Cold Hardening Epoxy Matrixes Modification by Carbon and Silicate Nanomaterials

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One of the actual issues of Russian gas- and oil-production complex is the development of high-performance polymer composites for efficient repair of ground and underwater gas and oil pipelines sections with interruption-free piping process. The leading position of in this area belongs to OAO NPO STEKLOPLASTIK which developed and keeps improving the cold hardening compositions applied as the base for glue and repair compositions.

Polymer matrixes based on epoxy resins have the highest strength and adhesion factors but their properties are far from the required for full enabling matrix characteristics. It is considered that conventional approaches to their structure optimization are almost s exhaust. However, cold hardening composition operating characteristics can be improved by nanodiamond micromodification of epoxy matrixes. Therefore the researches on carbon and silicate nanomodifier (NM) influence on physical-mechanical, adhesion and technological properties of these compositions are promising and interesting in terms of science and practice.

Fullerene C_{60} – one of the main representatives of ordered carbon forms and two types of carbon nanomaterials with disordered structure, namely ultradispersed diamonds (UDA) and diamond-carbon soot (UDAG) were used as the carbon NM in this work. Fullerene C_{60} was synthesized by electric-arc method but UDA and UDAG was originated from «dry» detonation developed at FSUE FRPC ALTAI. Silicate NM served organobentonite based on montmorillonite clay.

The influence of chemical and physical conditions on the hardening compositions preparation was studied to optimize the methods of NM homogeneous distribution in epoxy matrix and prevent their agglomeration. NM solubility in epoxy composite components and basicity of oxygen and nitrogen atoms contained in epoxyamine compositions defined solvation and reactive properties of respective compositions were considered as the chemical conditions. The physical conditions included intensity, ultrasonic processing time and changes in composition viscosity after NM introduction.

It is found that due to NM the adhesion strength increases significantly (up to 35%), the compression strength increases up to ~ 25%, composition hardening rate increases twofold but the initial viscosity shows a decrease.

The obtained results assumed as basis for development of polymer compositions used for repair of underwater gas- and oil-pipelines.