

## Features of Development and Functioning of the Refining Enterprises in the Russian Federation

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**Abstract:** Current trends of development of the Russian refining enterprises are distinguished in the article. Authors consider peculiarities of functioning and measures for increasing competitiveness as a factor of integrating refining enterprises of the Russian Federation to the world gold market.

**Key words:** Gold mining industry • Gold mining companies • Refining • Refining enterprises • Alluvial gold • Ore gold • Measured ingots • Standard ingots • Ore concentrates

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### INTRODUCTION

The refining enterprises are the enterprises where process of purification of the extracted precious metals from impurity and accompanying components, finishing precious metals to the quality conforming to the state standards and specifications, operating in the territory of the Russian Federation, or to the international standards is carried out [1].

They have to provide the fullest extraction of precious metals from raw materials according to technological standards and to make standard ingots with the content of the main metal not less than 99.5 % [2].

The field of activity of the refining enterprises is:

- Mining and enriching mineral raw materials;
- Collecting the secondary raw materials which contain precious and rare metals and receiving concentrates;
- Organization of refining raw materials and concentrates at refineries;
- Producing commodity products on the basis of precious metals;
- Realizing precious metals and production on their basis.

The London association of participants of precious metals market (LBMA) and the London association of platinum group metals (LPPM) are associations of participants of the precious metals market which activity is directed to the fact that in the precious metals market there should circulate the ingots made by the refining enterprises of the highest level.

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On all ingots of precious metals there are poured out the obligatory tags which concern:

- Serial number;
- Probe;
- Letters of precious metals;
- Brand of the manufacturer;
- Year of production;
- Ingot weight in grams or ounces.

To meet the requirements of these organizations the Russian refining enterprises issue ingots of two types: conforming to requirements of national and international standards.

Standard ingots are the ingots of precious metals made and marked by the Russian refining organizations according to the existing state and industry standards which have nominal weight from 11 kg to 13.3 kg and probe not less than 99.5%.

Measured ingots are the ingots of precious metals made and marked by the Russian refining organizations according to the existing state and industry standards and standards of the enterprises and also the ingots of foreign production corresponding to the international quality standards, weighing 1 kg and containing chemically pure main precious metal not less than 99.99% of total weight of an ingot.

In world practice standard precious metals ingots of very high quality, with high probe and a brand of respectable repeatedly checked LBMA and LPPM refining enterprises are given the status of "Good Delivery" which allows production of the enterprises to be highly appreciated and have a free entry into the world precious metals market.

In the Good Delivery list there are more than 55 companies from 28 countries on gold, 68 companies from 27 countries on silver, 30 companies from 10 countries on platinum and 23 companies from 9 countries on palladium registered.

The "Good Delivery" status is given to standard gold ingots of the following refining enterprises of Russia:

- Ekaterinburg Non-Ferrous Metals Processing Plant;
- Novosibirsk refinery;
- Shchelkovo plant of secondary precious metals;
- Prioksky plant of non-ferrous metals;
- Krasnoyarsk plant of non-ferrous metals;
- Kolyma refinery.

In 2012 the refining enterprises of Russia produced 218.7 t. of gold extracted by subsoil users and received as a result of passing production of non-ferrous metals, including processing scrap and waste that is 3.1% more than for the similar period in 2011, caused by an increase in demand in the global gold market [3].

The refining enterprises take an important place in the Russian market of gold. The main enterprises of today are the Prioksky plant of non-ferrous metals, Novosibirsk refinery, the Shchelkovo plant of secondary precious metals, Krasnoyarsk plant of non-ferrous metals, Ekaterinburg Non-Ferrous Metals Processing Plant, Kyshtymsky Electrolytic Copper plant and the Kolyma refinery.

The average cost of a refining in the Russian Federation in 2011 was 12 rub/gram of gold (decreased in comparison with the pre-crisis period by 25%) [5].

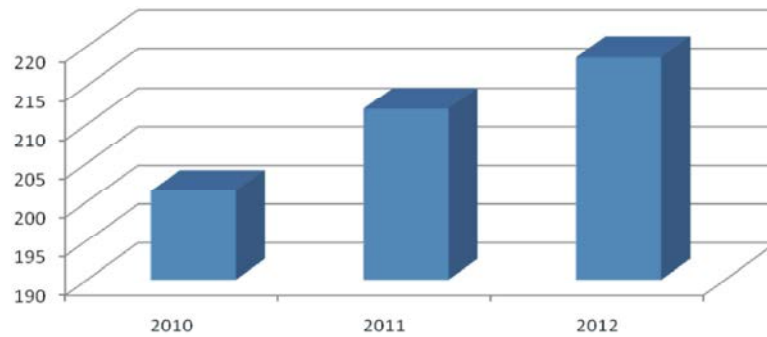


Fig. 1: Output of refined gold in the Russian Federation, 2010-2012, ton [4]

Shares in gold refining across the Russian Federation:

- Krastsvetmet - 45%;
- The Kolyma combine - 20%;
- Prioksky - 20%;
- Novosibirsk refinery of-10%;
- The Shchelkovo plant of secondary precious metals - less than 5%;
- Ekaterinburg Non-Ferrous Metals Processing Plant - 3%;

Others - less than 1%.

At present, current trends in the development and operation of refineries in the Russian Federation are:

- Processing of semi-finished products in the form of placer gold, gold concentrates and alloys produced in slime concentrating factories (SÑF), ore mining and processing enterprises (OMPE) and mining and smelting enterprises (MSE);

For this purpose, primarily pyrometallurgical processing techniques that allow clear the base alloy from the base inclusions and impurities for 2-3 technological operations and to use it in manufacturing new products.

- Refinement of semi-finished products - purification of the primary (draft) metals, received from raw materials, from impurity;

Draft metals contain 96 — 99% of the main metal, the rest is the share of impurity. Such metals can't be used by the industry because of low physical and chemical and mechanical properties. For their cleaning there are some types of refinement used: pyrometallurgical refinement, electrolytic refinement and chemical refinement.

- Production of ore concentrates demands full parting of the concentrates which have arrived for being processed with extraction of each precious metal separately, conforming to requirements of state standard specifications;

Therefore in these cases it is used both classical refining and anew developed sorptive, electrochemical and distillation processes allowing to divide precious metals most fully and to clear them of ignoble impurity.

- Volume reduction of refining placer gold is caused by reduction of production and development of ore gold objects;

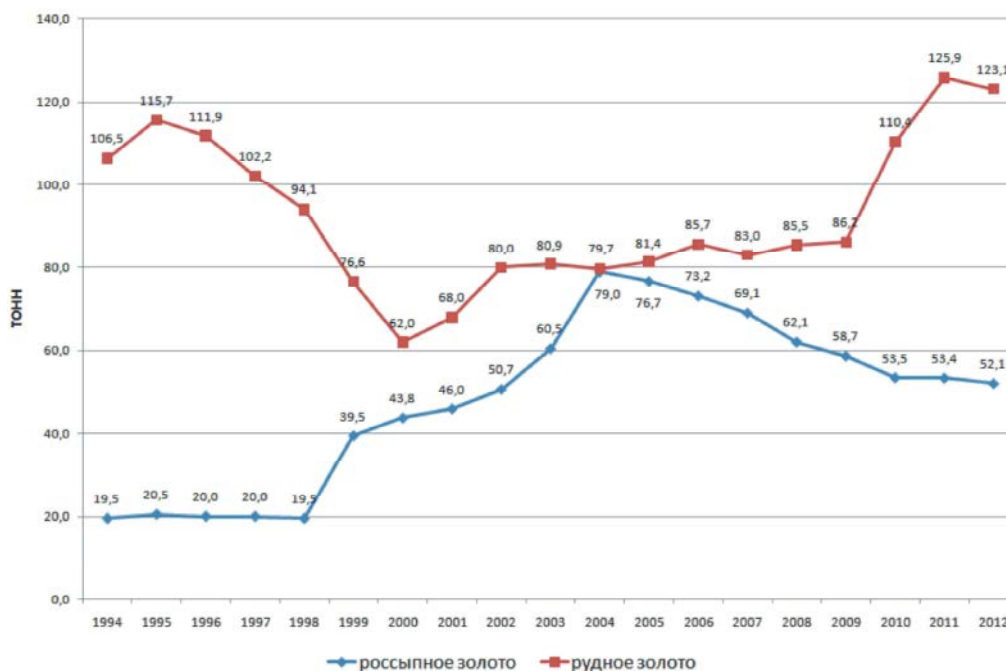


Fig. 2: Production of placer and ore gold in the Russian Federation in 1994-2012, t [4]

During the period of 1992-2010 production of placer gold was gradually decreasing while production of ore was on the contrary growing, thus, till 2002. Gold mining from scatterings prevailed over production of ore gold and now the share of ore gold exceeds the share of the loose one. As the main reasons, which should be noted, are lack of financing and high degree of physical and moral depreciation of fixed assets in the industry (Fig. 2).

- Lack of regular deliveries to refineries because of location of considerable refining capacities in the distance from the main regions of gold mining;

Creation of refining productions next to gold mining regions will allow to make a ready-made product excluding costs of concentrates transportation to a refining place, to solve a problem connected with the remote placemen location of refining capacities from gold mining areas and also gold miners problems on gold realization, work with banks etc.

- Application of refining methods which are divided into electrolytic, aqueous and dry.

Electrolytic methods are applied generally to gold and silver refining; consist in sedimentation of pure metal on the cathode with simultaneous precipitation of impurities in the form of slime. The gold received on this method, has a test not lower than 99.9 %. Advantage of electrolytic refining methods consists in lower cost of process, high extent of metals purification, favorable conditions for workers and possibilities of receiving platinum group metals as by-products (when adding to the fulfilled electrolyte of chemical agents).

Aqueous refining methods are applied to receiving silver, gold, platinum, palladium, iridium, rhodium and other metals of this group on a complex scheme with dissolution of metals in imperial vodka and their consecutive allocation from solution with various reagents (chloride ammonium, ammonia, sugar, etc.).

Dry methods of gold refining consist in processing melted metal, as a rule, with chlorine. Thus all ignoble metals form chlorides and disappear and silver chloride emerges on a surface of the pure melted gold. Test of gold is 996.5 % and silver (when restoring it from chlorides) – 999.0 %.

In Russia the geography of gold supply to refineries has subjective character and changes quite often. When choosing a refinery the crucial role is played not so much by its location, but the refining cost which isn't stable and identical to similar productions.

The cost of gold purification is from 0.6 to 1.1 % from the precious metal cost depending on the alloy in which it is. However, some plants can expose the fixed price for refining or, which is more rare, take a certain percent of gold for repayment of works.

Finally profitability of the refining enterprises keeps at the level of 1-5 %, though refineries have received from each 125 t. of the processed gold on the average 1% of its cost – overall about \$37.5 million.

After cleaning ingot gold comes back to the owner - artel - and is realized further in the three ways: goes on hi-tech productions as an industrial material (25%), gets to jewelers (45%) or is transferred to banks (30%). Often banks give out the credits to artels on the terms of the subsequent repayment of the processed gold - and it changes the owner already next day after revenues to a refining.

The refining market is rather narrow and customer-processor partnership is often built on the non-market principles. The enterprises offer more competitive conditions - high extraction, a fast refining cycle, the guaranteed quality of metal and low prices, - but the personal relations turn out to be more important, the client is given an opportunity to choose the most convenient and favorable processor [6].

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In modern conditions the rigid competition is observed among refineries in the domestic market. Nowadays 12 enterprises, according to the Resolution of the Russian Federation Government, have the right to carry out refining of precious metals; only 8 out of them have the status of Good Delivery of the London association of the precious metals market participants for their production and, respectively, compete with each other for customers' acquisition among the extracting companies. Cumulative processing capacities only of these 8 enterprises exceed gold mining volumes in Russia by 4-5 times in the absence of import ore concentrates. Each of the enterprises due to its specialization or location has competitive advantages. They try to use their advantages to the maximum. The refining market is rather narrow and partnership between the customer and the processor is often built on the bases of non-market principles. The enterprises offer more competitive conditions - high extraction, fast refining cycle, guaranteed metal quality and low prices, - but the personal relations turn to be more important and the client is given an opportunity to choose the most convenient and favorable processor.

Carrying out modernization of difficult technological processes and the equipment without the corresponding scientific and technical potential by the Russian refining enterprises is almost impossible. It is necessary to make continuous monitoring of all innovative solutions [7] in the field of technology of processing precious and rare metals, energy saving and ecological safety, to estimate them and to introduce them in operating production. In this regard an actual task of the enterprises is creating its own research and production base, completing it with competent experts and the most modern equipment.

Russia joined WTO and in the near future the Russian market will be entered by the foreign refining companies. In this case foreign competitors will be able to occupy a certain share of the market since they have lower cost of processing gold at the expense of large volumes of raw materials supplied by the customer. In refining production at the Russian or foreign plant, the share of conditional and constant expenses is very high. In this regard release costs of a production unit strongly depend on the size of processing volumes: other things being equal, prime cost is lower abroad than in the Russian Federation [8].

The main competitors of Russian refining enterprises are Swiss enterprises (Argor - Heraeus, Cendres & Metaux, Metalor Technologies, PAMP, Valcambi) and American enterprises (Umicore, Johnson Matthey). The foreign companies represent global corporations processing some hundred tons of gold a year. Such volumes result from the scale of their activity: metal is gathered from all over the world. Having opened the branch in the largest countries-producers of gold, refineries receive to process precious metals got from a subsoil of these countries.

Therefore the Russian refining enterprises plan by 2014:

- To reduce prime cost of precious metals refining by 3–5%;
- To increase volumes of precious metals refining up to 10%;
- To expand the resource base on secondary raw materials and import raw materials by 20–40%.

Increase of competitiveness of the Russian refining enterprises depends on the following factors:

- Introduction of innovative technologies;
- Minimizing of precious metals loss while being refined;
- Ensuring production stability on release of precious metals ingots conforming to the international standards requirements;
- Creation of a powerful research and production refining complex.

Everything has to occur progressively. The prior aim is to carry out capacities modernization, i.e.: process of gold refining (introduction of the modern equipment and automatic control systems), introduction of the process of a hydrometallurgical gold refining, modernization of ventilating and gas-purifying systems, treatment facilities, etc.

Realization of the specified actions will allow to reduce raw materials processing cycle, to reduce amount of used chemical reagents, electric power, to reduce considerably formation of production wastes and number of emissions in the atmosphere, to increase labor productivity and quality of finished goods [9: 32].

Thus, the increase of competitiveness of the Russian refining enterprises is the main factor of integration to the world market. For this purpose refineries need to introduce innovative technologies, to minimize precious metals losses during refining, to provide production stability on release of precious metals ingots conforming to the international standards requirements, to carry out the process of refining production diversification, to carry out placer gold refining, to create a powerful research and production refining complex.

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