INFLUENCE OF CLIMATE ON POLYMER AND COMPOSITE MATERIALS FAILURE

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Trouble-proof and long operating life under any climatic conditions are the main demands to modern equipment. That is why, the quality and reliability of construction materials are of great importance. Among those polymer and composite materials play a particular role because their operational characteristics significantly depend on climatic factors and duration of their influence. Solar radiation, moisture, temperature and air oxygen are usually considered to be the basic factors of weather conditions. Microbiological media, ozone and matters polyting enviroment, such as salts, oxides, soot etc., are refferred to additional ones. Maximum temperature of black body in the sun in tropic does not exceed 100°C. Polymer thermodestruction has not been observed at such temperatures. But temperature influence may result in thermal oxidative destruction and above-molecular structure change causing the alterations of polymer materials strength-deformation characteristics. Breaking of the polymer chain main connection (photo-and photo-oxidative destruction) and additional heating by the radiation are the results of solar irradiation. Because of penetrating radiation low ability maximum destruction has been observed in the surface layer. In the zone of cold climate at the temperature of -40°-60°C (1) this process penetrates deeper at the expense of free radicals concentration increase causing sharp decrease of polymer molecular mass in the surface layer and and cracking of the latter. As a result of critical fractures formation in the surface layer observed is brittle failure of entire material. Extreme daily fluctuations of air and product temperature in the zone of cold climate lead to the formation and accumulation of thermal stresses accelerating the process of material fracturing and its brittleness. Air temperature transition over 0°C taking place twice a day in spring and in autumn is accompanied by the moisture sorption and desorption, its freezing and thawing. As a result of sorbate moisture crystallization effects, observed is an increase of micro-and macro voids in polymer composite materials. This process intensifies porosity causing swelling of specimens' surface, fracturing of binding and denudation of reinforced plastics glass fiber. Besides, moisture can be the reason of hydrolitic destruction, plastisization and antyplastisization. Also, material operational cha-

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racteristics can be changed by it in actual atmospheric conditions at the expense of reversible processes which influence upon the material as the irriversible ones. At low temperatures being peculiar for the zone of cold climate ($-65^{\circ}...-71^{\circ}C$), polymeric materials have failed even under the action of static loads. That is why, temperature of brittleness is an important characteristic for polymer and composite materials in the zone of cold climate. This temperature is considerably dependent on the relaxation processes occurring in the glassy polymers. It is shown that all the processes described above are subjected to exponential relationship. On its basis the period of material preservation is determined by the formular: $$t_{xp} = t_2 + (t_3 - t_2) \ln \frac{\alpha(t_2)}{\alpha_K} / \ln \frac{\alpha(t_2)}{\alpha(t_3)}$$

SYMBOLS USED

$\alpha(t) = \frac{x(t) - x_K}{x_0 - x_K}$ = relative index of climatic stability

t_2 , t_3 = arbitrary time of exposition in atmospheric conditions

α_K = index of reliability

$x_0, x(t), x_K$ = initial, current and critical value material peculiar characteristic

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