Tungsten Production, Market and Forecast in the CIS

12th Edition

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Annotation

The present report is the 12th edition of research of the market of tungsten in Russia and the CIS.

The monitoring of the market is conducted since 1999.

Research objective is the analysis of the market of tungsten concentrates, tungsten anhydride and ammonium paratungstate, ferro-tungsten and metallic tungsten of the CIS countries, and also of chains of their processing in the nonferrous metallurgy, ferrous metallurgy, and the lighting industry. The situation on the world market of tungsten and its raw materials is briefly considered.

Objects of a research are tungsten ores, tungsten concentrates (scheelite and wolframite), ammonium paratungstate, tungsten anhydride, ferro-tungsten and metal tungsten.

This work is a desk research. As sources of information we used the data of Rosstat, the Federal Customs Service of the Russian Federation, statistics of rail transportation of the Russian Federation, the Agency of statistics of the Republic of Kazakhstan, the State Customs Service of Ukraine; as well as materials of the US Geological service (USGS), of the database UNdata, of the branch and regional press, of annual and quarterly reports of issuers of securities, and also websites of producers of tungsten raw materials, ferro-tungsten and metal tungsten.

Chronological framework of a research: 1999-2016; the forecast – 2017-2025.

Research geography: the Russian Federation – the detailed complex analysis of the market; the Republic of Kazakhstan, Ukraine, Belarus, Uzbekistan, Kyrgyzstan, Tajikistan – the general retrospective analysis of the market; the rest of the world – general information about dynamics and characteristics of the market.

The report consists of 9 chapters, contains 272 pages, including 72 Figures, 112 Tables and 1 Appendix.

Chapter 1 of the report gives the short characteristic of the world market of tungsten raw materials and metallic tungsten (stocks, extraction, production, export and import of a concentrate and metallic tungsten by the countries, the prices).

Chapter 2 of the report discusses data on tungsten mineral resources in the CIS countries (in more detail in Russia), the structure of stocks and the characteristic of the main deposits.

Chapter 3 considers dynamics of production of the W concentrates in Russia in 1996-2016, as well as in Uzbekistan and Kazakhstan. The current state of the Russian and foreign GOKs (mining and processing combines), making tungsten concentrates is described. Besides, this chapter contains data on exports and imports of the W concentrates in the Russian Federation, Uzbekistan, Kazakhstan, and Kyrgyzstan. The balance of production and consumption of concentrates in the Russian Federation in 1999-2016 is separately considered.

Chapter 4 is devoted to the market of ammonium paratungstate (PTA) and tungsten anhydride. Data on production of these raw materials are provided for Russia and Uzbekistan. The Russian foreign trade operations with tungstates in 1999-
2016, and also the balance of production and consumption during this period are
considered in detail.

**Chapter 5** of the report describes the current state of the industries consuming
tungsten raw materials:
– production of ferro-tungsten (main Russian producers, a detailed analysis of
the Russian export/import of FeW);
– production, exports and imports of metallic tungsten in the CIS (a description
of the main Russian and Ukrainian producers, the analysis of the Russian and
Ukrainian foreign trade operations with various tungsten products).

**Chapter 6** is devoted to the Russian export-import prices of a tungsten
concentrate, anhydride, ferro-tungsten, metallic tungsten in 1999-2016.

**Chapter 7** provides short characteristics of the industries consuming ferro-
tungsten and metallic tungsten.

**Chapter 8** considers projects and investments into the tungsten industries of
Russia and the CIS countries.

**Chapter 9** gives the forecast of production and consumption of tungsten raw
materials (a concentrate and anhydride) in Russia till 2025.

Contact information of the main enterprises, which are releasing and
-consuming tungsten raw materials, is given in the **Appendix**.

**Target audience of a research:**
- participants of the market of a tungsten concentrate and chains of its further
consumption – producers, consumers, traders;
- potential investors.

The offered research may serve as a **handbook** for the services of marketing
and experts making administrative decisions at the market of tungsten raw materials.
Introduction

Tungsten is a metal of silver-white color with a very high temperature of melting and high hardness. The tungsten density is 19.3 g/cm$^3$, $T_m = 3410 \pm 20^\circ$C, $T_b = 5900^\circ$C.

This metal found its industrial application at the end of the 19th century, when its effect on improvement of properties of steel was discovered. Intensive development of the tungsten industry is connected with the invention of the high-speed steel containing tungsten, and tungsten thus became one of the major alloying metals.

Tungsten finds applications in a number of industries thanks to the unique physical properties, among which are the high hardness, and a very high density and refractory qualities. The metal is also characterized by a high corrosion resistance. In the form of pure metal, tungsten is used generally in the electronic industry, but its numerous compounds and alloys find applications in various spheres of consumption.

By the hardness tungsten is second only to diamond. Thanks to ability to keep hardness at high temperatures and a high melting point, it can be used in at high-temperatures, in particular in the electrotechnical industry, in production of incandescent lamps and electron beam tubes, and also in applications connected with heating and welding (in the gas and tungsten and arc welding or in the so-called TIG welding). Among all metals, tungsten has the highest melting point and the smallest coefficient of a linear expansion at the largest tensile strength (above 1650$^\circ$C) that defines its applications in the aerospace industry for production of turbo-compressor jet engines.

In metallurgy tungsten is widely used not only for production of aviation special alloys, but also for smelting of high-speed steels, some grades of which contain up to 18% of tungsten.

Thanks to its high density tungsten, is a basis of heavy alloys, which are used for counterbalances, armor-piercing cores of subcaliber and arrow-shaped fin-stabilized shells of artillery pieces, cores of armor-piercing bullets and superfast rotors of gyroscopes for stabilization of flight of ballistic missiles.

Chemical compounds of tungsten are used in production of catalysts, inorganic pigments and high temperature (to 500$^\circ$C) lubricants (on the basis of a tungsten disulfide). The tungsten carbide, which is one of the hardest carbides and has a high melting point (2770$^\circ$C for WC and 2780$^\circ$C for W$_2$C), thanks to the hardness has the wide range of industrial applications: the heavy mechanical engineering, production of special alloys, wearproof abrasives and the high-speed tools, which production applies the combination of tungsten carbide with cobalt or a coating with a nitride or carbide of titanium.

Oxides of tungsten are applied at production of glaze to ceramics, and tungstates of calcium/magnesium are widely used in luminescent lighting fixtures. Crystal tungstates serve as scintillation detectors in nuclear physics and medicine. Other tungsten-containing salts find application in the chemical industry and tannic processes. "Tungsten bronze" (called so thanks to color of oxides of tungsten) is used at the paint production.
1. Brief characteristic of the world market of tungsten raw materials (stocks, production, prices)

Total confirmed tungsten reserves in the world, according to the US Geological Service (USGS), make 3.1 million tons. Distribution of world reserves of tungsten and the extraction of tungsten ores by countries is presented in Table 1.

Table 1. Stocks and extraction of tungsten ores in the world in 2003-2016 (in terms of WO₃), thousand tons

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* – data of USGS do not coincide with real production in the Russian Federation
Source: USGS

As seen, China possesses the largest reserves of tungsten; it is also the largest global manufacturer of a tungsten concentrate and tungsten products (Fig. 1). The second place in the world both on the extraction of tungsten ores, and on production of a tungsten concentrate belongs to Vietnam. This country put into operation its own tin-tungsten Nui Phao deposit in 2013.

The 3rd-4th place on stocks is shared by Russia and Canada (250 and 290 thousand tons in terms of tungsten anhydride).

The USA does not publish own data.

Nevertheless, America possesses sufficient strategic stocks of a tungsten concentrate and tungsten metal. Strategic reserves of mineral raw materials (not only tungsten) were created in the USA after World War II in a case of the termination of deliveries from external sources. Since 1999, the long-term program of sales of tungsten raw materials (generally ores and a concentrate) from National strategic reserves (NDS) of the USA began.
Situation in the world market of tungsten is complicated. The market of raw materials is actually monopolized by the People's Republic of China. Such situation developed already in the 90th.

Traditional Chinese advantages in the form of low costs (the key advantages in the industry – salaries, expendables and the electric power) in case of the tungsten industry were combined with an excellent resource base (a higher content of a useful element in ores and a territorial concentration of conveniently located ore fields). The content of a metal in the Chinese ores reaches 1-2% of WO$_3$, that several times higher than those at foreign producers. Therefore the prime cost of metal in China was approximately two times lower than for the most of their foreign competitors. Besides, explored reserves will last for 100 years at the modern production level.

The Chinese expansion led to the fact that at the end of the 2000th mines of India, Myanmar, South Korea, the USA and Kazakhstan completely stopped the extraction.

The tungsten industry of China for the last 20 years underwent the radical restructuring, connected with the closing of the unprofitable enterprises, merges and vertical integrations. From 2002 to 2004, the number of the mining enterprises in the country was reduced with 248 to 118 due to their official closing, merge and exhaustion of stocks. The Chinese producers of ammonium paratungstate (PTA) were also united and began to buy raw materials not only in the domestic market, but outside the country as well.
The growing economy of the People's Republic of China led to the significant growth of consumption of tungsten-containing materials for production of the finished goods intended for use in the domestic market.

Since 2005, the Chinese suppliers ceased to be exempted from taxes on import of raw materials and value added taxes, which resulted in the growth of the export prices of the processed material.

In 2006, according to the government strategy, the development of the industry of non-ferrous metals of China kept its rapid growth, and the internal consumption of tungsten production sharply increased. All this negatively affected volumes of supply of tungsten to the world market. A shortage of resources became also a main problem in 2006.

According to the Ministry of land and natural resources of China, in 2007 the government of the People's Republic of China took measures for regulation of production and export of tungsten for control over its total production, the improvement of the structure of the industry and environmental protection. The country leaders count on a gradual shift of balance of export quotas towards finished goods with the added value both at the domestic enterprises, and at joint ventures with participation of the foreign companies.

So, in 2007 the release of tungsten concentrate (with the 65% content of \( \text{WO}_3 \)) amounted to 59,270 tons that is by 210 tons more than in 2006.

For control, regular inspections of the enterprises making a concentrate of tungsten and rare-earth metals are carried out.

According to the new rules, which came into force in 2007, all newly created enterprises are obliged to have the annual capacity of not less than 5 thousand tons of ammonium paratungstate, 2 thousand tons of powder of tungsten or 2 thousand tons of tungsten carbide. The annual release by the separate enterprises should not be less than 100 tons of metal or 200 tons of alloys. The acting producers were also obliged to bring production into accord with new requirements.

Besides, in 2007, the government of the People's Republic of China established export duties in 5% for ammonium paratungstate, tungsten rolled products and tungsten oxide. However, this had no significant effect on the price level in the European market.

All this together with the world financial and economic crisis led to a sharp reduction of volumes of extraction of tungsten ores in China (by ~ 48-50%) in 2008-2009 and, as a result, to reduction of the worldwide extraction of tungsten ores by 40%.

In 2007-2008, the numerous companies worked on development of new and the re-start of the mothballed tungsten deposits in Asia, Australia, Europe and North America. As a result, new productions of tungsten concentrates were organized in Australia, Peru, Spain, the USA and Uzbekistan. However, the serious recession in the world financial markets in the second half of 2008 postponed the start of some planned additional productions.

In particular, at the end of 2008, in connection with the world financial and economic crisis, the development of the Chinese tungsten fields in the Provinces of Hunan and Jiangxi was suspended. In 2009, to help domestic manufacturers, the
Chinese government reduced export taxes on some tungsten production and offered loans to producers in exchange for tungsten concentrates and products.

Recession in the world industry in the crisis 2009 year led to an increase in quotas for production and export of tungsten from the People's Republic of China as measures of support of producers. So, in 2010 was decided to allow the release of up to 80 thousand tons of tungsten concentrate, in 2011 – to 87 thousand tons. Also export quotas were increased – from 14.6 thousand tons in 2009 to 15.7 thousand tons in 2011. However, in 2012 export quotas were reduced to 15.4 thousand tons.

By 2012, the need for a post-crisis restoration of capacities, the control of the government of China over production and export of tungsten, and also a temporary suspension of sales of tungsten concentrates and products by the National center of protection of stocks of the USA resulted in deficiency of the supply of tungsten and the increase in prices.

In March 2012, the USA, the EU and Japan submitted the application to the mechanism of settlement of disputes to the WTO to carry out consultations on restrictions of China for export of tungsten, molybdenum and rare-earth metals. In March 2014, the WTO in "the first instance" decided that the Chinese measures for control of export of the corresponding production are violations of standards.

According to Gosstat's data of the People's Republic of China, in 2013 the extraction of tungsten in China exceeded the established quotas: The ministry of natural resources and land use of China established the maximum level on volumes of production and processing of tungsten raw materials (in an equivalent of the content of 65% of tungsten trioxide) in 89 thousand tons, however about 138 thousand tons were actually released.

In 2014, the World Trade Organization decided that export quotas and tariffs of the People's Republic of China contradict rules of free international trade and are incompatible with obligations of China as a member of the WTO. China was forced to cancel quotas since January 1, 2015, and to reconsider duties including those on tungsten-containing products. As a result, the government of the People's Republic of China approved a 6.5% tax on use of natural resources for producers of a tungsten concentrate. Earlier the 65% tungsten concentrate was assessed with a tax of about 2000 yuans/ton (328$/ton) depending on production volumes.

Analysts of the tungsten market assumed that this metal will become cheaper after cancellation of the export duty and that the cost of the W concentrate will fall so, that to the Chinese miners it will become unprofitable to extract it. And it happened.

In 2016, the industrial slowdown in China and weak economic conditions in other countries finally led to the excess of tungsten in the world market (taking into account the processing of secondary raw materials).

Due to the focus of the Chinese production of tungsten on the domestic demand, the role of other exporters of a concentrate for other large markets increased. It explains the appeared interest in the mining projects outside China, which were considered insolvent earlier.

The Wolf Minerals company (Great Britain), according to the Hemerdon project, started in 2014 the construction of a Mining and Processing Plant with a
capacity of 5 thousand tons of the tungsten concentrate and 1 thousand tons of the tin concentrate. In July 2015, the enterprise was put into operation. In 2016, the company produced 700 tons of tungsten concentrate (in terms of anhydride). Website: wolfminerals.com.au.

In Vietnam, the Woulfe Mining company in 2013 (as was already noted) began production on the Sangdon field. The Sangdong plant was a large producer of tungsten for nearly 40 years, before cessation of production in 1992 due to the low prices of the metal. Woulfe Mining acquired the license for mining in 2006. Field reserves are estimated at 45.8 million tons with the WO₃ content of 0.35%. The mine it is planned to extract 1.2 million tons of ore a year. The capacity of the processing plant will make 5 thousand tons of tungsten trioxide and 230 tons of a molybdenum concentrate a year. In 2016, Vietnam produced 6 thousand tons of a concentrate in terms of trioxide.

Spain and Rwanda began to operate tungsten mines. Bolivia increases the production of W concentrates.

According to data of UNdata, the world trade in tungsten concentrates in 2013 amounted to $326 million, that is by 1.5% lower than in the previous year. The main suppliers of tungsten concentrates to the world market were Canada, Russia, Bolivia and Portugal, which total share in 2012-2013 was more than 70% of the world trade with concentrates (Table 2).

In 2015, the situation changed. The world export made $445 million (taking into account the deliveries of tungsten ore). The four largest exporters of concentrate were Canada, Russia, Bolivia, and Spain. In 2016, Canada mothballed the mine and ceased the export of a concentrate.

In 2016, Russia became the largest exporter of a tungsten concentrate (5.5 thousand tons). Such a large delivery is connected with the fact that the concentrate, stored in a reserve, was sold. More detailed information on the foreign trade operations of the Russian Federation is considered in Section 3.2.3.

Let's notice that the WO₃ content in concentrates of the different countries differs (range – 55-66%). Export of middling products with a lower content of tungsten trioxide is possible.
### Table 2. The largest exporters of a tungsten concentrate in 2007-2016, tons

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*n/d – no data

Source: UNdata

Among the importers of tungsten concentrates stand out China, the United States, and in recent years, South Korea (Table 3).

We note, that Russia in 2014-2015 also increased import volumes. Purchases by our country of an import concentrate in the presence of the own production are connected with several reasons, in particular with the difficult logistics on delivery of a concentrate from the Far East and Transbaikalia (all tungsten mining and processing plants (GOKs) are located in the east of the country) to the Central and Ural region, the where hydrometallurgical processing of raw materials is carried out.

Besides, after the introduction of the 10% export duty on export of a tungsten concentrate, which was initiated by OAO Gidrometallurg and ZAO Company Wolfram, there was a conflict between producers and consumers of these raw materials.
Table 3. The largest importers of tungsten concentrate in 2007-2016, tons

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Source: UNdata

Considering the world trade with metallic tungsten and products on its basis, it should be noted that the USA, Germany, Great Britain and Japan at the same time are both the largest exporters and importers (Tables 4, 5). More than 90% of export and more than 70% of import of these countries (except for the USA) fall on the raw tungsten (including the bars made by a simple sintering) and wastes (Commodity Nomenclature of Foreign Economic Activity code 810191). Possibly, Germany, Great Britain and Japan import the scrap material, and export the tungsten products obtained from it. The USA besides a scrap, imports tungsten powders, processes the imported materials into a wire and other products, which are delivered to the world market.

Table 4. Largest exporters of metallic tungsten and products from it in 2007-2016, tons

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Source: UNdata
Table 5. Largest importers of metallic tungsten and products from it in 2007-2016, tons

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Source: UNdata

The secondary production of tungsten became an important source of the metal for producers of Europe and the USA. These regions are the main centers for processing of alloys and carbide of tungsten. **About 45% of demand for the metal in Europe and the USA are satisfied at the expense of secondary raw materials.** The largest companies, processing secondary raw materials are Plansee Group, HC Starck and Kennametal.

In Asia, in Japan about 20-30% of the domestic demand for tungsten were satisfied with the secondary processing in comparison with about 15% in China. The growth of processing outside China led to a considerable decrease of influence of the People's Republic of China in the world market and to the decrease in consequences from the export restrictions introduced in this country. The secondary tungsten provided more than 20% of the world deliveries in 2014-2016, and, according to forecasts, its share will increase to 26% by 2018, driven mainly by a broader processing of scrap of hard alloys in People's Republic of China.

China is not only the largest producer of tungsten, but also its main consumer: about 55% of the world use of the metal (Fig. 2) fell to the share of the country in 2016, the share of the countries of Europe – 15%, of the USA – 15%, of Japan – 10%. 
According to data of International Tungsten Industry Association (ITIA), the main volume of the metal is used in production of hard alloys on the basis of tungsten carbide. Hard alloys are the main tool material providing high-performance processing of materials with cutting. Today, the hard-alloy tools used in the machining production makes up to 30%, and this tool removes up to 65% of facings, because the cutting speed of tools made of the tungsten alloys is by 2-5 times higher, than for the fast-cutting tools.

Up to 20% of tungsten is used in the ferrous metallurgy for a steel alloying. About 11% of the world consumption fall to products from metallic tungsten. This type of production includes bars, a wire, sheets, plates, electrodes, etc., which are used in the automotive, space, defense and medical industry, in electronics, in jewelry, in sports equipment, and as welding electrodes.

Other spheres of consumption of tungsten are presented by lubricants, catalysts, pigments, etc.

The prices of tungsten concentrates, as well as of all mineral raw materials, are subject both to a growth and a decline. The tendency to falling of the prices of tungsten concentrates is observed since 2011.

This trend is connected with an excess of tungsten raw materials in the market. In total, from July, 2011, to December, 2016, the sale price fell from XXX USD/MTU WO$_3$ to XXX USD/MTU WO$_3$, i.e. by 3.5 times (USD/MTU – the amount of dollars for 1 ton of a material, which contains 1% of WO$_3$, i.e. for 10 kg of anhydride in a concentrate). At the end of 2015, warehouses in China and worldwide accumulated almost the annual reserve of tungsten oxide (about 60 thousand tons). It put pressure upon the price. In the first half of 2015, the price of tungsten concentrate fell below the average world prime cost outside China – to the level of XXX
USD/MTU WO$_3$, and in the second half of the year, stepped over a threshold of the prime cost of most the Chinese mining enterprises – XXX USD/MTU WO$_3$. As a result, in 2015 many mines worldwide stopped the activity or reduced the outputs because of shortage of current assets.

In 2016, a further falling of the prices of tungsten was observed. The average sale price of a concentrate fell in a year by 18% to XXX USD/MTU WO$_3$. The minimum level of the price in 2016 was XXX USD/MTU WO$_3$ (at the beginning of the year).

The main reason for continuation of falling of the price in 2016 is an excess of tungsten raw materials of the second processing (tungsten oxide, ammonium paratungstate and ferro-tungsten) in the world market. The excess reserve of tungsten, which was formed in 2015, was not lowered considerably, but, according to experts, it also did not grow up. As a result, the situation with the prices was stabilized, and at the end of 2016, the selling cost approached the mark of XXX USD/MTU WO$_3$. This level is a limiting threshold of profitability of most of the Chinese producers of tungsten concentrates, so, it is a basis for formation of the world prices for tungsten. According to participants of the market, in the next several years the price, most likely, will balance around this mark, until excess reserves of tungsten raw materials are reduced to a minimum.

Infomine has data on the export-import prices of tungsten concentrates (without recalculation of USD/MTU) of the main participants of the world market (Table 6).

**Table 6. Dynamics of the prices of tungsten concentrates (in physical terms) of main world exporters and importers in 2007-2016, $/kg of tungsten concentrate**

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*The prices are on border of the state of the importer/exporter; Source: UNdata*