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Experimental Study of Dye Penetrant Technique in Non Destructive Testing

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Abstract—Non Destructive Testing represents the testing techniques which are based on application of physical principles applied for the purpose of determining characteristics of materials /components for detecting and assessing the harmful defects without effecting the usefulness of such materials. One of such method of testing is considered in this paper called Dye Penetrant Testing/Liquid Penetrant Testing of NDT and experiment is conducted on the sample taken and studied. This paper describes methodology of conducting the dye penetrant testing/technique and their applications.The results are interpreted after the examination, advantages and limitations , and necessary precautions that are to be taken during the testing are discussed in detail in this paper.

Keywords—NDT, penetrants,cracks,interpretation.

I. INTRODUCTION

Non Destructive Testing Plays an important role in the quality control of the finished products, and also during various stages of manufacturing.It is used for condition monitoring of various items during operation to predict and assess the remaining life of the component while retaining its structural integrity, B.Raj[1].According to Lalitha[2], every product is made up of material and these materials should go through the check of quality in order to get a quality Product as an end output.

Till today NDT is widely used in assembling, fabrication and also to observe the in service of the final product and its reliability .Mainly NDT is used to ensure merit of components during the manufacturing and forging phases, while continuing with NDT inspection use mainly go with two important references that should be taken, whether to consider it to continue in service for future and also should it be safe to use.

It is mostly used to find dimension and locate the subsurface and surface glitches and irregularities.

- In NDT the most advantageous part is that we can utilize the components without damaging .
- NDT is purposely used to lower the cost and eliminate setback during the manufacturing process.
- NDT is generally used to develop the reliability of product.

Common Application of NDT:

1. Flaw Detection
2. Soldering
3. Deterioration
4. Abrasion/ Wear.

According to USFRA –United State Federal Rail road Administration of safety analysis reported that track defects are the second most leading cause of the accidents on railways in US.

II. METHODS OF NDT

There are various types of NDT methods present .

1. Liquid penetrant Testing.
2. Magnetic flux leakage
3. Vibration analysis.
4. Infrared Testing.
5. Laser testing method
6. Ultra sonic testing.
7. Thermography
8. Electro magnetic testing.
9. Leak Testing
10. Radiography.

One of the above method called Liquid penetrant Testing is used for experimentation and interpretation.

III. LIQUID PENETRANT TESTING

Penetrant inspection utilizes the natural accumulation of a fluid around a discontinuity to create a recognizable indication of a crack or other surface opening defect.In order to locate the area of excess fluid (defect region),the

background area must be of sufficient contrast thus leading to distinct detection of the defect on the surface.

Penetrant inspection mainly depends on ability of liquid to wet the surface of a solid component / workpiece and flow over that surface to form a continuous and reasonably uniform coating,thus penetrating into cavities that are open to the surface.The ability of liquid to flow and enter into surface cavitiesw mainly depend on capillary action and surface tension. The cohesive forces between the molecules of a liquid causes surface tension.

Principle: Capillary action is the phenomenon of rise or depression of liquid in narrow cavities[3].

IV. MATERIALS REQUIRED FOR LPT

The following are the materials required for conducting the liquid penetrant testing.

1. Brush: Used to clean the test specimen.
2. Cotton cloth : Used for removing access penetrant.
3. Magnifying Glass: Used to observe small crack & flaws.
4. Hand Gloves: Used for protection & hygiene purpose.
5. Mask : To avoid inhalation of pungent smell.
6. Test specimen: Component on which the experiment is conducted.
7. Penetrant : Solvent removal Red penetrant.
8. Developer: Suspendable developer for liquid penetrant testing.
9. Cleaner: Penetrant remover/ cleaner for liquid penetrant.

Specifications of the chemical used.

Sl no	Name	company	code
1	Cleaner	Goldecs	36A
2	Penetrant	Goldecs	36A
3	Developer	goldecs	36A

Surface Condition:

- Surface condition for dye penetrate testing should be free from dirt, grease,particles that block pores or crack of test specimen.
- For conducting the testing the temperatures value range should be between 10^0C to 52^0C during whole testing duration.
- For crack to be identified it should be within a range of 1mm.

Crack Identification :

On test specimen the cracks present at different size,shape, depth ,etc their incitation and identification of crack differ.Crack identification also depends upon the type of penetrant used during experiment like fluorescent and visible type or coloured type.

V. PROCEDURE

The following are the procedure steps involved in doing the penetrant testing.

Step 1: Cleaning of the specimen .

The initial step in doing the test is to clean the surface area of the specimen to be inspected.By doing so the defect which is supposed to be inspected must open to the surface for facilitating the penetrant to enter into the defect as shown in Fig 1.a & Fig1.b.If this cleaning is not done then scale,flakes,grease,dirt, paint, and other chemicals will try to accumulate the penetrant.Once the specimen is cleaned then it is dried up for certain in order to see that there is no moisture content is present on the component which will stop the penetrant to enter into the defect.

Fig 1.a Cleaning of Specimen.

Fig 1.b Cleaning of Specimen.

Step 2: Application of Penetrant

The second step in the inspection process is the application of the penetrant on the specimen which is cleaned.Now thw pnetrant will move smoothly over the surface and also get into the cracks.It requires certain time for the penetrant to move into the crack . So time for which the penetrant enters into the crack is known as dwell time.For different types of materials there will

deffrent dwell times.Application of the penetrant can also be done by spraying or dipping the component in the bath of penetrant liquid or even by brushing.as shown in fig.2

Fig.2 Application of the penetrant

Step 3:Removal of excess penetrant

This is one of the important step in the inspection process.It is essential to clean the surface of the speciemen with the help of cloth or so. Now the penetrant is settled in the cracks .Ensure that the component is not excessively cleaned so that the penetrant is also effected.So care has to be taken so that is not cleaned insufficient nor cleaned.

Fig 3. Removal of excess penetrant

Step 4: Application of the Developer

After the removal of the penetrant is done , a thin coating of developer is applied over the surface to draw the penetrant out of the crack and increase its visibility, as shown in fig 4a.& 4b Another function of the developer is that it makes the surface of the specimen look contrast so that red penetrant is seen clearly.This increases the visibility of the defect.

Fig 4.a Application of developer

Fig 4.b Application of developer

Step 5 : Inspection and evaluation

This the last step of the inspection, were scanning of the surface for indications is carried.The scanning can be done in presence of the day light or with ultraviolet light.And the recognition can be made by human eye, as shown in fig 5 .Each indication that appears should be evaluated.This process gives the the information of the discontinuity on the surface of the specimen, because penetrant provides information only for the surface defects.

Fig 5. Inspection and evaluation

VI. ADVANTAGES

1. This method is capable of showing discontinuities open to the surface of the material.
2. These are usually applied for identification of cracks , laps,seams, porosity, etc like pressure vessels,pipes,weld joints.

3. This method is reliable in the detection of fatigue cracks which occur during the service life of a material.
4. It takes less time to identify the crack.
5. It is irrespective of shape,size and orientation of the defect.

VII. LIMITATIONS

1. It cannot identify subsurface defects of the component.
2. In order to apply this method the surface has to be surface cleaned.
3. It cannot be applied for porous materials

VIII. CONCLUSION

From the above experimentation is it observed that surface cracks are clearly seen after certain period of time once the developer is applied. This leads to the information that there are defects present on the surface which is seen in coloured.Thus this NDT method is evaluated and necessary defect is identified, and this helps in further remedial measures for the component.

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