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PRODUCTION OF ADHESION ADDITIVE FOR ROAD BITUMENS THROUGH THE RECYCLING OF SECONDARY POLYETHYLENE TEREPHTHALATE (PET)

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The study investigates the feasibility of using secondary polyethylene terephthalate (PET) as a raw material for producing an effective adhesion additive for road bitumen's. The expediency of physicochemical activation of PET with phenol is substantiated in order to improve its compatibility with the bitumen matrix and intensify interfacial interactions. It has been established that the interaction of PET with phenol is accompanied by adsorption, diffusion, swelling, and a decrease in the polymer crystallinity, leading to the formation of a gel-like structure with increased reactivity due to the formation of polar functional groups (–OH, –COOH, –COOPh). The application of additional mechanical activation under intense mechanical loading ensures effective destruction of the polymer framework, formation of active radicals, and increased permeability for phenol. In addition, mechanically activated PET can be used either as an independent adhesion additive or in combination with phenol-activated PET.

It is shown that the introduction of the obtained PET/phenol additive into bitumen is accompanied by a complex of interrelated physicochemical processes, including wetting, diffusion of maltene components, swelling of the polymer phase, adsorption of polar bitumen compounds, and the formation of intermolecular interactions. It has been established that, as a result of modification, structural rearrangement of bitumen occurs, manifested by a change in the ratio between the dispersed and dispersion phases and the formation of a spatially organized system with uniformly distributed swollen polymer particles. The presence of polar functional groups in the additive promotes the formation of hydrogen bonds, π–π interactions, and donor–acceptor complexes, thereby enhancing the adhesion of bitumen to the surface of mineral aggregates.

The proposed structural scheme of the modification process ensures the effective implementation of all stages of production and application of the adhesion additive based on secondary PET and can be adapted to industrial conditions. The obtained results demonstrate the prospects of using waste PET as a bitumen modifier and contribute to addressing environmental issues associated with the utilization of hazardous polymer waste.

Keywords: polyethylene terephthalate; bitumen modification; adhesion additive; wastewater; phenol; activation; microheterogeneous structure.

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