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A CASE STUDY OF PROBLEM IDENTIFY IN MACHINING PROCESS BY NON DESTRUCTIVE TESTING FOR IMPROVING PRODUCT QUALITY

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Abstract: The paper present the case study of machining process in industries various problem are occurring during process but most of this quality maintained is important factor for manufacturing good surface fining of products. So in this paper discussed about methods of NDT, X-RAY Radiography phenomena to understand internally aspects of product quality. Most of the non-destructive testing techniques are surely cost effective but time consuming this makes the overall stay time, production time and overall cost indulged in process high. By applying X-RAY Radiography phased array technique the maintenance scheduling and incurred cost of maintenance and also the overall operational cost can be reduced remarkably.

Keywords: X-RAY Radiography, Liquid Penetrant Method, Applications of NDT.

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INTRODUCTION

Non-destructive testing (NDT) is a wide group of analysis techniques used in science and industry to evaluate the properties of a material, component or system without causing damage. The terms Nondestructive examination (NDE), Nondestructive inspection (NDI), and Nondestructive evaluation (NDE) are also commonly used to describe this technology. Because NDT does not permanently alter the article being inspected, it is a highly-valuable technique that can save both money and time in product evaluation, troubleshooting, and research. Non-destructive Testing is one part of the function of Quality Control and is Complementary to other long established methods. By definition non-destructive testing is the testing of materials, for surface or internal flaws or metallurgical condition, without interfering in any way with the integrity of the material or its suitability for service.

The technique can be applied on a sampling basis for individual investigation or may be used for 100% checking of material in a production quality control system. Whilst being a high technology concept, evolution of the equipment has made it robust enough for application in any industrial environment at any stage of manufacture - from steelmaking to site inspection of components already in service.

A certain degree of skill is required to apply the techniques properly in order to obtain the maximum amount of information concerning the product, with consequent feed back to the production facility. Non-destructive Testing is not just a method for rejecting substandard material; it is also an assurance that the supposedly good is good. The technique uses a variety of principles; there is no single method around which a black box may be built to satisfy all requirements in all circumstances.

What follows is a brief description of the methods most commonly used in industry, together with details of typical applications, functions and advantages.

The methods Covered are:
- Radiography
- Magnetic Particle Crack Detection
- Dye Penetrate Testing
- Ultrasonic Flaw Detection
- Eddy Current and Electro-magnetic Testing

What is NDT?

NDT stands for non-destructive testing. In other words it is a way of testing without destroying. This means that the component- the casting, weld or forging, can continue to be used and that the non-destructive testing method has done no harm. In today's world where new materials are being developed, older materials and bonding methods are being subjected to higher pressures and loads, NDT ensures that materials can continue to operate to their highest capacity with the assurance that they will not fail within predetermined time limits.

NDT can be used to ensure the quality right from raw material stage through fabrication and processing to pre-service and in-service inspection .Apart from ensuring the structural integrity, quality and reliability of components and plants, today NDT finds extensive applications for condition monitoring, residual life assessment, energy audit, etc.

Common Application of NDT

- Inspection of Raw Products
- Inspection Following Secondary Processing
- In-Services Damage Inspection

Objectives

- To ensure product integrity, and in turn, reliability;
- To detect internal or surface flaws
- To measure the dimensions of materials
- To determine the materials' structure
- To evaluate the physical and mechanical properties of materials
- To avoid failures, prevent accidents and save human life;
- To make a profit for the user;
- To ensure customer satisfaction and maintain the manufacturer's reputation;
- To aid in better product design;
- To control manufacturing processes;
- To lower manufacturing costs;
- To maintain uniform quality level;
- To ensure operational readiness.

Types

- Visual Inspection
- Liquid penetrant method
- Ultrasonic Inspection
- Radiography methods
- X-ray radiography & fluoroscopy
- γ- ray radiography

- Eddy current testing
- Magnetic particle testing
- Thermography

LIQUID PENETRANT METHOD

Principle

A liquid penetrant is applied at the surface of the specimen. The penetrant is drawn by the surface flaws due to capillary action and this is subsequently revealed by a developer, in addition with visual inspection.

Procedure

- Cleaning the surface
- Application of the penetrant
- Removal of excess penetrant
- Developing
- Inspection

Applications

- Turbine rotor discs & blades
- Aircraft wheels, castings, forged components, welded assemblies
- Automotive parts – pistons, cylinders, etc.
- Bogie frames of railway locomotives & rolling stock
- Electrical ceramic parts – spark plug insulators, glass-to-metal seals, etc.
- Moulded plastic parts

ADVANTAGES

- Simple & inexpensive
- Versatile & portable
- Applicable to ferrous, non-ferrous, non-magnetic & complex shaped materials which are non-porous & of any dimension
- Detects cracks, seams, lack of bonding, etc.

LIMITATIONS

- Detect surface flaws
- Non-porous surface for material
- Surface cleaning before & after inspection
- Deformed surfaces & surface coatings prevent detection

ULTRASONIC FLAW DETECTION

Principle

Whenever there is a change in the medium, the ultrasonic waves are reflected. Thus, from the intensity of the reflected echoes, the flaws are detected without destroying the material.

Applications

- Quality control & material inspection
- Detection of failure of rail rolling stock axes, pressure columns, earthmoving equipments, mill rolls, mixing equipments, etc.
- Measurement of metal section thickness
- Thickness measurements – refinery & chemical processing equipments, submarine hulls, aircraft sections, pressure vessels, etc.
- Inspect pipe & plate welds
- Inspect pins, bolts & shafts for cracks
- Detect internal corrosion

3.3 Advantages

- Sensitive to surface & subsurface discontinuities
- Superior depth of penetration for flaw detection
- High accuracy – position, size & shape of defect
- Minimal part preparation
- Instantaneous result
- Automated detailed images
- Non-hazardous
- Portable

3.4 Limitations

- Surface accessibility for ultrasonic transmission

- Highly skilled & trained manpower
- Irregular, rough, coarse grained or non-homogenous parts, linear defects oriented parallel to the beam cannot be inspected – low transmission & high noise
- Coupling medium required
- Reference standards – equipment calibration & flaw characterization

X-RAY RADIOGRAPHY

Principle

X-rays are passed through the specimen under inspection and it is differentially absorbed by the specimen. The transmitted x-rays are received by the photographic film and the film is developed. The dark and light shadows reveal the defects present in the specimen and hence the defects are defected.

Displacement Method

X-rays are exposed over the specimen by keeping the x-ray source at position 'A' and then at 'B' by displacing the source through a certain distance. The images are recorded at positions 'A' and 'B'. From the displacements of the x-ray tube and the images, the exact position of the defect can be determined.

Fluoroscopy

X-rays are passed through the specimen and is made to fall on a fluorescent screen. With respect to the defects in the specimen, there will be a variation in intensity.

Merits

- No need of washing and developing films
- Low cost
- Image viewed immediately on screen
- Time consumption is less
- Movement of defects detected (real time images)

Demerits

- Poor resolution
- Low image contrast
- Electronic image intensifier required for increasing the contrast

Differences

- Image developed on photographic film
- High resolution & contrast
- Immediate image cannot be obtained.
- X-ray energy is converted into chemical energy.
- Expensive
- Time consumption is high.
- Image is developed on fluorescent screen.
- Fair resolution and low contrast.
- Immediate image can be viewed through the monitor.
- X-ray energy is converted into visible light.
- Inexpensive.
- Time consumption is low

Importance of NDT

- Applied directly to the product
- Tested parts are not damaged
- Various tests can be performed on the same product
- Specimen preparation not required
- Can be performed on parts that are in service
- Low time consumption
- Low lab our cost

What are some common defects?

- Porosity
- Undercutting
- Rollover or "Cold Lap"
- Slag inclusion
- Poor penetration
- Voids
- Hydrogen Embrittlement

CONCLUSION

NDT can save and/or avoid costs in millions of dollars for facilities that use its methods. There are proven NDT technologies to do this, from conventional to more advanced ones that are essentially based on the conventional ones. Their required training requirements and proper application are paramount for realizing ever-increasing benefits.

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