POLYMERS IN NUCLEAR POWER

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Products made of plastics have many applications in atomic science, generally understood as the safe use of nuclear phenomena, processes and technologies in various fields of industry, medicine, environmental protection, space science, science and defense. The basic property taken into account is most often the resistance of polymers to the effects of ionizing radiation. However, it should be remembered that radiolysis does not only lead to the degradation of chains, but in many cases also to their cross-linking. Thanks to cross-links, it is possible to achieve a radical improvement in the properties of the material. In this communication we would like to draw attention to three practical issues: ecological polymer composites constituting a barrier to ionizing radiation and H_2, radiolysis of polymers in radioactive waste storage facilities, and radiation-crosslinked electrical cables and wires. Artificial and natural polymer materials end up in radioactive waste repositories, such as used protective clothing, laboratory materials and equipment, disposable medical products, containers, packaging, documents, etc. The main gaseous product of radiolysis of hydrocarbon polymers is hydrogen. As the repository fills up, the H_2 content in the air will increase. We conducted studies on the radiolytic efficiency of hydrogen on behalf of the Los Alamos National Laboratory. The results were used in the planning and construction of an underground radioactive waste repository in Carlsbad, New Mexico. Products made of electron beam modified polyethylene have electrical properties as good as natural polyethylene, while also showing greater temperature resistance, higher resistance to oxygen, ozone, UV radiation and greater chemical resistance to acids, bases and organic solvents, including greases and oils. These products do not tend to crack under the influence of stress and liquid substances. One of the possible applications of polymer composites is shielding against photon radiation and neutrons. Polymer composites can replace lead, which is toxic and harmful to health, in many areas. The second phase of the composite uses: bismuth, tungsten, iron and barite (barium sulfate). The matrix is most often epoxies, silicones, elastomers, etc. The current topic is currently pressurized, composite tanks for storing and transporting hydrogen. A new proposal to increase their tightness is to additionally deposit a layer of SiO_2 on the inner surface using the gel-sol method. Radiation treatment allows, by inducing polymer cross-linking with ionizing radiation, to increase the performance parameters of composite materials. In the case of applying a layer of SiO_2, the influence of ionizing radiation on its properties also becomes interesting.

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