TITANIUM: STATE AND PERSPECTIVES OF PRODUCTION DEVELOPMENT IN KAZAKHSTAN

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Abstract

Kazakhstan set a course for industrial-innovative development of the economy, which means transition from primary processing of raw materials to technologically completed cycle of ready products. Manufacture of titanium is one of such examples. There are some problems in the development of industry as: weak demand for titanium in domestic market, dependence of production on the demand in foreign market; insufficient innovative -technological level of titanium production; undeveloped machine industry to produce a variety of products, based on titanium; significant amount of titanium scrap, sold at a dumping price. The article analyzes the development of titanium industry as part of mining metallurgy. Reduction of the cost of titanium products through the involvement of scrap into secondary circulation represents a perspective. It is suggested to set up production of stainless titanium-containing steels and to produce ferrotitanium for export. Use of 3D-printering technologies is the most promising solution of titanium scrap recycling, this will reduce the cost of titanium powder and the cost of the final product by about 60 - 75%. The authors expect that beyond 2017 economic recovery will start and it is necessary already now to prepare for it, to design and create new technologies with high added value.

Keywords: Ust-Kamenogorsk Titanium and Magnesium Combine, market of titanium

1. Introduction

The last quarter of 2014 was marked by the collapse of oil prices, which caused the collapse of all previously proposed forecasts, subsequent adjustment of plans and recount of budgets. Many experts give forecasts, but no one can say with certainty which scenario of development of events will be more vital, oil prices continue to fall. In this situation, each country is trying not to lose the achieved positions in the global market, to find new niches to export their products. At the same time countries search for their internal reserves, carrying out structural reforms, modernizing production, involving scientists to create fundamentally new technologies with high added value.

Experience of Kazakhstan in implementation of the State Program of Industrial-Innovative Development (SP IID) is of interest in this aspect [1, 2]. Over the last five years hundreds of new industries were created, 80 branches of industry demonstrated growth. Departure from raw materials' orientation of economy, increase of technological stages, increase of value added chain, implementation of cluster initiatives are the main goals of the program. A course is set on manufacture of missing components of final products, import substitution, increase of Kazakhstan content of ready-made product. The state supports and develops protective measures of entrepreneurship. According to the results of 2014 the share of Kazakhstan content in the products exceeded 30%. In 2014 the country with the volume of GDP equal to 231,6 billion USD came out on the 46th place in the world [3].

Mining and metallurgical complex: extraction of iron, manganese, aluminum, chromium, phosphate ore; production of ferroalloys, copper, lead, zinc, various precious and rare metals occupy a significant share in the economy (17% of GDP) [4, 5]. As for stocks of ferrous and nonferrous metals Kazakhstan holds the 8-9th place in the world. In supplies of titanium for aerospace industry the country is on the 4th place. Today all titanium is exported. However, implementation of the SP IID demonstrated the presence of domestic demand in titanium. To this end the activity of the main supplier of titanium JSC "Ust-Kamengorsk Titanium and Magnesium Combine (UKTMC) was analyzed.

2. Materials and methods

In the arsenal of feasibility studies there are quite enough tools that allow to carry out analysis, modeling processes and phenomena. It is obvious that such a complex and many-sided object of study, as market of titanium products requires the use of different ways of studying, generalizing and monitoring problems. Analytical methods, used in this article, are intended to provide an objective picture of the state and dynamics of titanium production in Kazakhstan and possibilities of development of the industry on the basis of the available raw materials.

The study also focuses on system forming links, in particular dependence of demand and supply of titanium on world market conditions. Methods of logical reasoning, based on the fact that the declines in world economic activity, as well as the slowdown of rates of development in a number of industrialized countries affect the price and consumption of titanium, are used.

In particular, the decline in the number of orders for aircraft, low business activity in power industry, defense industry, other industries affect the decrease of titanium consumption , which means that there will be some surplus of the product. In this situation the authors' task is with the help of available research methods to recommend the sectorial bodies that implement the industrial policy, effective trends of using titanium in the domestic market. In this case suggestions of scientists are based on laboratory studies of increase of titanium output from fresh raw materials, use of scrap.

Formation of titanium scrap yield, which is sold at a low price, is another example. The authors analyze what can be done with it, whether there is a possibility to process at the plant itself in order to reduce costs and avoid loss of such a valuable product.

To study the production and consumption of titanium the methods of statistical data collection, selection and analysis of the necessary information from periodicals, Internet resources have been used. Studies are based on grouping data. Indicators contrary to logic were checked or excluded in view of insecurity and uncertainty. For example, data about the production and prices at the beginning of the year, in the middle of the year, were then checked.

That is why it is necessary to study the dynamics of indicators. At the same time it is possible to give a correct assessment of the issue only by comparing the given object or figure in time (months, years) and space (industry average level, similar enterprises). Methods used in the work, are:

1. Method of systematization: such techniques as classification, typology, selection, etc.
2. System analysis. This method is based on goal-setting and sequence of actions' realization.
3. Method of statistical analysis: study of reality - facts and figures, that is, of primary material, which characterizes production volumes, expenses, price of titanium.

3. Analysis of the production of titanium in Kazakhstan

3.1 Export potential of the mining-metallurgical products, including titanium

Kazakhstan is rich in deposits of multicomponent complex ores. The group "Mineral products" is therefore the main export product. In September, 2015 it held 70.8% of total export of Kazakhstan [1, 6].

7 zircon rutile -ilmenite placer deposits with titanium reserves were explored. Exploitation of Satpayevsk deposit Bektemir (East Kazakhstan region) is being carried out, work continues in Obukhovsk (Akmolinsk region) and Shokashsk (Aktubinsk region) fields. In Satpayevsk deposit a project worth 4,5 mln USD was implemented constructing a mining - processing complex with output of 15 000 tons of ilmenite concentrate per year. Extraction of polymetallic ores accounts for more than 80% of the East Kazakhstan region economy [7, 8].

In the total amount of metal ores' extraction the share of non-ferrous metals in 2013 was 67.8% (535,381 mln. KZT or $ 3 485 mln. at the rate of 153.61 KZT per 1 US dollar). In 2013 precious and non-ferrous metals were produced in the amount of 7.21 billion USD (1,107,458 mln. KZT) [9].

Kazakhstan has an industry program of development of the mining-metallurgical industry, which includes measures in the following areas:

1. Organization of production of base metals by large enterprises;
2. Organization of production of final products of deeper processing on the basis of base metals by small and medium-sized businesses.

Also the development of resource potential of mining - processing complex is foreseen:

• increase of capacities of mining companies by production of already explored deposits;
• introduction of efficient technologies for processing off-balance- sheet, complex refractory ores, concentrates and dumps;
• use of secondary raw materials - scrap and wastes of ferrous and non-ferrous metals;
• modernization of transport - logistics infrastructure by increasing railroads tonnage capacity in the north and west of the country.

Data about export potential give an idea of the industry (**Table 1**) [10, 11 and 12]. If to talk about titanium, its production also depends on the above mentioned factors (**Figure 1).**

Because 2012 was successful for the majority of metals, the authors decided to take it as the basis for comparison with 2014 year, when the decline in oil prices and prices for a

number of metals started. For example, the average contract prices of copper declined by 9%, aluminum - by 5%, gold - by 11%, silver - by 41%. The global economic situation also shows the decline in prices for the above mentioned products - by 8.3%, 8.5%, 15.2% and 24.5%, respectively [11].

As seen, in 2014 as compared to prosperous 2012 year the volume of export of copper, silver, gold, titanium fell more than twofold because of decrease of demand and therefore of prices. In whole the market of metals , indicated in the table, is characterized by considerable volatility, which can be explained not only by the situation of the world market, but also by the policy of domestic manufacturers and foreign customers, who sign contracts. Measures of state regulation of economic sectors, tax system, as well as tariffs make a significant impact. The latter are of great importance within the EAEC framework.

The stage of production of titanium sponge is the main stage in the production of metal. Kazakhstan is among the 6 countries, owning the technology of manufacturing titanium sponge (China, USA, Russia, Japan, Kazakhstan, Ukraine). World production of this product is 155 thousand tons. In the supply of titanium mill products the US share is 40%, of Japan - 24%, of Kazakhstan - 16%, of Russia - 13%, of China - 7% [13]. Kazakhstan titanium is exported to the United States, the Netherlands, Great Britain, Japan, South Korea. Based on the above stated, the question arises: what should be the strategy in conditions of decline in demand and prices for metals, dependence of production on foreign markets? The measures undertaken by the government and suggestions of authors will be considered later. The next section presents the analysis of activity of the main manufacture of titanium - JSC "UKTMC".

3.2 About the company JSC "Ust-Kamengorsk Titanium and Magnesium Combine (UKTMC)

3.2.1 History

JSC "UKTMC" was put into operation in 1965, it supplies titanium and magnesium for export. In 1992 the plant was included into the Strategic plan of development of large industrial complexes of the country, and then in 1999 exploration work in the field "Satpayevsk" was carried out ,according to the results of which reserves of titanium raw materials were affirmed. In 2000 on the basis of this field a joint venture «Satpayevsk Titanium Mines Ltd» (Switzerland) was established. Following the acquisition in March 2014 of 50% share in the authorized capital of this company «UKTMC" became the 100% founder. Since 2002 the contract for deposit exploration operates [14].

Government and industry bodies worked actively to attract foreign investors, to use up-dated technologies. A number of large innovation projects with foreign partners has been implemented. In 2008 the Kazakh-French enterprise "UKAD" was established to produce titanium forgings, sheets, bars and wire (50 mln. Euro were invested) from ingots and alloys. The products are used in aerospace, oil and gas industry, nuclear energy industry and medicine.

In 2009, the Kazakh-Korean enterprise "POSUK Titanium" was established for the construction of a plant for the production of titanium ingots and plate slabs by electron-beam melting (70 million USD.). The plant was put into operation in December of 2014, part of the products will be used by shipbuilding companies in South Korea.

In order to increase the share of Kazakhstan's titanium in the world market and its use in the internal market the Development program of plant for 2012-2022 years was adopted. Modernization of equipment throughout the whole chain of titanium production, improvement of the automation of production, development of recycling technologies, expansion of the range of products for use in oil - gas industry are foreseen .

In 2014 JSC "UKTMC" registered in London the 100% daughter company «UKTMC International Ltd» for direct access to foreign consumers of products and capital markets. The produced spongy titanium is fully exported to the United States, the Netherlands, Great Britain, Japan and other countries. At this shipment of products is made according to long-term contracts.

Certification according to the system «Nadcap» confirmed the conformity of production of JSC "UKTMC" to international requirements to the suppliers of the aviation industry. According to experts' assessment JSC "UKTMC" has a 50% share in the market of titanium sponge in USA and 20% - in the world market [15].

Within the framework of the SP IID the construction of the second beneficiating plant on the basis of field "Satpayevsk" and the second ore-heat-treatment furnace in the workshop of titanium sullage is foreseen. Developments for improving the technology of vacuum-arc melting of titanium ingots, production of forgings for marine titanium alloys [16, 17] are being carried out.

In September of 2014 the Government of France, represented by the state company «ADEME» (Agency in the field of environment and power industry), and the joint venture "UKAD" launched the project "EkoTitanium." The project worth of 50 mln. Euro involves the construction of a plasma furnace for processing titanium scrap into ingots. This will allow the joint venture "UKAD" to forge titanium ingots into products for medical use and manufacture of aircraft engines. A good chance of vertical integration of "UKTMC", cooperation with foreign partners appear, and most importantly waste-free production is created.

3.2.2 Key indicators

It should be noted that in addition to titanium, the plant produces magnesium, vanadium and scandium. Analysis of the dynamics of the main indicators gives an idea about the activity of "UKTMC" (**Table 2**) [14]. As is seen, the sales proceeds from products is unstable, therefore and other indicators within its power, do not have stable dynamics. Costs per 1 USD of revenue are high enough - from 0.75 to 0.85 USD. The company allocates sufficient funds for investment. Unfortunately, earnings per share dropped significantly from 8.23 USD in 2012 to 0.35 USD in 2013. The authors have carefully studied all available materials about the work of the enterprise, but there is no explanation for this in them. We believe the decline is caused by revenue fall by 1.8 times, and also the change in accounting policy of the company with respect to its interest in the joint venture in 2012y.

To our opinion, fluctuations in the work of the company may be caused by the influence also of some institutional factors:

1. market mechanism of management is not fully formed in the economy, sometimes administrative methods of management operate;
2. the system of state regulation has barriers for business, economic incentives are not sufficient;
3. although the tax burden is lower than in EAEC member states (Belarus, Russia), tax administration and presence of corruption raises admonition;
4. the change of exchange rate of the national currency, inflation expectations cause concern of entrepreneurs, interfere with the normal planning of operation.

There are constant investments in new construction and modernization, both from the company and from foreign partners. This, of course, affects the costs. However, there is no sufficient scale of production and deeper processes where large added value is created.

3.2. 3 Dynamics of costs

Analysis of the structure of production costs and sales of the company speaks about the reduction of power costs, though in whole tariffs are rising countrywide (**Table 3).** Costs for raw materials also reduce, which is quite normal, considering that JSC "UKTMC" is the owner of the mine for the extraction of raw materials.

Wage increase and accordingly, increase of the social tax, which together account for 36%, impact on costs. Costs for chemicals increased significantly, this may be related to their acquisition from foreign companies, the price of which depends on the demand and is fixed in USD dollars (after August 21, 2015 the USD dollar rate rose strongly and now has passed the mark of 330 KZT). In addition, the statutory system of public procurement in Kazakhstan on almost all goods, works and services often does not allow purchasing materials of appropriate quality at an affordable price. That is why, in November 2015 amendments to the Law on Public Procurement to facilitate the conduct of business, were introduced. [18].

3.2.4 Securities

In circulation at Kazakhstan Stock Exchange (KASE) there are 1, 942, 380 ordinary and 107, 910 preferential shares. The structure of holders of ordinary shares did not change the last three years : Specialty Metals Company - 47,2%; New Asia Investment Group Ltd - 10%; Metal Capital Investment Ltd - 9%; Metal Resource & Technology Ltd - 8%; New Metal Investments Ltd - 8%; Kolur Holding - 6,8%; other - 11% [14]. Ordinary shares are recorded as capital; preferred shares have a mandatory warrant and are reflected in the mix of borrowings. The size of dividends is determined at the general meeting of shareholders.

The market value of ordinary shares is supported by annual capital gain. The attractiveness of shares is determined by the implementation of long-term development of the company, which provides for the production of titanium sheets and pipes for shipbuilding companies, desalination plants, power industry, medicine. Despite the decline in revenue and net profit, the balance cost of shares is held at a constant level, not less than 40 USD.

The company maintains a high quality of products that meets the requirements of manufacturers in aerospace and defense industries. As well as any enterprise, the company is under the influence of various risks. In the report it is pointed to a significant impact of price on profit as the result of changes in market conditions and also the impact of change of national currency rate on income. Volatility of KZT affects the creation of inventories, purchase of raw materials and reagents, purchase of equipment.

3.2.5 Sales market

The highest consumption of titanium in the world is in industry - 45% and civil aircraft industry - 40%. Kazakhstan titanium is fully supplied in aerospace industry [14]. Because of the unique high-strength the titanium alloys are used in the load-bearing elements of the airframe and landing gear. Titanium is the only light and heat-resistant material that is completely compatible with composites, so it is used for production of various parts of engine. Boing 787 approximately in half consists of composites and of 15% of titanium, thus the weight loss by 20%, compared with traditional aluminum constructions, is achieved. Boing 777 on 70% consisted of aluminum, only on 11% of composite and on 7% of titanium. Titanium content in airplanes of new generation increases on average by 2.5 times [19].

However, one cannot say that the demand for titanium will only grow, everything depends on orders for airplanes, other military equipment, needs of industry, other branches. To avoid risks of fluctuations in demand for titanium it is necessary to look for alternative areas of its use. So new consumers appeared on the market of Kazakhstan titanium in recent years (**Table 4)**. Also, there are companies willing to cooperate with JSC "UKTMC" by

investments for further development. However, the authors adhere to the idea of deeper processing of titanium and its application in the domestic market.

Conclusions follow from the analysis of titanium market:

1. Raw materials' base and capacities of the mining -metallurgical complex of Kazakhstan have a great potential for the production of a variety of titanium products.
2. Due to the fact that domestic consumption of titanium products is not set, the market depends on export and the work of JSC "UKTMC" is unstable.
3. The company is working hard to introduce innovations, it is necessary to expand further the range of titanium products, to produce goods of higher stages.
4. By-product extraction of other metals from ore, production of new alloys and materials will contribute the cost saving.

3.2.6 Search for market niches

The forecast of social-economic development of the Republic of Kazakhstan for 2015-2019yrs. provides for: growth of non-primary export by 1.7 times; reduction of power intensity of processing industry by 15% [20]. In metallurgy efforts will focus on maximizing the processing of raw materials within the country and the production of innovative products of high stages, which ensure the development of related industries, such as engineering, construction industry [21].

In the medium term time new projects will be implemented: construction of copper-smelting and electrolysis plants, two mining –and-processing integrated plants and factories for processing gold ores in the deposit "Yubileinoye". The implementation of such large-scale tasks supposes the development also of titanium industry. In this regard, the authors would like to express their views on the area of titanium use in the domestic market.

1. Industry. Industrial titanium is needed in the production of chemical products, heat exchangers, liquid separators, high-pressure vessels, for water desalination, which is important in conditions of Kazakhstan. As wear-resistant material, titanium is used in the manufacture of sport articles, jewelry, watches, glasses, bicycle frames and others.
2. Production of marine engineering. Titanium is used successfully in the manufacture of ship hulls, pumps, pipes and other parts, which are directly in contact with sea water. The use of titanium is possible in the infrastructure of Aktau seaport on the Caspian Sea and shipping on the Aral Sea.
3. Oil and gas extraction. The last years there is a trend of hydrocarbons' extraction in marine waters and at deep sea. Titanium is the best construction material for drilling rigs because of the corrosion resistance and high strength. Pipes made of titanium can reduce the cost of oil extraction, which is especially important in conditions of severe decline in world oil prices. Oil extraction on the Caspian shelf plate, launch of the project "Kashagan" make titanium irreplaceable for Kazakhstan.
4. Power industry. This branch is a large consumer of titanium in heat exchangers, in nuclear power stations. The construction of one block of NPS with capacity of 1 GWt consumes more than 160 tons of titanium mill products. Rising demands of large developing countries like China, Russia, India in electricity may be covered by the construction of nuclear power stations. Construction of NPS is planned also in Kazakhstan, currently search for a suitable construction site takes place.
5. Medicine. Titanium is ideal for manufacture of implants, cardio stimulators, various artificial limbs thanks to such properties as corrosion resistance, nontoxicity, compatibility with human tissues.

Today, practically there are no competitors for titanium and alloys on its base. The high price is the main obstacle to its mass use. Of course, the technology of production of

titanium products is constantly being improved, and, possibly, will reduce costs. For example production of titanium pipes by method of electron-beam melting is a new approach to solving this problem. The method significantly reduces the cost of processing, increases the usable metal yield by reducing the number of processing steps. Attention is paid in the next section to the issue of search for the most effective solutions to increase the output of titanium products due to improvement of technologies.

3.2.7 Technology of scrap processing

Processing of titanium concentrate consists of several basic technological stages: 1) magnesium-thermal production of titanium sponge, 2) ion -vacuum re-melting in metallic titanium for different purposes and quality, 3) production of rolled products and alloys, 4) titanium products (forging, stamping, welding, machining etc.).

The ingots of vacuum-arc remelting (VAR) have a cylindrical form and can weigh from 4 to 8 tons. Ingots are forged for production of slabs, billets, or used for investment casting. Slabs, sheets, rods, bars, wire, pipes from threaded sheets of candies are produced by method of rolling [23].

Scrap is always generated in one form or another in these stages (up to 90% of titanium production). It is estimated that the actual finished product contains only 30% of titanium ingot bars. The remaining 70% - scrap, which can be remelting and used again [24]. The reduction of the cost for titanium products by involving scrap into secondary circulation seems to be a promising direction. This will allow cheapening the secondary alloys by 30 or more percent while maintaining the basic structural properties, typical for titanium alloys.

It is known that expensive components of the charge and ion- vacuum remelting account for the major share of the cost of titanium ingots. It is estimated that every 10% of scrap reduce the cost of charge by 5-8%. Involvement into charge of 10% of scrap per 1 ton of melted ingots saves at average 100 kg of sponge and 10 kg of alloying elements [22]. Boing is developing the so-called "processing loop" in order to make maximum use of metallic scrap, which is generated from the production of their products directly at this enterprise. Prices for metallic scrap are at historically low levels. The reason is that some part of scrap is recycled and re-used, some part is accumulated.

Scrap is generated in pyro-metallurgical production and machining of titanium parts in the form of scrap, chippings. The main share of the scrap belongs to sub-standard class, because of the degree of oxidation, back fins, encases, they cannot be transferred into charge raw material for involvement in melting ingots.

There are no figures in JSC"UKTMC" on scrap generation, the reports include only amount availed from sale of scrap. If to follow the working regulations, then from the end of 2013 the Government of Kazakhstan prohibited export of scrap “to prevent critical shortage of scrap and scrap of ferrous metals in the domestic market”. In Kazakhstan 3.5mln. tons of scraps are generated annually, out of them 20% are exported [25]. His main consumers are the European Union, Moldova, Uzbekistan, Iran and China [26].

Here there are two problems: low load of capacities to process the scrap (23% in 2013); expensive railway tariff for scrap transportation. Prior to the ban the scrap price was 215 USD per ton, but Kazakhstan refineries want to buy it at dumped prices of 135 USD. For export of finished products, made of scrap, the state may get profit at least four times more. Therefore, the National chamber of entrepreneurs recommended the Government to consider the issue of including scrap in the List of commodities and to subsidize part of the cost of their shipping [27]. Taking into account the implementation of investment projects in metallurgy already by 2016y. shortage of ferrous scrap in the domestic market from 1,6 mln . to 2,8 mln. tons is expected.

However, such a ban cannot be applied to rare and non-ferrous metals, as often there is no production base for processing. First of all, one needs to create capacities at the same factories where scrap is generated. Active remelting of titanium scrap into ferrotitanium, instead of their export, is the solution of the problem [28]. This will enable the development of iron and steel industry, the production of titanium-containing stainless steels. Construction of iron and steel mini-plants for production of various groups of special titanium containing steels: construction, mechanical engineering, corrosion-resistant, heat-resistant, tool is profitable because it would allow Kazakhstan to reduce dependence on import of stainless steels and produce ferrotitanium for export.

Recycling by the manufacturer himself is significant in world practice. For example, VSMPO AVISMA Corporation in Russia mastered the technology for producing rich ferrotitanium from substandard titanium scrap. Ingots have easily fusible eutectics (1085˚) in the system: titanium-iron with titanium content of 65-75%. This method makes it possible to melt scrap in form of a piece, packaged and baled shapes and also loose crushed titanium chips [28]. Perfect constructions of furnaces for remelting titanium sponge into titanium and alloys are developed in Russian Federation. Use of ultra-high pressure press is excluded. Titanium is produced by a single melting operation according to electron- beam technology, practically there are no wastes. The cost of titanium sponge is 6 USD / kg. The cost of 1 kg of titanium tube is 50 USD / kg [29].

Chinese titanium company "Baoji Titanium Industry Company» (BAOTi) which, along with production of titanium sponge, melting - casting processing, forging and production of finished products, is actively engaged in recycling , is an example of successful recycling [30].

Use of 3D-printer technology is the most promising solution of recycling wastes in the world [31]. The British company Metalysis has developed the technology to produce relatively inexpensive material for the 3D-print of titanium powder on printer Renishaw. Powder is produced by recycling wastes or titanium oxide, which is part of natural rutile sand. It is believed that according to this technology the production cost of powder and product cost will be reduced by about 75%.

Currently Metalysis Company has started the construction of an enterprise to produce titanium powder for 3D-print in the town Yorkshire. Estimated project cost ranges from 50 mln. USD to 500 mln USD. It opens great opportunities at a relatively low cost value of titanium powder for manufacturing metal parts in 3D-printing [32]. In addition, up-dated technologies of direct metal deposition – Direct Metal Deposition (DMD-technology) appeared, which could mark the beginning of revolution in the multibillion-dollar titanium industry.

Norwegian company Norsk Titanium Components (NorskTiCompon), which has built a plant with a view that 3D-printing technology would significantly reduce the volume of titanium scrap and time for production of titanium products, is developing in the same direction [32]. The company anticipates that production scrap can be reduced to 20% and prices by reducing the cost will be 30-50% lower than competitors' prices. Simultaneously NorskTiCompon also will be able to produce titanium components of higher quality than similar products.

Considering that recycling of titanium is much more complicated than of other metals and the cost of titanium plates is about 174 USD / kg, it is necessary for Kazakhstan already in the current period to develop and move on to a new level of production of titanium products, based on 3D-printing technologies [31]. It is necessary to put the development of 3D- printer technology in the broad sense into the strategy and structure of industrial revolution of the Republic, into the work of institutional and governmental authorities for

2016-2020 yrs. Namely they must determine the position of national economy in the world, its strategic positions and effective resistance to various permanent global crises: power-ecological, raw material, financial, etc.

4. Conclusion

Currently many construction materials are on the edge of exhaustion of their possibilities. Therefore demand for efficient products, for safe and environmentally friendly products from titanium and titanium alloys constantly grows. However, titanium is one of those products that have a narrow demand and its production on the basis of comprehensive study of demand must be very carefully planned. However, consumers of titanium products must properly plan their inventories to avoid overproduction or deficiency. It must be borne in mind that it is very difficult to enter this market, since the manufacturers are known and for a long time cooperate with customers.

To expand the area of application of titanium and its alloys it is necessary to develop unprecedented earlier composite materials and introduction of new 3D printing technology. There are all preconditions in Kazakhstan for this purpose:

• Availability of scientific reserve (research on this issue).
• Favorable investment climate in the country.
• Developing transport logistics, enabling to deliver products quickly to China, Europe, the Middle East (autobahn "Western Europe-Western China"). Great perspectives open in connection with plans of China to build in two years a railroad from China via Almaty, Bishkek, Tashkent, Samarkand, Ashgabat to Turkey.

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Table 1 - Export potential of the mining - metallurgical complex of Kazakhstan, mln. USD.

	2005	2010	2011	2012	2013	2014	2014г. в % к 2012г.
Refined copper	1436,2	1866	2976,7	3427,9	2678	1829,8	53,4
Ferroalloys	966,9	1826	3370,6	3893	1715,7	1 557,1	40,0
Rolled steel	920,8	1248	2157	1332	1165,5	1019,3	76,5
Silver	189,1	333,6	618,3	988,9	643,7	480,2	48,5
Aluminum	20,4	362,4	523,9	461,9	464,4	385,7	83,5
Zinc	312,8	554,2	767,3	1030,9	455,6	588,2	57,1
Gold	200,3	865,2	983,5	862,7	445,8	358,5	41,6
Scrap of ferrous metals	249,2	179,9	233,8	226,6	212,9	35,8*	15,8
Lead	89,1	177,4	356,1	323,8	159,1	209,5	64,7
Chromium oxide	32,8	83,8	110,2	116,4	108,5	101,3	87,0
Titanium	96,7	103,9	169,2	219,1	107,9	89,7	40,9
Tantalum	19,6	26,1	66,2	86,6	100,1	67,8	78,3
Manganese	36,9	64,4	105,5	79,8	102,9	81,4	102,0
Source: KAZNEX INVEST " and the Report of the National Bank of Kazakhstan on the Balance of Payments, published BNews.kz. ** Government of Kazakhstan imposed a ban on export of scrap at the end of 2013y.*							

Table 2 - Dynamics of the main indicators of JSC"UKTMC" in 2010-2015yrs., thous.USD

№	Indicators	2010	2011	2012	2013	2014	By three quarters of 2015y.
1.	Sales proceeds from products	104139,4	183526,7	224983,9	121280,4	91341,6	162986,6
2.	Cost of sales of products	91122,4	136371,0	186266,1	113569,9	73797,6	142902,2
3.	Shareholders' equity and liabilities	175652,9	217706,4	248035,6	281081,6	294735,7	382920,0
4.	Invested cash assets	16328,7	30577,6	27063,0	21380,5	15256,2	12155,8
5.	Income tax from operating activities	1657,1	10986,3	6208,4	6521,2	7215,0	6142,0
6.	Net profit	5079,1	19429,5	18857,8	712,1	1279,3	678,6
7.	Book value of ordinary shares , $	40,36	50,23	57,74	56,25	47,55	46,0
8.	Earnings per share, $	2,61	10,01	8,23	0,35	0,63	0,33
9.	Rate of national currency, accepted in financial reporting (KZT) for 1 USD.	*147,35*	*146,62*	*149,11*	*153,61*	*179,12*	*186,38 (average dated as of 20.08.2015)*

Source: Consolidated financial statement for 2010-2014yrs., for three quarters of 2015y., placed on the site of Kazakhstan Stock Exchange (KASE).

Table 3 - Structure of costs for production and sales of products of JSC"UKTMC",%

№	Cost items	2010	2011	2012	2013	2014
1	Electricity and heat power	33,5	30,1	24,7	29,4	21,4
2	Raw materials	27,1	26,3	33,5	26,0	23,9
3	Wages	14,2	13,8	13,7	15,8	18,2
4	Chemicals, fuel and other materials	12,6	14,8	13,5	14,8	18,0
5	Depreciation and amortization	8,6	9,6	10,2	10,2	11,1
6	Social tax expenses	1,3	1,5	1,4	1,6	2,4
7	Repair and maintenance	1,0	1,7	1,4	0,6	1,8
8	Other expenses	1,7	2,2	1,6	1,6	3,2

Source: Consolidated financial statement for 2010-2014yrs., for three quarters of 2015y., placed on the site of Kazakhstan Stock Exchange (KASE).

Table 4 - Sales proceeds from products. Broken down into geographical segments (spongy titanium and titanium ingots), %

№	Name of the buyer	Country	2010	2011	2012	2013	2014
1	Veltraid	UK	50	34	27	33	39
2	Presvik Trading	USA	31	27	20	16	14
3	Waterloo	USA	15	11	7	7	*
4	Almetko	USA	-	-	21	14	13
5	Ardor	UK	3	27	24	30	34
6	Others	-	1	1	1	-	-

Source Annual reports of JSC "UKTMC" for 2010-2014yrs.
** Accurate data are absent.*

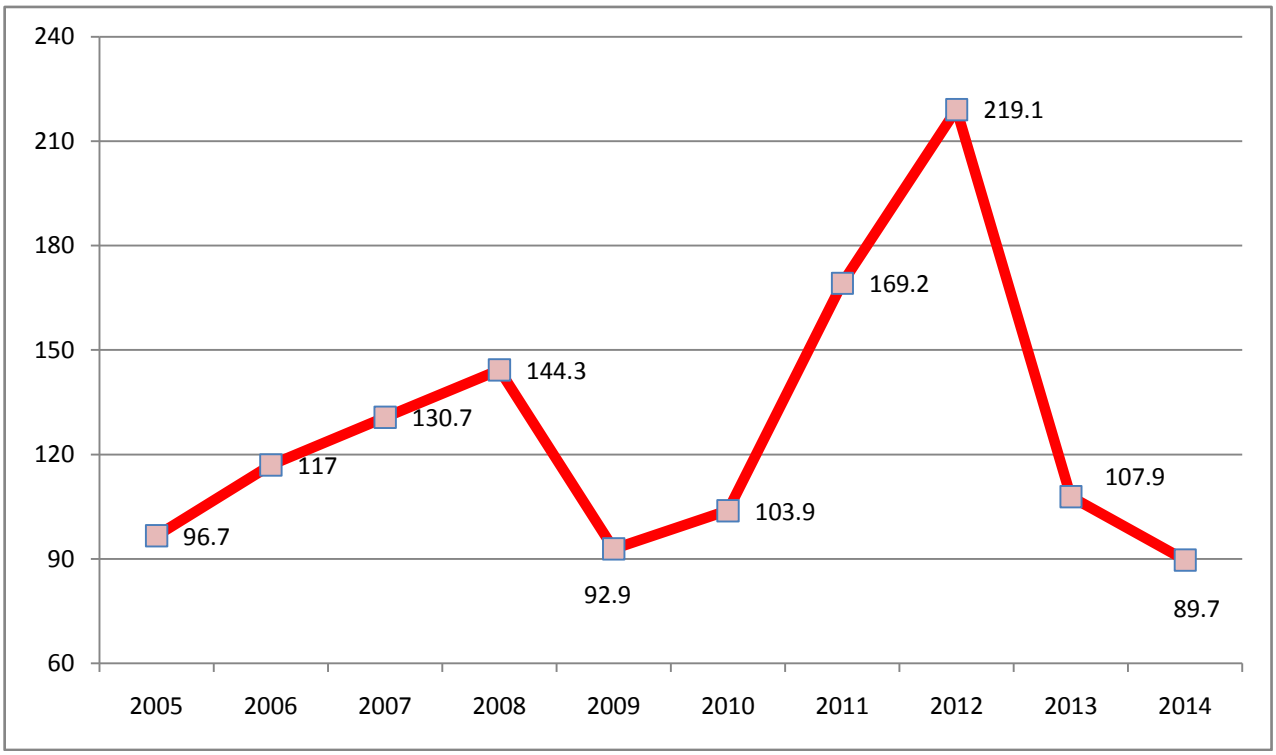

Figure 1 - Dynamics of export of titanium by Kazakhstan, mln.USD [10,11,12]