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ОПТИЧЕСКИЙ КОНТРОЛЬ ГЕОМЕТРИЧЕСКИХ РАЗМЕРОВ ТОКОПОДВОДЯЩИХ АНОДНЫХ ШТЫРЕЙ НА ЭЛЕКТРОЛИЗЕРАХ СОДЕРБЕРГА

Аннотация: *данная работа направлена на рассмотрение проблемы изнашивания токопроводящих анодных штырей на электролизерах содерберга с высотным течением. Проанализирована задача автоматического контроля геометрических размеров токопроводящих анодных штырей. Определен и рассмотрен возможный метод контроля геометрических размеров штырей.*

Ключевые слова: *электролиз глинозема, оптический контроль, компьютерные наблюдения, компьютеризированная система проверки токоподводящих анодных штырей.*

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OPTICAL CHECKING OF GEOMETRICAL DIMENSIONS OF CURRENT-CARRYING ANODE PINS ON SODERBERG ELECTROLYSERS

Abstract: *this work addresses to the problem of wear-out of current-carrying anode pins of Soderberg electrolysers with an upper current supply. A task of automated checking of geometry of the current-carrying anode pin is analyzed. A possible method of checking of geometrical pin parameters is determined and described.*

Keywords: *electrolysis of alumina, optical checking, computer vision, computer-aided testing of current-carrying pins.*

At the moment in Russia (*IC RUSAL*) more than 50% of the primary aluminium is produced on Soderberg electrolysers with an upper current supply. These electrolysers with self-baking anode are used for more than 60 years. These electrolysers have a high specific energy consumption, also there is an acute problem of ecological safety of the production.

In Soderberg electrolysers the current supply from the anode busbar to the anode body is performed from above by the current-carrying pins, which at the same time are bearing elements that keep the anode in the suspended state. Current-carrying anode pin Ø140 mm consists of an anode bus and a steel bar. The bar is made from rolled steel, in the upper part it has a cylindrical shape that becomes conoidal in the lower part.

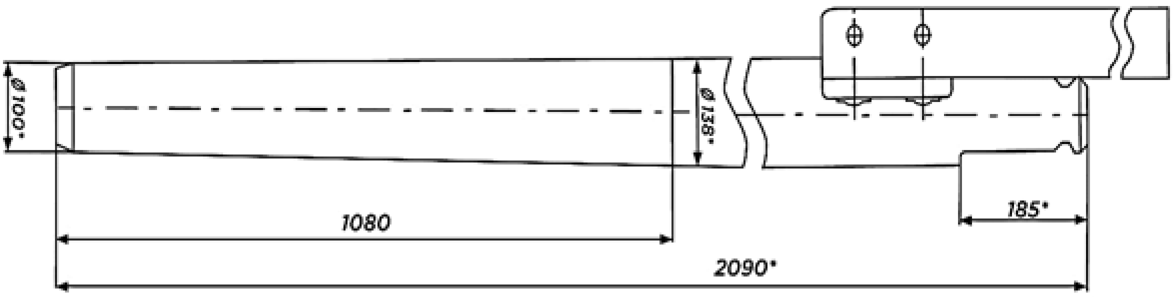

Fig. 1. Bimetallic current-carrying pin

During operation the pins suffer different changes of geometrical forms and sizes (length reduction, change of the end). These changes occur first of all due to the active corrosion, as a result of the steel and anode mass interaction at high temperature.

Current distribution in the anode is changed due to the pin wear, it leads to the decrease of the process efficiency because the main losses of voltage occur on the way of the current passage «anode pin – anode face» [1]. At that the change of the pin geometry affects negatively on the accuracy of the horizon alignment, which in turn can lead to a wrong current distribution. In the research works of different researchers [3] it is stated that if a size of one anode pin is changed to the lower limit, then effect on the cone forming becomes negative, it leads to an increase of the anode layering, forming of hills-and-hollows on the anode face, nonuniform combustion. In works [3–4] it is pointed out that the geometry of the anode pin is a key factor for the anode layering.

During the use of the self-baking anodes the stud pulling for a specific horizon on electrolyser with the help of a potroom crane is required. To do that stud-pulling cranes with programmed numerical control (PNC) are used, they allow to automate the process of pin replacement. The PNC system ensures accuracy of the positioning mechanism for the pin ejecting, ±5mm, but instability of external factors, and first of all of size changes of the pin, do not allow to ensure the required accuracy of the pin positioning as per the cone baking [2].

At present in the industry (*KrAZ, BrAZ*) checking of the pin condition is done periodically with the help of control templates manually, according to its results reject of worn-out pins is performed. This method of checking does not solve a task of ensuring positioning the pins to a set horizon with a required accuracy.

Solving this task is possible by using the system of optical checking of anode pins geometrical parameters. On the basis of the requirements this system must be placed on the stud-pulling crane, and the information received from the control system will serve as the basis for defining suitability of the pin, and defining the stick-out distance from the grasping rake, and to align it with the set horizon. The required data about the geometrical sizes are taken according to the product image [5]. The image must transfer the information about the size in such a way that ensures its reading with a set accuracy according to the pattern. A set of conditions must be observed: contrast selection of pixels on the image, fixation of the relative position of the object and measuring system, keeping the conditions of transferring the information when changing the measuring object.

The use of the proposed checking system will allow to improve the energy efficiency of the alumna production due to more precise placing the pins on the set horizons, it will improve the current distribution in the anode, and decrease the loss of voltage on a separate electrolyser.

References

1. Mintsis M.Y. Aluminum electrometallurgy / M.Y. Mintsis, P.V. Polyakov, G.A. Sirazutdinov. – Novosibirsk: Nauka, 2001. – 368 p.

2. Manual for the metal-maker of the non-iron metal. Aluminum smelting / Under the edit. of Y.V. Baimakov, Y.E. Kontorovich. – M.: Metallurgy, 1971. – 560 p.

3. Mintsis M.Y. Current distribution in the aluminium electrolyser / SibSRU. – Novokuznetsk, 2002. – 126 p.

4. Begunov A.I. About the strategy of aluminium industry development // Non-iron metals. – 2004. – №3. – P. 62–62.

5. Zabolotskiy A.D. Automated methods of checking the linear dimensions of the fiber optic items. Analytical review for 1970–1981 – №2959 CRDE of information / A.D. Zabolotskiy [and others]. – 1982. – P. 75.

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