ФОНД ОЦЕНОЧНЫХ СРЕДСТВ ПО ДИСЦИПЛИНЕ «ПРОФЕССИОНАЛЬНАЯ ПОДГОТОВКА НА АНГЛИЙСКОМ ЯЗЫКЕ»
МОДУЛЬ «КАПИЛЛЯРНЫЙ КОНТРОЛЬ»

Материалы текущего контроля

Радел 1: Основные сведения о методах неразрушающего контроля

Ex. 1: Read the text about some NDT methods quickly. For each numbered paragraph in the text choose the appropriate name of the method from the list:

a) Magnetic Particle Testing (MPI)
b) Acoustic Emission Testing (AE)
c) Radiography (RT)
d) Visual and Optical Testing (VT)
e) Leak Testing (LT)
f) Penetrant Testing (PT0
g) Ultrasonic Testing (UT)
h) Electromagnetic Testing (ET)

NDT METHODS

Many people are already familiar with some of the technologies that are used in NDT and NDE from their uses in the medical industries. Most people have also had an X-ray taken and many mothers have had ultrasound used by doctors to give their baby a check up while still in the womb. X-rays and ultrasound are only few of the technologies used in the field of NDT/NDE. The number of NDT methods that can be used to inspect components and make measurements is large and continues to grow. Researchers continue to find new ways of applying physics and other scientific disciplines to develop better NDT methods. However, there are six NDT methods that are used most often. These methods are visual inspection, penetrant testing, magnetic particle testing, electromagnetic or eddy current testing, radiography, and ultrasonic testing. These methods and a few others are briefly described below.

1. This method involves using an inspector's eyes to look for defects. The inspector may also use special tools such as magnifying glasses, mirrors, or borescopes to gain access and more closely inspect the subject area. Visual examiners follow procedures that range from simple to very complex.

2. Test objects are coated with visible or fluorescent dye solution. Excess dye is then removed from the surface, and a developer is applied. The developer acts as blotter, drawing trapped penetrant out of imperfections open to the surface. With visible dyes, vivid color contrasts between the penetrant and developer make

"bleedout" easy to see. With fluorescent dyes, ultraviolet light is used to make the bleedout fluoresce brightly, thus allowing imperfections to be readily seen.

3. This NDE method is accomplished by inducing a magnetic field in a ferromagnetic material and then dusting the surface with iron particles (either dry or suspended in liquid). Surface and near-surface imperfections distort the magnetic field and concentrate iron particles near imperfections, previewing a visual indication of the flaw.

4. Electrical currents are generated in a conductive material by an induced alternating magnetic field. The electrical currents are called eddy currents because they flow in circles at and just below the surface of the material. Interruptions in the flow of eddy currents, caused by imperfections, dimensional changes, or changes in the material's conductive and permeability properties, can be detected with the proper equipment.

5. This method involves the use of penetrating gamma or X-radiation to examine parts and products for imperfections. An X-ray generator or radioactive isotope is used as a source of radiation. Radiation is directed through a part and onto film or other imaging media. The resulting shadowgraph shows the dimensional features of the part. Material thickness and density changes are indicated as lighter or darker areas on the film.

6. This technology uses transmission of high-frequency sound waves into a material to detect imperfections or to locate changes in material properties. The most commonly used ultrasonic testing technique is pulse echo, wherein sound is introduced into a test object and reflections (echoes) are returned to a receiver from internal imperfections or from the part's geometrical surfaces.

7. When a solid material is stressed, imperfections within the material emit short bursts of acoustic energy called "emissions." As in ultrasonic testing, acoustic emissions can be detected by special receivers. Emission sources can be evaluated through the study of their intensity, rate, and location.

8. Several techniques are used to detect and locate leaks in pressure containment parts, pressure vessels, and structures. Leaks can be detected by using electronic listening devices, pressure gauge measurements, liquid and gas penetrant techniques, and/or a simple soap-bubble test.

Ex. 2: Look at the list of words and phrases below. Divide them into 8 boxes according to what method they are used to describe in the text. Then, translate them into Russian.

special tools excess dye pulse echo to distort fluorescent dye solution bleedout alternating magnetic field visual examiners to dust borescope acoustic emission magnifying glass penetrant radioactive isotope developer interruptions pressure vessels iron particles high-frequency sound waves to stress imaging media to accomplish permeability to fluoresce eddy currents dimensional features to gain access shadowgraph to induce receiver X-radiation listening devices

Visual and Optical Testing	*special tools,…*
Penetrant Testing	*penetrant,…*
Magnetic Particle Testing	*to dust,…*
Electromagnetic Testing	*to induce,…*
Radiography	*X-radiation,…*
Ultrasonic Testing	*pulse-echo,…*
Acoustic Emission Testing	*to stress,…*
Leak Testing	*leak,…*

Раздел 2: Основные сведения о капиллярном контроле

Ex. 2: Find the English equivalents of the following words and word combinations:

капиллярное действие	**capillary action**
керамический материал	**ceramic material**
проявитель	**developer**
время выдержки	**dwell time**
усталостная трещина	**fatigue crack**
флуоресцирующий краситель	**fluorescent dye**
шлифовочная трещина	**grinding crack**
закалочная трещина	**hardening crack**

дневной свет	**natural light**
проникающее вещество	**penetrant**
пористость	**porosity**
пористый материал	**porous material**
свеча зажигания	**spark-plug**
аэрозольный баллончик	**spray**
простота использования	**usability**
шов; спай	**weld**

Раздел 3:Теория капиллярного контроля

Ex.3: Calculate the maximum depth of filling the slot-like capillary penetrant with parallel walls. Capillary depth l_0.Capillary width *b*, penetrant based on kerosene. . Atmosphere pressure $p_a = 10^5$ kPa. The data for calculations to select from the table below, in accordance with an embodiment.

Using:

1. Laplace formula: $p_k = (2 \cdot \sigma \cdot \cos q)/b$.
2. Boyle's law: $(p \cdot V = \text{const})$.

Var.	l_0, *mm*	*b*, μm	σ, N/m	Cos q
1	1	1	$0{,}5 \cdot 10^{-2}$	0,9
2	2	2	$1 \cdot 10^{-2}$	0.8
3	3	3	$1{,}5 \cdot 10^{-2}$	0.95
4	4	4	$2 \cdot 10^{-2}$	0.85
5	5	5	$2{,}5 \cdot 10^{-2}$	0.9
6	6	6	$3 \cdot 10^{-2}$	0.8
7	7	7	$3{,}5 \cdot 10^{-2}$	0,95
8	8	8	$4 \cdot 10^{-2}$	0,85
9	9	9	$4{,}5 \cdot 10^{-2}$	0,9
10	10	10	$5 \cdot 10^{-2}$	0,8

Evaluation (5 points) is placed at the correct course of solutions and the right result. In other cases, the job must be further developed.

Раздел 4: Средства капиллярного контроля

Ex. 4: Read the text and explain the words in bold. Find in the text the English equivalents of the following words and word combinations:

- уровень чувствительности
- обеспечить ровное покрытие
- гладкая поверхность
- подвергать ультрафиолетовому излучению
- быть подверженным загрязнению

- обеспечить большой контраст
- значительно уменьшить
- легко наноситься на поверхность материала

PENETRANT TESTING MATERIALS

The penetrant materials used today are much more **sophisticated** than the kerosene and whiting first used by railroad inspectors near the turn of the 20th century. Today's penetrants are **carefully formulated** to produce the level of sensitivity desired by the inspector. To perform well, a penetrant must possess a number of important characteristics. A penetrant must:

- spread easily over the surface of the material being inspected to provide complete and even **coverage**.
- be drawn into surface breaking defects by capillary action.
- remain in the defect but remove easily from the surface of the part.
- remain fluid so it can be drawn back to the surface of the part through the **drying and developing steps**.
- be highly visible or fluoresce brightly to produce easy to see indications.
- must not be **harmful** to the material being tested or the inspector.

All penetrant materials do not perform the same and are not designed to perform the same. Penetrant manufactures have developed different formulations **to address** a variety of inspection applications. Some applications call for the detection of the smallest defects possible and have **smooth** surface where the penetrant is easy to remove. In other applications the **rejectable defect size** may be larger and a penetrant formulated to find larger flaws can be used. The penetrants that are used to detect the smallest defect will also produce the largest amount of **irrelevant indications**.

Penetrant materials are classified in the various industry and government specifications by their physical characteristics and their performance.

Penetrant materials come in two basic types. These types are listed below:

- Type 1 - Fluorescent Penetrants
- Type 2 - Visible Penetrants

Fluorescent penetrants contain a **dye** or several dyes that fluoresce when **exposed to** ultraviolet radiation. Visible penetrants contain a red dye that provides high contrast against the white developer **background**. Fluorescent penetrant systems are more sensitive than visible penetrant systems because the eye is drawn to the **glow** of the fluorescing indication. However, visible penetrants do not require a darkened area and an ultraviolet light in order to make an inspection. Visible penetrants are also less **vulnerable** to **contamination** from things such as cleaning fluid that can significantly reduce the strength of a fluorescent indication.

Раздел 5: Технология капиллярного контроля

Ex.5. Choose the correct variant of question:

1.The advantage that liquid penetrant testing has over an unaided visual inspection is that:

a) The actual size of the discontinuity can be measured
b) The depth of the defect can be measured
c) The cause of the impact can be seen
d) It makes defects easier to see for the inspector

2. When fluorescent penetrant inspection is performed, the penetrant materials are formulated to glow brightly and to give off light at a wavelength:

a) Close to infrared light
b) Close to the wavelength of x-rays
c) That the eye is most sensitive to under dim lighting conditions
d) In the red spectrum

3. Once the surface of the part has been cleaned properly, penetrant can be applied by:

a) Spraying
b) Brushing
c) Dipping
d) All of the above

4. The total time that the penetrant is in contact with the part surface is called the:

a) Soak time
b) Baking time
c) Dwell time
d) Immersion time

5. Minimum penetrant dwell times are usually

a) 1-5 minutes
b) 1-30 minutes
c) 5-60 minutes
d) 60-100 minutes

6. Which of the following is an advantage to LPI?

a) Large areas can be inspected
b) Parts with complex shapes can be inspected
c) It is portable
d) All of the above is an advantage

7. A penetrant must:

a) Change viscosity in order to spread over the surface of the part

b) Spread easily over the surface of the material
c) Have a low flash point
d) Be able to change color in order to fluoresce

8. Developers come in a variety of forms and can be applied by:
a) Dusting
b) Dipping
c) Spraying
d) All of the above

9. Developer times are usually in the range of:
a) 10 minutes
b) 10 seconds
c) 20-30 minutes
d) 5-60 minutes

10. Penetrants are designed to:
a) Perform equally
b) Perform the same no matter who manufacturers them
c) Shift in grade and value when the temperature changes
d) Remain fluid so it can be drawn back to the surface of the part

11. The pentrants that are used to detect the smallest defects:
a) Should only be used on aerospace parts
b) Will also produce the largest amount of irrelevant indications
c) Can only be used on small parts less than 10 inches in surface area
d) Should not be used in the field

12. Which level of penetrant is the most sensitive?
a) Level I
b) Level II
c) Level III
d) Level IV

13. Which emulsifier system is oil based?
a) Hydrophilic emulsifier
b) Lipophilic emulsifier
c) Solvent removable emulsifier
d) All of the above have an oil base

14. Developers are used to:
a) Make the penetrant fluoresce
b) Reduce the dwell time
c) Pull trapped penetrant material out of the defect
d) All of the above

15. Dry developer can be applied:

a) To a wet part
b) To a partially wet part but needs to be placed in a dryer immediately
c) To a dry part
d) All of the above

16. When a permanent record is required which type of developer can be used:
a) Lacquer developer
b) Nonaqueous developer
c) Layered developer
d) Peeling developer

17. Which of the following should be removed in order to obtain a good penetrant test?
a) Varnish
b) Oxides
c) Plating
d) All of the above

18. A good cleaning procedure will:
a) Remove all contamination from the part and not leave any reside that may interfere with the inspection process
b) Remove a small amount of metal from the surface of the part
c) Should leave the part slightly flourescent in order to identify any discontinuities
d) Should etch the part slightly only if it is made from 4041 aluminum

19. Which penetrant method is easiest to use in the field?
a) Fluorescent, post-emulsifiable
b) Visible dye, water washable
c) Visible dye, solvent removable
d) Fluorescent, water washable

20. Penetrant can be applied by
a) Dipping
b) Brushing
c) Spraying
d) All of the above

Материалы итогового контроля

1. Theory of Penetrant testing
2. Penetrant equipment
3. Advantages and limitation of Penetrant testing
4. History and development of Penetrant testing
5. Precleaning
6. Penetrant application
7. Penetrant procedure
8. Evaluation of the test result
9. Principles of Penetrant testing
10. Penetrant removal
11. Development time
12. Postcleaning
13. Penetrant testing application
14. Advantages and limitations
15. Principles of Penetrant testing
16. Comparator, test panels
17. Penetrant
18. Developer
19. Penetrant materials
20. Prerequisites penetrant testing
21. Application of a Developer
22. Emulsifier/ remover
23. Environmental considerations of Penetrant testing
24. Surface Condition Considerations
25. Application of Developer
26. Postcleaning
27. Penetrant equipment
28. Technique and variables
29. Interpretation evaluation
30. Penetrant materials

Список использованных источников:

1. Квашнина О.С. Nondestructive testing. Учебное пособие. - Томск: Изд. ТПУ, 2006. - 70 с.
2. Практикум по неразрушающим методам контроля для студентов нелингвистических специальностей.