Research Group

InfoMine

Association of independent consultants and experts
in mineral resources, metallurgy and chemical industry

Review of Molybdenum Market in the CIS

Demo

Moscow
December 2006

Internet: www.infomine.ru
e-mail: info@infomine.ru

Contents

List of Tables

List of Figures

Annotation

In the CIS, deposits of molybdenum have been explored in Russia, Armenia, Uzbekistan, Kazakhstan. For the latest 3 years, in the CIS, leader in development and mining of molybdenum ores was Armenia (Zangezur and Agarak copper-molybdenum combines), where volumes of molybdenum production was 7.9 kt in 2005. Russia produced 7.5 kt in 2005 (JSC «Molybdenum», JSC «Zhireken GOK»), Uzbekistan – 800t (Almalyk Mining-metallurgical Combine). In Kazakhstan, in early 2006, mining of Shorsky deposit, began; in 2007 mining of Kyzyltu deposit is to begin.

In the former USSR, a single system of mining, production of concentrates and obtaining final molybdenum products existed, including enterprises in various Republics of the USSR. After the USSR breakage, the previous economic ties were broken, and many enterprises were stopped: some owing to the lack of market of resources, and other owing to shortage of resources.

Nevertheless, investments in molybdenum sector, both from Russian and foreign industrial groups, allowed, in latest years, to organize production and sale of Mo products (JSC «Molybdenum», Russia; Zangezur and Agarak MMC, Armenia); to launch new productions and plants: ferromolybdenum at JSC «Zhireken GOK», JSC «Polema», JSC «Klyuchevsky ferroalloy plant» and JSC «Kamyshin casting-ferroalloy plant», (Russia), PJSC «Armenian Molybdenum Production» (Armenia); molybdenum oxide at joint venture «Uzmetall Technology» (Uzbekistan).

In latest years, high prices on molybdenum are noted at world market; one more feature is expanding share of Chine at the market, which exports a large share of its molybdenum products. In this situation, Russian producers practically completely export molybdenum concentrate produced, whereas Russian domestic demand for ferromolybdenum and molybdenum metal are satisfied at the expense of imports. In Armenia and Uzbekistan, molybdenum concentrate produced is completely processed inside the countries, and final mo products are exported.

The main commodity molybdenum-containing product in Russia is ***ferromolybdenum***. Experts of «InfoMine» forecast increasing production of ferromolybdenum in Russia by 10-15% per year in nearest years. A part of the Russian ferromolybdenum is exported that is encouraged by high world prices on the product. In this connection, increasing domestic consumption of ferromolybdenum will be up to 5% annually. Production of ***molybdenum metal*** in Russia slightly increases, whereas domestic demand is satisfied mainly by imports of the product. «InfoMine» doesn't expect significant increasing domestic consumption of molybdenum metal in nearest years, which will be up to 300 tpy.

Introduction

Molybdenum (from the Greek meaning "lead-like"), is a chemical element with the symbol Mo and atomic number 42. It has the sixth highest melting point of any element, and for this reason it is often used in high-strength steel alloys. Molybdenum is found in trace amounts in plants and animals, although excess molybdenum can be toxic in some animals. Molybdenum was discovered in 1778 by Carl Wilhelm Scheele and first isolated in 1781 by Peter Jacob Hjelm.

Characteristics. Molybdenum is a transition metal with an electronegativity of 1.8 on the Pauling scale and an atomic mass of 95.9 g/mole. It does not react with oxygen or water at room temperature. At elevated temperatures, molybdenum trioxide is formed in the reaction $2Mo + 3O_2 \rightarrow 2MoO_3$.

In its pure metal form, molybdenum is silvery white and very hard, though it is somewhat more ductile than tungsten. It has a melting point of 2623°C, and only tantalum, rhenium and tungsten have higher melting points. Molybdenum burns only at temperatures above 600°C. Molybdenum has the lowest heating expansion of any commercially used metal.

Molybdenum has a value of approximately $65,000 per tonne as of 4 May 2007. It maintained a price at or near $10,000 per tonne from 1997 through 2002, and reached a high of $103,000 per tonne in June 2005.

Applications. The ability of molybdenum to withstand extreme temperatures without significantly expanding or softening make it useful in applications that involve intense heat, including aircraft parts, electrical contacts, industrial motors, and filaments. Molybdenum is also used in alloys for its high corrosion resistance and weldability. Most high-strength steel alloys are 25% to 8% molybdenum. Despite being used in such small portions, more than 43,000t of molybdenum is used as an alloying agent each year in stainless steels, tool steels, cast irons, and high temperature superalloys.

Because of its lower density and more stable price, molybdenum is implemented in the place of tungsten. Molybdenum can be implemented both as an alloying agent and as a flame-resistant coating for other metals. Although its melting point is 2623°C, molybdenum rapidly oxidizes at temperatures above 760°C, making it better-suited for use in vacuum environments.

Molybdenum disulphide (MoS_2) is used as a lubricant and an anti-corrosion agent. It forms strong films on metallic surfaces, and is highly resistant to both extreme temperatures and high pressure. Sodium molybdate is a bright orange pigment used with ceramics and plastics. Molybdenum trioxide (MoO_3) is used as an adhesive between enamels and metals. Molybdenum powder is used as a fertilizer for some plants, such as cauliflower.

Occurrence. The world's largest producers of molybdenum materials are the United States, Canada, Chile, Russia, and China.

Though molybdenum is found in such minerals as wulfenite ($PbMoO_4$) and powellite ($CaMoO_4$), the main commercial source of molybdenum is molybdenite (MoS_2). Molybdenum is mined as a principal ore, and is also recovered as a byproduct of copper and tungsten mining. The large mining areas in Colorado (Climax) and in British Columbia yield molybdenite while the Chuquicamata

mines in northern Chile produce molybdenum as a byproduct of copper mining. The Knaben mine in southern Norway was opened in 1885, making it the first molybdenum mine. It remained open until 1973.

Molybdenum is the 42nd most abundant element in the universe, and the 25th most abundant element in Earth's oceans, with an average of 10.8 mt/km³. The Russian Luna 24 mission discovered a single molybdenum-bearing grain (1 × 0.6 μm) in a pyroxene fragment taken from Mare Crisium on the Moon.

A side product of molybdenum mining is rhenium. As it is always present in small varying quantities in molybdenite the only commercial source for rhenium are molybdenum mines.

Revealed world resources of molybdenum estimate around 18.4 mln t that is enough to provide world demand for the metal for a long time.

World production of molybdenum in concentrates is currently 130-140 kt per year. By late 90s, oversaturation of world market of molybdenum products resulted in dropping prices that forced the main producers to decrease output of the products. As a result, in early 2000s, the demand outstripped the supply and the prices began to grow since late 2002.

World mining of molybdenum ores in 2005 grew 15.6% year-on-year to 163 kt. Above 75% of world production of molybdenum in ores and concentrates falls to 3 countries: USA, Chile and China.

Estimated world demand for molybdenum grew from 100 kt (in equivalent of Mo) in 1990 to 181 kt in 2005, by 4.3% annually in average. The greatest consumers of molybdenum are USA, Japan, Germany and China, to which together around a half of world demand belongs.

In China, consumption of molybdenum for 2001-2005 was doubled, up to 18 kt.

In 2004-2005, mining of molybdenum ore in the world exceeded the demand. Nevertheless, shortage of molybdenum products took place owing to restricted capacities on processing the resources. In 2006, the situation remained the same.

In late 2005, 25 projects on mining of molybdenum ore and production of concentrate were considered, with total capacity of 105 kt/per year (in equivalent of molybdenum), including 6 projects on processing with total capacity of 42 kt per year.

Prices on molybdenum began active growth since March 2004 in conditions of shortage of the processing capacities and growing demand for molybdenum (mainly from stainless steel producers). By May 2005, the prices grew to USD40 – 50/pound of molybdenum (from USD4.5/pound in 1994 – 2004. In mid-2005, when the supply of molybdenum increased, the prices slightly decreased. In February 2006, the prices level was USD20-30/pound. A factor, keeping rather high level of the prices, was decreasing supplies of molybdenum from China, where, in conditions of growing domestic demand for Mo, a number of mines was closed.

1. Mineral resources base of molybdenum in the CIS

1.1. Reserves and deposits of molybdenum in the CIS

Above 90% of molybdenum is mined as molybdenite (MoS_2), which occurs in molybdenum ores of all types. Of mine importance are other molybdenum-containing minerals: wulfenite ($PbMoO_4$), powellite ($CaMoO_4$), ferrimolybdite ($Fe_2O_3 \cdot 3MoO_3 \cdot 7{,}5H_2O$).

In the CIS, as rule, rather lean Mo ores are mined. 2 types of molybdenum deposits are of commercial use in the CIS: copper-molybdenum and skarn.

Copper-molybdenum deposits are presented by vein-stockwork lodes in granites, containing molybdenite and sulfides of copper and iron (Sorsk deposit, Khakassia; Zhireken deposit, Chita region; Kadzharan deposit, Armenia; deposits Kalmakyr, Sary-Cheky, Uzbekistan).

Skarn deposits, characterized by low content of metals, are presented by skarns with commercial-grade impregnation of molybdenite and scheelite ($CaWO_4$) (Tyrnyauz deposit, Kabardino-Balkaria).

In the ex-USSR, 60 deposits of molybdenum are known, and explored deposits of molybdenum mainly belong to Russia, Kazakhstan, Uzbekistan and Armenia (Table 1). From estimate of «InfoMine», reserves of molybdenum in the CIS exceed 3 mln t.

Table 1. The main deposits of molybdenum-containing ores in the CIS

Deposit	Degree of development	Size (in reserves)*	Company-operator
Russia			
Eastern Siberia			
Sorsk	operational	large	JSC «Molybdenum» (Sorsk GOK)
Zhireken	operational	medium	JSC «Zhireken GOK»
Shakhtaminsky	conserved	small	Shakhtaminsky RU (Priargunsky GKHO)
Agaskyrsky	standby	large	-
Orekitkansky	standby	large	-
Malo-Oinogorsky	standby	large	-
Bugdainsky	developing	large	JSC «Norilsk Nickel»
North Caucasus			
Tyrnyauz	Mining has been stopped temporarily	large	JSC «Tyrnyauz GOK»
Northern territory			
Lobash	being explored	large	-
Kazakhstan			
Kounrad	conserved	small	-
Sayak Group	conserved	small	
Boshchekul’	developing	small	JSC «Kazakhmys»
Kyzylty	developing	small	LTD «Stepnogorsk mining-chemical combine» (SMCC)
Shorsky	operational	medium	LTD «Stepnogorsk mining-chemical combine» (SMCC)