

COMPOSITE SYSTEMS BASED ON LOW-DENSITY POLYETHYLENE AND DISPERSE THERMOCATALYTICALLY MODIFIED CELLULOSE-CONTAINING WASTES

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In our previous studies, it was shown that the low-density polyethylene (LDPE)-based composites filled with disperse microcrystalline cellulose Thermocel are characterized by an increased elastic modulus and tensile strength. Thermocel was obtained from wood bleached sulphate pulp using a thermocatalytic method.

In the present work, thermocatalytically modified industrial cellulose-containing wastes such as newsprint waste paper, pine sawdust and cotton residues are used for the formation of composite systems.

The thermocatalytic processing conditions of the above-mentioned wastes which provided a sufficiently effective powder-like product are established. These conditions are determined by the origin of the raw material and particle shape. In the case of sulphate pulp, the necessary content of a catalyst, hydrochloric acid, is 0.05% and the necessary impregnation time is about 15 min, whereas, in the case of cotton residues, these parameters are 0.25% and 30 min, respectively. This is connected with the large length of fibres, an increased degree of polymerization of cotton cellulose as well as with the presence of wax and fatty substances. The latter inhibits the catalyst access to the pulp. For all the disperse products obtained from unlike raw materials, the sizes of particles are practically the same. The largest Thermocel particles are obtained by chemical modification of cotton residues, some of them reach 170 μm . In the case of pine sawdust, approx. 90% of particles have sizes from 3 to 20 μm . In the case of sulphate pulp and newsprint waste paper, approx. 60% of particles have sizes from 10 to 40 μm .

For LDPE filled with Thermocel obtained from various raw materials, an increase in the filler content results in an increase in the elastic modulus and a decrease in the relative elongation, whereas is an initial decrease in the tensile strength and in its further growth when the filler content exceeds 30%. The highest increase in the tensile strength is observed for composites filled with Thermocel obtained from newsprint waste paper. For the filler content of 55%, its value exceeds the tensile strength of polyethylene and the LDPE-sulphate pulp Thermocel (filling degree 70%) 1.25 and 1.1 times, respectively.

The possibilities of industrial processing of these composites were also studied. It was elucidated that the composites with a filling degree of up to 55% can be processed into articles with complicated configuration by injection moulding.

The results obtained testify that the thermocatalytic method of Thermocel production can be regarded as a potential industrial method for the modification of different cellulose-containing waste products, with the object of expanding and unifying the environmentally friendly class of fillers applicable to the production of thermoplastic composites.