

Korneev Dmitriy

Implementation of technical solutions to reduce the content of non-metallic
inclusions in aluminum alloys of 6XXX series

ABSTRACT

Dissertation for acquisition of
master's degree in the direction of Metallurgy (April 22, 2002)
master's program - "Process management in foundry technologies" 22.04.02.08

Krasnoyarsk 2017

The Master's dissertation was created at the Department of Metal Processing by the Institute of Non-Ferrous Metals and Materials Science of the Federal State Autonomous Educational Institution of Higher Education "Siberian Federal University"

Scientific adviser:

Sanacheva G.S, candidate of technical sciences, associate professor

Reviewer:

Rotar V.V. - Director of the Quality Assurance Department, RUSAL ETC

Defense of the Master's dissertation will be held on June 27, 2017 at 10:00 in the Siberian Federal University at the address:

660025, Krasnoyarsk, Krasnoyarskiy rabochiy prospect, 95, aud. 348.

With the author's abstract of the Master's dissertation can be found on the SFU website

<http://edu.sfu-kras.ru/engineering> and in the open access archive: <http://elib.sfu-kras.ru>

The head of the master's program:

Candidate of Technical Sciences, assistant professor

V.N. Baranov

INTRODUCTION

Today aluminum is used in the construction of high-rise buildings and skyscrapers - just imagine how much they would weigh when using, for example, steel, what depth the foundation would have to lay and how much it would have increased the cost of the entire building! The small weight of aluminum drawbridges reduces the weight of their mechanical part, minimizes counterweights and gives more room for the imagination of architects. In addition, with lightweight designs it is easier, more convenient and faster to operate.

Most often in construction, aluminum billets of flat and cylindrical shapes are used, which as a result of processing are converted into suspended ceilings, windows, doors, stairs, wall panels, roofing sheets and not only.

Alloys of the 6xxx series in the form of billets are excellent for extrusion, which opens a huge space for the manufacture of the most complex architectural forms.

Given the 100% recyclability of aluminum structures with a significant reduction in carbon dioxide emissions, it is this metal that becomes the perspective material for construction.

The extruded aluminum profile is made from billets. The production of billets is the first and important stage in the production of aluminum profiles.

In order to meet the world requirements of consumers for the quality of billets with the required chemical composition and properties ensuring optimal parameters in the production of aluminum profiles, it is necessary to ensure a high level of quality at the first stage of the technological chain - casting of billets. At this stage of the chain of production of billets, it is necessary to ensure the purity of the metal from nonmetallic inclusions.

The object of research is the production technology of billets from aluminum alloys of the series 6xxx

The subject of the research is the materials and equipment used in technology billets from aluminum alloys of the 6xxx series,

The purpose of the work: to develop technical solutions that allow to reduce the content of nonmetallic inclusions in billets of 6xxx series.

To achieve the goals the following tasks are solved:

- assessment of the impact of process waste on the number of non-metallic inclusions in the melt;

- Evaluation of the effect of a ligature rod with different boron content on the number of nonmetallic inclusions

- assessment of the effect on the content of non-metallic inclusions of the use of duplex foam ceramic filters and the installation of furnace refining RFI

- development and implementation of technical solutions for the production of pilot batches of cylindrical bars of the 6xxx series

- production of a batch of billets series 6xxx to confirm the results achieved by assessing the quality of the consumer.

Scientific novelty of the work

The developed technical solutions allow to reduce the content of nonmetallic inclusions in billets of 6xxx alloys.

Practical significance of the work

1. limiting the involvement of technological waste and the use of a ligature rod with a lower boron content makes it possible to ensure the purity of the metal in accordance with the requirements of consumers of billets of the 6xxx series.

2. Products manufactured using the developed technical solutions will expand the markets for its consumption and qualify products from consumers with stricter requirements for the purity of the metal.

Personal contribution of the author

All the results of the research were obtained with the personal participation of the author.

Place of the dissertation. Department of Foundry Production of the Institute of Non-Ferrous Metals and Materials Science of the Federal State Autonomous Educational Institution of Higher Education "Siberian Federal University".

Place of international internship. Company MECAS ESI Group, Czech Republic.

Approbation of work. The main provisions of the thesis are not presented in the mass media in connection with the confidential policy of UC RUSAL.

Publications. None.

The volume and structure of the dissertation.

The dissertation consists of an introduction, a literary review, a special research unit and a conclusion.

THE CONTENT OF THE WORK

The literature review examined the state of the aluminum industry market, the main production and consumption markets for aluminum and its alloys. The main world companies for the production of aluminum are presented.

The classification of nonmetallic inclusions in aluminum alloys and the nature of their occurrence are considered. The existing methods of controlling the presence of nonmetallic inclusions in aluminum alloys are reflected.

Theoretical bases of filtration and degassing of aluminum alloys, as well as basic equipment, are presented.

The review of methods of casting deformable aluminum alloys, the main types of defects of billets. The technology of production of billets from 6xxx series alloys at JSC RUSAL Sayanogorsk is considered.

The review of the market of extrusion industry and the basic scheme of production of aluminum profiles from billets is presented.

In a special research part, the work carried out to find technical solutions to reduce nonmetallic inclusions in billets of 6xxx alloys is reflected:

1. production of experimental batches of billets according to the optimal technology of melt modification.
2. Production of pilot batches of billets according to the corrected technology of involving technological waste.
3. Production of lots of billets using the RFI furnace refining unit and duplex foam ceramic filters.

In conclusion, the main conclusions and results of the work are presented.

MAIN RESULTS AND CONCLUSIONS

Technical solutions for reducing nonmetallic inclusions in billets of 6xxx alloys are developed:

- limiting the involvement of process waste in the production of billets
- the use of a ligature rod of foil quality in the production of billets
- application of a metal refining plant in ladles, RFI furnace refining
- the use of high-permeability ceramic foam filters

The developed and proposed technical solutions make it possible to reduce the number of nonmetallic inclusions in billets of 6xxx alloys, which is confirmed by the customer's quality assessment.

CONCLUSION

The set goals of the master's dissertational work were fulfilled in full. The results of studies of metal purity in the consumer Sapa confirm the achievement of the required level of nonmetallic inclusions as a result of the assessment of the consumer Sapa.