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Experimental Study on Non Destructive Testing Techniques (NDTT)

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Abstract— Defects are needed to develop new methods and to assess the performance and reliability of used methods and procedures. It is crucial to have representative defects in order to have an accurate and realistic assessment of the performance of NDT. Representativeness should be to the actual service-induced defects that the NDT method is used to evaluate. While various techniques have been used to create such defects, all conventional techniques seem to have some shortcomings that limit true assessment of the NDT performance. This paper describes developments of NDT technology. It is well known that water has a detrimental effect on the performance of adhesive joints, and is amongst the most common elements for a bond to encounter in service. Surface analysis has subsequently been performed on the failure surfaces of these specimens, which has helped to explain the variations seen in the mechanical performance after exposure to moisture. It is well known that introduction of a crack-like defect into a structure reduces its stiffness. . It is shown that most of the traditional limitations can be overcome using the currently available technology. Finally, three real-world application cases are presented showing the use of such cracks.

Keywords— NDT[1], Penetrant[2], Cracking[3], and Corrosion[4]

INTRODUCTION

As we all know that every product in the Industry is made up of material .So the material which we are selecting should be a QUALITY in order to get a final product as a QUALITY PRODUCT. For that reason QUALITY CHECK is important in the Industry in Industry we can check the **QUALITY** of a product by two ways

1. Destructive testing
2. Non-Destructive testing

In DESTRUCTIVE TEST the specimen is subjected to fracture under load and mechanical properties are measured by this testing. Eg. Tensile test, Impact test, Hardness test and Fatigue test. Compressive Strength test.

NON DESTRUCTIVE TESTS are employed for finished products to determine Internal defects such as Slag Inclusion, Porosity, Blow holes etc and Surface defects.

1.1 IMPORTANCE OF NDT

1. To improve the quality of a product
2. To improve the customer satisfaction
3. To reduce in-service accidents
4. Inspection of Raw Products
5. Inspection Following Secondary Processing
6. In-Services Damage Inspection
7. Flaw Detection and Evaluation
8. Leak Detection
9. Estimation of Mechanical and Physical Properties

2. COMMON APPLICATION OF NDT

1. Welding
2. Cracking
3. Corrosion
4. Erosion/Wear
5. The US has 578,000 highway bridges.
6. Corrosion, cracking and other damage can all affect a bridge's performance.
7. The collapse of the Silver Bridge in 1967 resulted in loss of

47 lives.

8. Bridges get a visual inspection about every 2 years.
9. Some bridges are fitted with acoustic emission sensors that "listen" for sounds of cracks growing.

Figure 1 **Bridge failure**

Figure 2 **inspection for in-service damage**

Figure 3 Cracking

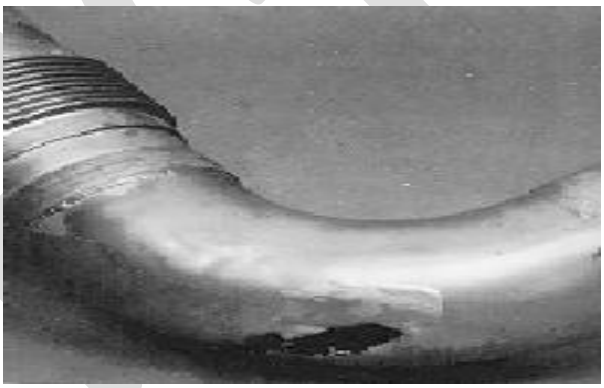

Figure 4 Corrosion

3. METHODS OF NDT

The following are the NDT methods that are most often used to inspect defects in material
Visual and optical testing,
Penetrate testing,
Magnetic particle testing,
Radiography testing and
Ultrasonic testing.

3.1 VISUAL AND OPTICAL TESTING

It is the simple method.
Visual inspection involves using an inspector's eyes to look for defects. The inspector also uses special tools such as magnifying glasses, mirrors to gain access and more closely inspect the subject area. Surface defects, dimensional accuracy and penetration in the welded joints are inspected by this method.
Most basic and common inspection method**.** Tools include fiber scopes, bore scopes, magnifying glasses and mirrors are used to inspect.

3.2 LIQUID PENETRANT INSPECTION

Is applicable to discontinuities that are open to the surface or surface connected. As surface opening is required, it cannot detect anomalies like inclusion, segregation etc. Liquid Penetrant Inspection detects only those discontinuities that are present on or open to the surface part. The principle of the technique is that a liquid is drawn by capillary action in to the defect and, after subsequent development; any surface breaking defects may be rendered visible to the human eye. This method of examination involves the use of a solvent soluble colored dye, which penetrates in to surface discontinuities by capillary attraction. After an interval or penetrant dwell time, the excess dye is removed and the exact position of any discontinuities present is detrained by the use of a non-aqueous wet developer, which gives a white background against the colored penetrant in the discontinuity.

3.2.1 MATERIALS:

The materials that may be used in this procedure are:
Penetrant: P-Met Company PP 110/NDT-19 or equivalent
Remover : P-Met Company PC 120/NDT-17 or equivalent
Developer: P-Met Company PD 130/NDT-18 or equivalent
Pre-cleaner: Remover may be used for this purpose.

3.2.2SURFACE CONDITION

The surface undergoing examination and any adjacent area within at least 1 mm shall be dry and free of any dirt, grease, lint, scale, welding flux, spatter, of or any extraneous matter that would observe surface openings or otherwise interfere with the examination. Weld ripples or surface irregularities shall be removed by any suitable process to a degree the irregularities cannot mask or be confused with the flux files of any discontinuity.
Temperature of the test surface will not be less than 10˚ C and not more than 52˚ C through out the test.

3.2.3 CRACK INDICATION.

A liquid with high surface wetting characteristics is applied to the surface of the part and allowed time to seep into surface breaking defects. The excess liquid is removed from the surface of the part, developer (powder) is applied to pull the trapped penetrant out the defect and spread it on the surface where it can be seen. Visual inspection is the final step in the process. The penetrant used is often loaded with a fluorescent dye and the inspection is done under UV light to increase test sensitivity. It is most preferred to check the gas lines.

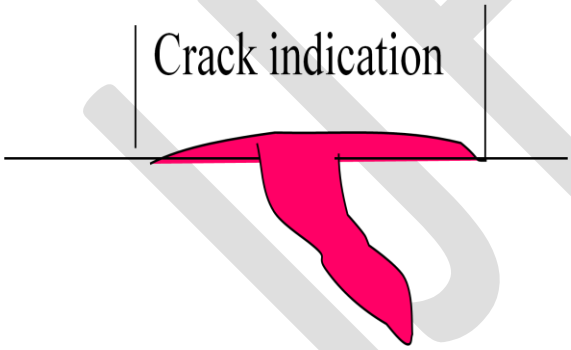

Figure 5 Actual discontinuity

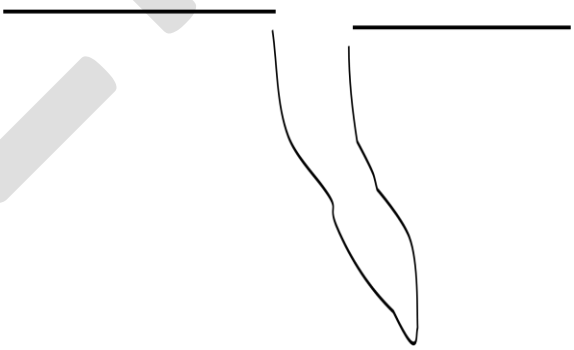

Figure 6 Human eye acuity

Figure 7 liquid penetrant inspection

Figure 8 liquid Penetrant inspection

3.2.4 STAGES IN PENETRANT TESTING

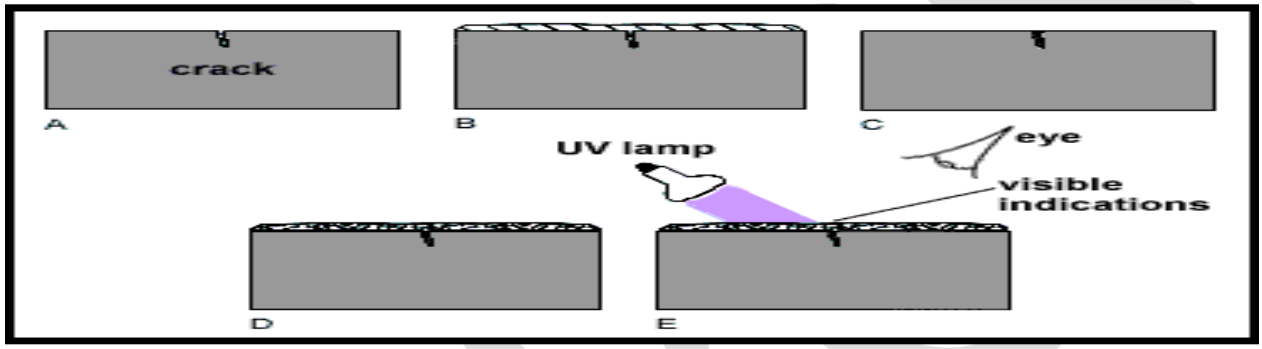

Figure 9 liquid penetrant examination steps.

Stage 1 Pre-examination cleaning: Ensure that the part or area of the part is free from grease and oily films. To accomplish this step use a clean wiper moistened with pre-cleaner.

Stage 2 Penetrant applications: A uniform coating of red dye is applied to the dry surface of the part under examination by dipping, brushing or spraying. If the penetrant is applied by spraying using compressor air type apparatus, filters shall be placed at the air outlet to preclude contamination of the penetrant from oil, waste and dirt sediment that may have collected in the lines. Avoid pools of penetrant on the part. Penetration times shall be as below, table-1, during which time the temperature of the material surface will be between 10˚.C - 52˚C.

Material **Form**	**Type of discontinuity**	Penetrant dwell time	Developer dwell time
Alluminium, **-castings**	Cold shuts, porisity,	10 Min.	10 Min.
Steel or high temperature alloy **welds**	Lack of fusion or cracks	10 Min.	10 Min.
Wrought iron Extractions **Forgings plate**	Laps cracks (all forms)	20 Min.	10 Min.

Table-1 penetration & development time for solvent removable penetrants

At any point of time penetrant should not be allowed to dry on the surface of the part. In the event of this occurring, further application of penetrant must be made for the original dwell time again before continuing with the sequence of this procedure.

Stage 3 Penetrant removal: Removal of the excess wet penetrant will be accomplished by using clean dry wipers. This operation shall be replaced until most traces of penetrant have been removed. Final removal of the trace residue of the penetrant can be removed by a clean wiper lightly moistened with solvent remover.Allow the part to dry by evaporation or with the assistance of a cold blast of air. Under no circumstances has the surface of the part to be flooded with solvent remover and excessive cleaning has to be avoided as there is a possibility of removing penetrant from shallow discontinuities.

Stage 4 Development: Immediately after the removal has been removed from the part and the surface is dry apply a uniform thin layer of non aqueous developer. Ensure that spraying covers the area of the part under examination. The minimum development time would be as per figure-1 and the time shall begin directly after the developer coating has dried on the surface of the part. The maximum bleaded out time shall be 30 minutes.

Stage 5Inspection: After the developer has been allowed to dry and the appropriate development time has been allowed to else, assessment of the indications shall be made either in natural or artificial light.

Stage 6 Post examination cleaning: After inspection has been carried out, the part shall be cleaned using a dry wiper. To assist in the removing of the developer a lightly moistened wiper in remover or water spray may be used

Note: It is important that this step 6 should be carried out as soon as possible to prevent the developer fixing itself on to the part.

ADVANTAGES

1.Highly sensitive to small surface flaws.
2.Simple in application.
3.Large areas & No. of parts can be inspected rapidly.
4.Complex geometric shapes are routinely inspected.
5.Visual representation of flaw.
6.Spray cans are very portable
7.Relatively inexpensive

LIMITATIONS:

1.Only surface breaking defects can be detected.
2.Only nonporous surface can be inspected
3.Pre cleaning is very critical.
4.Surface finish & roughness can affect inspection sensitivity.
5.Proper disposal of chemicals is essential.

INTERPRETATION RESULTS

All indications revealed by penetrant inspection do not necessarily represent defect, since a spurious indication may be encountered. In such a case, those areas exhibiting spurious indications should be re-tested by surface cleaning and reapplication of developer.

CONCLUSIONS

1. Discontinuities at the surface will be indicated by bleeding out of the penetrant; however, localized surface imperfections such as may occur from machining marks or surface conditions may produce similar indications which are not relevant to the detection of unacceptable discontinuities. Any indication in excess of the acceptance standard, which is believed to be non- relevant shall be regard as a defect and shall be re-examined, in accordance with paragraph 9.0, to verify whether or not actual defects are present. Non relevant indications and broad areas of pigmentation, which would mask indications of defects, are unacceptable.

Defects which occur as discontinuities at the surface will be indicates by the bleeding out of the penetrant.

1.However, localized surface imperfection, suction may occur from machining marks or surface conditions may produce similar indications, whichever not relevant to the detection of defects.
2.Any indication which is suspected to be non-relevant is to be considered relevant till it is proved otherwise.

3.Relevant indications are those which result from mech. Discontinuities linear indications are those indications in which the length is more than 3 times rounded indications are those indications which are circular or elliptical with the length less than three times the width.

REFERENCES:

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