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Application of Non-Destructive Testing in Oil and Gas Industries

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***Abstract*: The field of non-destructive testing (NDT) and non-destructive evaluation (NDE) of materials is constantly evolving. This paper provides the recent advances and researches about non-destructive testing (NDT)methods for defect characterization. Non-destructive testing is a different kind of tests which are used to learn about the physical properties of specimens. By the other techniques like tensile testing and hardness testing the specimen is destructed after the experiment but in this testing type the specimen is not destructed. There are eight different NDT methods: Visual Inspection, Microscopy, Radiography, Dye penetrate, Ultrasonic, Magnetic Particle, Eddy Current and Acoustic Emission. These methods are only separated in application technics. The most useful of them must be chosen for specimen that will be investigated.**

***Keywords*: non-distructive testing, gas industries**

1. Visual inspection

Visual inspection is an inexpensive method for detecting equipment flaws and defects. It is one of the most widely used method for detection of discontinuities before they cause major problem e.g. Poor welding Defects. It means inspection of equipment and structures using a common sense such as human vision. It is sometimes carried out with devices such as Boroscopes, Fiberscopes etc. Generally, almost all specimens are inspected visually to determine Accuracy. Human eye is most valuable NDT tool. Yellow green light of wavelength 5560A is most suitable for human eye at normal condition.
Tools used in Visual Inspection:

- Mirror
- Magnifying glass
- Microscope
- Boroscope
- Endoscope

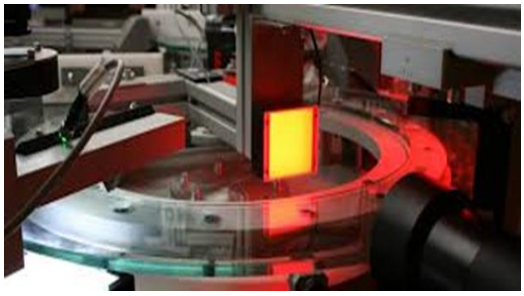

Fig. 1. Visual Inspection

A. Applications of visual inspection:

- It is used to inspect whether there is a misalignment of parts in the equipment
- It inspects the plant components for any leakage or abnormal
- It is used to identify defects in weldments
- Ultrasonic Testing

Ultrasonic testing (UT) is a non-destructive test method that utilizes sound waves to detect cracks and defects in parts and materials. It can also be used to determine a material's thickness, such as measuring the wall thickness of a pipe.

Fig. 2. Set up of ultra-sonic testing

These Ultrasonic testing utilizes sound waves whose frequencies (50 kHz - 50 MHz) are above the audible range for the human ear. The piezo-electric effect of the ultrasonic transducer makes it possible to transmit and receive from within the equipment. The instrument makes it possible to inspect the internal structure of the equipment, and to detect thickness changes, welds, cracks, voids, delamination and other types of material or structural defects. The limitation of this method is that data acquisition and evaluation depends on the expertise of the technician. This makes it difficult to arrive at non-subjective readings and precision.

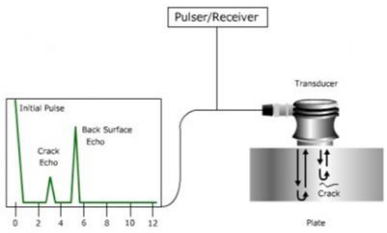

Fig. 3. Ultra-sonic testing

B. Applications

- Detect internal corrosions
- Measurement of metal section thickness
- Detection of failure on pressure columns
- Inspect pipe and plate welds

2. Radiography

Industrial radiography is a method of non-destructive testing where many types of manufactured components can be examined to verify the internal structure and integrity of the specimen.

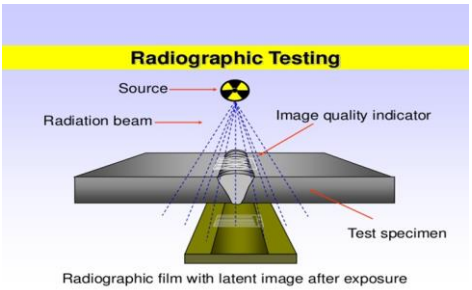

Fig. 4. Radiographic testing

Because these waves have short wave lengths, they can penetrate and travel through structural materials such as steel and metallic alloys. Industrial Radiography can be performed utilizing either X-rays or gamma rays. Both are forms of electromagnetic radiation. The difference between various forms of electromagnetic energy is related to the wavelength. X and gamma rays have the shortest wavelength and this property leads to the ability to penetrate, travel through, and exit various materials such as carbon steel and other metals.

A. Applications

- For detection of porosity internal cracks
- For measurement of geometry variation and thickness of component
- For identifying internal defects

B. Magnetic particle testing

It is combination of two non-destructive testing methods that are magnetic flux leakage testing and visual testing. Consider bar magnet which has a magnetic field in and around the magnet. Any place that a magnetic line of force exits or enters the magnet is called a pole. A pole where a magnetic line of force exits the magnet is called a north pole and a pole where a line of force enters the magnet is called a south pole. The first step in a magnetic particle inspection is to magnetize the component that is to be inspected. If any defects on or near the surface are present, the defects will create a leakage field. After the component has been magnetized, iron particles, either in a dry or wet suspended form, are applied to the surface of the magnetized part. The particles will be attracted and cluster at the flux leakage fields, thus forming a visible indication that the inspector can detect.

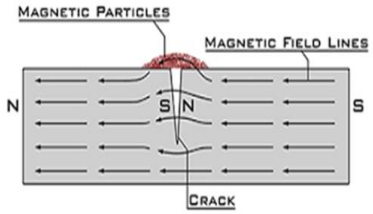

Fig. 5. Magnetic particle testing

C. Applications

- Flaw detection
- Leak detection
- Material sorting and chemical composition
- Micro structure characterization

D. Dye penetration testing

Dye penetration testing is based upon capillary action, where low surface tension fluid penetrates into clean and dry surface-breaking discontinuities. Penetrant may be applied to the test component by dipping, spraying, or brushing. After adequate penetration time has been allowed, the excess penetrant is removed, a developer is applied. The developer helps to draw penetrant out of the flaw where an invisible indication becomes visible to the inspector. Inspection is performed under ultraviolet or white light, depending upon the type of dye used - fluorescent or non-fluorescent which is used to identify defects.

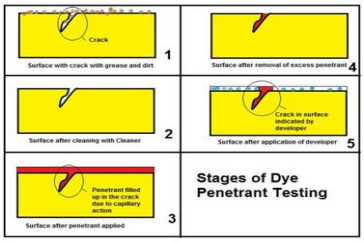

Fig. 6. Dye penetration test

E. Applications

- Parts with irregular shapes can be inspected easily
- It is low cost compared to other methods
- Can detect surface and sub-surface defects

3. Conclusion

Non-destructive testing is a technique for damage assessment, disaster prediction and quality control, to detect the defects without affecting the internal structure. This thesis presents and proposes some novel techniques for weld flaw classification from industrial radiography for improving the safety of nuclear power plant, petrochemical industries etc. using image processing and clustering. So, there is always a future scope for making the image enhancement, segmentation and feature extraction techniques simpler and more effective by

reducing computational complexity which will help in faster and more accurate recognition of weld defects from non-destructive testing.

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