Non- Destructive Testing (NDT) for Weldment Integrity Assessment

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Abstract

NDTs are widely used in manufacturing sector for the assessment of the weldment before sending it to destructive testing (DT) techniques. The main purpose of NDT is to detect the surface and sub- surface discontinuities/ defects, presence of which may adversely affect the mechanical properties of weldment. NDT does not affect the basic structure and mechanical properties of the component being inspected in any way. In this way this technique saves a lot and resources in terms of time and money. The weldment may have different types of defects such as porosity, cracks, undercutting, lack of fusion etc. These defects can be easily determined without damaging the work piece and necessary remedies can be taken to alleviate the severity of the defect.

Keywords: **Non- Destructive Testing, Dye penetrant inspection, Magnetic particle test, Ultrasonic Testing.**

Introduction

NDTs are extensively used in various engineering field such as electrical, mechanical, civil, forensics, aeronautical, medicine etc. NDTs are frequently used in various industries where damage/ failure of component would cause significant economic loss. Submerged arc welding (SAW) has been used to create weldment for this work. The following methods have been used to assess the integrity of the weldment.

Dye Penetrant Inspection (DPI)

Dye penetrant inspection or liquid penetrant inspection (LPI) is an inexpensive inspection method to detect/ locate surface- breaking defects in non- porous components. This method can be applied to ferrous and non- ferrous metals. This testing method is used to disclose surface irregularities by bleed out of a colored or fluorescent dye from the flaw. Cleaner, penetrant, developer are three ingredients of this method. These ingredients were used successively one after another in order to bring in light any discontinuity, if there is any.

First critical step in this procedure is preparation of a cleaned surface. The cleaned surface must be free from oil, grease, water or other contaminants that may obstruct penetrant from entering flaws.

Figure 1.Ingredients of Dye penetrant test

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After the surface has been cleaned thoroughly, the penetrant is applied by spraying. Now the penetrant is left to lie on the surface for sufficient amount of time in order to allow as much penetrant as possible to be drawn or seep into a discontinuity. This particular time allowed for penetrant to seep into discontinuity is called penetrant dwell. It is the total time during which penetrant is allowed to rest on surface. Penetrant dwell time is usually recommended by its producers. Penetrant dwell time depends on the penetrant material used, material being inspected, application, and the type of discontinuity expected. The minimum dwell time generally range from five to sixty minutes. There is no harm in using longer time as long as the penetrant is not allowed to dry.

Figure 2.Penetrant applied on weld bead

Figure 3.Weld bead after removing excess penetrant

Next step in this method is removal of excessive penetrant. It is most delicate step of this method because excess penetrant must be removed from the surface without affecting the absorbed penetrant in the discontinuity.

After removing the excess penetrant properly, developer is applied. A thin layer of developer is applied in order to draw trapped penetrant in the discontinuity back to surface so that it is visible to the naked eye. The developer is allowed to lie on the surface for sufficient amount of time to permit the extraction of the trapped penetrant out of the surface discontinuity. This time allowed is usually ten minutes. Longer time may be allowed for tight cracks.

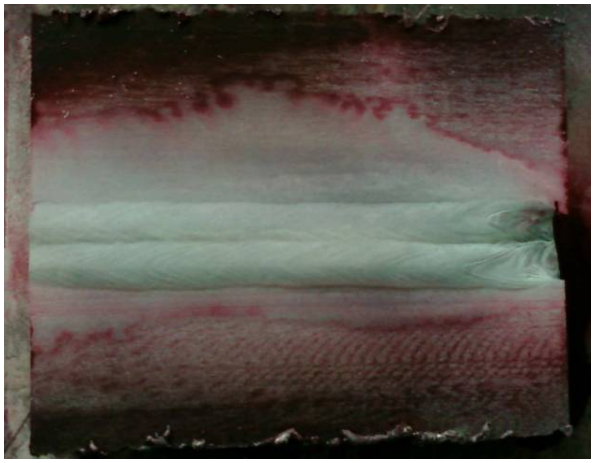

Figure 4.Developer applied on surface

Inspection has been performed on the surface. Inspection revealed no surface crack or other discontinuity.

Magnetic Particle Test

Magnetic particle test is a method for detecting discontinuities that are primarily linear and located at or near the surface of ferromagnetic components and structures. This method is governed by law of magnetism.

Figure 5.Material magnetized by applying yoke

Figure 6.Magnetic particle applied

In the first step of this method material or area under inspection is magnetized by applying yoke on the area. Yokes are generally C- shaped electromagnets which are used to induce to a magnetic field between the poles (legs). These are used for local magnetization. Many portable yokes contain articulated legs (poles) that permit the legs to be adjusted to contact irregular surfaces or two surfaces that join at an angle.

In further step magnetic particle of suitable size has been applied in the magnetized area. During inspection no accumulation of magnetic particle has been observed which suggests that the area is free from any linear sub- surface discontinuities.

Ultrasonic Testing

In this method, ultrasound uses the transmission of high- frequency sound waves in a material to detect a discontinuity or locate changes in material properties. This method is sensitive to both surface and sub- surface discontinuity.

Figure 7.Ultrasonic test is being conducted on weldment

Inspection revealed minor lack of fusion at the interface at the start and end of weld.

Conclusions

Different methods used in this work have its own pros and cons. From the above work it is obvious that DPI is cheap and easily portable method but can only detect the surface defects. Magnetic particle test can only be applied on ferromagnetic material, which is salient limitation of this method. On the other hand, ultrasonic test overcomes the individual limitations of both methods, since it can be applied to both, ferrous and non- ferrous material and can detect surface and sub- surface defects. But in general, no particular method is

suitable for all type of materials and welding processes.

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