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POLYMER MATERIALS, APPLICATION AND RESEARCH OF PROPERTIES

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Polymer materials cannot be overestimated from the point of view of practical application. Currently, there is not a single industry and sphere of human life where at least one type of polymer is not used. They are widespread mostly in the automotive, aircraft, shipbuilding and rocket engineering, medicine and pharmacology, the oil industry, the manufacture of household appliances and construction. For example, in medicine, polymers such as polyvinyl chloride (PVC) are used for manufacture of medical devices such as tubes, catheters, syringes and gloves. In the automotive industry – polymers can be used in the manufacture of automotive parts such as bumpers, fenders and panels. They provide strength and flexibility

There is such a question about polymers. Is the popularity of polymer materials really justified? Let us discuss it.

Polymer is the term used to describe large molecules consisting of repeating structural units, or monomers, connected by covalent chemical bonds. The term is derived from the Greek words: «polys» meaning «many», and «meros» meaning «parts» [1].

Mankind has been using such natural polymer materials as leather, wool, silk, cotton for a long time. Constructional materials (cement, lime, clay) are also widely used, which, when they are properly processed, they form three-dimensional polymer bodies. The first mention of synthetic polymer materials dates back to the late XIX – early XX centuries, these were polystyrene and polyvinyl chloride.

At present, from the point of view of nanotechnology, one of the most popular areas of current research and development are Polymer nanocomposites (PNC) and the research area covers a wide range of topics: nanoelectronics, polymer bionanomaterials, reinforced NNA, drug delivery systems based on nanocomposites, etc. A striking example is the material developed by Toyota. The material is a nanoglin-polyamide, the company calls it as Nylon-6, which uses layered sheets of synthetic clay with a thickness of about five atoms between layers of a nylon polymer base material. Nylon-6 has significantly higher tensile strength and resistance to deformation when it is heated. Since 2001, this has been followed by larger products such as bumpers, body panels and fuel tanks [2].

It was decided to create its own durable material using polymers and evaluate its properties. The choice fell on the research and creation of thin films.

The purpose of this work is to study the effect of the composition of the solution on the properties of thin films obtained from it.

Methods. The object of the study is a soap bubble, which is a thin multilayer film of a special solution filled with air.

Two types of solutions are used for comparison: Solution № 1: 20 % vol. surfactant, 45 % vol. water, 15 % vol. glycerin and as an additive – 20 % vol. polyvinyl alcohol (PVA). Solution № 2: 20 % vol. surfactant, 65 % vol. water, 15 % vol. glycerin.

The calculated volumes of components were added to a conical flask with glycerin and thoroughly mixed. Thin films are obtained by blowing the resulting solution using tubes on a desktop previously covered with a plastic film.

Discussion of the results. To test the strength of thin films on the surface of the desktop, 10 bubbles were inflated in a row. The number of inflated soap bubbles from the solution with the addition of PVA – 10, without additives – 7. Also, the bubble inflated on the surface of the table had to be pierced with a finger, after wetting it with the same solution. The soap bubbles were of the same size, about 10 cm in diameter. The number of soap bubbles that did not pop during piercing out of 10 attempts for a solution with an additive of PVA turned out to be 10, and for a solution without additives only 6.

To assess the elasticity, the maximum size of the soap bubble was measured, the diameter was measured 5 times. The average value of the maximum diameter for a solution with the addition of PVA is 34 cm, for a solution without additives – 37 cm.

The study of the stability or «life time» of a soap bubble was carried out on a bubble with a diameter of about 5–10 cm. The time for which the bubble burst 5 times has been determined. The average value for a solution with the addition of PVA is 316 s., and for a solution without additives – 183 s.

The number of soap bubbles during the creation of the "matryoshka" was investigated. To do this, the surface was moistened with a solution, then the tube was dipped into a soap solution along the entire length lowered into the bubble, and bubbles were inflated one by one in the other. For two solutions, this value was the same and equal to 5.

Conclusion. The most durable and stable films were obtained from a solution with the addition of PVA, elasticity slightly deteriorates. Polymers are durable materials due to their molecular structure. They consist of long chains of molecules that can be interconnected in various ways. These bonds ensure the strength and resistance of polymers to various types of loads, such as stretching, compression, bending and impact.

References

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