Non-Destructive Testing Methods

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Performing different types of Non-Destructive Testing (NDT) on critical mixer components is a relatively common requirement. This testing is most often required on very large or critical reactor type mixers but can also be requested on more standard mixers. The following is a basic review of the most common NDT methods available and where each technique can be used in the production of fluid mixers.

Liquid Penetrant Examination (LPE)

LPE is considered a "surface" method due to their limitation to detect discontinuities in surface or near surface locations. When the liquid penetrant (red in colour) is applied to the test part, it will seep into surface openings (i.e. cracks) by capillary action. The excess penetrant is then removed from the parts surface and a developer (talc-like absorbent spray, normally white in colour) is applied to the surface, which draws out any penetrant that seeped into surface cracks. Visible indications of cracks appear as red lines on the white-coated surface of the test piece. This is the least expensive and most common of all the NDT methods.

Magnetic Particle Inspection (MPI)

This method is also a surface method similar to LPE but with the added limitation that the test pieces must be of a ferromagnetic material. A magnetic field is applied to the test piece and a medium is applied to the area to be tested. The medium is normally a liquid with very small fluorescent magnetic particles in suspension. The magnetic particles are attracted to magnetic flux leakage, which occurs at surface discontinuities (cracks). A black light is often used to highlight areas where the fluorescent particles have congregated. This method is more sensitive than LPE and only slightly more expensive.

Ultrasonic Inspection

This method employs a high frequency sound in the range of 0.2 MHz to detect **internal** discontinuities. Ultrasonics is based on the principle that a change in acoustic impedance (the resistance to the passage of sound) in a material, will cause a reflection of some or all of the incident sound beam, much like an echo. The high frequency sound is transmitted into the test piece by a piezoelectric crystal, which has the ability to change electrical energy to mechanical energy and vice versa. The "echoes" received are converted to electrical signals which can be displayed on a video monitor. Interpretation of the video display is very important and therefore a high degree of operator training is required.

Eddy Current

This method employs an eddy current probe (generator & test coil) and an indicator (voltmeter). The probe produces a magnetic field, which induces eddy currents into the test piece. A signal results from the change in eddy current, caused by a defect in the material, interfering with eddy current flow under the probe, as the probe scans past it. A defect is seen on the indicator as a change in voltage. This method can detect surface defects in both magnetic and non-magnetic

material as well as subsurface defects in non-magnetic material. In addition, this method can be used for measuring the thickness of non-conducting coatings on metals.

Radiography

This NDT method uses penetrating radiation (X-ray, Cobalt 60 isotope, etc.) which as it passes through an object, is absorbed in differing amounts, according to the material density and thickness. The energy emitted on the other side of the test piece is registered on radiographic film with a crack or void in the material showing up as a dark spot on the film. While it is one of the most expensive NDT methods, radiography is an excellent way for detecting internal discontinuities.

Technique	Use	Relative Cost
LPE	Can be used on almost any welded component. Common pieces tested include, shaft/coupling joints, hub ear welds, pedestal weldments, formed areas of blades & blade welds.	1.0
MPI	Same use as LPE but is the preferred method for use on magnetic material due to its increased sensitivity. In addition this method produces better results on rough surfaces.	1.05
Ultrasonics	This technique is used for testing gear forgings. Typical geometry of wetted parts and the normal lack of full penetration welds excludes use of this method for shaft and impeller systems.	1.5
Eddy Current	Normally limited to testing coating thicknesses, i.e. paint on drive assemblies or coatings on wetted parts.	1.05
Radiography	Very rigorous testing method. Virtually any mixer component can be tested using this technique.	2.5