

PAPER • OPEN ACCESS

Analysis of the status and development prospects of Siberian metallurgical cluster in Russia

To cite this article: E V Protopopov *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **866** 012001

View the [article online](#) for updates and enhancements.

ECS
The Electrochemical Society
THE KOREAN ELECTROCHEMICAL SOCIETY

**The best technical content in
electrochemistry and solid state
science and technology!**

Available until November 9, 2020.

PRIME™
PACIFIC RIM MEETING
ON ELECTROCHEMICAL
AND SOLID STATE SCIENCE
2020

**REGISTER TO ACCESS
CONTENT FOR FREE! ▶**

Analysis of the status and development prospects of Siberian metallurgical cluster in Russia

E V Protopopov, M V Temlyantsev, G V Galevsky, N A Kozyrev, S G Korotkov and A R Fastyskovskii

Siberian State Industrial University, 42 Kirova Street, Novokuznetsk, 654007, Russia

E-mail: kafcmet@sibsiu.ru

Abstract. The characteristics of metallurgical production and metal products of Kuzbass enterprises, their heat and energy supply, environmental safety, training of specialist for their needs, directions of their innovative development are considered. It was confirmed that the metallurgy of Kuzbass forms the basis of Siberian metallurgical cluster in Russia and includes 7 enterprises, of which ZSMK is the undisputed leader. Metallurgy takes the 2nd place with the volume of 26.6% in the structure of the industrial sector of Kuzbass.

1. Introduction

Historical traditions, the ore base, the safeguarding of national interests, the length of the territory predetermined the formation and development of three metallurgical clusters in Russia: central, Ural and Siberian. The basis of the Siberian cluster is the metallurgy of Kuzbass [1, 2].

In the structure of the industrial regional sector, metallurgy takes the 2nd place after coal mining and processing with a volume of 26.6% of PS ratio. These two sectors ensure all-Russian priorities of Kemerovo Region in the production of such important industrial products as tram rails – 100%, main rails – 65%, coal and coal concentrate – 58.5%, ferrosilicon – 52.6%, rolled metal – 10.7%, steel – 9.9%. The metallurgical complex includes seven enterprises and is geographically located in three cities: Novokuznetsk, Guryevsk, Yurga. The metallurgical capital of Kuzbass is Novokuznetsk. There are 4 metallurgical enterprises in the city, among which ZSMK is the undisputed leader.

2. Characteristics of metallurgical industries and metal products

JSC “EVRAZ West-Siberian Metallurgical Plant” is a full-cycle enterprise that includes coke-agglomeration, steelmaking, rail and rolling production [3].

The coke-chemical production of the plant, one of the largest coke-chemical enterprises in Russia, was launched in 1963 and annually produces more than 3.5 million tonnes of coke, the main consumer of which (over 80%) is blast-furnace production. The composition of the by-products includes: ammonium sulfate, naphthalene, coal tar pitch, coal oil, benzene, toluene, solvent, anthracene fraction and others (more than 20 items).

The blast furnace production includes 3 blast furnaces with a total working volume of 8000 m³.

In 2019, pig iron production is planned at the level of 6 – 6.1 million tonnes. Thus, 9.5 – 10 million tonnes of iron ore materials are needed for that – 75% of it is the sinter of own production, and 25% – is pellets, mainly purchased on the Russian market of iron ore raw materials. The demand for coke is 2.6 – 3 million tonnes. Coke is produced from coal mines and open pits of the “Coal” division. To



increase the share of own iron ore raw materials, the Tashtagol mine is being reconstructed with an investment of 6.8 billion rubles.

Steelmaking includes 2 oxygen-converter shops.

In the oxygen-converter shop No. 1, steel is smelted in three converters with a capacity of 160 tonnes. The production capacity of the workshop in 2018 amounted to 2 057 000 tonnes of steel, steel is cast into molds. In the oxygen-converter shop No. 2, steel is smelted in two 350 t converters. The workshop capacity in 2018 amounted to 3 919 000 tonnes of steel. Steel is casted in molds and on two continuous casting machines to produce billets with a cross-section of 150-150 mm, 150-200 mm, 200 (250) 1050-1750 mm.

Rail production includes electric steelmaking and rail and beam shops.

The electric steel-smelting shop provides balk and ball-rolling mills with billets. Two modern arc electric furnaces with a capacity of 95 MVA are equipped with gas-oxygen burner systems and foaming slag in the furnace, operate according to the technology with cutting off the furnace slag and leaving some of the metal and furnace slag in the furnace, provide low energy consumption, electrodes and metal charge. The metal discharged from the furnace is processed on two aggregates of complex processing of steel “ladle furnace” and a high-performance ladle vacuum generator. The prepared liquid steel is poured into two modernized bloom casters equipped with a metal protection system against secondary oxidation and an electromagnetic stirring system. The workshop ensures the production of 1.4 million tonnes of continuously cast billets of high-quality and high-quality steels per year.

Rail and beam shop produces products of rail and construction assortment. The reconstruction of the rail and beam workshop completed in 2013 made it possible to produce all types of rails in one workshop: trunk, tram, crane, wit and rails for the subway. The rail and beam workshop was the first in Russia to master the technology of differentiated hardening and received a certificate for differentiated heat-strengthened rails up to 100 meters long. These rails have increased wear resistance and improved performance. Also, the capabilities of the new rolling mill make it possible to produce products of the construction range: beams, channels, piling bar, square and round billets. The volume of production is about 1 million tonnes of rolled metal per year.

Rolling production includes blooming, a continuous billet mill, two continuous small-section mills, a continuous wire mill, a ball rolling mill and is focused on the production of construction rolled products (reinforcement, beams, channels, angels, etc.) in volumes up to 4.2 million tonnes per year.

JSC “Guryevsk Metallurgical Plant” the oldest plant in Siberia and Kuzbass has been operating since 1816, first as a producer of copper and silver, and since 1840 – iron and its alloys [4]. The steelmaking capacities of the plant allow producing up to 210 thousand tonnes of steel per year in two open-hearth furnaces. Section rolling production differs with its rolling mill from other similar ones, and the ball rolling line is equipped with complexes with a capacity of more than 200 thousand tonnes per year. Today from 16 to 23% of mineral raw materials in Russia and the CIS are crushed by balls made in Guryevsk.

JSC “Kuznetskie Ferrosplavy” – the enterprise started its operation in 1942 and is one of the largest producers of ferrosilicon in Russia [5]. Currently, the enterprise accounts for 52% of the total Russian production of ferrosilicon and 100% of the production of high-quality compacted silica fume. In 2011, the “Yurginsky Ferrosplavny Zavod”, a branch of JSC “Kuznetskie Ferrosplavy”, was put into operation with four furnace units, full cycle of production and waste processing.

LLC “West Siberian Electrometallurgical Plant” was commissioned in 2014. The company operates four ore-thermal furnaces of RKO-9MVA and RKO-8.5MVA makes. The plant’s capacity for smelting high-quality ferrosilicon manganese with a low phosphorus content is 53 thousand tonnes per year. The main consumer of products (75% of the total) is JSC “EVRAZ ZSMK”.

JSC “RUSAL Novokuznetsk Aluminum Smelter”, the first part of which was commissioned in 1943, the second in 1961 [6]. Currently, the plant operates as part of the electrolysis and foundries. The production of raw aluminum is carried out on top-worked cells, as well as on the cells with

prebaked anodes. A total of 531 cells were installed in 3 series of electrolysis. The annual production of raw aluminum is 210 thousand tonnes.

The foundry equipment includes: 4 IAT 6M2 induction furnaces, 8 electric reflective mixers, 2 semi-continuous casting machines, 6 casting conveyors, “Brohot” automatic line, “Wagstaff” cylindrical casting machine, continuous homogenization furnace and cylindrical bars cutting “Hertwich”. The main products of foundry are cylindrical ingots and small ingots from 6 to 22 kg. About 70% of the products are alloys, including multicomponent ones. About 52.7% of the plant's production is supplied to the domestic market and to the CIS countries.

3. Heat and power supply for metallurgy of Kuzbass

The leading group includes products of electrothermal production – aluminum and ferroalloys. Electricity consumption by metallurgical enterprises accounts for 28.5% of total electricity consumption in the Kuzbass and is distributed among enterprises as follows – from 10% for the Novokuznetsk aluminum plant, to 0.15% for Guryevsk metallurgical plant.

The analysis of the structure and generating capacities of Kuzbass fuel and energy complex shows that 8 thermal power plants and 2 block stations with a total installed capacity of 4979 MW operate on its territory, which confirms the guaranteed provision of metallurgical enterprises with heat and energy resources at the required level.

4. Improvement of the the environmental safety of metallurgy in Kuzbass

In 2017, emissions of the main polluting substances by enterprises of the Kemerovo region amounted to 1 million 487 thousand tonnes, including solids 146.5 thousand tonnes [1]. The total contribution of metallurgical enterprises amounted to 19.6%. In 2017, the volume of fresh water withdrawn was reduced to 142.27 million m³, which is 7.2% of the volume of recycled re-sequential water supply (1965.15 million m³).

5. Training of specialists for the needs of Kuzbass metallurgy

The share of the labor force in Kuzbass is 55.4%, and the share of those receiving professional education is 21.7% of the population younger than the working age. At present, almost 29 thousand people are employed at metallurgical enterprises, which is ~ 2% of the able-bodied population in Kuzbass [1]. A multilevel system for training metallurgical personnel is currently being implemented.

6. Directions of innovative development of metallurgical production in Kuzbass

The immediate plans of the Kuzbass metallurgical enterprises include reconstruction and modernization of production in the following directions [2]: in the conditions of JSC “EVRAZ ZSMK”, improvement of rail steel production in order to improve the quality of metal products; mastering the production of sheet metal products at the casting and rolling complex; long drawing profiles for use as reinforcement; technologies for flash butt welding of differentially heat-strengthened railway rails into long-length (up to 800 m) strings; in terms of JSC “RUSAL Novokuznetsk Aluminum Plant”, a conversion of technology implemented by JSC “RUSAL Novokuznetsk” with the installation of cells RA-167 and S-8BME EcoSoderberg.

7. Conclusion

In 2018, the following industry structure was implemented in the industrial sector of Kuzbass (% of PS ration): coal industry – 51.5, ferrous metallurgy – 24.3, energy – 8.5, ferrous metallurgy (scrap and metal processing) – 4.1 chemical and petrochemical industry – 3.1, food industry – 2.8, non-ferrous metallurgy – 2.3, construction materials and metal structures – 2.0, engineering – 1.4. The metallurgical complex includes seven enterprises and is geographically located in the cities of Novokuznetsk, Guryevsk, Yurga. The range of metal products includes cast iron, steel, all types of rails, rolled products (construction, balls, metalware), silicon, manganese-containing ferroalloys, aluminum and aluminum alloys. The total number of employees at metallurgical enterprises is 29

thousand, which is 2% of the able-bodied population of Kuzbass, amounting to 1481 thousand (55.4% of the total population of Kuzbass). The total electricity consumption by metallurgical enterprises is 10 299 million kWh or 28.51% of the total electricity consumption in Kuzbass. At the same time, electricity consumption by metallurgical enterprises is, %: JSC “RUSAL Novokuznetsk Aluminum Plant” – 9.97, JSC “EVRAZ ZSMK” – 9.4, JSC “Kuznetskie Ferrosplavy” – 9.0, JSC “Guryevsk Metallurgical Plant” – 0.14. Over the past 15 years, diversified environmental programs have been implemented at metallurgical enterprises, which led to a 70% reduction in emissions into the air basin and fresh water intake to 7.2% of the volume of recycled re-sequential water supply, amounting to 1.97 billion m³.

Priority areas of modernization and reconstruction of metallurgical enterprises include improving the production and welding of main rails, mastering the production of sheet metal products at the casting and rolling complex, the production of long profiles by drawing, and the transition to modern technology for the electrolysis of aluminum.

References

- [1] Ryabov V A and Stoblova O B 2017 *Bulletin of KemSU. Series: Biological, Technical, and Earth Sciences* **3** 41–45
- [2] *Program of Kemerovo Region – Kuzbass “Development of the industry of Kuzbass” for 2019–2024* <http://docs.cntd.ru/document/550201933>
- [3] *Encyclopedia of Zapsib* http://www.rusmet.ru/promnews/show/12223/Enciklopediya_Zapsiba
- [4] *Guryevsky Metallurgical Plant* <http://gmzkem.net/>
- [5] Korennayat K A 2017 *Metallurgy: Technology, Innovation, Quality: Proc. of the XX Int. Sci. and Practical Conference* (Novokuznetsk: SibSIU) part 1 pp 18–20
- [6] Zhirnakov V S, Bolshakov D G et al 2017 *Proc. of the XX Int. Sci. and Practical Conference* (Novokuznetsk: SibSIU) part 1 pp 11–17