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# INFLUENCE OF REPEATED LOADING ON THE EFFICIENCY OF ELECTRODYNAMIC TREATMENT OF ALUMINIUM ALLOY AMg6 AND ITS WELDED JOINTS

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The mechanism of reduction of preliminary stresses in repeated loading and electrodynamic treatment of AMg6 alloy and its welded joints were investigated on the basis of the developed procedure. It was established that the history of loading of AMg6 alloy has no substantial effect on relaxation characteristics of metal subjected to repeated impact by current pulses.

**Keywords:** *aluminium alloy, welded joint, residual stress, electric current pulse, electrodynamic treatment, efficiency of treatment, relative yield strength, tensile strength*

During service of welded structures of aluminium-magnesium alloys operating under conditions of influence of pulse electric and magnetic fields, the residual stresses causing fracture of single elements can arise at certain conditions. The beginning of plastic flow of metal begins at values of working stresses below the relative yield strength [1–3].

Since the end of the last century a number of domestic and foreign scientific organizations conduct research works on optimization of structure and properties of structural materials and welded joints using their treatment by pulse electromagnetic fields. It was established that pulse influence of current on metals and alloys affects the fatigue resistance, static strength and other mechanical characteristics [4]. At the same time the data of work [3] evidence negative role of electromagnetic effect on the strength of metals and alloys.

One of the methods of electric current impact on the metals is electrodynamic treatment (EDT) based on initiating of electrodynamic forces in the material, which are formed during passing of electric charge through the current conducting material [5]. While summing them with outer loadings, applied to the structure being treated, the local fields of plastic yielding of metal arise in the zone of current impact [6].

During investigation of EDT influence on aluminium alloys and low-carbon steels the main attention was paid on studying mechanism of stress state relaxation [7–9] and evolution of structure of base metal and welded joint [10]. It should be noted that questions about changing strength characteristics of welded joints under the impact of energy of current charges initiated by EDT practically were not studied. At the same time in the works [3, 4] different opinions about influence of pulse electromagnetic fields on the strength of structural materials are given. Besides

there are no data in modern literature about the effect of repeated loading on relaxation of stresses in metal at electromagnetic effects.

The purpose of this work is investigation of influence of EDT on mechanical properties of aluminium alloy AMg6 and its welded joints at uniaxial tension as well as on relaxation of stresses at repeated loading of metal.

The EDT of specimens of base metal and welded joints of annealed aluminium alloy AMg6 of 4 mm thickness with a size of 110 × 30 mm working area loaded by uniaxial tension at the speed of 0.1 mm/s were carried out. Three levels of tensile loadings were preset: at the low elastic stresses of 52–60 MPa; at the stresses of 116–147 MPa close to elasticity limit of AMg6 alloy (which approximately correlates with the level of residual welding stresses in the alloy being investigated); at the stresses beyond elasticity limit. The tension in elastic-plastic zone was brought to 260–280 MPa, i.e. till generating Portevin–Le Chatelier effect which is manifested in the discontinuous yielding of metal in the zone of prefracture [11].

EDT was performed using laboratory machine, the description of which is given in the work [9]. EDT of specimens after tension was performed using contact of working electrode with a surface of a metal according to the scheme presented in [7]. The specimens were subjected to tension till generating stresses of preset value in them and treated with a series of current discharges, after each pulse the drop of tensile force in the material was controlled. The EDT was conducted at the energy of current discharge  $E = 140, 300$  and  $800$  J.

After termination of EDT, the 50 % of investigated specimens were subjected to fracture and remained part was again subjected to tension and treatment under similar conditions to determine influence of repeated cycle of EDT on stress relaxation.

The changes of mechanical properties of AMg6 alloy and its welded joints at different levels of loading