THEORETICAL UNDERPINNING of NEW FORMULATION WATERPROOFING AGENTS' DEVELOPMENT

It is said about the major approach fundamentals with the usage of low-energy corduroy alongside with the surface texturing characterized by multimode degree of roughness.

It is used as the basis of getting new hydrophobic mixtures (which have not been described before.)

As it has become now the practical interest is represented by high hydrophobic materials with marginal angle of water leakage > 125°. A special place among such materials is taken by super hydrophobic materials and coatings characterized by high contact angles (> 150°)and narrow-angle leaning of the surface to the horizon at which a water drop rolls (slides) off the surface.

A number of scientific publications devoted to highly-hydrophobic and super-hydrophobic surfaces, descriptions of new methods for surface textures, synthesis of new hydrophobic agents are increasing. It has become clear that this property is determined not so much by the characteristics of materials as a whole, but by the nature and ability of its barrier (boundary) layer of a few nanometers thick. It made us to take a new approach to the issue, having refused from the traditional methods for the production and evaluation of surface hydrophoby. The chemical structure and terrain feature peculiarities effects to the degree of marginal angles and angle of inclination.

The most important results on production compound methods and nanocoating with the given topology; structure and varying water-proofing have been obtained.

Resulting from some recipes given, particularly for concrete, we have obtained super hydrophobic coating on the surfaces from which at absolutely insignificant angles of inclination the droplets rolled like the pellets of mercury rolling down the glass surface. For the known reasons we could not report the data before receipt of a patent. Thus far in vitro complete surface hydrophobicity (waterproofing) has not been achieved (the contact angle with water $\theta = 180°$), and resulting from general considerations it is difficult to expect it as the contact angle of pure paraffin with water is within 106÷109°, and of a hydrophobic body itself – fluorine plastic - 112 ÷118°.

However, the nature shows us the examples of complete hydrophobicity (waterproofing), i.e. absolutely no sprinkling (the surfaces of some plants are covered with wax, and waterfowl feathers are covered with grease.) The contact wax angles with water and the contact grease angles with water are about 100 per cent. Therefore, these phenomena cannot be explained as a simple water-repellency. And it turned out that the phenomena of total water-proofing is determined by the surface roughness.

The roughness of the surface wettability of the surface causes the deviation of the measured contact angle on a smooth surface. In accordance with Ventzel-Deryagin's formulas [1,2], the contact angle of rough surface is related to the contact angle of smooth surface by the following equation:

$$\cos\theta = S/So \cdot \cos\theta o = r \cdot \cos\theta o,$$

$r = S/So$ – roughness coefficient equals the ratio of S the real surface area to the apparent surface area So.

As can be seen from this formula on the rough surface the marginal angle increases in case of hydrophobic surfaces, when $\theta o > 90°$, i.e. the value always is >1.

In the scientific literature this phenomenon is described as a heterogeneous mode of wetting on the hydrophobic surface. **From this formula turns out that at an angle of 109 ° the sufficient wetting r =3, that the contact angle of the surface was equal to 180°.**

However, a single formula cannot explain all the known facts of the complete surface waterproofing, i.e. it gives us neither the form of roughness nor the drop size of the adherent fluid. Terms and conditions of wetting depend on the geometry of the solid surface topography. Since the super hydrophobic state with heterogeneous wetting regime seems very promising, this assignment has become major in scientific and technological developments.

To get the material with large contact angles it is necessary to use the coeffect of surface roughness and its hydrophobic chemical structure. Namely by the selection of the surface texture the super waterproofing states can be achieved.

Most of the currently used methods allow getting hydrophobic materials based on disordered surface textures. In this case the process coating technological modes or surface treatments are selected in a process of a long lasting and laborious experimental work.

At the same time highly ordered and well-controlled surface roughness can be produced by means of coating composition from scientifically based dispersions and suspensions.

The process for producing super hydrophobic coatings based on apply of filling compounds with a multimodal particle size distribution was the most effective for its implementation in the production technology.

This is the main difference we obtained from known waterproofing compositions from previously published in inventors' certificates and patents. It is namely the advantage of our approach to the problem of water-repellency and direct impact on the achievement of a positive technical result.

The prospect of a process for producing super hydrophobic coatings based on the use of nanofillers with multimodal distribution of the particle size is due primarily to the relative ease of coating on large areas. Furthermore, application of composite compounds, thus can not only impart hydrophobicity to the surface texture, but also binds it to the substrate surface chemically, thereby increasing the stability of the hydrophobic coating in operating conditions.

In conclusion, it should be noted that the provision of multimodal surface roughness and mechanical strength of the used texture turned out to be the basic demands made for achieving the texture and the strongly super hydrophobic surface materials condition. This has been achieved by us.