Research and technological development

Approach

Due to the growth in prices for raw materials and electricity tariffs, as well as the difficult situation on the world aluminium market, UC RUSAL has raised requirements on the technologies used, focusing attention on modern innovations that make it possible to lower costs, improve energy efficiency and minimise the negative impact on the environment. The Company strives to develop its own scientific and technical solutions, to maintain the quality of products on the level of world standards. One of UC RUSAL’s priorities is to develop its own scientific and technical base to create the best possible production technologies, making it possible to meet high international production standards and to assist in reducing the negative impact on the environment.

An in-house scientific and technical base is one of UC RUSAL’s key competitive advantages, and allows the Company:

- to perform R&D, create its own aluminium and alumina production technologies and new innovations that streamline production and reduce its cost;
- to implement complex engineering and construction projects;
- to perform technical maintenance, repair and replacement of equipment at all Company enterprises.

UC RUSAL has a Technical Policy that determines the Company’s key areas of development.

Research and development work is performed at the UC RUSAL Engineering and Technology Centre (ETC) in Krasnoyarsk, the Russian National Aluminium and Magnesium Institute (VAMI) in St Petersburg and SibVAMI in Irkutsk.

The Company also works with leading universities: Hong Kong University of Science and Technology, Moscow State University and Siberian Federal University (SFU), the Institute of Metallurgy and Material Engineering of the Russian Academy of Sciences, the Institute of Metallurgy of the Urals Division of the Russian Academy of Sciences (UrD RAS), the National Institute of Steel and Alloys (MISIS), UralMechanobrom, UralPromEnergoProject, the Institute of Solid State Chemistry of UrD RAS, the RUSREDMET Chemical Engineering and Technology Centre and others.

UC RUSAL actively assists in the development of science in Russia, placing orders on the performance of R&D in the academic institutions of RAS and scientific and production sites.

In March 2012 a memorandum of understanding was signed with the Canadian company Orbite Aluminae, the developer of unique technologies for production of smelter-grade alumina and associated rare earth metals from low-grade ores.

Operating results

The greatest attention was paid to the following areas in 2012: improving the energy efficiency of technologies, reducing production cost, increasing the output of high-value-added products, creation of new aluminium and alumina production technologies while complying with the areas of energy efficiency and low-cost production.

The main areas of work in alumina production in 2012 were:

- improving energy efficiency and reducing the material intensity of existing production facilities;
- creating new technologies and markets for treatment of the wastes of alumina production;
- creating new energy-efficient technologies for treatment of the non-Bayer alumina-containing raw materials of Siberia, to reduce logistics costs on the delivery of alumina to the Company’s aluminium smelters.
Among other things, the Company implemented the following R&D measures in the reporting period:

- testing of an environmentally friendly and competitive Soderberg aluminium electrolysis technology;
- engineering and testing of electrolysis cells using inert anodes;
- improving the RA-400 technology;
- developing and testing energy-efficient electrolysis cells;
- developing and testing aluminium-zirconium alloy production technologies for the electronics industry;
- developing alternative binding material technology;
- developing zero-waste production of alumina (treatment of red mud);
- developing technologies for producing alumina from low-grade domestic raw materials.

In August 2012 the R&D project on the development of technology to produce aluminium alloys with rare-earth and transition materials, and to develop equipment for the production of electrical wire rod from them, was completed.

UC RUSAL continues to perform the project on the implementation of electrolysis cells that work on inert anodes, which is scheduled for completion in 2015. This project plays an important role in the development of the aluminium industry, due to the technological specifics of the process, which makes it possible to minimise carbon dioxide emissions and reduce operating costs. As part of the preparation of the electrolysis cell with inert anodes for industrial tests, the Engineering and Technology Centre (ETC) of UC RUSAL has developed a design of an electrolysis cell for a current strength of more than 100 kA. The technical solutions included in the structure of the electrolysis cell are tested on large laboratory electrolysis cells at a current strength of 3 kA. Several variants of cathode lining were tested in 2012. The tested technical solutions will be implemented in production in 2014.

The Company also performed work on development of aluminium-zirconium alloys for wire with greater electrical power transmission capacity for the electronics industry. Within the framework of state co-financing, together with Siberian Federal University, in an amount of more than USD 960 thousand, technology for producing aluminium-zirconium wire with an improved wire working temperature of 90 to 150°C was developed. The transmission capacity of the wire from this alloy can be doubled. In 2013 UC RUSAL plans to invest funds in the organisation of production of the new product at the Irkutsk and Bratsk Aluminium Smelters.

In 2012 UC RUSAL submitted an application to receive financing for scientific research and development of zero-waste production technology. The Company received nearly USD 1.4 million in state co-financing for the project on processing of red mud. The academic partner in project implementation was the Institute of Metallurgy of UrD RAS, which brought in organisations such as MSIS, URALMECHANOBR Research and Development Institute for Preparation and Beneficiation of Minerals, UralPromEnergoProject, the Institute of Solid State Chemistry of UrD RAS and others.

UC RUSAL ETC is developing a technology to process red mud containing a large number of valuable elements: ferrous oxide, titanium and other metals. Once the technology for removing these components is created, there will no longer be any need for expensive disposal of red mud, and a new source of additional profit will appear for alumina enterprises. More than 20 million tonnes of red mud containing many useful components for other industrial sectors are stored annually at the UC RUSAL alumina production facilities. The purpose of the project is to create technologies to manufacture products for the following areas of application:

- ferrous metallurgy – as a substitute feed stock;
- the cement industry – as ferriferous, mineral and other additives, materials for road construction and backfilling of mine openings;
- extraction of rare earth metals for the electronics and defence industries.

Laboratory and factory testing were performed on the use of red mud and products of its processing by potential consumers – ferrous metallurgical enterprises and the cement industry, a technology for treatment of red mud to receive iron-ore concentrate with an iron content of more than 50%, and a new technology for using carbonizing sorbate to extract scandium oxide from red mud.
Under the conditions of tariff escalation and the rising costs on transport of raw materials for alumina production, as well as the political instability in the countries where the raw materials are worked, the processing of raw materials from the Russian regions is a crucial task for the Company. To resolve this task, UC RUSAL began work in 2012 to create a technology for processing of low-grade raw materials. Proprietary technical solutions were developed based on Russian and international best practices, and seven patent applications were submitted (Patent Cooperation Treaty (PCT)), various types of raw materials in the Siberian region were analysed and the preferred raw materials base for the Company was chosen.

One of the key areas of RUSAL ETC’s work is the development of an energy-efficient hydrometallurgical (acid) technology for processing raw materials. This development work will make it possible to reduce costs on the transport of alumina to the Company’s main aluminium smelters, strengthen resource security, and reduce the production cost of aluminium. Based on the Company’s estimates, the technical solutions under development will cut energy consumption on processing of raw materials in half compared to sintering technology.

Upgrade and development of promising technologies

In addition to the aforementioned areas of development, UC RUSAL also implemented a number of upgrade projects:

- eco-friendly Soderberg technology was implemented at KrAZ and BrAZ;
- the performance of foundry projects at SAZ, IrkAZ and BrAZ, aimed at increasing the production volume of marketable value-added products and improving the quality of manufactured products;
- measures involving the use of anodes, aimed at increasing energy efficiency, improving performance indicators, and increasing the production of calcinated coke;
- projects of environmental protection measures, including the construction and reconstruction of sludge ponds at BrAZ, IrkAZ, development and implementation of effluent treatment technology at NkAZ, construction of dry gas-treatment units at VgAZ, BrAZ, NkAZ and others.

UC RUSAL is constantly developing and improving its aluminium production technology. The Company has developed and is improving the electrolysis technologies developed by the ETC – RA-300, RA-400 and the newest member of the series, RA-500, the use of which will make it possible to reduce the energy required for production and ensure a positive environmental and economic effect. The RA-300 electrolysis technology is used at the Khakass Aluminium Smelter and will be used at the Boguchansky Aluminium Smelter. RA-400 electrolysis technology will be used at the Taishet Aluminium Smelter.

The project to install unique equipment and introduce new types of products to increase the production volume of powder products was completed in September 2012. The total growth in production of powder products by UC RUSAL enterprises in the first half of 2012 equalled 29.4% compared to the same period of 2011.

In 2012 the Company began developing technology as an alternative to coal pitch binding material. UC RUSAL performed pilot testing on Koppers and Ruetgers carbon pitch and a preliminary technical and economic analysis of their use. In the reporting period, representatives of UC RUSAL and Koppers reached an agreement to organise a joint venture in Russia on the production of petroleum pitch using the oil sludge of Russian refineries, which costs less than foreign shipments. Development of RUSAL ETC–VUKHIN technology to produce compound pitch through the joint distillation of coal pitch and cracking residue is being performed in parallel. It is planned that the production cost of the petroleum-coal pitch produced in this way will be lower than foreign alternatives.

In the medium term, the Company plans to create a centre for the production of high-value-added products. This project includes the modernisation of five UC RUSAL aluminium smelters, aimed at changing their manufacturing profile.

Going forward, the Company plans to continue projects aimed at improving its energy efficiency, lowering production cost and creating new technologies.