TCR Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical |Fertilizer| Chemical | Refinery| Engineering| Automobile

A Monthly News Letter April, 2013 **Volume 05**

APR -Acoustic Pulse Reflectometry

Non destructive tube inspection technique.

Introduction

Heat exchangers are used to transfer heat energy from one fluid to another. Typical heat exchangers known to us in our daily lives are condensers and evaporators of air conditioning units and refrigerators.

Boilers and condensers in thermal power plants are examples of large industrial heat exchangers. Heat exchangers are also abundant in chemical and process industries. There is a wide variety of heat exchangers for diverse kind of uses.

Periodic inspection of heat exchanger tubes is inevitable to avoid forced shut downs as it affects the heat transfer phenomenon. Inspection of heat exchanger tubes for internal damage is no longer a lengthy, tiresome, time consuming with the advent of expertise involving acoustic eye procedure.

Acoustic pulse reflectometry is a breakthrough, non-invasive solution for today's hard-to-inspect tubes up to 4" inner diameter. It enables ultra-fast, accurate inspection of boilers, Fin Fans and other heat exchangers, regardless of tube shape or material.

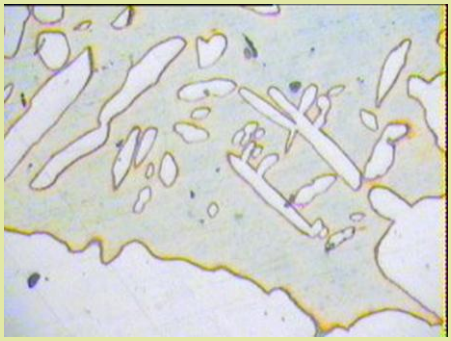
Acoustic Pulse Reflectometry (APR) technology is an advanced, yet easy-to-use tool that overcomes the limitations of many conventional inspection techniques. With its simple operation, there is far less dependency on operator expertise, providing reliable inspection of even the most challenging tube sizes and configurations,

TCR Advanced is the leading service provider agency for APR services to tube inspection.

About APR

Currently, the most commonly used techniques for inspecting tubes found in heat exchangers are based on invasive testing. Eddy current, magnetic flux leakage, Iris tube inspection and ultrasound-based methods require a probe to be traversed through the entire length of each tube being examined. Over the years, customers have simply become accustomed to the limitations of invasive technology, including:

Microstructure of the Month



Magnification: *400 X*

MOC: *ASTM A182 Gr. F 51*

Composition of Laves Phase: *Fe2Mo, Ti21Mo9, Fe50Cr5Si5*

Observation: *Microstructure shows austenite pools in ferrite matrix. Laves phase is observed as shown by arrow.*

Useful hints: *Color metallography is an important tool to reveal inter-metallic phases that may hamper the corrosion resistance of the high grade material like Duplex Stainless Steel.*

Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical |Fertilizer| Chemical | Refinery| Engineering| Automobile

A Monthly News Letter April, 2013 **Volume 05**

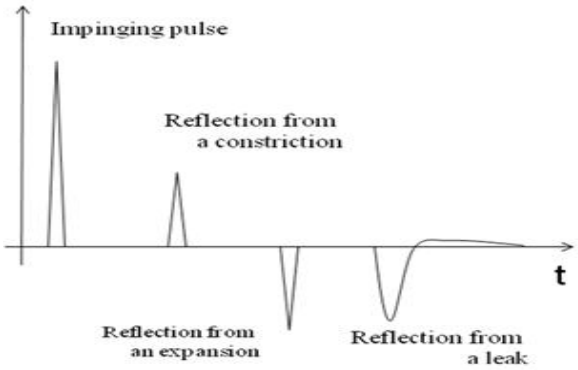
- Delays: Under ideal conditions, invasive technology report inspection time of about 1 minute per tube is often cited, though this rate is very difficult to maintain over an entire shift.
- Breakdowns: Probes often get stuck in cases where the tubes have not been cleaned properly, which is difficult to ascertain before hand. Though some flexible probes are currently available, some bends (e.g., U-tubes) are too tight for such probes. In such cases, the tube has to be inspected from both ends.
- Configuration issues: Existing NDT-based inspection methods (e.g., ultrasound, eddy current) have difficulty in inspecting tubes as they cannot traverse due to the configuration or type of material. This proves to be very costly as for experts to interpret the data and the need to manufacture probes for each specific job becomes more complex.

APR, on the other hand, is a non-invasive technique, which creates a "virtual probe" that navigates in bends, coils, elbows, fittings, etc. without difficulty. This technology lets you test any tube from a single point outside the tube in less than 9 seconds, saving considerable time and resources.

Acoustic Pulse Reflectometry (APR) is based on the measurement of one-dimensional acoustic waves propagating in tubes. Any change in the cross sectional area in the tubular system creates a reflection, which is then recorded and analyzed in order to detect defects.

How Does APR Work?

An acoustic pulse injected into a semi-infinite straight-walled tube will propagate down the tube without generating any reflections. This pulse can be measured by mounting a small microphone with its front surface flush with the internal tube wall, through a hole in this wall. The microphone will measure the pulse once only, as it passes over the microphone diaphragm.



If the pulse encounters a discontinuity in cross section, a reflection is created. The amplitude and form of the reflection is determined by the characteristics of the discontinuity: a constriction will create a positive reflection, whereas dilation (increase in cross section) will create a negative reflection. None of these discontinuities will change the shape of the pulse in their vicinity, but the reflection measured by the microphone will be an attenuated and smeared replica of the impinging pulse, due to propagation losses. A hole in the tube wall, on the other hand, will create a reflection having a more complicated shape, affected by the size of the hole and the radiation of acoustic energy to the space outside the tube.

The Acoustic Eye core technology is based on Acoustic Pulse Reflectometry (APR). With this technique, a wideband acoustic pulse is shot into the tube and any reflections that are created by changes in the cross section of the tube are recorded by a microphone. The Acoustic Eye proprietary algorithms analyze and

Metallurgy for Industries

Power | Petrochemical |Fertilizer| Chemical | Refinery| Engineering| Automobile

A Monthly News Letter April, 2013 **Volume 05**

interpret the reflections, resulting in a complete cross sectional analysis of any disruption or problem and its location.

APR has been studied as a research tool in several academic labs throughout the world, not yet emerging to a point of commercialization, due to several limitations of previous systems. Amongst them are bulkiness and algorithmic difficulties. As a result of extensive R&D efforts Acoustic Eye has developed the first viable tool for industrial applications across many industries based on APR.

Acoustic Eye's innovations have greatly reduced the size of the reflectometer, from an academic system which incorporates tubes of 6 or more meters in length, down to 40 centimeters. In addition, various algorithmic advances facilitate the precise detection of fault size and location, even in presence of strong ambient noise.

APR offers many advantages over other defect detection tools. Most inspection equipments require the tube system to be physically scanned by some form of probe (magnetic, electrical, ultrasound), which can prove difficult or impossible in many applications where the tubes are inaccessible, like underground, buried in an aircraft wing, in a heat exchanger, etc. Neither any hazardous radiation is emitted as in X-ray systems, nor there is problem of waste disposal to deal with, as in using fluorescent dyes.

Advantages of APR

- Fast and reliable for ID defects
- Non invasive technique
- User friendly
- Single click calibration
- Compatible with variety of tube materials and configuration such as finned tubes, bends, spiral etc.

For Further details Contact us at testing@tcradvnaced.com , Ph: +91-265-2657233

* * *