (electricresistance-welded) pipe materials where a failure of such materials could have an impact on a high-consequence area (HCA). The spirit of this requirement appears to require action if, and only if, significant seam-related deficiencies are in evidence or if they can be reasonably anticipated. This leaves open the option of categorizing these types of pipelines by performance such that potentially problematic pipeline segments can be subjected to special (i.e., seam quality) inspections while those that show little or no propensity for such problems can be subjected to metal loss and deformation inspections only. This document is intended to establish a systematic procedure to permit an operator to characterize the relevant ERW pipe segments as to the likelihood of significant seam-related deficiencies. The author is particularly grateful to Rich Turley of Marathon Ashland Pipe Line LLC for helping to formulate the essential steps in deciding when an integrity assessment is needed. Rich made significant inputs to Figure 1 of this document.

5) **Hook crack reduction in ERW linepipe steel.** G.N. Eaves, Sr. Cameron, V.J.Casey, P. Nestico, W. Bernert. 1992 Steelmaking Conference Proceedings.

An investigation was performed to examine hook crack occurrences in ultrasonically tested electric resistance welded (ERW) line pipe. Two separate mechanisms were identified through metallographic and sulphur print evaluations. To reduce hook crack frequency, designed experiments were performed evaluating the effects of steel chemistry and casting variables. This work showed that hook cracks were caused primarily by manganese sulphide stringers as well as steelmaking deoxidation products. Hook crack complaints were virtually eliminated by reducing casting speed and sulphur level, or alternatively, using low sulphur calcium-bearing steel.

6) **Use of Electromagnetic Stirring During Slab Casting for Hot Rolled Tubular Products.** Gass, R T; Jackson, T T. Steelmaking Conference Proceedings. Vol. 74; Apr. 1991. pp. 539-545.

Use of in-strand electromagnetic stirring (EMS) has proven to be a reliable method to create a significant amount of equiaxed structure in slabs which normally exhibit no equiaxed structure. The amount of equiaxed structure can be easily predicted by a simple model of cast speed, stirrer position, and superheat. It was determined that the use of below mold electromagnetic stirring reduced the frequency and length of internal cracks and the center segregation in the as-cast slabs. Customer trials showed that the EMS material performed equivalently to current non-EMS material in terms of tensile properties and the frequency of hook crack formation. These results suggest that in-strand EMS can provide a greater level of product reliability (above Inland Steel's current high standards) to reduce slab casting defects which could contribute to the formation of hook cracks. Use of EMS did not significantly change the as-hot rolled impact properties of the steel grades investigated. It was also determined that the sample location, testing orientation, and casting strand have a more significant effect on the as-hot rolled impact properties than the use of EMS when compared in a heat vs. heat trial. To improve the crack arresting done by the equiaxed structure, trials with modified EMS operating practices of the upper EMS units will be performed in 1991. By increasing and equiaxed/columnar zone ratio, further reduction in internal crack length is expected.

7) **Characterization and Prevention of Hook Cracks in Tubular Products.** Saucedo, I G; Alavanja, M; Philippi, D. Steelmaking Conference Proceedings. Vol. 74; Washington, D.C ; USA; Apr. 1991. pp. 679-689. 1991

Longitudinal surface cracks, commonly called hook cracks, are occasionally observed in structural tubes made from conventional 0.2% carbon steel hot band. This defect appears at the tubular products manufacturing facility when welding and forming hot band made from continuously cast slabs. Initially, hook cracks were believed to be related to cracks formed in the slab during the continuous casting process. Because of this the as-cast slabs, hot bands, and resistance welded tubes with and without hook cracks were examined using macroetches, detailed metallography, scanning electron microscopy, and electron microprobe analysis. The results indicate, however, that there are no open cracks in the slabs. Instead, the sulfur prints revealed regions with higher S-concentration, characteristic of refill structures located half way through the thickness. Examination of the hot band indicated that rolling led to banding in the as-rolled structure, which appears as longitudinally oriented ferrite and pearlite lines, with grain boundary cementite and martensite also formed in some instances. The refill structures in the slabs were aligned in the hot band structure with MnS inclusions forming stringers along the ferrite--pearlite bands. Prevention of the hook cracks at the steelmaking shop requires modifications to the chemical composition of the steel to reduce refill formation. At the caster it is necessary to implement a systematic preventive and predictive maintenance program. In addition, it is necessary to judiciously apply the hot band to reduce thermal--mechanical effects during tube manufacturing.

8) The effects of steel mill practice on pipe and tube making. Robert K. Nichols.

The effects of chemistry, melting, casting, and rolling on slitting, forming, welding and heat treating are highly complex and inter-related. This paper is not meant to be an exhaustive discussion of each variable upon the others but rather to show examples of steel mill practices and how they can affect the production of pipe and tube.