REVIEW

by the foreign scientific consultant, T.A. Ryspaev, Dr.Sc. (Eng.), scientifically Director of the Zoz GmbH, Wenden, Germany, on the doctoral dissertation by Almat A. Kamenov, titled "Research of the properties of cast iron used for pouring anodes in aluminum electrolysis production", submitted for the degree of Doctor of Philosophy (PhD) in Metallurgy (8D07201)

The dissertation by Almat Aitasovich Kamenov addresses a relevant and critical problem for the global aluminum industry: improving the energy efficiency of the electrolysis process by optimizing the properties and design of the anode assembly. In the context of the global imperative to reduce industrial energy consumption and carbon footprint, this research holds significant scientific and practical value.

A key strength of this work is its comprehensive approach to problem-solving. The author has not limited his study to a single aspect but has proposed a holistic solution that encompasses both the development of a cast iron with an optimized chemical composition and the refinement of the anode assembly design itself.

The dissertation presents a thorough analysis of the significant energy losses stemming from high contact resistance at the "steel stub – cast iron seal – carbon anode" interface. The author has theoretically grounded and experimentally developed an integrated technology for refining industrial cast iron using steelmaking slag and lime. This technology enables the effective reduction of harmful impurities, specifically lowering phosphorus content to <0.18% and sulfur to <0.06%. This, in turn, leads to the elimination of the continuous phosphide eutectic network within the alloy's structure, which is the primary reason of the electrical resistivity reduction.

Particularly noteworthy is the novel and patented anode stub hole design featuring trapezoidal protrusions. This solution exemplifies an effective engineering approach where geometric modifications simultaneously achieve two objectives: enhancing energy efficiency by increasing the electrical contact area and improving manufacturability by creating stress concentrators that facilitate the removal of the cast iron seal with less force.

All theoretical principles and calculations, including thermodynamic modeling, are substantiated by extensive laboratory and pilot-scale industrial testing, underscoring the high reliability of the obtained results. The economic analysis reveals a significant potential impact from the implementation of the proposed solutions, with a projected payback period of 4.5 months.

The primary scientific findings of this dissertation are published in four articles, including one in a peer-reviewed journal indexed in the Scopus database (35 percentile) and three in journals recommended by the authorized national committee in the Republic of Kazakhstan. The novelty and practical applicability of the research are further confirmed by three patents from the Republic of Kazakhstan for an invention and utility models.

The dissertation by A.A. Kamenov constitutes a complete and rigorous scientific work, conducted at a high scholarly level. The research findings possess

clear scientific novelty and hold practical interest for enterprises across the aluminum industry.

In my professional opinion, the dissertation by Almat Aitasovich Kamenov, "Research of the properties of cast iron used for pouring anodes in aluminum electrolysis production" fully satisfies the requirements for the degree of Doctor of Philosophy (PhD), and the author is deserving of the degree in the field of Metallurgy (8D07201).

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