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# **Tungsten market review in the CIS**

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## **Summary**

The present report covers the research of the current state of tungsten market in the CIS countries and the forecast of its development. The report consists of 7 parts, contains 130 pages, including 30 figure and 54 tables. The given work is the armchair research. Rosstat, the State Statistics Committee of the CIS countries, Federal Customs Service of the Russian Federation, official statistics of rail transportation of the Ministry of Railways of the Russian Federation, branch and regional press, annual and quarterly reports of emitters of the securities, and also the enterprises Internets sites were used as sources of information on tungsten manufacturers and consumers.

In the first chapte of the report the brief characteristic of the tungsten world market state (stocks, manufacture, the prices) is presented.

In the second chapter the minarel-raw-material source of tungsten in the CIS is described in detail.

The third chapter covers manufacture, export, import and consumption of tungsten concentrate in the CIS countries. The given chapter also considers in details the "know-how" of tungsten concentrate production. Besides descriptions of the basic enterprises - manufacturers of tungsten concentrate in the CIS countries are presented.

The fourth chapter covers the manufacture, export and import of tunsten-containing production in the CIS. The given section presents the data on manufacture of ferrotungten, tungsten anhydride and paratungsten ammonium, metal tungsten, tungsten carbide and hard alloys. Besides descriptions of the basic enterprises - manufacturers of the given production are presented.

The fifth chapter presents data on metal tungsten consumption. The given chapter includes the description of balance, dynamics and structure of consumption of metal tungsten in Russia, and also a brief characteristic of the branches consuming the given product.

The sixth chapter covers projects and investments into tungsten industry of the CIS countries. Here projects of the development and renewal of tungsten extraction in the CIS countries CIS are submitted.

In the seventh chapter of the report the state and the forecast of manufacture and consumption of tungsten in the CIS for the period till 2010 is presented.

In the appendix addresses and contact information of the enterprises-producers of tungsten production in the CIS countries CIS are presented.

## **Introduction**

Tungsten is the metal of silver-white color with rather high temperature of fusion and the high hardness. Density of tungsten - 19,3 gr/sm<sup>3</sup>, t of fusion=3410±20°C, boiling point=5900°C.

Metal got industrial application at the end of the XIX century after its influence on the improvement of steel properties had been discovered. Intensive development of the tungsten industry is connected with the invention of the fast-cutting steel containing tungsten which, thus became one of the major alloying metals.

The basic amount of tungsten is used for manufacture of ferrotungsten which is added to steel as an alloying additive. Mass application of tungsten in electrolighting, and then in electrovacuum technical equipment became possible when at the beginning of the XX century the industrial "know-how" of tensile metals, based on the use of powder metallurgy method was developed.

Tungsten also finds wide application in ceramic-metal hard alloys. Tungsten carbide is the basis of these alloys where cobalt and nickel are used as the cementing additive.

## 1. Brief characteristic of the of the tungsten world market (stocks, manufacture, prices)

The total confirmed stocks of tungsten in the world according to Geological service of the USA make up 2,9 million t. In Table 1 distribution of tungsten world reserves through the countries is submitted.

**Table 1 Confirmed stocks and extraction of tungsten ores in the world (in terms of WO<sub>3</sub>), thousand t**

Country	Stocks, thousand t	Extraction, thousand t			
		2003	2004	2005	2006
The USA	140	-	-	-	-
Austria	10	1,4	1,4	1,35	1,35
Bolivia	53	0,4	0,44	0,52	0,53
Canada	260	2,75	-	0,7	2,5
China	1800	52	67	61	62
The North Korea	20	0,6	0,6	0,6	0,6
Portugal	25	0,7	0,75	0,82	0,9
Russia	250	3,9	3	4,4	4,5
The other	360	0,29	0,51	0,71	0,95
<b>Total</b>	<b>2918</b>	<b>66,1</b>	<b>62,7</b>	<b>70,1</b>	<b>73,3</b>

Source: Geological service of the USA, «Infomine» (data across Russia)

Apparently, China possesses the biggest tungsten stocks, it is the largest world manufacturer and exporter of tungsten concentrate and tungsten production. The stocks second place is shared by Canada and Russia. The second place in the world as far as the extraction of tungsten ores and manufacture of tungsten concentrate is concerned belongs to Russia. The USA, having the 3 place in the world tungsten stocks, has not produced tungsten concentrate since 1994. At present tungsten deliveries to the USA completely depend on China and Russia.

Nevertheless, the USA possess sufficient strategic stocks of tungsten concentrate and metal tungsten. Strategic stocks of mineral raw material (not only tungsten) have been accumulated by the USA after the Second world war for protection against the termination of deliveries from external sources. Since 1999 the USA began realization of the long-term program of tungsten raw material sales (basically of ores and concentrate) from the National strategic reserves (NSR).

In 2003 the National strategic reserves of the USA were estimated to be 28 thousand t of tungsten concentrate and 479 t of tungsten powder. In 2003-2004 Congress of the USA authorized sale of about 1,5 thousand t of tungsten concentrate.

In the nearest years dominating role of China in world deliveries of tungsten will most likely be kept as well as in its manufacture.

Lately the tungsten industry of China has passed the radical re-structuring connected with the shut-down of unprofitable enterprises, merges and vertical integration. Starting with 2002 up to 2004 the number of the mining enterprises in the country was reduced from 248 down to 118 due to their official closure, merge and exhaustion of stocks. The Chinese manufacturers of paratungsten ammonium (PTA) were also united and tried to start purchasing of raw material outside the country.

The growing economy of China has led to the essential growth of tungsten containing materials consumption for manufacture of the finished goods that are use at the domestic market.

In August 2005 the Chinese government officially declared cancellation of tolling operations for a number of raw materials used for manufacture of ferroalloys, including tungsten. The Chinese suppliers are not exempted from taxes for import of raw material any more as well as VAT, that, probably, explains increase of the export prices for the processed material.

In 2005-2006 there was a sharp jump of the tungsten prices. It took place as a result of China carrying out of the program of internal consumers protection through system of state regulation. In 2005 the price of tungsten concentrate grew 2,8 times, up to \$7994 /t, and by 2006 rose 1,2 times and made \$9636 /t. This parameter turned out to be the highest for the latest seven years.

China provides the major part of global deliveries of primary tungsten, however since 1999 it reduced export volumes. In 2005 China exported 16 thousand t of tungsten.

In 2006, according to the government strategy, development of the industry of nonferrous metals of China had been growing quite fast. And, hence, internal consumption of tungsten production sharply increased that had a negative effect on the volume of tungsten deliveries to the world market. In 2006 the shortage of resources became the main problem.

According to the Ministry of ground and natural resources of China, in 2007 the Government of People's Republic of China introduced measures for regulation of tungsten extraction and export with the purpose of control over the total amount of manufacture as well as perfecting of industry structure and preservation of the environment. The country leaders expect gradual shift of export quotas balance aside finished goods with the added cost, both at domestic enterprises, and at joint ventures with participation of foreign companies.

In particular, according to the information of the Ministry of ground and natural resources of People's Republic of China, in 2007 tungsten concentrate production (with 65% content of  $WO_3$ ) should not exceed 59,270 thousand t, that is 210 t more than in 2006.

In January - April, 2007 tungsten concentrate production in China was 10% reduced down to 24,13 thousand t.

By the statement of the Ministry of ground and natural resources, regular inspection of the enterprises producing tungsten concentrate and rare-earth metals will be carried out for the control over the adherence of these norms.

Besides according to the new rules which came into effect in January 2007, all the founded enterprises are obliged to have annual capacity of 5 thousand t of paratungsten ammonium, 2 thousand t of powder tungsten or 2 thousand t of tungsten carbide minimum. Annual release of a separate enterprises should be 100 t of metal or 200 t of alloys minimum. Manufacturers that are on stream are also obliged to upgrade their production according to new requirements.

Since January 1, 2007 the Government of People's Republic of China established 5% export duties for paratungsten ammonium, tungsten rolled metal and tungsten oxide. In the immediate prospects, in opinion of trading firms, it does not render influence on the price level of the European market as business activity remains rather low. The European buyers of Chinese tungsten production expect price increase in the long-term prospect.

In case the Chinese producers increase tungsten price due to introduction of export duties, buyers in Europe will be compelled to get it at the increased prices.

Taking into consideration these changes the future manufacture of tungsten in China as expected to be basically focused on internal demand, and other large markets, for example, the USA, Japan and Europe will be served by exporters. It helps to explain resurfaced interest to mining projects outside China which seemed to be unessential earlier.

Thus Canadian company **Tiberon Minerals Ltd** informed, that project Nui Phao in Vietnam would be put on stream in 2008. According to the company, the new mine can provide for 4900 t increase of global deliveries annually. That will be one of the first new mines outside China which will replenish small, but extremely important economically group of such enterprises.

Other Canadian company **North American Tungsten Corporation** carried out reorganization in 2006 and renewed manufacture at Kantang mine located in the province North-West territories (Canada).

In 2007 Company **Hunan Nonferrous Metals**, one of the largest manufacturers of tungsten in People's Republic of China, and **Australian King Island Scheelite (KIS)** signed Letter of intent to jointly develop the tungsten ores deposit in the southeast of Australia

In March the Chinese company Xiamen Tungsten which has the lead in Chinese People's Republic in tungsten manufacture left this project. The company attributed this to the fact that probable sum of expenses for King - Island mine operation appeared too big.

Planned productivity of this mine is 600 thousand t of tungsten ore and 7 thousand t of tungsten concentrate annually.

Hunan Nonferrous also negotiates with other Australian company, **Thor Mining**, for joint development of tungsten and molybdenum ores deposits in the Australian state Northern territory. Company **Luoyang Mudu Mining and Smelting** and its partners have begun the construction of the largest in China factory for manufacture of tungsten and molybdenum production in the city of Loyang.

The factory is being built jointly by the company Luoyang Mudu and the companies Beijing Tianlong Tungsten and Molybdenum (Beijing Tianlong) and Luanchuan Zhonghe Burden (Luanchuan Zhonghe). Luoyang Mudu possesses 52% of factory shares, and each of its partners has 24% of shares. Cumulative investments into this project are planned to be at the level of \$38,86 million. Planned annual productivity of this factory will be 5 thousand t of paratungsten ammonium, 5 thousand t of tungsten ammonium, 2 thousand t of tungsten powder.

## 2. Mineral-raw material sources of tungsten in the CIS

About 15 tungsten minerals are currently in use, only four of them have industrial value: wolframite, scheelite, hubnerite and ferberite (Table 2).

**Table 2: Basic minerals of tungsten**

Minerals	The compound	Content, %	
		WO <sub>3</sub>	W
Ferberite	FeWO <sub>4</sub>	76,3	60,5
Wolframite	(Fe, Mn)WO <sub>4</sub>	76,5	60,6
Gubnerite	MnWO <sub>4</sub>	46,6	60,7
Scheelite	CaWO <sub>4</sub>	80,6	63,9

Deposits of tungsten are subdivided into the following basic groups:

- contact metasomatic (skarn),
- greisen deposit,
- vein deposit,
- gravel deposit.

**Skarn** deposits are the largest and have important industrial value. They are dated mainly to the zones of contacts of granitoids of increased basicity with carbonate depths. Tungsten here is featured by scheelite, sometimes - molybdoscheelite (Ca (W, Mo) O<sub>4</sub>). Tyrnyauzskoye deposit (Kabardino-Balkariya, Russia) belongs to this type.

**Greisen** (stockwork) deposits have wide spreading and are known for their large stocks. They represent a chain of quartz - wolframite or quartz - scheelite strings in silica-alumina, less often carbonate breeds changed by hydrothermal processes. The basic tungsten mineral is wolframite, less often scheelite. Frequently these minerals are accompanied by cassiterite (stannum-tungsten deposits), the basic mineral of stannum. Akchatau deposits (Kazakhstan) belong to the given type, for example Spokoyinskoye (East Zabaykayliye).

**Vein hydrothermal** deposits occupy predominating position in the global mining of tungsten. This type is usually represented by series of quartz veins or individual veins containing impregnated ore or nested congestions of minerals. In this group quartz - cassiterite-wolframite and quartz - wolframite deposits have the greatest industrial value. The following deposits belong to this type in the CIS territory: Dzidinskoye (Buryatiya), Iultinskoye (Chukotka), Antonovskoye (Easten Zabaykayliye), Bom-Gorkhonskoye (Western Zabaykayliye), Bogutinskoye (Kazakhstan).

**Gravel** tungsten deposits are formed as a result of washout of ledge ores, they contain wolframite and scheelite. Alluvial deposit are poorer in tungsten



content as compared to vein deposits, and now their industrial value in the CIS is insignificant.

Contents of the basic ore minerals of tungsten - wolframite and scheelite in ores is rather low. Minimum contents of  $WO_3$  in ores when their mining is profitable, makes 0,14-0,15% for large deposits and 0,4-0,5 % for smaller deposits.  $WO_3$  content at large deposits differs approximately between 0,2-0,3 up to 2%.

In the CIS territory there are 83 tungsten deposits, among them 46 deposits are real tungsten ores deposits. The basic deposits are specified in Table 3. The general estimate of tungsten stocks (ton of  $WO_3$  equivalent) in the CIS territory, according to "Infomine" estimation, makes up about 3 million t. Thus essentially tungsten deposits stocks make up to 93% of total stocks, gravel deposits - 2%, complex tungsten containing ores where tungsten has the subordinated value contain about 5%.

**Table 3: Basic tungsten deposits in the CIS territory**

<b>Deposit</b>	<b>Development stage/ Developer</b>	<b>Reserves*</b>	<b>Accompanying elements</b>
<b>Russia</b>			
<i>North Caucasus</i>			
Titrnyauzskoe	suspended	large	Mo, Cu, Bi
Kti-tiberda	standby	average	
Gitch-Titrnyauzskoe	standby	the small	Mo
<i>West Siberia</i>			
<i>Gorny Altai</i>			
Kalgutinskoe	mined/ «Kalgutinskoe RU» Ltd.	the small	
<i>East Siberia</i>			
<i>Republic of Buryatia</i>			
Holtosonskoe	Under development/ Joint-Stock company «MRA «Djidinsky volfram»	the small	
Inkurskoe	suspended	large	
Inkurskaya rossip	Not planned for development	the small	
Malo-oinogorskoe	standby	large	Mo, S, Re
<i>Chita Region</i>			
Spokoininskoe	mined / Joint-Stock company «Novoorlovsky GOK»	average	mica
Barun-shiveinskoe	suspended	the small	
Bom-gorhonskoe	mined / «Staratelskaya artel «Kvarz»	the small	Bi