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RESEARCH OF DEFORMATION CHARACTER FOR RETORTS OF APPARATUSES WITH CYCLE REMOVAL 7 T AT TITANIUM PRODUCTION

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There are presented the results of observations on character of the deformation for retort apparatus by capacity 7 t/cycle output of titanium sponge. It is carried out comparison of the profiles deformation of the walls of retort apparatus with cycle output at 7 and 3 tons. There are made conclusions about deadline for the time limit service the basic reasons for the withdrawal from exploitation retort operation, and also some options for increase of the service life.

Key words: titanium sponge production, control retort, heavy-load apparatus, cycle output.

In modern chloric metallurgy of titanium renewal of titanium tetrachloride in fusion of magnesium at temperatures 750…870 °C and surplus pressure of rare gas 0.02…0.03 MPa with subsequent vacuum separation of the got reactionary mass is used widely. Processes conduct in the impermeable apparatuses (reactors) of cylindrical form. Retorts are exploited by cycles, repeatedly participating in a technological process, and the conditions of its work are characterized by plenty of heatshifts with the overfills of temperatures from 25 to 1030 °C, by influence of aggressive environments (fusions of magnesium and chloride of magnesium, steams of titanium tetrachloride) and mechanical loading. In these connection questions of reliability, emergency danger and determination of optimal time limit for retort, as a basic piece of changeable equipment, at the production of spongy titanium are actual.

During three years, since the moment of starting of production titanium spongy in the metallurgical shop of OAS «Solikamsk magnesium plant» was executed by the continuous watching the state of retorts for apparatuses 7 t/cycle with the estimation of original appearance and character of deformation. There are estimated sight original appearance outward and inside surfaces of retorts, the defects of metal are fixed, technology of conduct for processes of renewal and vacuum separation is watched. Additionally to it after ten, fourteen, eighteen and every subsequent cycle control of wall thickness of shell ring and bottoms of retorts with the help the UT-301 reflectogauge are produced.

From long-term experience of exploitation of similar equipment is known [1,2], that the overhead belt of retort is tested the most thermal and mechanical loading. On this basis, the most of measuring of external retort diameters was executed on the area of shell ring, located in a direct closeness from flange of retort.

Equations for dependence of external diameters of retorts from the quantity of cycles were worked out:

$$D_{200} = -2{,}255n + 1767{,}658\ ; \quad (1)$$

$$D_{400} = -3{,}2`7n + 1771{,}865\ ; \quad (2)$$

$$D_{600} = -2{,}936n + 1769{,}951\ , \quad (3)$$

where D_{200}, D_{400}, D_{600} are a size of outward diameter of retort, a lower index specifies distance from flange of retort, mm; n is an quantity of cycles; a coefficient before the value of *n* is characterized speed of decrease of retort diameter on the average for one industrial cycle, mm.

It is educed, that on all retorts character of deformation for shell ring of coincide, there is observed extraction of wall of the overhead shell ring with a bend in the internal volume of retort and loss of primary form. The most intensive deformation of wall retorts is observed in a section, located in the distance a 400 mm from flange. Here speed of decrease of outward diameter for retort is most high and makes a 3,217 mm for a cycle. It is thus set that noticeable changes in geometry of the overhead shell ring are looked over already after a fifth cycle.

On results measuring the size of middle loss for wall thickness of retort for one industrial cycle was expected:

- in points 1,2 in the distance a 400 mm from flange are a 0,142 mm/cycle;
- in points 3,4 in the distance a 600 mm from flange are a 0,190 mm/cycle;
- in points 5-7 on an elliptic bottom are a 0,266 mm/cycle.

It is certain that the most wear of wall thickness for a cycle is observed on the elliptic bottom of retorts from corrosion in the magnesium chloride at a temperature 800…850 °C and processes erosions which take place at the plum of magnesium chloride from the apparatuses of renewal.

During exploitation there are determined maximum time limits of employment of retorts, and also most critical factor of wear on which most often produced rejection of retorts. It is set that the most widespread reasons of output of retorts from exploitation are spelling of the weld-leads and considerable deformation with the loss of rounded of shell ring. Presence one or two these defects observed after 18-19 industrial cycles on all retorts without an exception. Thus, the first type of defects is a presence of cracks in the weld-leads, is removed. For the correction of defects of the weld-leads of retorts the complex of repair-and-renewal measures was worked out, after realization of which possibility repeatedly to enter retorts in work. During further exploitation of retorts not a single case of destruction or spelling of the repair weld-leads was fixed. The second type of defects is decrease of retorts in a diameter with the loss of rounded of shell ring - it is possible to attribute to irremovable. It is certain that narrowing of shell ring in it overhead part near water-cooled flange of retort, at a size a more than 60…65 mm, frequently accompanied by wedging of blocks of spongy titanium during extraction on a horizontal press.

The researches [3] are shown that executed comparison of retorts heavy and small apparatuses. For apparatuses 7 and 3 tons/cycle distribution of retorts on reasons of rejection and character deformations are different. According to data of statistics, 62 % from the general quantity of retorts for small apparatuses are rejected by reason of shell ring lengthening, while at seven tones retorts lengthening is

insignificant and for 20 cycles of exploitation averages about 1 %, at length of retort 4300 mm.

During watching to the retorts of heavy lead apparatuses maximum time of service, which is equal to 22 cycles, was certain. The type of wall for seven tons retort has the less expressed signs of deformation, goffers and dents, characterized for the retort wall of small apparatus absent. At the same time there are general for that and other retort feature of deformation: losses of rounded of shell ring and maximal wall wear, located at the level of area of blowing in the furnace of renewal.

Development of measures on the increase of maximum time of service for retorts of heavy lead apparatuses must be sent to reduction of deformation of the overhead shell ring.

Conclusion. For period of industrial tests for retorts (from 2008 to 2011) the cases of violation of impermeability of apparatus are not fixed by reason of wall burnout or weld-leads of retort. The insignificant lengthening of shell ring of retorts is fixed, which does not exceed 1 % length of retort and does not have influence on technology of conduct of processes for renewal and vacuum separation. The most critical section is located at the distance a 200…400 mm from flange of retort, where speed of decrease for outward diameter of retort arrives at a 3,217 mm for a cycle, that in future serves as an obstacle at extraction of blocks of spongy titanium. The most wear of wall thickness for a cycle is observed on the elliptic bottom of retorts and makes a 0,266 mm/cycle.

During the carried out work maximum time of service for retorts is certain, repair-and-renewal measures are worked out on the removal of spelling of the weld-leads. The increase of maximum time of service for retorts can be attained by the decline of deformation speeds in a critical section, and also by means of geometry change for retorts and transition from the cylindrical to the conical form of shell ring.

LIST OF LITERATURE

1. Титан [Текст] / В. А. Гармата, А. Н. Петрунько, Н. В. Галицкий и др. – М. : Металлургия, 1983. – 559 с. – Библиография в конце каждого раздела.
2. Сергеев, В. В. Металлургия титана [Текст] / В. В. Сергеев, А. Б. Безукладников, В. М. Мальшин. – 2-е изд. перераб. и доп. – М. : Металлургия, 1971. – 320 с. – Библиография в конце каждого раздела.
3. Мальшин, В. М. Конструктивные особенности аппаратов для получения губчатого титана [Текст] / В. М. Мальшин, А. Н. Павлюченко, А. Е. Андреев // Металлургия и химия титана : научные труды Института титана. – Запорожье, 1976. – С. 6-12.