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A Study of NDT Techniques Together with Its Significance in Industries

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ABSTRACT

The objective of this paper is to provide detail study of non-destructive testing (NDT) techniques together with its significance in industries. Manufacturers are affected by diverse customer needs, which demand better quality, shorter manufacturing & delivery time, lower price and lower scrap. Success in any competitive context depend upon customer satisfaction either in terms of cost or in terms of quality of product, or, ideally, both. So NDT techniques play a critical role in this scenario.

Keywords – Application. Non-Destructive Testing.

1. INTRODUCTION

Excessive repairs [1] results in reduction of performance, efficiency and useful operating life. So it is fruitful [2] to go towards incipient failure detection & corrective action. It is prerequisite to long-term reliability. Non-destructive testing (NDT) implies Inspection or measurement of surface or internal flaws without destructing it. NDT is an effective technique [3-5] and reduces Mena Time to Repair (MTTR) by improving trouble shooting capabilities & Mean Time between Failure (MTBF) increases due to proactiveness. These techniques [6] can be applied in manufacturing processes such as welding, casting, forging, surface treatment, etc. in which flaws or defects are prominent.

2. HISTORICAL EVENTS IN NDT

NDT techniques are being used for very early in industries. Some of the historical events [8] in NDT which are as follows-

- 1880 - 1920 The "Oil and Whiting" method of flaw detection in railways. This was the precursor to modern liquid penetrant tests.
- 1920 Dr. H. H. Lester begins developed industrial radiography for metals.
- 1926 for material thickness measurement electromagnetic eddy current instrument is was available.
- 1927 - 1928 Magnetic induction system to detect flaws in railroad track developed
- 1930s Robert F. Mehl demonstrates radiographic imaging using gamma radiation from Radium.
- 1935 - 1940 Liquid penetrant tests developed
- 1935 - 1940s Eddy current instruments developed
- 1940 - 1944 Ultrasonic test method developed in USA by Dr. Floyd Firestone.
- 1950 J. Kaiser introduces acoustic emission as an NDT method.

3. NDT TECHNIQUES

This Section shows details of NDT techniques, advantages, disadvantages and application part.

3.1 Visual Inspection

To detect surface defects by naked eye. Normally applied without the use of any additional equipment, VT can be improved by using aids such as a borescope to improve its effectiveness and scope.

Application

- Surface crack in gears, pulleys, crank shafts.

Advantages

- Faster process as It does not require sophisticated apparatus and it is a very inexpensive method
- Modest skills required
- Low cost
- Disadvantages
- Superficial
- Only for surface defects
- High interpretation skills needed

3.2 Liquid penetrant Testing

To reveal surface defects by using colored or fluorescent dye. It increases the "see ability" of small discontinuities that might not be able to detect by naked eyes.

Application

- Surface crack, Porosity
- Crack detection in weld.

Advantages

- Simplicity
- Low cost and No sophisticated equipment needed

Disadvantages

- Multiple stages in complete process so difficult to automate
- Requires particular type of testing conditions like suitable of light arrangement
- Surface cleanliness needed.

3.3 Ultrasonic Testing

To detect surface and sub-surface defects in sound conducting materials. A crack in the testing specimen reflects some energy back to the transducer, which is detected and displayed.

Application

- Thickness Measurement
- Delaminations & Inclusions Identification
- Flaw detection in welds, castings and connections

Advantages

- High Penetration & Higher accuracy
- Portable Instrument, light weighted units
- Relatively quick & One sided access needed

Disadvantages

- Coupling medium needed
- Trained Professional Needed
- Good surface condition needed means it is free from rust and excessive paints
- Small and thin parts are difficult to inspect

3.4 Eddy Current

To be applied on coated and uncoated objects and the testing can be carried out on all accessible surfaces on welds of almost any configuration. Eddy currents are based on the principle of electromagnetic induction.

Application

- Cracks & Porosity
- Defect discontinuities such as seams, laps, pits, cracks, voids and Inclusions
- Material thickness measurement

Advantages

- Faster process & little or no surface preparation needed.
- Easily automated
- No contact needed
- No special operator skills needed

Disadvantages

- Probe size affects sensitivity
- For simple geometries
- Shallow depth of penetration

3.5 Magnetic Particle Testing

The principle is to induce magnetic flux in the testing specimen, while the flux lines running along the surface at right angles to the defect. If there is any discontinuity the flux will stay out in to the air at the opening of the crack. The crack edge becomes magnetized and magnetic attractive poles North and South formed. These have the power to attract finely divided particles of magnetic material such as iron powder.

Application

- Subsurface defects
- Checking pipes for crack & Cast and welds

Advantages

- Faster process
- Easily automated
- Little and no surface preparation
- Cheap and robust probes

Disadvantages

- Every component needed to be tested twice
- Diagonal defects are difficult to detect

3.6 Radiography

It is based on using short wavelength radiation passing through the testing specimen. X-rays, produced

electrically, and Gamma rays emitted from radio-active isotopes. These are radiations which are differently absorbed by the material through which it passes. The interesting fact is the greater the thickness, the greater the absorption. Furthermore, the denser the material the greater the absorption.

Application

- Hidden flaws, Inclusions, Porosity, voids and cavities, Cracks
- Weld inspections

Advantages

- Equipment is portable
- Film radiography leads to permanent records of results and compatible to computer analysis
- Large areas can be inspected in one time.

Disadvantages

- Access to opposite side is needed
- Gamma radiography requires special mechanisms for storage and extension of source
- Extensive expertise needed
- Sensitivity decreases with thickness.
- Cracks must be parallel to beam

3.7 Thermography

Detects radiation in the infrared range of the electromagnetic spectrum and produce images of that radiation, called thermograms. The amount of radiation emitted by an object as per the law of radiation, increases with increase in temperature, therefore, thermography process identifies variations in temperature.

Application

- Detection of near surface defects
- Rolling element bearing fault detection

Advantages

- Quick survey

Disadvantages

- Affected by weather conditions
- Expensive

3.8 Vibration Analysis

The main process in vibration analysis is conversion of the mechanical vibrations into an electronic signal and then signals analysis by means of computer. The causes of vibration as imbalance, bent shaft, misalignment and looseness.

Application

- Rolling element bearing fault detection,Vibration Measurement in Motor, Gear Box, Bearing life measurement, Automobile Engine

Advantages

- Time efficient & Cost effective

Disadvantages

- Difficult to quantify data
- High cost

4. CONCLUSION

As per the objective discussed in abstract, this paper provided detail study of non-destructive testing (NDT) techniques together with its significance in industries. Also shows that NDT can be an effective tool in the inspection and condition assessment of defects without damaging the specimen. It can provide knowledge that may not be possible to deduce from visual inspection alone.

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