ESTABLISHMENT OF INNOVATIVE PRODUCTION AND RENOVATION OF IN-PROGRESS PRODUCTION AS BASIS FOR STRATEGIC POSITIONING OF TNC KAZCHROME JSC ON GLOBAL CHROMIUM ALLOYS MARKET

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ABSTRACT

The current global market of construction and mechanical engineering industry displays stronger tendency of high chromium metal ware consumption [1]. Ferrochromium market on medium- and long-term prospects is primarily focused upon manufacturers of stainless steel and intended for meeting upward demand in production of high competitive characteristics (content, properties, and cost).

A problem of limited high quality raw material resources, used in ferroalloy production industry, that the company manufacturing plants encountered during the recent years, is obtaining great significance; and this affects the levels of competitive ability and liquidity of products on market. Increase and variety of consumers' requirements to saleable products and also environmental standards force producers to explore resources-efficient and low-waste methods enabling decreasing direct costs in ferroalloy manufacturing. In addition to that logistics of ferroalloys delivery to consumers plays an important role in production costs, and in regards to TNC Kazchrome JSC this fact is of low control.

It is generally-known that the present-day production prioritizes technologies characterized by high level of utilization of raw materials and furnace plant and, at the same time, by low level of waste generation. In order to ensure fulfillment of the above said priorities, there mastered innovative processes and utilized modern equipment on-site. In this strategically critical aspect Kazchrome is underatking specific actions like two big projects of agglomeration of chromium and manganese resources already launched and implemented at company plants and eight more different fields strategic projects are being currently implemented.

From political-social view strategical development program implementation by Kazchrome will enable increasing innovative industrialization level and expanding export potential both in the Region and in the Republic of Kazakhstan.

Kazchrome is currently one of the major global ferrochrome manufacturers and meets certain part of global demand of producers of stainless steel and other chromium steel products. Kazchrome, being a part of ENRC Plc, is a present-day worldwide vertical integrated company comprising chrome and manganese operating assets, mining and concentrating pits, shafts and mills, ferroalloys plants and power station.

Kazchrome comprises the following assets:

- Aksu Ferroalloys Plant (Aksu Plant);
- Aktobe Ferroalloys Plant (Aktobe Plant);
- Donskoy Mining and Concentrating Plant (DGOK);
- Kazmarganets Mining Plant (RU Kazmarganets).

Almost all (99.5 %) grades of manufactured ferroalloys are sold on global market. The fundamental consumers of ferroalloys are steel-making plants in China, Japan, Korea, Central and Eastern Europe, USA, Russia, Ukraine and others. Considering this, due to the fact geographical

location of Aktobe and Aksu Plants are far away from end-consumers and international sea routes, railway fees increase results in increasing of raw materials transportation costs and final products.

Aiming to minimize direct costs, highly automated and heavy furnaces and effective system of gas cleaning are used as best practices of today ferroalloy industry, but subject to multiple use of raw materials, i.e. disposal of solid and gaseous wastes of process. Along with that, for improvement of furnace performance data priority will be charge materials preparation (concentration, grading, drying and agglomeration), as well as pre-heating and pre-reduction of charge feed, introduction of new profit-proved production process applying methods of injection metallurgy and plasma arc energy, betterment of ferroalloys quality and manufacturing of new complex alloys and ligatures, and perfection of casting and breaking [2].

Moreover, against significant growth of world economy major marketing companies and analytics predict a positive consumption growth rate for stainless and ferrochrome between 2012 and 2020. Based on such predictions as well as life history and profitability of existing production processes, Kazchrome has to implement new production capacities aiming to keep a share on global market. The current share of Kazchrome on global market of ferrochrome is shown on figure 1.

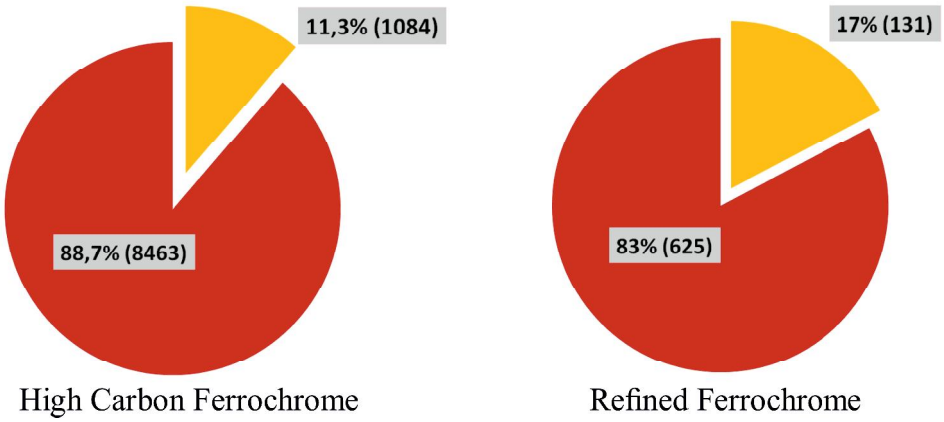


Figure 1: Current share of Kazchrome on global ferrochrome market, in k tons

Today, according to company business strategy a line of innovation-based projects are in progress of accomplishment. At this time there are two big projects of raw materials agglomeration been put into commercial production, which are:

1. Pelletizing Plant at DGOK. – Within the project frameworks from 2005 till 2009 two plants for 0-5mm chrome ore pelletizing were built with 1400 kt/a overall nominal capacity of sintered chrome pellets. This plant two times exceeds capacity rate of the existing one in South Africa. Outotec is a general designer and supplier of a main part of equipment.

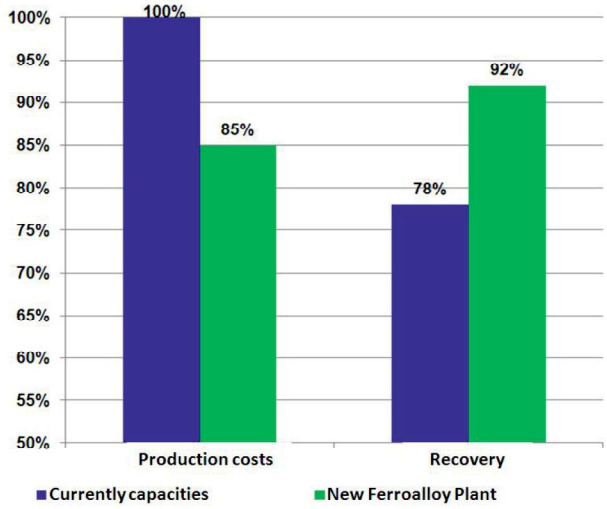
2. Agglomeration Department at Aksu Plant. – The agglomeration machine of 350 kt/a for 0-5 chrome and manganese pelletising was built and commissioned in 2010. The agglomeration shop is intended for pelletising of fine chrome and manganese ore, dust from ferroalloy gas cleaning systems, as well as silica sand screenings, which are deemed as unusable in melting furnaces. Ferroalloy gas, treated as secondary energy resources at plant, is utilized as fuel for feed ignition.

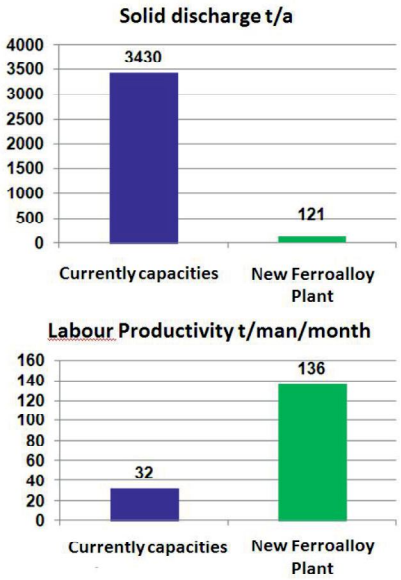
As a result of these projects implementation the company has the issues relating to deficit of lumpy raw charge availability fixed and produces more 1500 kt annually pellets and agglomerated products.

In the framework of the business strategy since 2009 a new ferroalloy workshop No4 (plant) is being constructed at Aktobe Plant according to the project of SMS Siemag. The designed capacity of this shop is 440 kta high carbon ferrochrome; total investments make about 750 million

US dollars. As of the current date equipment deliveries are almost completed and construction and erection works are in progress. Four 72 MVA DC sealed furnaces are installed in this new shop. It should be noted, these furnaces are the most high-capacity kilns for today that will be engaged in ferrochrome manufacturing.

The anticipated performance if this project is realized is presented on graphs:

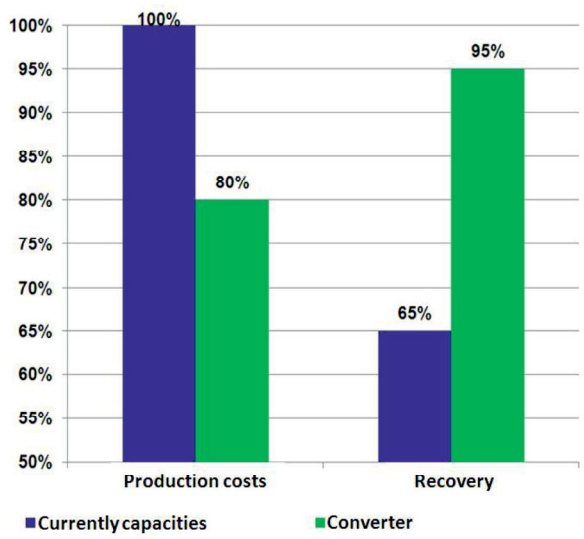


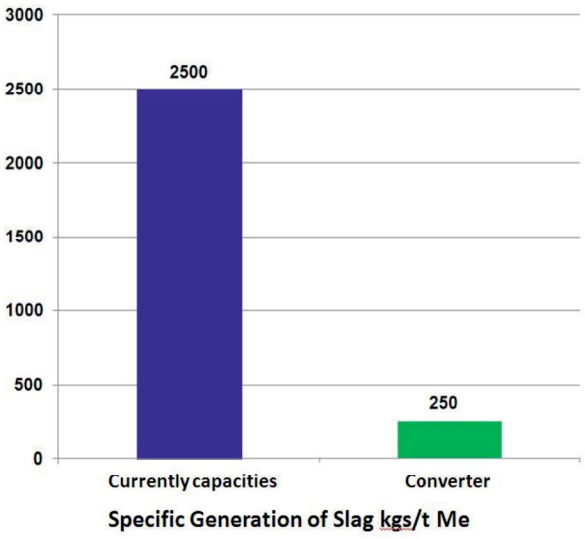


The new shop combines also converter department that is under designing now and will be used for production of 65 kta medium carbon ferrochrome through AOD (argon-oxygen decarburesation) of liquid high carbon ferrochrome with further vacuum treatment. Construction phase will be effected as per the project of SMS Siemag. Total investments into project make about 100 million US dollars. The peculiarity of such production process of medium carbon ferrochrome in converter is non-use of reductants (ferrochrome silicon) and limestone, leading to expansion of infinite alloys mix by carbon content.

This project has basic engineering already developed as well as contracts for detail engineering and equipment supply concluded and signed.

The anticipated results of this project implementation are presented on graphs:





Every 10 years the plant is involved in capital repair of furnaces; repairs costs per a furnace depend upon its capacity and fluctuate within 5.0 to 15.0 million US dollars. In the period of repairs equipment worn parts are being replaced with the new ones but not changing significant furnace units in order to increase performance data of production. Since recently the company management initiated a suggestion on presentation of engineering solutions that will help to improve furnace performance, that means adaptation of new equipment and technology dedicated to minimize specific costs, to increase throughput, etc. in shops.

The anticipated outcomes of the project:

- ✓ Higher production output up 35 %;
- ✓ Low specific consumption of electric power down 25 %.

Within the frames of this project furnaces will be equipped with systems of charge heating (SCH), a sealed roof and 81 MVA transformers.

Along with Shop №6 at Aksu Plant, in the Shop №4 there scheduled building of 120.0 kt/a mixing department for manufacturing of low carbon ferrochrome. The concept of production by means of mixing lays in blending of chrome ore with quicklime and melting the mixture in 3-phase tilting furnace to generate ore-lime flux that later is poured into a reaction vessel and added with liquid ferrochrome silicon, cocktailing from one ladle into another in a mixer (about 6 times).

This method of melt mixing has a number of the following advantages:

- ✓ Minimization of production costs for saleable ferrochrome;
- ✓ Availability to manufacture ferrochrome with C 0.05 % max;
- ✓ Free requirements to raw materials, meaning insignificant fluctuations of Cr_2O_3 content in ore does not impact upon performance of low carbon ferrochrome production;
- ✓ Decrease of ecological risks thanks to generation of stabilized slag instead of disintegrating slag during production of ferrochrome.

For this project basic engineering is developed and capital investments are assessed.

Kazchrome Growth Strategy up to 2030 foresees utilization of ferroalloy gas and solid wastes. This strategy sets forth the following goals:

- ✓ Total disposal of ferroalloy gas at plants of Company and simultaneously generation of electric and heat powers and synthetic kinds of fuel;
- ✓ Creation of production with 100% treatment of solid wastes (slag, slime, dust) to generate saleable products to be needed on market and/or for internal use.

In view of high consumption volume and high cost of electric power in medium- and long-term, Kazchrome considers necessary to provide co-generation of electric and heat power. Therefore, Aktobe Plant is finishing construction of new smelting workshop No4 by the end of 2013. The first line of production is scheduled to be launched in the fourth quarter of 2013. In accordance with Environmental Law of the Republic of Kazakhstan and recommendations of the Kyoto Greenhouse Gases Protocol exhaust ferroalloy gases are planned to be utilized. For this purpose an electric power station (PS) as a part of this shop is to be constructed to generate 45-55MW at first stage using off-gas from ferroalloy making furnaces.

During the first stage the project envisages to utilize ferroalloy gas in full in the amount of 48000 nm^3/h that is generated by four furnaces of Shop No 4, Aktobe Plant, and produce electric power of 45-55 MW annually with addition of natural gas 10 % max of total raw gas for firing. The second stage involves expansion of PS capacity up to 180MW. PS is dedicated to supply power to the smelting workshop No4 at Aktobe Plant. The deadline of commissioning of the first line is 2014.

Generally, with new shop No4 commissioned company will get a multiplicative effect. Generation of solid wastes of production is expected to be increased. From 1943 till now Aktobe Plant has been engaged in producing ferrochrome and this production solid wastes (slag, dust) storage at the specific area called Slag Stockpiles is simultaneously performed. Nowadays, the more 12 million tons of ferrochrome wastes are accumulated at Stockpiles. These wastes contain 2-3 % conditioned ferrochrome and this equal about 300 thousand tons. Considering that slag of high carbon ferrochrome is treated into construction ballast, the main component of this Stockpiles is slag of refined ferrochrome (RF) that contains about 40 % $2CaO{\bullet}SiO_2$ (larnite) a raw for construction cement.

Therefore Aktobe Plant initiates a project of processing of stale slag of refined slag. This project provides for separation of stale slag of RF into metal and mineral components. Metal components will be used in metallurgical foundry as metal concentrate, and mineral components will be used in construction materials making, like bricks, cement and so on. Laboratory experiments are successfully conducted based on Loesche installations, and currently preparations for pilot testing and basic engineering and a feasibility study are under way.

It should be noted, the company is involved also in realization of another big project of high carbon ferrochrome production, called as "Designing and Construction of New Smelting Shop No5 for Ferroalloy Production". Design capacity of this shop is similar to that of Shop No 4 under construction, but probably it could be of higher power than its predecessor. This year pilot testing based is planned to be conducted at Technological Center Midrex, USA, results of which will define principal industrial site for construction of shop facilities.

In addition, Kazchrome participates in testing of biotechnology of liquid fuel and chemical polymers production, if using ferroalloy gas, and this is not typical for company. The technology of biofuel generation through using ferroalloy gas is developed by LanzaTech and based on microbial treatment of gas, namely using of new class of bacteria with improved ability, by means of anaerobic fermentation of gas that contains carbon monoxide (CO). Ferroalloy gas is a potentially source product for microbial fermentation production of ethanol and composes of both CO and H_2. This technology foresees usage of microorganisms for these gases processing and making of fuel (ethanol, butanol, acetone, propanol) and chemical products like polymers [3].

CONCLUSIONS

Absolutely all strategic projects implemented within the frameworks of the Business Strategy of TNC Kazchrome JSC, are dedicated to maintain share on global ferrochrome markets, decreasing production costs, increasing operating capabilities of furnaces and diminishing of ecological and labour risks.

TNC Kazchrome JSC intends to enter into mutually beneficial cooperation with potential companies in order to handle critical problems within Business Strategy aiming transferring innovation-based technology and mechanisms, to minimize mutually risks, including ecological ones, and to gain extra profit.

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