Electroslag Processing of High-Temperature Alloy Shavings

Nowadays, waste recycling is of great importance for saving material and energy resources. Among the secondary metal raw materials, a separate place is occupied by waste in the form of shavings. Shavings accumulation is pretty big, and its processing is difficult, due to low bulk density, oxidation, contamination with residues of lubricating-cooling liquid and non-metallic impurities.\(^1\)

From the point of view of returning to production, shavings of high-alloy steels and alloys that contain expensive alloying elements are of particular interest. In mechanical engineering, for the manufacture of various parts of gas turbines, heat-resistant nickel-based alloys CrNi70WMoTiAlV and CrNi75MoNbTiAl are used. In spite of nickel (70–77%), the composition of these alloys contains a significant amount of chromium (up to 22%), as well as expensive alloying materials such as tungsten, molybdenum, vanadium and niobium. Therefore, the problem of processing the shavings of these alloys with minimal losses is very urgent.

For processing in widespread arc and induction furnaces, the shavings must be briquetted in order to avoid significant waste losses and to facilitate melting conditions. Due to its high strength, it is difficult to obtain high-quality briquettes from the shavings of heat-resistant alloys by cold pressing. Therefore, electroslag melting can be more effective for processing such non-briquetted shavings, as shown in a number of works.\(^2\)–\(^4\) Taking into account the relatively low carbon content, in the CrNi75MoNbTiAl (up to 0.10%) and the CrNi70WMoTiAlV (up to 0.16%) alloys, most preferable is the variant of melting in an electroslag crucible furnace (ESCM) of a consumable metal electrode of a specific alloy with simultaneous supply of shavings of the same composition.\(^5\)

Experimental

In order to clarify technical and economic indicators and possibilities of heat-resistant alloy shavings processing by the ESCM method, experimental melts were carried out. Due to the absence of lumpy waste, initially consumable metal electrodes, which are necessary for electroslag process, were obtained by remelting shavings in an induction furnace. By such remelting, cast

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**Figure 1**

Scheme of joint electroslag crucible melting of shavings and a consumable electrode: (1) refractory brick; (2) liquid metal pool; (3) liquid slag pool; (4) consumable metal electrode; (5) shavings; (6) power supply.