THE DETECTION OF DEFECTS IN STAINLESS STEEL VESSELS

History

There is a requirement for reliable methods to assess the integrity of food processing vessels. Cracks, pinholes, and corrosion which could lead to contamination of the product with concomitant ingress of bacteria or chemical coolants leading to possible reduced shelf life, rejection of the product, or at worst food poisoning. Environmental Health Departments, Retail organisations and other authorities around the world require testing to be carried out on a regular basis to reduce the risk of product contamination from bacteria and/or harmful chemicals caused by cracks in the Vessel Wall. It is the responsibility of the processor to comply with 'Due Diligence' procedure.

It has been an ongoing requirement to detect cracks and pinholes in processing plant, such as tanks, silo's, spray dryers, evaporators, fluid beds, Cyclones and many other items within the industry. One of the reasons for regular inspection is due to the aggressive nature of cleaning (CIP) and processing, when the materials are expanded and contracted due to fluctuating temperatures.

In the past, these inspections have been carried out using chemical dyes, the vessels are first cleaned, then the coloured or fluorescent dyes are applied (sprayed) onto the surface of the vessel, there is a penetration period, normally 1 hour, then the surface is washed normally with water. It has been assumed that any cracks or pinholes will hold the dye and other surfaces will be clean after washing. In practice, large cracks have been unable to hold this dye after the washing process. Small defects may not even allow the dye to penetrate due to surface tension or product residues held after cleaning. The vessel is then viewed with white light or U/V depending upon the type of dye.

After many years of experience in the NDE business, Managing Director Mike Bowling who qualified at Cambridge in Ultrasonics, Radiology, MPI/LPI, Weld and casting engineering, Mike decided to challenge this methodology. Having spent considerable time developing various inspection techniques in the aerospace and nuclear industries, this was a good background for the challenge.

In 2003 after many field trials using all of the latest testing methods, it was decided that eddy current showed the best potential for this type of material, having been proven over many years in the aerospace industry as a crack detection method. Many manufacturing companies were approached to find the very latest equipment for this task. The results were a bit disappointing as the largest probe available had a surface contact area of 15mm, imagine trying to test a large processing tank with 15mm scans, it would take weeks to test. Also, the equipment was very complicated and required extensive training to understand how to interpret the results. Eddy currents are created through a process called electromagnetic induction. When alternating current is applied to the conductor, such as copper wire, a magnetic field develops in and around the conductor. This magnetic field expands as the alternating current rises to maximum and collapses as the current is reduced to zero.

So, the task was to produce an instrument that could scan large surface areas, being robust, simple to operate, and could also determine the depth of the defect. This was the birth of an instrument technology now known as Magnerscan.

Victor Donnelly
Global Sales and New Business
Development Manager
vdonnelly@eit-international.com
www.eit-international.com

EIT International
Biopharma House,
Winnall Valley Road
Winchester
SO23 0LD, UK
enquiries@eit-international.com

MAGNERSCAN

The method is able to detect and show the depth of surface and sub surface defects electronically, without the assistance of any chemicals. The system is able to detect defects by wiping the scanner across the examination surface, then either listening or viewing through visual (bar graph) and audible (earphones) defect display.

The sensitivity can be checked against standard cracks in an approved test block made from stainless steel. This test block is made from 316 stainless steel and has built in cracks of 1/2mm, 1mm, 2mm, 3mm. The Magnerscan unit is then calibrated against the depth of defect that you require to find, and the alarm is set.

EIT International have now produced a defect limitation standard for the examination of vessels and plant in the food processing industry. Up until now there has been no standard, as the technology in the marketplace could not determine the depth of the defects. We have been called to many plants to cross check the results from other companies examinations of vessels, where they have dye tested and found many reflectors using ultra violet lighting, these reflectors have been marked up for weld repair. When we carried out these cross checks, many of the marks were simply surface indications that didn't require any action.

It is not only a very expensive exercise to weld repair stainless steel tanks, but also the materials are weakened after these repairs, especially if proper welding procedures are not adhered to. So, it is very important to correctly assess the condition of these vessels by using technology able to accurately determine the depth of defect.

Another technique that we currently use is material thinning assessment. If the vessel wall is welded, either from manufacture or repair, there is a possibility that after welding, the surface is polished. This polishing may reduce the material thickness from say 2mm to 1mm, therefore becoming a stress area that may cause cracking. We normally examine random areas of the vessel where there is evidence this type of work.

Briefly, the magnerscan method requires the examination surface to be cleaned. **(Degreasing the surface is not necessary, as product residues remaining in the cracks will not hinder the test. This can be proven by placing masking tape over the test crack surface).**
The scanner heads are to be placed on the surface, in order for the system to recognise the construction material of the vessel. **(Many different grades of stainless steel may be used).**
There are ten sensitivity settings for this instrument, to ensure detection of large through defects at the lower end of the scale, and **(small surface defects at the higher end of the scale).** In some cases, the client may only require the detection of large through defects.

Scan across the examination surface by making contact between the scanner and the vessel surface, then quickly move across the surface ensuring overlap, when the alarm sounds, stop and assess the area using the single probe, mark for repair and continue with the test. When the test is completed, repair the areas marked, re-examine and complete.

Defects are then identified on the interim report sheet, using our unique defect mapping system. This enables defect positions to be clearly identified for the certificate and for any future re-examination.

Victor Donnelly
Global Sales and New Business
Development Manager
vdonnelly@eit-international.com
www.eit-international.com

EIT International
Biopharma House,
Winnall Valley Road
Winchester
SO23 0LD, UK
enquiries@eit-international.com