STRUCTURE AND CLASSIFICATION OF WATERPROOFING MATERIALS

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ABSTRACT

The internal structure or structure of waterproofing materials expresses a certain nature of the bonds and the order of adhesion of the particles from which they are formed. Coagulation structures are formed due to relatively weak forces of molecular interaction between particles - vander Waals cohesion forces acting through the interlayer of a liquid medium. Condensation structures arise during the direct interaction of particles or under the influence of chemical compounds in accordance with the valency of the contacted atoms, or under the influence of ionic and covalent bonds. Natural and most synthetic rubbers at room temperature, cellulose, polyisobutylene and some other polymers used in the manufacture of waterproofing materials have an amorphous structure. The classification of waterproofing is given.

KEYWORDS: *Waterproofing, Coagulation Structures, Amorphous Structure, Polymers, Crystallization, Condensation.*

INTRODUCTION

Waterproofing materials have two interrelated characteristics: internal structure (structure) and quality indicators (properties). The relationship is established with optimal structures, when stable bonds in them ensure the stability of the basic properties under various external and internal changes in the material in the structures. The internal structure, or structure, of waterproofing materials expresses a certain nature of the bonds and the order of adhesion of the particles from which they are formed. Their structure is characterized by chemical and physicochemical bonds between contacting particles of different degrees of dispersion. Their structure can be homogeneous and mixed. Homogeneous structures include crystallization, coagulation and condensation structures. Solids that do not have a crystallization structure are classified as amorphous. The structure does not remain unchanged. It is constantly undergoing changes, which is facilitated by the constant movement of atoms and molecules and interaction with the environment.

Crystallization structures were formed by crystallization of the solid phase and subsequent intergrowth of crystals into a strong mono- or polycrystalline aggregate. During crystallization from a solution or melt under normal conditions, an ordered arrangement of structural particles (atoms, ions, molecules) is formed in space in the form of crystal lattices. Each type of bond corresponds to its own characteristic type of crystal lattice: ionic, molecular, atomic, with hydrogen bonds. However, real crystals usually have deviations from the structure of ideal crystals: they have lattice distortions, vacancies, dislocations, impurities, and this affects the properties of materials.

Coagulation structures are formed due to relatively weak forces of molecular interaction between particles - van der Waals cohesion forces acting through the interlayers of a liquid medium. The medium forms a kind of mobile spatial grid in the structure, which is different from the rigid framework grid in crystalline structures. Due to the moving layers, materials with a coagulation structure have thixotropy, i.e., the ability to liquefy under the influence of mechanical influences (mixing, shaking, vibration, etc.) with a reversible restoration of structure and properties in the subsequent period of rest. Thixotropy, reduced strength, pronounced creep are the most characteristic properties of the coagulation structure.

Condensation structures arise during the direct interaction of particles or under the influence of chemical compounds in accordance with the valency of the contacted atoms, or under the influence of ionic and covalent bonds. Perhaps the formation of mixed structures as sets of two or three homogeneous ones, for example, crystallization-coagulation, etc. Spontaneous transition of the coagulation structure to condensation-crystallization, etc. is possible. Such changes give the substance a different strength, deformability, thixotropy, etc. Many waterproofing materials: rolled, asphalt concrete, layered concrete, mastics and others have a coagulation structure or mixed types of structures are pronounced in them, for example, at low temperatures.

Bitumen, tar, thermoplastic synthetic resins, etc. form a mobile spatial grid of structures of waterproofing materials. As a rule, they have a homogeneous structure - coagulation, amorphous, etc. Under operating conditions, the structure of these materials undergoes changes: at low temperatures, some of the components can crystallize with the formation of polydisperse organic crystals; at elevated temperatures - go into a viscous state with an amorphous structure; under the influence of aging factors, irreversible phenomena can occur in the structures and properties of the material (thinning of the interlayers, increase in brittleness and concentration of the solid phase, etc.).

The amorphous structure is characterized by the absence of crystals, the random arrangement of atoms, molecules, not oriented relative to each other. Often an amorphous structure is apparent, since a more thorough study reveals a regular arrangement of molecules in the central part of individual microcrystals. Natural and most synthetic rubbers at room temperature, cellulose, polyisobutylene and some other polymers used in the manufacture of waterproofing materials have an amorphous structure. Under certain conditions, the amorphous structure of a substance can gradually turn into a crystallization one, which is always more stable, although not always the most favorable for waterproofing materials. A certain volume in the structure is occupied by closed or communicating pores. They can be of different origin and different sizes, but in all cases, pores remain undesirable in waterproofing materials, since they reduce their water resistance. Pores and other types of leaks are usually referred to as defects in the structure of the material, since they can be stress concentrators and accumulators of an aggressive environment. Particularly dangerous are defects in the form of microcracks that can turn into macrocracks.

In the manufacture and operation of waterproofing materials, optimal and rational structures are distinguished. In the optimal structure, the components and pores are evenly distributed throughout the volume of the material, there are no or minimal defects, there is a continuous layer of binder in the form of a rigid or movable spatial grid with the smallest size of the average thickness of the liquid medium films, which, however, are not discrete. The structure has the highest packing density of solid components.

A non-optimal structure is a structure that does not satisfy at least one of the indicated mandatory criteria for optimality.

Optimal structures correspond to improved quality indicators of materials. From the structures of this type, a rational one is selected, in which the waterproofing material has a set of specified quality indicators in real production and operation conditions.

Waterproofing is classified:

1) By location:

– In space: atmospheric, underground and underwater;

– On the plane: vertical, horizontal and inclined;

- In the building structure: external, internal;

2) Purpose: anti-filtration, anti-corrosion, sealing, heat and waterproofing;

3) Device method:

– Painting;

– Plastering (coating), including shotcrete, cement, asphalt and other coatings;

– Pasting (from roll and film materials);

- Cast (spill on the surface, filling into the gap);

– Impregnation (impregnation of porous materials);

- Injection (injection into the ground, cracks, cracks);

- Filling (from hydrophobic powders and sands);

- Mounted (from sheets and profile elements);

4) Type of material:

- Cement (the main binder is cement);

– Asphalt (the content of fillers prevails);

– Bituminous (bitumen content prevails);

- Polymer cement (the main binder is a polymer);

- Polymer (plastic) from materials related to plastics and elastomers;

- Metal;

5) Designs:

– Single and multilayer;

- Reinforced and non-reinforced;

– With a protective layer and without it;

- Keyed or compensatory (reliability of waterproofing properties is ensured by changing the geometric dimensions of the seam);

– Ventilated (undercover space communicates with outside air);

6) Electrical insulation reliability:

– Normal (when the transient electrical resistance of the insulated structure is not lower than 104 Ohm•m) and reinforced (not lower than 105 Ohm•m).

Waterproofing materials differ not only in structure, but also in texture, i.e., in the orientation of the main structural components. Typical textures are layered, fibrous, granular-cemented, granular-loose, disordered and combined. Often, for the sake of simplicity, textural features are referred to as structural characteristics of a material. The composition, structure, textural features of the material, as well as the nature of the internal thermal state predetermines the main properties of waterproofing materials.

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