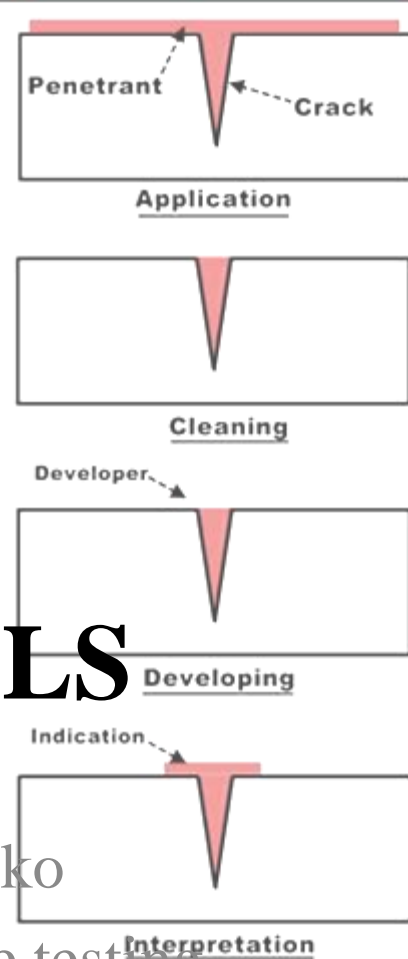


PART 4

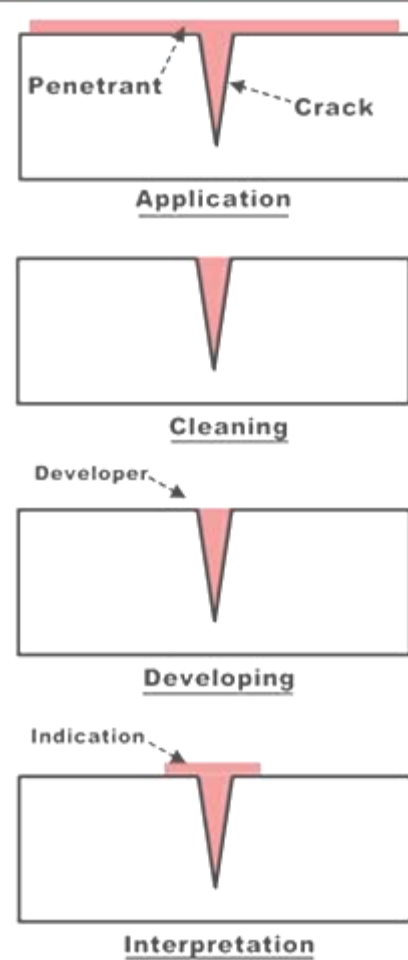
PENETRANT MATERIALS

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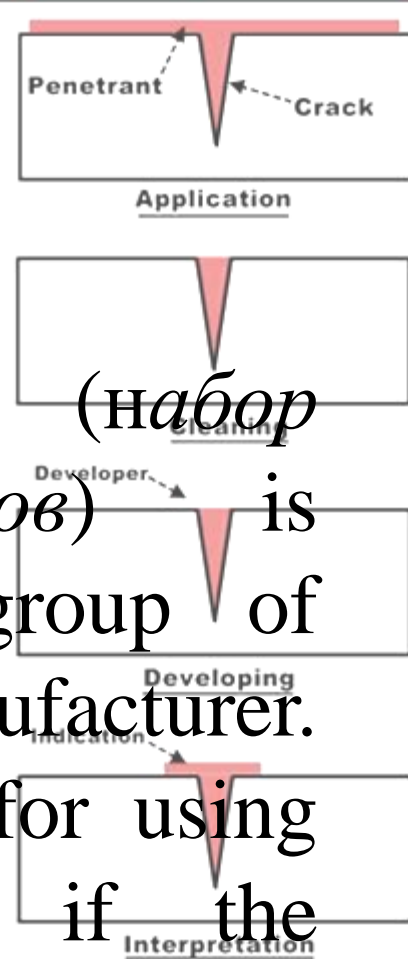
Content:

1. Abstract
2. Precleaners
3. Penetrants
4. Removers
5. Developers



Abstract:

The term “**penetrant family**” (*набор дефектоскопических материалов*) is sometimes used to indicate a group of materials all from the same manufacturer. There are usually some provisions for using materials outside the “family” if the combination of the difference material can be proven compatible through qualification tests.



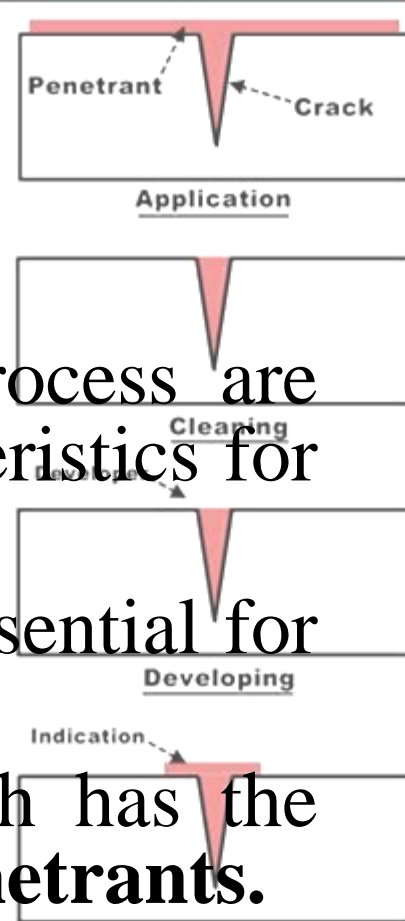
Abstract:

The material used in the penetrant process are classified into four groups. The characteristics for each will be presented in detail.

The first group of materials that are essential for a penetrant test **are precleaners.**

The second group of materials, which has the greatest influence on sensitivity, **are penetrants.**

The third group comprises **the emulsifier and solvent removers,**
and **the fourth group** the **developers.**



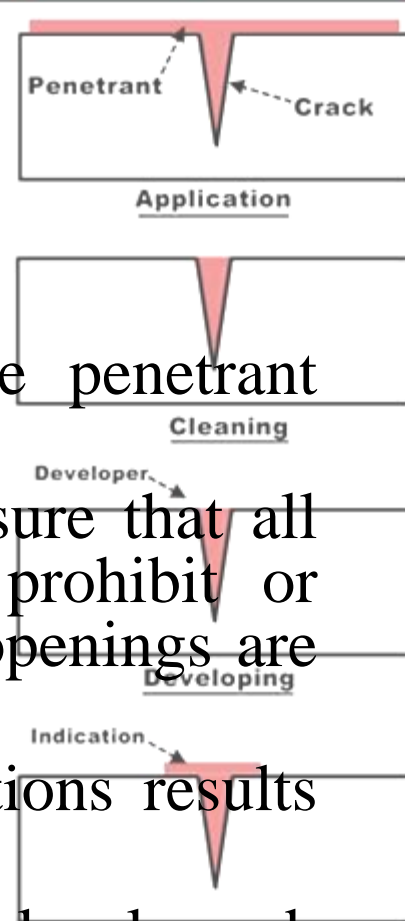
Pre-cleaners:

Pre-cleaning is an essential first step in the penetrant process.

The surface must be thoroughly cleaned to assure that all contaminants and other materials that may prohibit or restrict the entry of the penetrant into surface openings are removed.

Thorough cleaning is essential if the examination results are to be reliable.

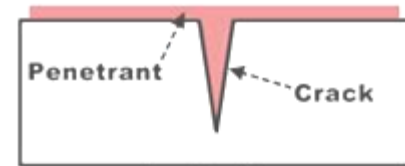
Not only does the surface have to be thoroughly cleaned, but openings must be free from contaminants such as oil and water, oxides of any kind, paint or other foreign material which can greatly reduce the penetrant sensitivity.



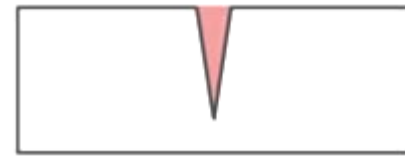
Pre-cleaners:

Typical cleaners include the following:

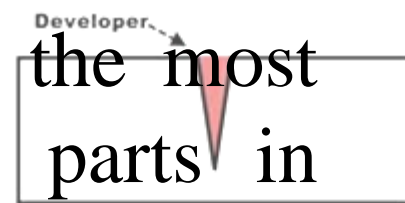
- **Solvent** (*растворитель*) are probably the most widely used liquids for pre-cleaning parts in penetrant testing. There are a variety of solvents that can be effective in dissolving oil, films, grease, and other contaminants. The solvents should be free of any residues that would remain on the surface. These must be removed by some type of mechanical cleaning process.



Application



Cleaning



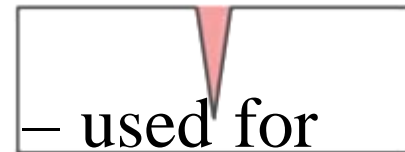
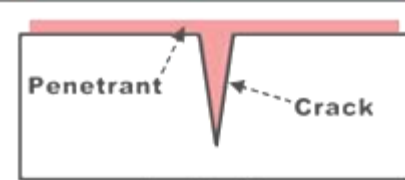
Developing
Indication



Interpretation

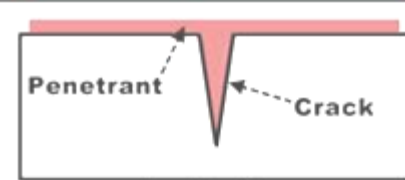
Precleaners:

- **Alkaline cleaners** (*щелочные очистители*) – used for precleaning are nonflammable water solutions that, typically, contain specially selected detergences that are capable of removing various type of contamination.
- **Ultrasonic cleaning** (*ультразвуковая очистка*). Of all the precleaner materials and processes, ultrasonic cleaning is probably the most effective. Not only will the contaminates be removed from the surface, but also if there are entrapped contaminates in discontinuities and other surface openings, the power that is generated in the ultrasonic cleaning process will usually be effective in breaking up and removing them.

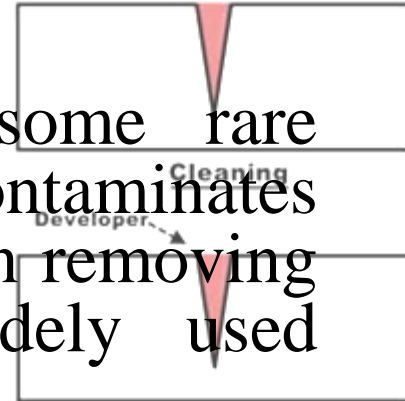


Pre-cleaners:

- **Steam cleaning** (*очистка паром*) In some rare instances, steam may be used to remove contaminants from the surface. Although very effective in removing oil-based contaminants, this is not widely used technique.
- **Water and detergent cleaning** (*водосмываемые очищающие средства*) There are various devices that utilize hot water and detergents to clean part surfaces. This technique depends largely upon the type of the contamination that is present on the test surface. Usually, if parts are covered with oil or grease, the contaminants will not be satisfactorily removed from the surface with this cleaning technique.



Application

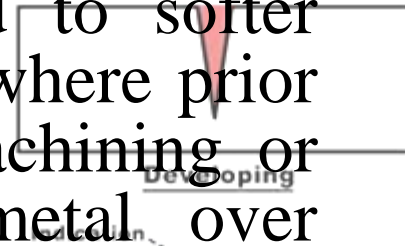
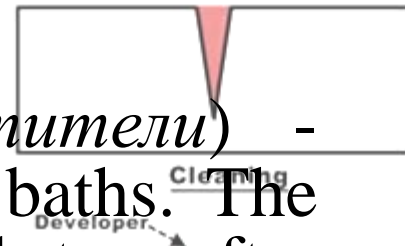
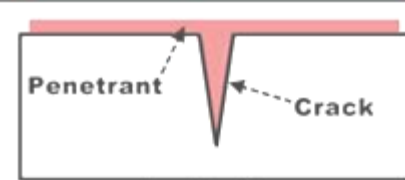


Developing



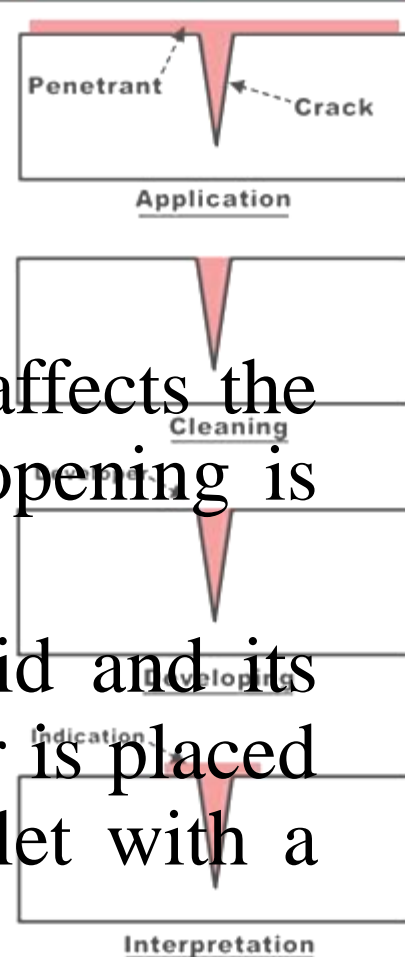
Pre-cleaners:

- **Chemical cleanings** (*химические очистители*) - usually involve eachans, acids, or alkaline baths. The precleaning approach is primary confined to softer materials, such as aluminum and titanium, where prior mechanical surface treatments, such as machining or grindig, could possibly have smeared metal over discontinuity openings.
- Both acid or alkaline liquids are usually effective in the removal of rust and surface scale; however, a slight amount of the surface material is also removed, so this process must be very carefully controlled. Steps must be taken to assure the complete removal of the liquids from all surface openings.

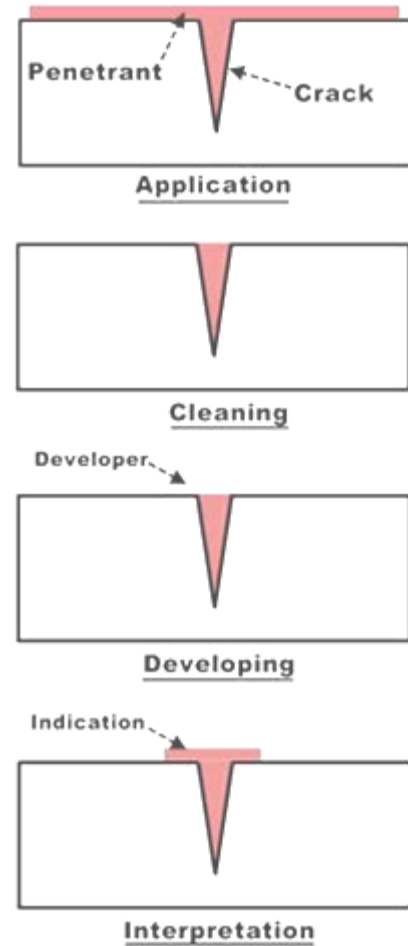
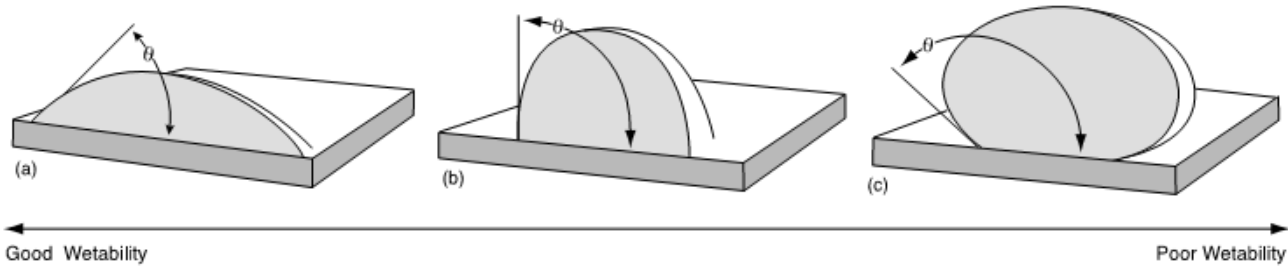


Penetrants:

- The most important characteristic that affects the ability of a penetrant to penetrate an opening is that of “wetability” (*смачиваемость*)
- Wetability is a characteristic of a liquid and its response to a surface. If a drop of water is placed on a very smooth, flat surface, a droplet with a very pronounced contour will result
- Although water is a liquid and is “wet,” its wetting characteristics are not good enough to make it an effective penetrant.

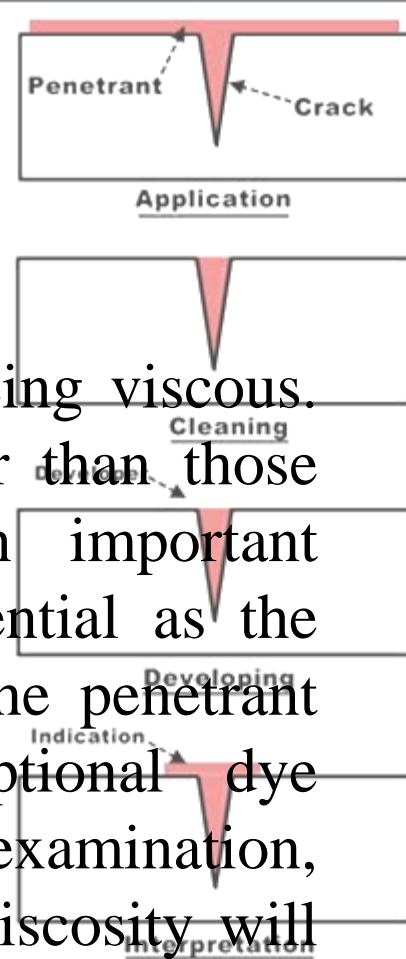


Penetrants:



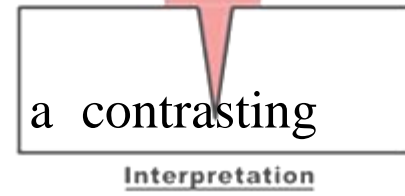
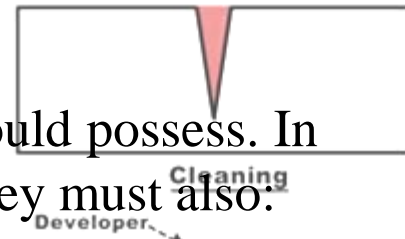
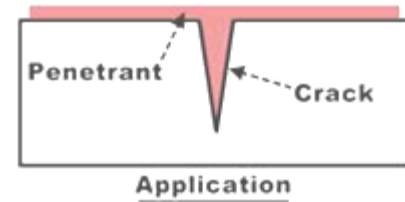
Penetrants:

- Viscosity is defined as the state or quality of being viscous. Liquids with higher viscosity values are thicker than those with lower ones. Although viscosity is an important characteristic of a penetrant, it is not as influential as the wetting characteristics and dye concentration. If the penetrant has good wetting characteristics and exceptional dye concentration, it will still provide a meaningful examination, even if the viscosity is high. The difference in viscosity will influence the actual dwell time, or the amount of time that it will take for the liquid to effectively penetrate a given surface opening.



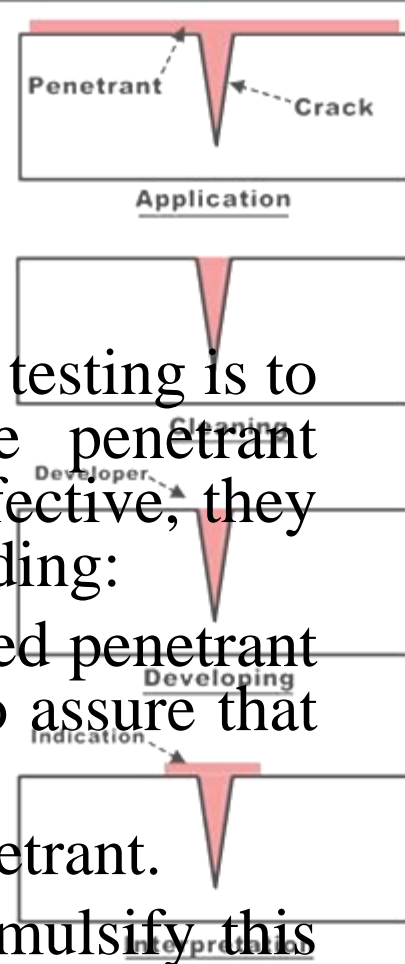
Penetrants:

- There are other characteristics that an effective penetrant should possess. In addition to being able to penetrate small surface openings, they must also:
- Be relatively easy to remove from the surface during the removal step
- Be able to remain in the discontinuities until they are withdrawn during the development step
- Be able to bleed from the discontinuities when the developer interacts with it and have the ability to spread out in the developer layer
- Have excellent color and the ability to be displayed as a contrasting indication in order to provide the sensitivity that is necessary
- Exhibit no chemical reaction between the penetrant materials and the test specimen
- Not evaporate or dry rapidly



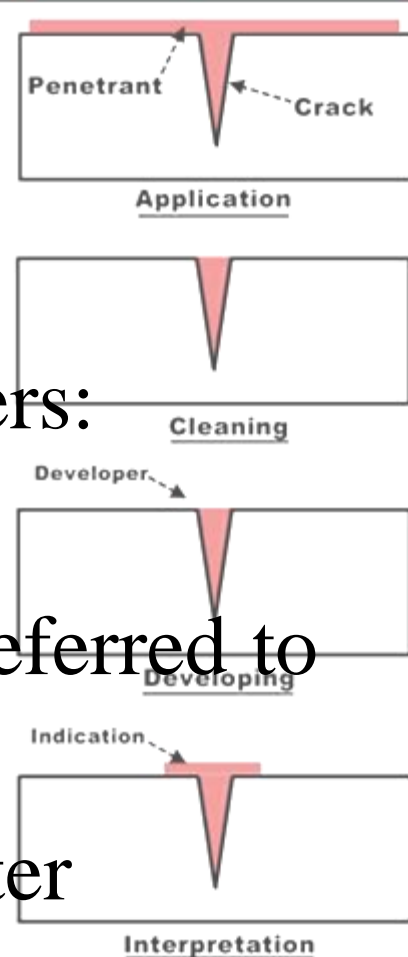
Removers:

- The purpose of the emulsifiers used in penetrant testing is to emulsify or break down the excess surface penetrant material. In order for these emulsifiers to be effective, they should also possess certain characteristics, including:
- The reaction of the emulsifier with any entrapped penetrant in a discontinuity should be minimal in order to assure that maximum sensitivity is achieved.
- The emulsifier must be compatible with the penetrant.
- The emulsifier must readily mix with and emulsify this excess surface penetrant.
- The emulsifier mixed with the surface penetrant should be readily removable from the surface with a water spray.



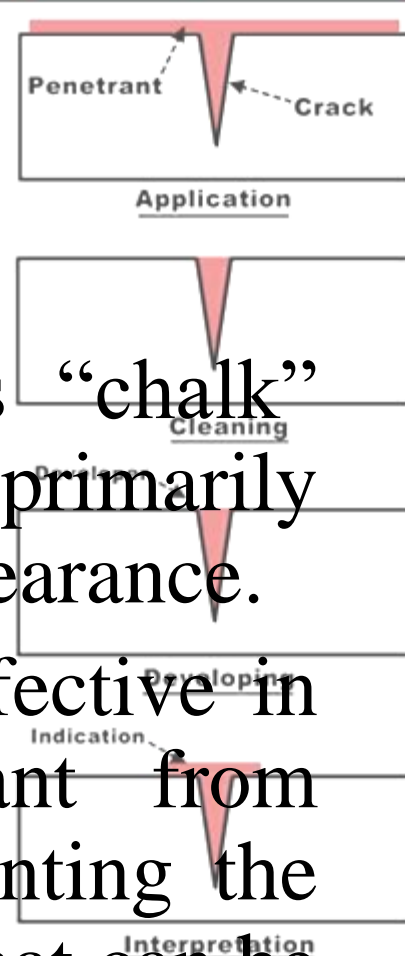
Developers:

- There are four basic types of developers:
 - Dry developer
 - Solvent-based developers, also referred to as “spirit” or nonaqueous
 - Wet developers suspended in water
 - Wet developers that are soluble in water



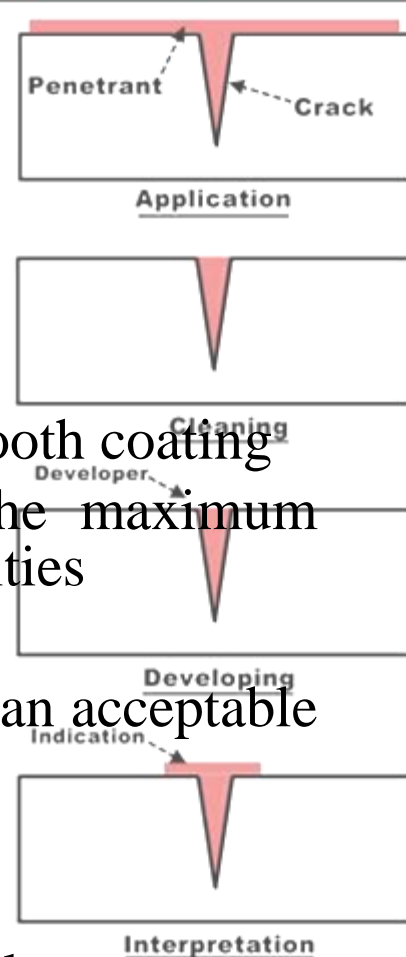
Developers:

- Developers have been described as “chalk” particles («*меловые частицы*»), primarily because of their white, chalk-like appearance.
- In order for the developers to be effective in pulling or extracting the penetrant from entrapped discontinuities, thus presenting the penetrant bleed-out as an indication that can be evaluated, they should possess certain key characteristics.



Developers:

- They should:
- Be able to uniformly cover the surface with a thin, smooth coating
- Have good absorption characteristics to promote the maximum blotting of the penetrant that is entrapped in discontinuities
- Be non fluorescent if used with fluorescent penetrants
- Provide a good contrast background that will result in an acceptable contrast ratio
- Be easily applied to the test specimen
- Be inert with respect to the test materials
- Be nontoxic and compatible with the penetrant materials
- Be easy to remove from the test specimen after the examination is complete



PART 4

PENETRANT MATERIALS

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