To eliminate the effect of the scatter of properties of individual specimens on the investigation of kinetics of the diagram of cyclic deformation under the influence of irradiation, an experiment on one specimen was carried out. To start with, the specimen was tested outside the reactor (in a furnace) until the stabilized deformation diagram was obtained. Then the specimen was tested in the reactor after it had been cooled and held unloaded for about 1 day. As the integral irradiation dose increased, once a day (during the entire reactor campaign) the specimen was deformed at the same temperature and with the same plastic deformation amplitude until a stabilized hysteresis loop was obtained. We observed a gradual increase in the maximum half-cycle stress which, after 9 effective days of irradiation, was 16% higher than that recorded for the material in its initial state (Fig. 2).

Thus, the resistance of alloys of the 0Kh16N15M3B type to elastoplastic deformation under conditions of cyclic alternating shear at 650°C is increased under the influence of reactor radiation.

LITERATURE CITED

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STRENGTH OF MATERIALS UNDER COMPLEX STRESS WITH LOCAL DYNAMIC LOADING

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One of the least investigated features of the performance of materials under a complex load is their fracture caused by local dynamic interaction with liquid and solid particles. This type of loading is frequently observed in engineering where it restricts the development in many fields. Examples of such loading are the erosive effect of solid and liquid particles on turbine blades, and the impact of rain and dust particles on helicopter blades, compressor blades of air-jet engines, and surfaces of aircraft. Parts of power generation plants become damaged by liquid streamlines generated during the collapse of cavitation cavities. All kinds of material are subjected to this type of damage. Equally diverse are the active media; water, metals, organic liquids, solid soil particles, unburnt fuels, etc.

Restricting ourselves only to the consideration of reasons of interaction between materials and liquid particles and excluding (e.g., by selecting suitable materials) intense chemical, thermal, electrical, and other additional types of action, it is possible to describe the features of loading and of the stressed condition of the material taking into account the particle speed, the curvature of its impact on the surface, and the properties of liquid and material.

Fig. 1. Stress system in the surface layer of material at the contact spot with liquid particles ($\sigma_R$, $\sigma_\theta$, $\sigma_z$ are the radial, tangential, and normal stresses in the contact spot; $\sigma_R^1$, $\sigma_\theta^1$, and $\sigma_z^1$, $\sigma_\theta^1$ are the radial and tangential stresses produced by the Rayleigh wave and the longitudinal wave, respectively).

Fig. 2. Testing device for the investigation of the local dynamic strength section of materials in a flow of finely dispersed liquid particles: 1, 8) valves; 2, 10) filters; 3) steam cooler section; 4) nozzle; 5) working channel; 6) specimen; 7) diffusor; 9, 11, 12) cocks; 13, 14) rotameters; 15) measuring disc; 16) contact pressure gauge; 17) mechanized value; 18) starter unit.

Figure 1 shows that in a three-dimensional stress system a contact spot between a particle and solid obstacles is formed which is surrounded by a biaxial system of stress waves [1]. The action of liquid particles on the obstacle can be represented, as a first approximation, by a uniform pressure $p$ acting on the contact spot whose radius $r$ changes in time proportionally to $\sqrt{t}$; in a nondimensional form it takes the shape

$$R = r \frac{C_1}{r_0V},$$

where $r_0$ is the radius of curvature of the particle at the point of impact on the obstacle; $C_1$, longitudinal wave propagation speed in the obstacle material; $V$, particle impact velocity on the obstacle.

The duration of loading is only a few microseconds and it produces in the surface layer of the material a tension-compression stress pulse spreading from the impact center with a Rayleigh wave (surface wave). This was shown theoretically in [2] and experimentally by the dynamic photoelasticity method in [3].

Since in most cases the action is of fatigue type, it is determined by the ratio of size to speed of particles randomly colliding with the material surface [4]. An analysis of this type of loading provides a number of its fundamental features:

- a dynamic wave-type stress determines the exposure by the material of the properties responsible for its dynamic strength;

Fig. 3. (a) Development of damage as a function of the stress system and (b) schematic diagram showing the application of additional stresses: 1) additional tensile stress (I); 2) additional compressive stress (II); 3) no additional stress.