1 ur 1

JPRS L/8311

6 March 1979

USSR

TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS
(FOUO 3/79)

U. S. JOINT PUBLICATIONS RESEARCH SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

BIBLIOGRAPHIC DATA SHEET	1. Report No. JPRS L/8311	2.	3. Recipient's Accession No.

4. Title and Subtitle
TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS, (FOUO 3/79)

5. Report Date
6 March 1979

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Joint Publications Research Service
1000 North Glebe Road
Arlington, Virginia 22201

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

As above

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

This serial report contains information on the development and productivity of the automotive and tractor industry; chemical industry and chemical machinery output; electronic and precision equipment; metallurgy and metalworking equipment; construction equipment and building materials.

17. Key Words and Document Analysis. 17a. Descriptors

USSR
Automotive Industry
Agricultural Machinery
Chemical Industry
Construction
Construction Materials
Construction Equipment
Electronics Industry
Metallurgy
Metalworking Equipment
Economics

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 2C, 5C, 7A, 11F, 13C, 13F, 13H, 13I, 13M

18. Availability Statement FOR OFFICIAL USE ONLY. Limited Number of Copies Available From JPRS	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 53
	20. Security Class (This Page) UNCLASSIFIED	22. Price

FORM NTIS-35 (REV. 3-72)

THIS FORM MAY BE REPRODUCED

USCOMM-DC 14952-P72

JPRS L/8311

6 March 1979

TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS

(FOUO 3/79)

CONTENTS

PAGE

CHEMICAL INDUSTRY AND RELATED EQUIPMENT

CONSTRUCTION, CONSTRUCTION MACHINERY, AND BUILDING MATERIALS

METALLURGY

METALWORKING EQUIPMENT

CHEMICAL INDUSTRY AND RELATED EQUIPMENT

UDC [54+66]: 338.984 (47+57)

CHEMIZATION OF NATIONAL ECONOMY DISCUSSED IN BOOK

Moscow PLANIROVANIYE KHIMIZATSII NARODNOGO KHOZYAYSTVA in Russian 1978 signed to press 1 Jan 78 pp 1-7

[Annotation, Table of Contents and Introduction of book edited by I. V. Rakhlin]

[Excerpts] Title Page:

Title: PLANIROVANIYE KHIMIZATSII NARODNOGO KHOZYAYSTVA (Planning the Chemization of the National Economy)
Publisher: Khimiya
Place and Year of Publication: Moscow, 1978

Signed to Press Date: 1 January 1978

Number of Copies Published: 2,900

Number of Pages: 223

Annotation:

The book deals with the group of problems involved in planning chemization as one of the most important directions in scientific-technical progress. It states the methodological problems of planning new chemical products and processes at all stages of their design and use, as well as at different levels of the hierarchical system (enterprise, association, sector); it describes the methodology for drafting comprehensive intersectoral plans for chemization of the national economy.

The book will be useful for a broad group of workers in enterprises and organizations of the chemical industry, as well as for teachers and students at VUZ's.

Table of Contents

Introduction

The core of the party's economic strategy at the present stage and in the long-range future is, as was emphasized at the 25th CPSU Congress, a further increase in the country's economic power, expansion and radical updating of the production capital. This poses tremendous tasks for the sectors that must satisfy the growing demand for metals, fuel, energy, chemical products, timber and building materials.* On the basis of this, accelerating and increasing the efficiency of chemization of the national economy becomes particularly important.

Chemization of the national economy means introducing, in conformance with the plan, chemical materials and chemical processing methods into all spheres of physical production and everyday life, on the basis of an accelerated growth of the chemical industry and the origin and development of new sectors of it.

Under today's conditions, the process of chemization is made up of elements such as the development and improvement of the major sectors of the chemical industry--the material basis of chemization; continuous development and introduction into all sectors of the national economy of new, highly efficient chemical processes and materials; the utmost development of chemical and related fields of science and technology, as the determining factor in the creation of new and improvement in the quality of existing materials, as well as the intensification of production processes. Chemization should be regarded as a unique means of increasing food and raw material resources on a scale that is essentially not achieved by other means.

There is a group of strategic, social, technical and economic factors that bring about the accelerated development of production and the use of chemical materials and products, as well as putting industrial processes into operation on the basis of chemical methods. This process is to a certain extent objective, for it is brought about by the action of the economic laws of socialism.

If one traces the history of the development of world technology and manufacturing methods, it can be established that the creation and rapid growth of practically all new sectors are inseparably bound with the use of improved chemical materials and processes. A number of economical industrial processes developed earlier are also implemented on the basis of chemization. The invasion of polymers into technology and everyday life, swift in its rates and scale, perhaps constitutes one of the most essential factors in the fundamental conversion of the material-technical basis of modern production that has begun.

The appearance of new chemical methods and materials has not only come about through the requirements of technology, In a broader concept, this process occurs due to the effect of the socioeconomic conditions of human life.

Increasing efficiency and accelerating chemization are integrally bound and depend increasingly on improving its planning. The urgency of solving this problem is caused not only by the rapidly growing effect of introducing chemical products and industrial processes on the rates of scientific and

---

* "Materialy XXV s"ezda KPSS" [Materials of the 25th CPSU Congress], Moscow, Politizdat, 1976, p 42.

technical progress in the consumer-sectors, a change in the qualitative structure of production and many extremely important national economic indicators, but also by the intensive expansion of the scale and sharply increasing complexity of the structure of the demand for chemical products, the shortage, not yet overcome, of some chemical materials and the need to select the most efficient ways to ease it and the change in the nature and directivity of the interrelations between the consumer-sectors and the producer-sectors of the chemical output of the CEMA member countries, etc.

While in the initial stages, planning the development of chemistry and of chemization was based on the frontal development of the entire chemical industry and other sectors producing chemical goods, in the last decade, because of the growing complexity of the economic and industrial relations, there is increasing importance in comprehensive plans for specific purposes, specifying the carefully worked-out coordination of the efforts of all the participating organizations. At the same time, a great deal of experience has been accumulated in the production cooperation of many ministries and departments with the chemical industry, in order to execute these plans.

Practical experience shows that in the process of planning the development of the sector it is impossible to take into consideration the entire aggregate of factors determining the national economic efficiency of a certain specific decision, as for example, the all-round chemization of a sector. At the same time, the departmental approach to chemization of a sector is useless and one-sided. Therefore, the disparities arising between the interests of individual sectors should be overcome in appropriate plans for the development of the chemical industry and chemization of the national economy.

Successful compilation and execution of the comprehensive plans for chemization depend to a great extent on a clear understanding of their directivity and economic content, of the problems solved by them and of the methodology and organization for working them out. Under today's conditions, however, a unified understanding of the content of the comprehensive programs and plans has not yet been achieved, and the actual definition of "comprehensive program" remains quite debatable.

In order to increase the substantiation of the plans for chemization, a number of requirements must be taken into consideration in the process of working them out. Particularly included among them are:

Ensuring the priority of national economic interests and a major orientation toward solving problems facing the economic system as a whole;

Raising the degree of comprehensiveness of all the planning calculations made at various levels and stages, and this assumes more complete coordination of the plans for chemization with analogous developments in the remaining directions of scientific-technical progress and with other economic processes, achievement of balance in the plans for the use, production and import of chemical products and greater coordination in the use of various chemical materials in individual sectors, revealing the best proportions among the interchangeable chemical and nonchemical types of resources, etc.;

Reducing the periods for drawing up the plans and ensuring the possibility of working out different variants and high-quality corrections for the planning decisions with a view to taking into account more fully the conditions of the period being planned.

This book is the first attempt to state the methodological and practical problems involved in comprehensive planning of chemization as one of the most important directions in scientific-technical progress. An adequate planning system should be in accordance with chemization. So far, however, in the practical work of planning there is still no system of indicators that regulate completely enough the process of introducing chemical materials and chemical technology into the national economy. As a result, there may be a certain lack of correspondence between the planning of the production and the consumption of the chemical goods. In this connection, particular attention is paid in the monograph to working out a system of such indicators, to the possibility of using the intersectorial balance and economic-mathematical and statistical methods to improve the planning of chemization, and to the methodological problems of creating comprehensive plans for chemization at different levels.

The book was written by a collective of authors. The individual chapters were prepared by:

Gabidullin, V. M.--Chap. 7.
Ioffe, V. M.--Chap. 11.
Krichevskiy, I. Ye.--Chap. 12.
Palmerovich, D. M.--Chap. 5.
Parksheyan, Kh. R.--Chap. 3.
Rabin, M. G.--Chap. 10.
Rakhlin, I. V.--Introduction, chaps. 1, 3, 4.
Sidorova, N. A.--Chap. 6.
Sokolov, O. S.--Chap. 7.
Fedorov, K. G.--Chap. 2.
Shchukin, Ye. P.--Chap. 9.
Yanvarev, V. A.--Chap. 8.

12151
CSO: 1821

CONSTRUCTION, CONSTRUCTION MACHINERY, AND BUILDING MATERIALS

HOTEL FOR FOREIGN OLYMPIC JUDGES UNDER CONSTRUCTION

Moscow NA STROYKAKH ROSSII in Russian No 11, Nov 78 pp 56-59

[Article by O. Kedrenovskiy, chief project architect]

[Text] The hotel complex of the USSR Sports Committee [Sportkomiteta] for housing foreign referees during the Olympic Games is being built on Lenin Prospekt in quarter 19, southwest. It will be well connected in transportation respects with the Olympic village and the stadium imeni V. I. Lenin in Luzhniki.

The choice of the location of the hotel was dictated by the effort to have an architectural accent at the location on the prospekt [boulevard] where the perimetral brick buildings of the end of the 1950's have been replaced by the so-called free planning using fully prefabricated panel houses. In addition, in the near future construction is to be completed and public amenities provided over the broad territory inside the quadrangle formed by the Lenin Prospekt, Ukal'tsova Street, Vernadskiy Prospekt and Kravchenko Street. This space, which is a flood plane included in the gathering area of the Ramenka River has just been built up with modern residential and public buildings on Vernadskiy Prospekt, it has been planted and well arranged: a cascade of ponds has been built. After completion of the construction of the hotel and also the MGU athletic complex which is planned alongside, the entire territory will be converted to a city park.

The complex is located deep within the site, 80 meters from the thoroughfare. Considering the existing relief, a study was made of the number of the terraces dropping in the direction of the park zone. On one of them 3 to 4 meters below the Prospekt level, the hotel buildings are located, on another, at the Lenin Prospekt level, there is a reception area with a large parking area for automobiles and buses connected to the local side access to the Prospekt. A broad pedestrian bridge and also stairs and a ramp lead to the main entrance on the first floor.

The hotel building is made up of three independent parts--the basic building, a restaurant and conference hall with a press center connected to each other by the first-floor access hall.

The basic 22-story building extends along the Prospekt. In the central section the rizalites are clearly expressed. This solution gives the building the required plasticity, it will be successfully combined with respect to style with the 19-floor residential towers distinctively shifted in plan view.

The plain lobby of the hotel is located on the first floor of the high-rise part. It has a registration desk, administration offices, portiers, service office, currency exchange office, a postal substation, and shops. A four-passenger elevator and two cargo and passenger elevators and also a large distribution hall were designed along the axis of the entrance.

In the basement there is a small lobby with entrance into which the automobiles and buses will drive. A barber, cloakroom, restrooms, administrative and management facilities are located there.

The second floor has been set aside for the directors, the medical aid station, the domestic services combine, the reading room for the hotel personnel.

On the standard floors there are 431 comfortable rooms, including 160 single rooms, 191 double rooms, 48 triple rooms, and 32 semidelux rooms. They will sleep 750 people. There are facilities for service personnel, rooms for drying and cleaning clothing and footwear.

The halls are used floor by floor with alternation by floors as snack bars, television guest rooms or automated game rooms, the corridors with residential rooms are well insulated from the noisy elevator and floor hallways.

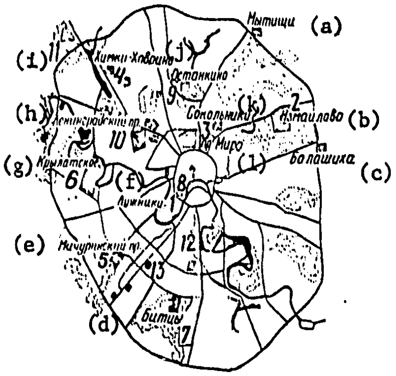
All of the rooms are equipped with modern bathrooms in the standard execution applied in all of the Olympic hotels under construction. In the antirooms, there are built-in storage closets, and in the rooms, in addition to the usual furniture, there are built-in window seats.

The hotel roofs are designed to be used. All of the passenger elevators will provide access to the roof. Open solariums and areas under shade are provided here for rest and exercise. On the roof level on the main facade side there is a glassed in training room which can also be used for billiards and table tennis. It will be possible to equip a summer buffet and bar in this area.

The building is crowned with a five-story tower which houses the machine rooms for the elevators and various engineering facilities. This raised portion with a lighted sign Olimpiady-80 [Olympics-1980] will lend distinction to the entire silhouette of the building.

The three-story structures of restaurant and the conference hall are adjacent to the basic building on the parking facade side.

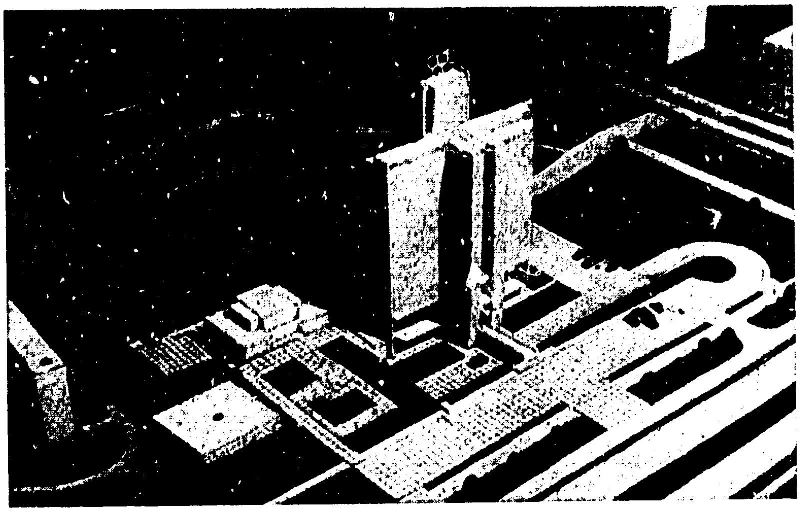
In the basement of the restaurant which is connected to the underground loading platform, there are storage rooms, refrigeration chambers, a number of auxiliary shops and also a dining room for the hotel personnel.



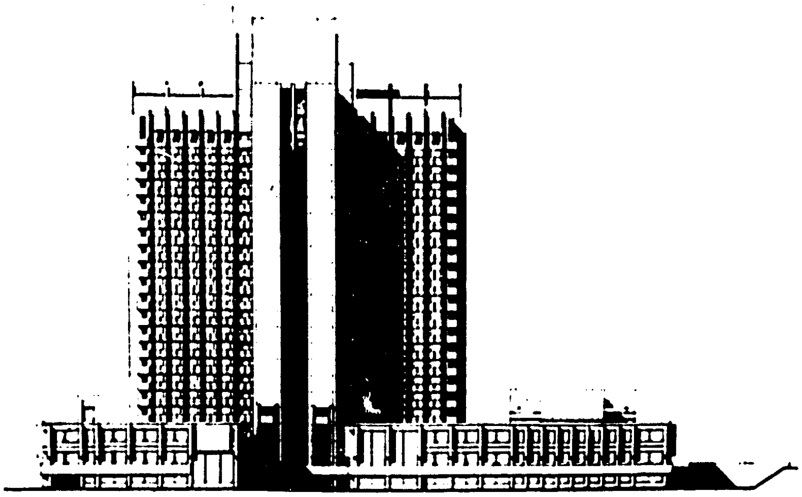
Placement of Olympic Projects within the Structure of the City (See Journal No 1, 1977): 1--Sports structures in Luzhniki: all-purpose hall (No 2, 1977); ASU-Olimpiada [Olympics Automated Control System] building (No 8, 1978); 2--Olympic projects in Izmaylova: the all-purpose hall (No 3, 1977), the hotel complex (No 6, 1978); 3--The sports complex on the Mira Prospekt (No 4, 1977); 4--The all-purpose hall in Khimki-Khovrino (No 5, 1977); 5--The Olympic village complex: the master plan (No 6, 1977); the sports center (No 7, 1977); the service center (No 8, 1977); the administrative center (No 9, 1977); the cultural center (No 12, 1977); 6--The sports construction complex in Krylatskoye: the bicycle path (No 1, 1978); the bicycle track and archery fields (No 2, 1978); 7--The equestrian sports base in Bittsy (No 3, 1978); 8--The main press center (No 4, 1978); 9--The television and radio complex in Ostankino (No 5, 1978); 10--TsSKA soccer and track and field events on Leningrad Prospekt (No 7, 1978); 11--Planernaya equestrian sports base (No 9, 1978); 12--International post office on Warsaw Highway (No 10, 1978); 13--Hotel for foreign referees.

Key:
(a) Mytishchi
(b) Izmaylova
(c) Balashikha
(d) Bittsy
(e) Michurinskiy Prospekt
(f) Luzhniki
(g) Krylatskoye
(h) Leningrad Prospekt
(i) Khimki-Khovrino
(j) Ostankino
(k) Sokol'niki
(l) Mira Prospekt

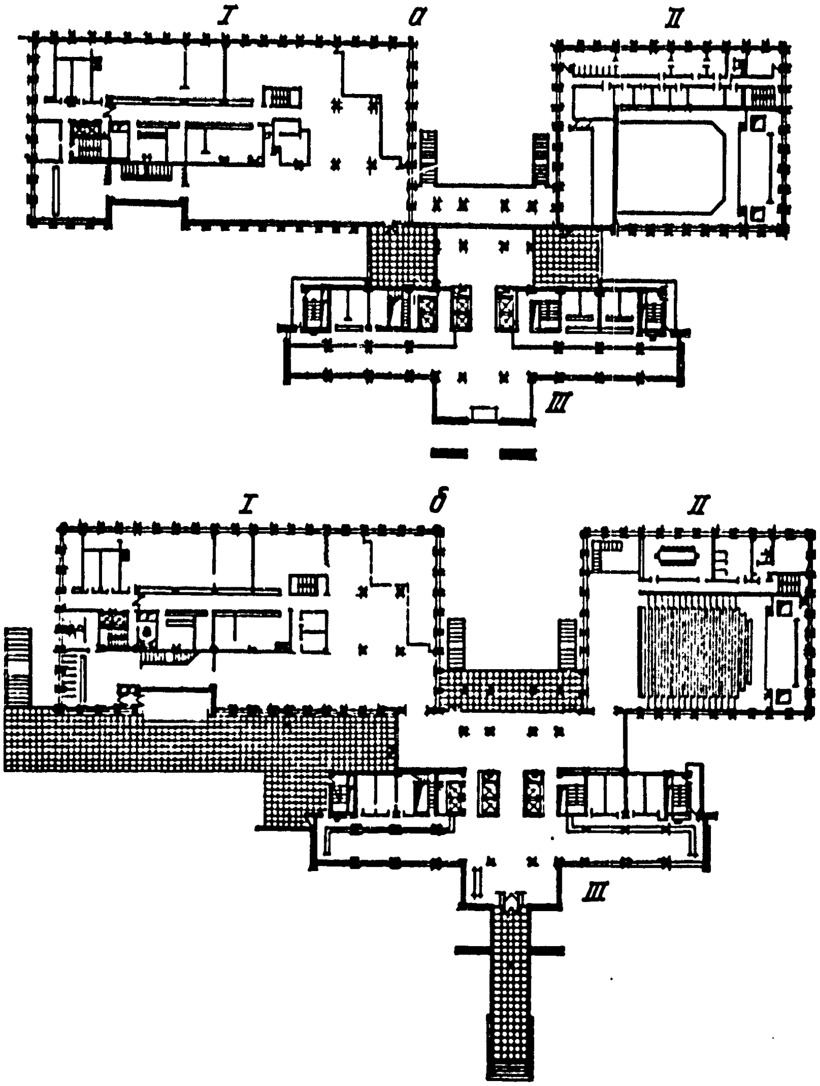
The plan view of the first and second floors of the restaurant building having freight elevators, service and front stairs is identical. Each of them has its own kitchen units, dining and banquet rooms which seat a total of 600 people. The third floor is an engineering room.



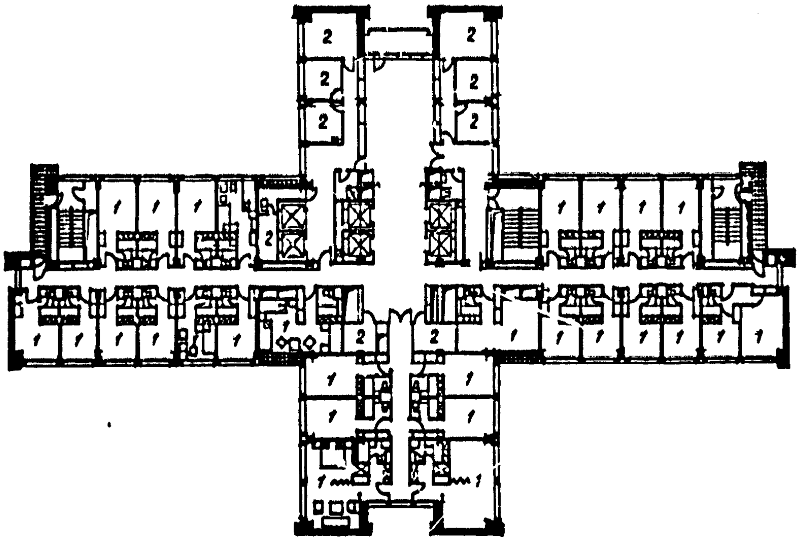
General View of the Hotel Complex for the Foreign Umpires (Photo from the Model)



Facade of the Highrise Modern Hotel Complex from the Park Zone Direction. To the left--restaurant; to the right--conference hall.



Floor Plans of the Hotel Complex: a--First floor; b--Second floor; I--Restaurant; II--Conference hall; III--Hotel.



Floor Plan of a Standard Floor of the Hotel for Foreign Referees: 1--Residential rooms; 2--Auxiliary facilities and service personnel rooms.

This division of the restaurant into two independent parts, each with its own complete production cycle will make it possible if necessary to keep one floor for people living in the hotel and by using an independent entrance, open the other for the residents of the city.

In the basement of the conference room an entrance hall with cloakroom, buffet and bathrooms are planned; on the first floor there is a foyer connected to the hall of the hotel, a viewing room for 500 people, the facility for a presidium, and on the second floor, a press center with international interview area.

In special respects the complex is a frame-panel type building. Its facades will be executed from the standardized mounted ceramic concrete panels faced with light glass tiles. The windows will have wood-aluminum frames; for the first floors there will be aluminum windows; for the screens on the balconies, sheets of corrugated aluminum. The basements of the building and, in part, the walls of the lower floors, will be faced with polished granite. The aluminum structural elements will also be used in the top in the form of sheds over the utilized areas of the roofs.

Along with traditional materials, washable wallpapers of various colors, synthetic rugs, precious varieties of wood harmonizing with modern furniture will find application in the interior decoration of the rooms and corridors. The elevator halls will be faced in natural stone. The ceilings will be decorative-aluminum and acoustic ceilings using Akmigran tile.

The greatest attention will be given to the finish on the main loby of the hotel which is 5 meters high with open galleries on the mezzanine. The columns will be covered with white marble, the parapets of the mezzanine, with thinly sawn travertine, and the rear wall, which is the background for the supports of the portier and kiosks will be covered with fumed oak; the supports themselves will be made of fumed oak with artificial leather. The floors will be of marble.

In the restaurant materials are used which give the interiors comfort and intimacy. The columns are faced with travertine. In contrast to the restaurant, the conference hall and foyer will be in a severe style.

The design of the hotel was developed at workshop No 3 of Mosproyekt-1 guided by Lenin Prize Laureat in Architecture Ye. Stamo. The authors were architects O. Kedrenovskiy, P. Klokov, engineers Yu. Kalyadin, E. Krivoshein, and I. Zhukova.

The hotel will be built by construction administration No 32 (chief M. Palies, section chief G. Gershval'd) of Mosstroy-7 Trust of the Order of Lenin Glavmosstroy. The structural elements will be installed by construction administration No 119 of the Prommontazh Trust.

At the present time the structures for the 16th and 18th floors, the sanitary engineering and electrotechnical equipment are being installed. The finishing men have begun work.

10845
CSO:1821

METALLURGY

LEAD AND ZINC BYPRODUCT EXTRACTION ADVANCES DETAILED

Moscow TSVETNYYE METALLY in Russian No 12, Dec 78 pp 2-4

[Article by A.P. Sychev, Ye.F. Sagimbayev and T.M. Bel'kova: "Lead and Zinc Industry Improves Utilization of Raw Material"]

[Text] At enterprises of the lead and zinc industry a great job is being done on fulfilling the decree of the CPSU Central Committee titled "Regarding the Work of Party Organizations of the Ust'-Kamenogorsk Lead and Zinc and Balkhash Mining and Metallurgical Combines on Mobilizing Collectives for the Achievement of High Indicators for the Thorough Utilization of Raw Material." The basis of radical improvements in the utilization of lead and zinc raw material has been the improvement of technological processes in all forms of conversion. In the 10th Five-Year Plan period considerable capital has been earmarked for the redesign and retooling of existing enterprises of the lead and zinc subindustry, with the renovation and modernization of equipment, which will make it possible at a lower cost to increase the output of nonferrous metals, to increase labor productivity and to reduce the loss of metal.

At the present time 18 elements and 40 kinds of commercial products are extracted from lead-and-zinc raw material. Extraction in metallurgical conversion equals on average, in percentages: 95.71 Pb, 94.34 Zn, 83.43 Cd and 84.88 S.

An example of the achievement of high results in the thorough utilization of raw material is the Ust'-Kamenogorsk Lead and Zinc Combine, where zinc, lead, sulfuric acid and rare metal production have been combined successfully, and a closed system has been created for the cross processing of semifinished products in the zinc and lead branches. In producing commercial oxygen, nitrogen and argon are also trapped. At this combine are extracted almost all components of the raw ore arriving for processing and of the industrial products from other plants, and 26 kinds of commercial products are produced.

Very high extraction of lead, 97.45 percent, has been achieved at this combine. The level of extraction of zinc (96.54 percent) and cadmium (91 percent) is also high, although the combine is behind the Chelyabinsk Zinc Plant with regard to these figures.

Conducive to the achievement of high results has been the improvement of processes for fuming lead slag, and improvement of the indicators of the smelting section on account of the processing in shaft furnaces of higher-quality sinter, produced with a sinter plant employing blasting from below.

As the result of the introduction of hot preleaching of lead cakes with the precipitation of impurities from solutions, the extraction of zinc has increased by 0.2 percent, and that of cadmium by 0.1 percent. The mastery of one-step leaching of matte with counterflow washing of zinc cakes has reduced their yield by 8 percent and has increased the extraction of zinc from raw ore by 0.15 percent, and of cadmium by 0.3 percent. The use of automatic loading control has increased the efficiency of Waelz furnaces 3 to 4 percent.

A leading place among zinc plants for the degree of thoroughness in the utilization of raw material is held by the Chelyabinsk Electrolytic Zinc Plant. Here have been achieved the highest indicators among domestic zinc plants for the extraction of zinc (96.83 percent) and the thoroughness factor for the utilization of raw material (95.7 percent).

A key trend in improvement of production efficiency and of the thoroughness of utilization of raw lead and zinc ore has been the improvement of technology and the enlistment for processing of all industrial products and production waste.

A special place among raw material resources has been held by available reserves of slag from shaft smelting of lead. The capacities of slag-processing plants have grown considerably in the Ninth and 10th Five-Year Plan periods. For example, a high-capacity slag sublimation plant has been constructed and put into service at the Chimkent Lead Plant. In 1977, 86 percent of the slag from ongoing production was processed in an ShVU [slag sublimation plant]. In the process of mastering the plant, there was improvement in the quality of the sublimates produced in terms of their zinc content. In the first quarter of 1978 sublimates contained 56.3 percent zinc. According to the know-how gained by the Ryaztsvetmet Plant, the operation of an ShVU has shown that it is possible to carry out the process using natural gas without the use of a solid reducing agent.

The slag sublimation plant at the Ust'-Kamenogorsk Lead and Zinc Combine has been reconstructed. The mastery of a mixer-accumulator has been conducive to reducing unscheduled downtime of the plant, to reducing cycles, to preventing the pouring of matte into the furnace, and to stabilizing its operation. Because of the improvement of the technology for processing slag, the indicators of the ShVU have been improved and the extraction of zinc in sublimates has been increased, equaling 84.5 percent in 1978. But much remains to be done for the purpose of stabilizing the operation of the plant.

At the Achisay Polymetals Combine there has been an increase in the capacity of the Waelz section and the composition of the Waelz burden has been altered (the percentage of slag has been increased), as the result of which the extraction of zinc in Waelz oxides has increased and equaled about 89 percent in 1978.

Existing methods of processing slag do not solve the problem of complete extraction of copper and noble metals from it. For the purpose of solving the problem of the thorough utilization of slag, UKSTsK [Ust'-Kamenogorsk Lead and Zinc Combine] in conjunction with VNIItsvetmet [All-Union Scientific Research Institute of Mining and Non-Ferrous Metallurgy] has developed a method of processing it without waste, including the Waelz process and magnetic concentration of the clinker, while producing sublimates which will be bound for the zinc production process for iron concentrate containing copper and noble metals and suitable for utilization in lead production, and of a nonmagnetic clinker fraction representing raw material for the production of building materials.

The effective processing of sintering and shaft smelting dust containing rare and trace elements has been conducive to a considerable extent to improving the degree of thoroughness of the utilization of raw material in lead production. Separate processing of a portion of this dust has been arranged for at almost all plants of the subindustry. In spite of the fact that it has been carried out for a long time, the degree of extraction of rare metals from it is still insufficient. It is possible to correct the situation by a more reasonable distribution of rare elements over intermediate products.

Of great importance for improving the thoroughness of the utilization of raw material has been the introduction of oxyelectrothermal smelting of lead concentrates ("Kivtset-TsS"), which, together with improving the extraction of lead and zinc, will considerably improve working sanitation and health conditions and will lower harmful environmental effluents to health standards.

At the present time the "Kivtset" technology has been mastered at the Irtyshsk Polymetals Combine. For the purpose of processing copper-and-zinc concentrates, the intent is to redesign the "Kivtset" unit at this combine, to increase its output and ensure maximum extraction of zinc and utilization of sulfur-containing gases.

The intent is to introduce oxyelectrothermal smelting of raw lead ore with a "Kivtset-TsS" unit at UKSTsK, the Dal'polimetall Association and the Elektrotsink Plant.

At VNIItsvetmet studies and tests on an industrial scale have been made of a new method of processing storage battery scrap--the KEPAL method. This method includes mechanized separation (concentration by sink-float separation) of storage battery scrap with the separation of chlorine and metallurgical processing of concentration products with the high extraction of metals. It satisfies modern requirements for working conditions and environmental protection.

Based on test results, a section for processing storage battery scrap has been planned and its construction has begun at the Leninogorsk Polymetals Combine.

The degree of thoroughness of the utilization of raw material in zinc production is determined primarily by an efficient system for processing zinc cakes.

At UKSTsK, cakes from internal production and a portion of Leninogorsk cakes are processed by the Waelz method, an important disadvantage of which is the production of a copper-bearing clinker poor in copper, gold and silver content. Most promising is the hydrometallurgical method of processing zinc cakes, which makes it possible to extract all valuable components in the closed cycle of zinc and lead plants.

Workers at the Leninogorsk Zinc Plant in conjunction with associates at VNIItsvetmet have developed and carried out hydrometallurgical processing of zinc cakes from current production; this has been responsible for a three-percent increase in the extraction of zinc at the plant, and a 4.1-percent for cadmium. With the startup of the high-temperature leaching section for zinc cakes, all cakes from current production will be processed and old dumps will gradually be utilized.

In 1974 at VNIItsvetmet was developed and mastered on the industrial scale a technology for combined hydrometallurgical processing of zinc cakes and sublimates for the Almalyk Zinc Plant. A project for redesigning the leaching section has been carried out for the purpose of introducing this technology for the entire amount of zinc cakes from current production and of sublimates. The capacities of Waelz furnaces which have been freed will be utilized for the purpose of processing slag from old dumps at the Chimkent Lead Plant. The introduction of combined hydrometallurgical processing of zinc cakes and sublimates to the full extent at the Almalyk Zinc Plant will improve the extraction of zinc, cadmium, copper and noble metals.

An analysis of the operation of lead and zinc enterprises has shown that they have at their disposal great resources for improving the thoroughness of the utilization of raw material. Testifying to this primarily is the considerable gap in figures for the extraction of metals for individual plants. For example, the extraction of lead in refined lead, sublimates and matte is 2.85 percent lower at the Chimkent Lead Plant than extraction in refined lead at UKSTsK. The extraction of zinc from raw ore at the Chelyabinsk Zinc Plant is considerably ahead of figures for other plants.

Enterprises have not been utilizing to the full extent their opportunities for reducing the loss of metals and for utilizing sulfur from exhaust gases.

In recent years the purification of exhaust gases has been improved at lead and zinc plants. For example, URFM-2 bag filters have been put into service at the Chimkent Lead Plant and electric separators for cleaning roasting gases at the Chelyabinsk Electrolytic Zinc Plant; construction has been completed on new sets of gas purification facilities at the Ust'-Kamenogorsk Lead and Zinc Combine; and dust trapping systems have been expanded at the Chimkent lead and Belovo zinc plants.

Together with the construction of new gas purification facilities, much attention has been paid to improving the level of utilization of dust trapping units; as a result, the residual dust content of process gases from key conversion processes is being reduced gradually and significantly. But the residual dust content of gases is still high at enterprises such as LPK [Leninogorsk Polymetals Combine], UKSTsK and ChSZ [Chimkent Lead Plant].

In evaluating as a whole the possible ways of reducing dust and gas effluents and of achieving healthier air in the areas of location of lead and zinc plants, it should be mentioned that for the purpose of a full solution to this problem it is necessary to introduce new metallurgical processes ("Kivtset," dual-contact, etc.), to redesign and expand dust trapping and gas purification systems, and to build units for sanitary prepurification of gases.

The maximum utilization of all resources at hand at plants of the lead and zinc subindustry, for reducing the loss of valuable components of raw ore, the introduction of new metallurgical processes and the improvement of existing ones, the modernization and consolidation of equipment, and the mechanization and automation of key and ancillary processes will be conducive to solving one of the major problems assigned to the country's non-ferrous metallurgy industry by the 25th CPSU Congress, that of further improving the efficiency of the production of non-ferrous metals and the thoroughness of the utilization of raw material.

8831
CSO: 1821

METALLURGY

NICKEL INDUSTRY'S WASTE-FREE PRODUCTION PROSPECTS EVALUATED

Moscow TSVETNYYE METALLY in Russian No 12, Dec 78 pp 7-9

[Article by T.V. Gran': "Prospects for Creating Waste-Free Production in the Nickel Industry"]

[Text] The major waste in metallurgical processing of sulfide and oxidized nickel ore is represented by slag, relatively mild sulfur gases from pyrometallurgical conversion processes, and saline discharge from hydrometallurgical sections.

Waste-free production of nickel can be created on the basis of improving the operation of existing plants and by using new waste-free processing systems.

In the USSR's nickel industry the first waste-free enterprise has been created--the Pobuzhskiy Nickel Plant, where ferronickel is produced from oxidized nickel ore by electrosmelting, after which it is concentrated by blasting in converters. The major mass of nickel and iron contained in the raw ore is extracted in commercial ferronickel. The slag produced is crushed and it is all handed over to a construction organization for utilization. In addition, total recycling of water is carried out at this plant.

This example has demonstrated the fundamental feasibility of setting up new enterprises with a waste-free technology in the nickel industry or in construction.

Is it possible to improve the technology of existing enterprises, in order that they might operate without dumps or by producing them to a minimum? For this it is necessary to consider ways for and the feasibility of eliminating or utilizing gases, slag and industrial waste.

The following are the major ways of raising the level of utilization of sulfur from exhaust gases from metallurgical production:

1. Raising the concentration of SO_2 in these gases and ensuring uniformity of gas stream volumes and constancy of the SO_2 content over time, by:

Developing and introducing at existing enterprises new processes and metallurgical technology equipment, e.g., continuous conversion units, autogenous smelting units, etc., producing concentrated sulfur gas (10 to 20 percent SO_2).

Improving existing processes and equipment, such as by using improved sprayers in converters, involute, for example, which will make it possible to raise the concentration of SO_2 in gases to six percent; sealing ore roasting and electric stripping furnaces, packing gas flues, and enriching the air with oxygen when converting and roasting in fluidized bed furnaces (in these the content of SO_2 in gases is raised to about 8.0 percent); installing heat recovery boilers after the metallurgical units, instead of thinning exhaust gases with air for the purpose of cooling them.

2. Using chemical methods of enriching gases poor in SO_2, for the purpose of subsequently processing them into acid or elemental sulfur.

3. Using high-temperature or catalytic methods of reducing SO_2 with natural gas to produce elemental sulfur.

4. Building and putting into service new sulfuric acid capacities, as well as units for the byproduct derivation of elemental sulfur from gases.

Long-term plans for development of the subindustry call for raising the utilization factor for sulfur at enterprises which process sulfide ore to 90 to 93 percent, which will be able to be considered a solution to the problem of utilizing the sulfur from gases at these plants.

The problem of processing low-sulfur gases at Ural nickel enterprises which work with oxidized ore has still not found an intelligent solution because of the low concentration of SO_2 in them, since more than 40 percent of the sulfur is found in low-content sinter and shaft smelting gases, for which now only one engineering solution has been able to present itself--neutralization.

Dump slag in the nickel and cobalt subindustry represents a complex multicomponent silicate system, containing rock-forming components with an admixture of moderate amounts of non-ferrous metals and sulfur.

All slag in the nickel industry comes under the heading of acid slag, and its modulus of basicity is less than one.

Slag arrives at the dump in a liquid-molten state or in pelletized form.

The physical and chemical properties of this slag make it possible to use it as a promising raw material for the production of building materials and products, such as mineral wool, cast stone products and cast slag ballast. Pelletized slag, being an already considerably crushed product, can be used also as a filler for mortar and concrete.

Of the useful properties of this slag, mention should be made of its highly uniform composition as compared with natural materials used in the silicate industry.

The following represent promising trends in the utilization of slag:

a) Production of mineral wool products (increase from 0.3 to 0.6 percent of all slag produced in the subindustry).

b) In pelletized form, for filling mine workings (increase from three to four percent to nine to 12 percent).

c) As rubble for construction and landscaping, and for producing binders (cement).

d) For the production of slag pyroceramics.

As already mentioned, a promising way to utilize slag is to produce cement from it. The production of binding materials from nickel industry dump slag has been studied by the Leningrad Area Institute of Standard and Experimental Design (LenZNIIEP), the Leningrad Construction Engineering Institute, the Leningrad Branch of the USSR ASiA [Academy of Builders and Architects], the Kola Branch of the USSR Academy of Sciences, the Noril'skproyekt Institute, etc.

Studies have shown that slag crushed to cement fineness, when hardening promoters are added to it (lime or gypsum), can serve as a binding material for the fabrication of building products. Hardening of these products must take place in kilns or autoclaves. The concrete types produced have a mechanical strength of 300 to 400 kg/cm^2.

Research and testing along this line are continuing. For example, at the present time the Rezh Nickel Plant and the Yuzhuralnikel' Combine in conjunction with building institutes are conducting tests on the addition of slag to the burden in the production of clinker at the Sukholozhskiy and Novotroitsk cement plants. At the Gipronikel' Institute [State Planning and Scientific Research Institute of the Nickel, Cobalt and Tin Industry] research work is under way on the electrosmelting of raw sulfide ore into slag suited for the production of cement to be used in the preparation of foundation concrete.

For the purpose of solving the problem of the utilization of crushed dump slag for the production of cement, organizations of the USSR Gosstroy must develop engineering specifications for the production of binding materials from this type of raw material and for the production of building products from them.

With a favorable solution to the problem of the production of slag cement based on binders, it is possible to utilize as much as 60 percent of the dump slag formed in the subindustry.

The USSR Academy of Sciences Kola Branch has done extensive research on the production of cast stone products from liquid-molten slag and has demonstrated its suitability for pouring large blocks (up to one ton), as well as products of medium and small size (up to 40 kg). As much as 10 percent of the slag formed in the subindustry can be directed for these purposes in the future.

In 1975 at Gipronikel' technical and economic estimates were made for arranging for the processing and utilization of nickel dump slag, which showed that this type of arrangement would be highly effective, and the period for paying off the capital investment would equal about two years.

In the future a solution will also be found to the problem of eliminating industrial discharge. The most complicated thing here is the processing of saline industrial discharge which contains, in g/l, as much as 60 Na^+, 90 SO_4^{2-} and 20 Cl^-. Every year many thousands of tons of valuable chemical products--sodium sulfate and sodium chloride--are wasted with these. At the present time a technology is being developed for producing commercial products, such as sodium sulfate, chlorine and alkalis, from saline industrial discharge.

A more radical solution is represented by the development of a processing system for the electrolytic refining of nickel which would not produce saline discharge. This is possible in principle, and studies along this line are under way.

Refining of raw nickel can also be arranged for by the carbonyl method. Able to serve as an example of an enterprise with a waste-free technology is the new INKO refining plant put into operation in 1973, which uses a high-pressure carbonyl process.

The major raw material for this plant is the metallic fraction from the copper-nickel matte processing section. In addition, nickel concentrate and commercial products from electrolysis sections are processed at the plant. The raw material is melted and blasted in rotary converters with oxygen blasted from above. The raw material for the carbonyl process is metal granules containing, in percentages, 72 Ni, 18 Cu, 3 Fe, 1 Co and 5 S.

It can be concluded from the above that, for the purpose of converting existing nickel plants to a waste-free technology, it is necessary to complete research on the enrichment of low-content sulfur gas, to increase dramatically the scale of production of sulfuric acid, to make arrangements for sulfur production, to develop and introduce a technology for processing saline discharge with the production of commercial salts, and to make arrangements for the total utilization of slag.

An analysis has demonstrated the fundamental feasibility of in the future converting existing enterprises which process nickel sulfide ore to a waste-free technology.

The further development of the production of nickel must be based on the use of new processes making it possible to utilize raw ore completely. The highest figures for the thoroughness of the utilization of raw material are provided by combination systems in which hydrometallurgical processes prevail.

The Mekhanobr Institute [All-Union Scientific Research Institute of Mechanical Processing of Minerals] has developed a process for concentrating Noril'sk ore while producing a rich nickel concentrate and separating a considerable portion of the iron in an independent pyrrhotine concentrate, from which nickel is also to be extracted. For the purpose of processing the pyrrhotine concentrate, Gipronikel', Gintsvetmet [State Scientific Research Institute of Non-Ferrous Metals], NGMK [Noril'sk Mining and Metallurgical Combine] and a number of other organizations have developed an oxidative autoclave leaching method, which makes it possible to produce a rich nickel sulfide concentrate containing 11 to 12 percent Ni and elemental sulfur as a separate product. Almost all the iron will be concentrated in ferruginous dump tailings. A demonstration has been given of the basic feasibility of processing them into high-quality raw material for ferrous metallurgy.

At Gipronikel', on a laboratory scale a waste-free technology has been developed for sulfuric acid leaching of sulfide products, which makes possible the utilization of all components according to the following system: non-oxidative liquation smelting into matte; dissolution of the matte in circulating sulfuric acid; processing of the hydrogen sulfide thus produced into elemental sulfur; oxidation and hydrolysis of the iron with recovery of the acid formed to dissolve the matte; processing of the sulfide precipitate of non-ferrous metals with the derivation of a concentrate of precious metals, cobalt, nickel and iron; and production of iron pellets from the hydroxide.

By this system are produced nickel, cobalt and copper briquets, iron oxide pellets or gas reduction iron, elemental sulfur and a concentrate of platinic metals. The extraction into finished products, according to laboratory data, equals: nickel 97.5 percent, copper 97.6 percent and cobalt 96.9 percent.

Possible is a variant of this waste-free technology which includes carbonyl processing of a sulfide cake (obtained as the result of leaching) containing nickel, cobalt, platinoids and iron residues. The finished products will be nickel pellets, autoclave copper (as a powder, briquets or rolled metal), high-purity reduced iron, and special materials with a ferronickel and copper-nickel base.

The Gipronikel' Institute in conjunction with a number of other organizations has been conducting other research aimed at increasing the thoroughness of the utilization of raw material and at creating waste-free processing systems on this basis. Under the heading of this work come autogenous forms of smelting raw sulfide ore which produce concentrated gases, continuous conversion, smelting in furnaces with an immersed jet, into ferronickel, etc.

Under way at the present time are a fair number of processes making it possible to create a waste-free processing system for an enterprise for the purpose of processing sulfide ore. These include autogenous smelting with the production of sulfur or sulfuric acid and the total utilization of slag, oxidative autoclave leaching of a pyrrhotine concentrate with utilization of tailing iron and sulfur, continuous conversion of matte (also with utilization of the sulfur), and carbonyl refining of raw nickel. It is possible to use a hydrometallurgical system for processing raw sulfide ore after further improvement of this system on a semi-industrial scale.

Important factors in the creation of new waste-free technologies are represented by the need to develop methods of utilizing ferruginous tailings and of processing slag, which must be solved in combination in investigating, planning and implementing new processing systems.

8831
CSO: 1821

METALLURGY

CHELYABINSK ELECTROLYTIC ZINC PLANT'S WASTE-FREE PRODUCTION EFFORTS DETAILED

Moscow TSVETNYYE METALLY in Russian No 12, Dec 78 pp 4-7

[Article by S.F. Matveyeva: "The Chelyabinsk Electrolytic Zinc Plant on the Way to Waste-Free Production"]

[Text] The Chelyabinsk Electrolytic Zinc Plant works mainly on concentrates derived from copper-and-zinc ore from the Urals. The distinctive features of Ural concentrates are: a reduced content of zinc and cadmium, a high content of iron, copper and sulfur, a high degree of dispersion, and a high percentage of water soluble compounds. The content of zinc in concentrates at Ural concentration plants does not exceed 50 percent, and in concentrates at the Gayskiy and Uchaly concentration plants, 45 to 46 percent.

The high iron content in concentrates and its close structural relationship to zinc are the reasons for the low solubility of zinc in roasting products; this dramatically complicates hydrometallurgical processes, increases the output of zinc ions, complicates their processing, and increases the consumption of fuel and auxiliary materials. But the plant has achieved notable success in recent years in improving the thoroughness of the utilization of raw material.

The successes of the plant's team have been the consequence of the system which has been formed for organizing production, representing a combination of technical, organizational, economic and sociopsychological measures. This system embraces all subdivisions and services of the plant which in one way or another have been promoting the efficient utilization of raw material.

The following are the main lines along which the thoroughness of the utilization of raw material is being improved:

1. Improvement of extraction by the use of advanced technological processes and improved equipment, by the mechanization of labor intensive jobs, by the automation of the monitoring and control of technological processes, and by improving working conditions and production standards.

2. Enlisting in the processing of metal-containing materials production waste, also, including from dumps of past years, as well as waste from other non-ferrous metallurgy enterprises and allied industries.

3. Improvement of product quality by reducing the associated metals in products and by segregating them into commodity products.

4. Introduction of environmental protection measures.

Roasting is one of the most important forms of conversion in the production of zinc.

The construction and mastery of a highly mechanized storage facility for concentrates has made it possible to convert to containerized transportation of concentrates, there has been a considerable reduction in the loss of concentrates on the way and in the performance of loading and unloading operations, and labor costs for these operations have also been lowered.

The key trend in the improvement of the roasting process itself in recent years has been an increase in the unit capacity of "fluidized bed" furnaces as the result of using oxygen. The efficiency of roasting furnaces has been raised 35 percent, there has been a considerable reduction in the content of sulphides in roasting products, and the direct extraction of zinc has increased. A reduction in the output of zinc cakes has made it possible to process in addition cakes from reserves from past years.

Improvement of the design and of the utilization of electric separators has reduced losses of valuable components with gases in the roasting conversion process to 0.02 percent of the total zinc charge.

The utilization of oxygen in roasting zinc concentrates and the reconstruction of sulfuric acid production by converting existing systems to the system of dual contact and intermediate absorption have been responsible for positive results with regard to mastery of the processing of gases with a high SO_2 content, with a corresponding growth in capacity without increasing the number of operating personnel. This has been conducive to improvement in the extraction of sulfur into sulfuric acid and to healthier air.

One more system was redesigned according to the dual contact system in 1977. It has been operating in the autothermal mode with high ratings. The content of SO_2 in exhaust gases has equaled a total of 0.01 percent with 99.6 to 99.8 percent conversion. Full completion of the redesign of sulfuric acid production is planned in 1979.

The increase in the percentage of Ural concentrates in the raw material being processed has served as an impetus toward modifying the systems and modes of leaching roasting products and cleaning solutions.

Studies made in conjunction with VNIItsvetmet [All-Union Scientific Research Institute of Mining and Non-Ferrous Metallurgy] have demonstrated the feasibility of employing a one-step leaching system and counterflow washing of zinc cakes.

Up until recently, cleaning copper and cadmium from solutions was carried out at the plant in two steps, using antimony salts as activating additions, with a fairly low consumption of zinc dust (about 34 to 35 kg/ton of zinc). This did not provide the required degree of thoroughness for cleaning solutions and did not provide for separation of the cement deposit derived into copper and cadmium.

In 1976, in conjunction with VNIItsvetmet, was introduced a three-step system for cleaning zinc solutions of impurities, with the separation of the major amount of copper into copper cake in the first cleaning step. The quality of neutral solutions was thereby improved.

The content of impurities in the cleaned solution was reduced considerably, which is obvious from the following data, in mg/l:

	1975	Five months, 1978
Cu	0.10	0.06
Cd	2.73	1.1
Ni	0.43	0.26
Co	1.8	0.63

There has been a reduction in the output of copper-and-cadmium cake and the content of cadmium in it has been increased, which has made it possible to improve the technology for processing copper-and-cadmium cake while producing commercial copper cake.

The mastery of three-step cleaning has created an opportunity for introducing a xanthate-free system for separating cobalt. According to this system, the concentration of cobalt takes place during the cementational precipitation of cadmium, and cobalt is separated from the process with solutions for the production of hydrous zinc sulfate. The use of expensive and highly toxic ethyl xanthate is completely eliminated and losses of zinc and cadmium are reduced.

Conducive to improvement in the thoroughness with which raw material is being utilized have been improvement and intensification of the Waelz process for zinc cakes. The high content of iron in them (27 to 30 percent) has caused intense slag incrustation in Waelz furnaces. Since 1975 oxygen has been supplied to furnaces, and the output of furnaces has reached 94 to 95 tons of burden per 24-hour period. The full effect from this measure can be gotten only after eliminating the slag incrustation phenomenon.

In the conversion process for Waelz oxides there has been a considerable reduction in the loss of zinc and of cadmium, especially, with lead cakes, as the result of the introduction of oxidative high-temperature preleaching of the lead cake and continuous "inverse" leaching of the Waelz oxide.

Much useful work has been done in the conversion of rare metals. The most important are the selective precipitation of rare metals, the use of a more active reducing agent, and improvement in the electrolysis of indium. As a result, the extraction of indium from Waelz oxide during the last five years has been increased by more than 5.0 percent, and at the present time it is 10 to 20 percent (absolute) higher than at other domestic zinc plants. All indium is being produced with the State Emblem of Quality.

A combination of industrial engineering measures carried out in the electrolysis section (installation of additional electrolytic cells, mechanization of cleaning sludge from cells, etc.) has made it possible to improve the quality of zinc precipitation, to raise the yield of metal in pig zinc, and to reduce losses of it in dross and melting loss.

The results of the plant's work on improving the extraction of valuable components are characterized by the following data, in percentages:

	1971	1975	Five months, 1978
Extraction			
Zn	96.0	96.64	96.88
Cd	90.42	90.64	91.36
In	71.0	75.3	76.38
S	88.14	88.67	88.89
Utilization of sulfur	92.54	94.64	93.57
Thoroughness of utilization of sulfur	94.7	95.4	95.57

Universally recognized is the national economic importance of processing production waste and of developing and introducing waste-free technological processes. This objective has become the determining one in the plant's work.

The improvement in the quality of roasting products and intensification of the Waelz process have made it possible to set up the processing of cakes from dumps of past years. The processing of sludge from cleaning facilities has been set up.

A production system has been developed and introduced for processing chemical industry waste containing 40 percent zinc in carbonate form.

In conjunction with the GIredmet [State Scientific Research and Planning Institute of Rare Metals], an original system has been created for processing semiconductor material waste, including the extraction of indium. Gallium is being extracted by the sorption method from indium production waste.

The plant is close to creating a waste-free production process system.

Measures for the improvement of the thorough utilization of raw material have been carried out by the plant in close alliance with environmental protection objectives.

Based on the revision of all technological processes, the opportunity has been created of eliminating the disposal of metal-containing solutions into the sewer system and of utilizing them in technological processes. As a result, the total disposal of contaminated waste has been reduced considerably, and purification facilities put into service in 1974 have been only 40 to 50 percent loaded.

In operation at the plant are three closed water circulation systems: in the sulfuric acid production process; for the purpose of extinguishing the slag in the Waelz furnace; and for the purpose of central cooling of the zinc electrolyte. Recycling of water has been introduced in many sections. The total circulation of water at the plant equals 96.5 percent. Only 3.5 percent of the water used for technological needs is disposed of after preliminary thorough cleaning to the maximum permissible concentrations, for reservoirs for business and everyday purposes.

The plant could convert to 100-percent recycling of water, if a favorable solution were found to the problem of cleaning chlorine from waste water.

In recent years the plant has been greatly involved in this problem, in cooperation with TsNIIolovo [Central Scientific Research Institute of Tin], Kazmekhanobr [Kazakh Institute of Mechanization of Processing], the Azerbaydzhan SSR Academy of Sciences Institute of Petrochemical Products, the Ural Institute of Wood Technology, and the Chelyabinsk Branch of VODGYeO [All-Union Scientific Research Institute of Water Supply, Sewerage, Hydrological Structures and Hydrogeology]. But there has as yet been no success in developing an efficient system for the separation of chlorine with the utilization of chloride precipitates.

Conducive to healthier air have been the redesign of sulfuric acid production, improvement of the system for removing dust from metallurgical production process gases, the introduction of unit-by-unit overhauling and the sealing of equipment, and strict monitoring of the observance of technological cycles.

In the purification of gases from the drying of lead and zinc cakes, and in the unit for producing hydrous sulfate in fluidized bed furnaces, percussion-type scrubbers (SUD's) have been operating successfully, the use of which has made it possible to reduce the content of precious dust in these gases from 1 to 2 g/nm^3 to 0.1 to 0.2 g/nm^3.

A high degree of removal of Waelz oxide has been achieved with bag filters. The dust content in exhaust gases has not exceeded 12 to 17 mg/nm^3.

A highly difficult problem has turned out to be the purification of induction furnace gases in the remelting of zinc. With the introduction of rotary cyclone dust separators in this conversion process, all metallurgical production gases will be subjected to dust removal.

The improvement of product quality has also had a considerable influence on improvement of the thoroughness of the utilization of raw material.

The reduction in the content of impurities in commercial products (cf. table) testifies to the great job done by the plant's team along this line.

An objective evaluation of the plant's job in improving product quality is represented by the output of products with the State Emblem of Quality.

In 1976 80.4 percent of all products bore the Emblem of Quality, and in 1977, 81.73 percent.

Reduction in Content of Impurities in Commerical Products, in Percentages

Type of Product	Zn		Cd	
	1976	1977	1976	1977
Clinker	1.49	1.02	-	-
Lead cake	8.85	7.68	0.22	0.17
Copper cake	8.13	6.51	0.4	0.32
Cleaned solution, mg/1	-	-	2.13	1.63

Successes in improvement of the thoroughness of the utilization of raw material at the plant have been due not only to the growth in the technical level of production, but also to the precise formulation of organizational work.

The plant has made extensive use of information on the know-how of domestic and foreign zinc plants and enterprises of allied industries.

A comparative analysis is regularly made of all technological indicators of plants, the reasons are found for the plant's lagging behind with regard to individual indicators, and measures are developed for eliminating the lag.

Questions relating to technological discipline and to reducing the loss of valuable components are discussed in daily selective operations meetings with section process engineers. In compulsory monthly meetings of shift foremen for all production processes and of section process engineers, a detailed analysis is made of the month's work results, with reports by foremen and process engineers, and suggestions for improving figures are discussed.

Questions relating to reducing the loss of valuable components and to improving the thoroughness of the utilization of raw material have found reflection in systems for paying workers, in a milieu of socialist competition.

The plant extracts from complex multicomponent raw material 12 elements and 11 types of products. The cost of producing byproducts equals 23.4 percent of the total output of commercial products.

But the plant's opportunities for improving the thoroughness of the utilization of raw material have been far from exhausted.

The following are the most important objectives of the 10th Five-Year Plan period:

Mastery, with an experimental unit, of a technology for processing commercial copper-and-zinc products from Ural concentration plants. The solution to this important problem will expand the plant's raw material base considerably and will increase the extraction of copper and zinc for the subindustry as a whole.

Completion of the redesign of the sulfuric acid production process, by converting all systems to the system of dual contact of gases with intermediate absorption.

Construction of one more Waelz furnace, for the purpose of enabling the processing of all current cakes and cakes from dumps of past years, with a growth in the production of zinc.

Improvement of systems for processing zinc cakes and Waelz oxides.

Modernization of filtering equipment in hydrometallurgical sections.

Improvement of the leaching technology, and other measures.

8831
CSO: 1821

METALLURGY

UDC: 669.243.052

WASTE-FREE TECHNOLOGY INTRODUCED AT POBUZHSKIY NICKEL PLANT

Moscow TSVETNYYE METALLY in Russian No 12, Dec 78 pp 9-13

[Article by S. P. Kormilitsyn, V. D. Linev, A. Ye. Burochkin, B. P. Onishchin, and V. A. Nechiporenko: "Adoption of Waste-Free Process at the Pobuzhskiy Nickel Plant"]

[Text] The Pobuzhskiy Nickel Plant (PNZ) in Kirovogradskaya Oblast went into operation in 1973, receiving its raw materials from a local oxidized nickel ore body. The plant employs reduction electrosmelting of the ore into ferronickel in place of reduction-sulfidizing smelting of ore into matte, which is traditionally utilized in this country.

Selection of the smelting process proceeded from the possibility of increasing comprehensiveness of ore utilization by the commercial recovery of substantial quantities of iron in addition to nickel and cobalt. A positive influence was also exerted by such factors as the possibility of total elimination of utilization of short-supply metallurgical coke, process simplicity, and the possibility of producing stack gases which do not contain sulfur dioxide, that is, producing less environmental pollution.

The process employed at PNZ (Figure 1) includes the following: preparation of materials for smelting and charging, roasting the charge in rotary tube furnaces, smelting of the hot matte in large-capacity electric furnaces, ladle refining of the obtained crude ferronickel from sulfur with molten soda, then from silicon and chromium in a vertical oxygen converter with dinas (acid) lining and from carbon, phosphorus and residual silicon, sulfur and chromium in a similar converter with magnesite-chromite (basic) lining. After the product is poured into 30-50 kg ingots, the metal is reduced with ferrosilicon and aluminum. Poor ore of the following content, in percentages, is processed:<1 Ni, ~43 SiO_2 and 22.5 Fe.

The refined ferronickel should contain not more than 0.10% Si, C, Cr, Cu (each) and 0.04% S and P. The chemical composition of the actually obtained metal and specification requirements are contained in Table 1, from which it is evident that product from PNZ exceeds specifications in Si, C and P content and meets specifications in S and Cr content.

Ферроникель[1]	Марка[5]	Ni+Co	Co	Si	C	Cr	Cu	S	P
Рафинированный[2]	ФН-07	≥6,0 / 6,9—8,0	≤0,5 / 0,3—0,42	≤0,10 / 0,02—0,04	≤0,10 / 0,03—0,04	≤0,10 / 0,045—0,087	≤0,10 / 0,04—0,095	≤0.4 / 0.03—0.04	≤0,4 / 0,01—0,02
Углеродистый[3]	ФН-08	≥5,0 / 5,6—6,5	≤0,4 / 0,25—0,37	≤2,0 / 0,6—1,6	≥0,9 / 0,9—1,3	≤1,3 / 0,65—1,30	≤0,08 / 0,02—0,07	≤0.04 / 0,034	≤0,11 / 0,09
Литейный[4]	ФН-09	≥4,0 / 4,0—5,19	—	≥4,5 / 4,6—6,6	≥1,5 / 1,5—2,5	≥1,0 / 1—2,1	≤1,0 / 0,03	≤0,10 / 0,1—0,03	≤0,15 / 0,09—0,15

Table 1.

Chemical Composition of PNZ Commodity Output, % (numerator -- according to Technical Specifications 48-3-59-75, denominator -- actual content)

Key:

1. Ferronickel
2. Refined
3. Carbon
4. Foundry
5. Grade

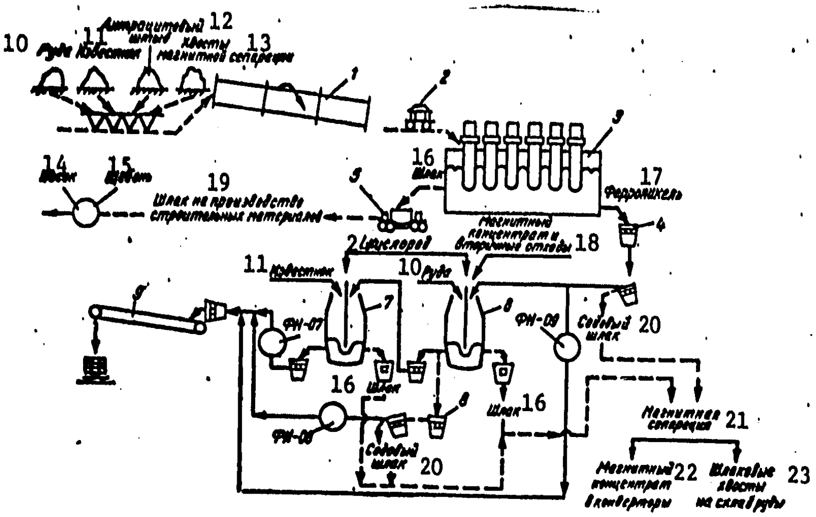


Figure 1. Diagram of Processing of Oxidized Nickel Ore at the Pobuzhskiy Nickel Plant

Key:

1. Tube rotary furnace
2. Bucket car
3. Ore heating furnace
4. Ladle with molten soda
5. Slag car
6. Converter with "acid" lining
7. Converter with "basic" lining
8. Ladle with molten soda
9. Casting machine
10. Ore
11. Limestone
12. Anthracite dust
13. Magnetic separation residue
14. Sand
15. Crushed rock
16. Slag
17. Ferronickel
18. Magnetic concentrate and secondary waste
19. Slag to building materials production
20. Soda slag
21. Magnetic separation
22. Magnetic concentrate to converters
23. Slag residue to ore storage
24. Oxygen

It is important to note that the content of trace impurities in the ferronickel which are harmful for steelmaking (Sn, Sb, Pb, Zn, and others) is two thirds to half that in grade 1 steel scrap utilized in steelmaking.

At the present time the following, in percentages, is being recovered from ore refined into ferronickel at PNZ: 85 Ni, ~70 Co and 50 Fe. Nickel recovery is more than 10% (abs.) higher than at Ural plants smelting ore into matte. An estimate of comprehensiveness of utilization is given for the average composition of PNZ oxidized nickel ore (Table 2) for two cases: smelting of this ore into ferronickel and matte process smelting, obtaining metallic nickel and cobalt.

Table 2. Results of Calculation of Comprehensiveness of Utilization of Ore at PMZ

1 Технологические варианты	2 Извлечение, %			3 Комплексность использования руды, %
	Ni	Co	Fe	
4 Производство рафинированного ферроникеля.	85	96	60	66
5 Производство металлических никеля и кобальта	76	32	—	52.4
6 Производство литейного ферроникеля	89	68	70	73.7

Key:

1. Process variants
2. Recovery
3. Comprehensiveness of ore utilization, %
4. Production of refined ferronickel
5. Production of metallic nickel and cobalt
6. Production of foundry ferronickel

Installation of an efficient dust-trapping system was provided at PNZ. Tube furnace gases are dry-cleaned, while gases from the electric furnaces and converters are scrubbed. Tube furnace dust is return-cycle. Table 3 contains figures on the gas scrubbing system employed on the principal metallurgical equipment, their present achieved working efficiency, and composition of waste gases.

In all cases gases ejected into the atmosphere contain less than 0.3 g/nm^3 of particulates, which is lower than the maximum allowed by health standards.

The plant operates with fully recirculating water supply and has two water cycles: conditionally pure, and dirty. In the first cycle (85% of the entire water balance) water used to cool the components of metallurgical furnaces and installations (cooling water jackets and coolers of electric furnaces, electrostatic sprayers and tuyeres of converters, oxygen station equipment) is cooled in a cooling tower prior to recycling and is subjected to chemical softening and stabilization. The second cycle services the wet scrubbing systems. All water contaminated by nickel-containing dust is collected and sent to a thickener. The upper drainoff from the thickener, after cooling in the cooling tower, is recycled. The lower drainoff is clarified in settling ponds and then cooled, while solid suspended matter is collected in these ponds and periodically (once every

Table 3. PNZ Gas Scrubbing Systems and Chemical Composition of Gases Ejected Into the Atmosphere from the Principal Metallurgical Equipment

1 Металлургические агрегаты	2 Схема газоочистки	3 К. п. д. газоочистки, %	4 Состав газов, %*				
			CO_2	CO	O_2	H_2	5 SO_2 (по данным НИИОгаза)
Трубчатые печи 6	Циклонные аппараты—электрофильтры 10	99,7	$\frac{5,8-14,8}{8,03}$	$\frac{0-0,2}{0,06}$	$\frac{5,1-14,6}{11,15}$		
Электроплавильные печи 7	Водоорошаемый газоход—мокрый скруббер—турбулентный газопромыватель—каплеотделитель 11	99,73	$\frac{17,2-40,4}{24,6}$	$\frac{0-6,2}{1,3}$	$\frac{5,8-13,4}{8,9}$	$\frac{0-1,7}{0,5}$	
Конверторы «кислой» стадии рафинирования 8	Водоорошаемый газоход—турбулентный газопромыватель—каплеотделитель 12	97,75	$\frac{0,8-3,8}{2,4}$	$\frac{0-0,2}{0,08}$	$\frac{18-20,6}{20,1}$		0,074
Конверторы «основной» стадии рафинирования 9			$\frac{1-30,6}{14,5}$	$\frac{0,2-1,2}{0,34}$	$\frac{4,8-20,2}{13,5}$		0,09

* В числителе—интервал концентраций, в знаменателе—средние значения.

Key:

1. Metallurgical equipment
2. Gas scrubbing process
3. Gas scrubbing efficiency, %
4. Composition of gases, %*
5. SO_2 (according to figures of the State Scientific Research Institute for Industrial and Health Gas Purification)
6. Tube furnaces
7. Electric smelting furnaces
8. "Acid" refining stage converters
9. "Basic" refining stage converters
10. Cyclone dust separators, electrostatic precipitators
11. Sprinkler-containing gas duct, wet scrubber, turbulent gas scrubber, steam trap
12. Sprinkler-containing gas duct, turbulent gas scrubber, steam trap

---

* In the numerator -- concentration interval, in the denominator -- average values

---

2 or 3 years) removed, in the summer, and fed to the start of the process to be refined together with ore. Thanks to the closed water circulation cycle, additional fresh water is required (7.1% of total consumption) only to replace evaporation losses.

Elimination of discharge of harmful pollutants into the air and water made it possible to locate the plant in the center of a settled, fertile farming area. Since the plant has been in operation there has not been recorded a single instance of adverse effect by the metallurgical production on the ecology of the plant's environment.

The work force at PNZ, together with specialists from the Gipronikel' Institute, have expended a considerable effort to increase metal recovery and to develop a waste-free technology.

Study of the nickel requirements of the nation's economy led to the necessity of designing and installing a process for producing new grades of ferronickel with increased carbon, silicon and chromium content, and correspondingly increased the number of customers. It is preferable to utilize carbon ferronickel to produce a large number of grades of low-and medium-alloy steels, while foundry ferronickel is extensively employed in machine tool building for producing high-quality iron castings (see Table 1).

The process for producing new kinds of ferronickel has made it possible either partially or totally to eliminate oxygen conversion and acidification and requires only additional soda treatment. This results in a 7-20% increase in recovery of iron and a 0.4-4% increase in nickel and cobalt recovery, and in addition operating costs are reduced. Utilization of silicon, carbon and chromium sharply increases the comprehensiveness of ore processing (see Table 2), which reaches almost 74% with utilization of ferronickel to produce foundry metal.

Efficiency of production at PNZ has improved substantially since installation of the process for refining secondary nickel-containing metallic waste in oxygen converters. The process takes place autogenously with the excess heat in the acid-stage converters, heat generated by the oxidation of silicon and chromium. From 95 to 96% of the nickel and more than 70% of the iron is recovered as commodity output. The volume of processing of secondary materials can reach 35% of the crude ferronickel by weight without disturbing process conditions. In practical terms consumption of secondary metal waste has steadily decreased from 1973 through 1977 (from 22.5 to 7.9%), and the plant sees substantial reserve potential in this regard. We must note that in processing such nickel-containing waste in matte converters at other nickel enterprises, the iron is entirely lost.

A magnetic separation unit was installed and put into operation at the plant in 1977 for final recovery of ferronickel inclusions trapped in converter and soda slags (Figure 2).

The magnetic concentrate, recovered with the aid of a magnetic disk, overhead electromagnet and an electromagnetic sheave, contains 1-3% Ni + Co and is returned to the converters for processing, while the separation rejects are utilized in ore electrosmelting, replacing a portion of the limestone. The introduction of magnetic separation and complete cycling of converter and soda slags made it possible to increase start-to-finish recovery of

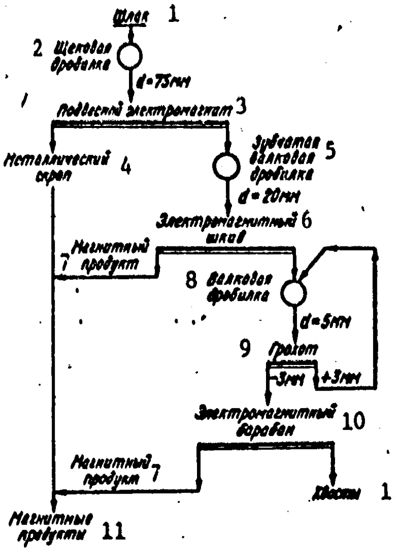


Figure 2. Converter Slag Magnetic Separation Process Diagram

Key:

1. Slag
2. Jaw crusher
3. Overhead electromagnet
4. Metal scrap
5. Toothed-roll crusher
6. Electromagnet sheave
7. Magnetic product
8. Roll crushing mill
9. Screen
10. Electromagnetic drum
11. Magnetic products
12. Rejects

Ni + Co by 1.0% and to reduce irrecoverable losses of these metals by 0.8%. At the present time full-scale testing is in progress on final processing of a portion of molten converter slags in electric ore smelting furnaces, bypassing magnetic separation.

In 1977 the plant began production of construction crushed rock and sand of electric melting waste slags. Slags containing 0.06% Ni, 10% Fe, 52% SiO_2 and 22% CaO in molten form are hauled to the slag yard. As it cools down, the slag layer is sprinkled with water, which causes it to crack and split, so that the pile can be worked with excavators. Jaw crushing and screening the slag produces good-quality crushed rock for road construction, conforming to GOST 5578-65, and sand. The material is of the following size: -70+40 mm; -40+20 mm; -20+5 mm, and -5 mm. Since this unit went into operation all slag produced in electric ore smelting has been utilized, following processing, in construction. Since that time the production process at PNZ has been practically totally waste-free.

Minimal required capital outlays helped achieve such a rapid incorporation of slag processing with a comparatively simple equipment and process arrangement.

According to studies conducted at the Leningrad Construction Engineering Institute and confirmed by the operating performance of a semi-full-scale unit with an output capacity of 80 tons per day, cement of grades 160-200 is obtained when the slag is ground to -0.05 mm and with the addition of 15-20% activating agent (portland cement, lime, etc). Approximately 600,000 tons of cement can be produced annually from PNZ slags. At the same time remaining ferronickel inclusions can be recovered by magnetic or air separation in the process of grinding the slags.

Work is to be continued in the following areas in order to achieve further increase in the comprehensiveness of utilization of raw materials and to increase plant profitability:

increase in iron recovery, primarily by increasing the percentage share of foundry ferronickel production;

the search for ways to obtain useful employment of cobalt contained in the ferronickel;

organization of cement production based on electric melting slags;

recovery of ferronickel inclusions from the slags.

3024
CSO: 1821

METALLURGY

UDC: 669.33.052

LOSSES OF VALUABLE CONSTITUENTS IN COPPER REFINING REDUCED

Moscow TSVETNYYE METALLY in Russian No 12, Dec 1978 pp 19-21

[Article by N. P. Shubin: "Losses of Valuable Components Reduced at Uralelektromed' Combine"]

[Text] A campaign to reduce losses of valuable components at all stages of production, more comprehensive utilization of raw materials and development of production without waste has become one of the leading trends in efforts to improve the economic effectiveness of this enterprise.

Efforts by the combine's work force are concentrated in the following areas.

Improvement in the process of beneficiation of Gumeshevskaya ore. At the end of 1976, after the ore was played out at the Pyshminskiy Mine, the concentration mill was fully converted over to processing of Gumeshevskaya ore, which sharply differs in character from the ore previously processed.

The people at the combine, working together with scientists from the Unipromed' Institute, designed and in 1977 incorporated an improved process of concentrating Gumishevskaya ore under full water cycling conditions.

The diagram in Figure 1 includes bulk flotation, fining of bulk concentrate, with subsequent separation of copper and iron sulfides and magnetic separation of bulk flotation residue.

Following are the ore flotation reagent and process figures:

Size yield -- 0.074 mm, percentage of ore	60-65
Size yield -- 0.074 mm, percentage of bulk concentration	85-90
Butyl xanthate consumption, g/t:	
bulk rougher flotation	35-40
check flotation	25-30
copper check flotation	8-10
Foaming agent consumption, g/t:	
bulk rougher flotation	15-20
check flotation	5-10
Lime consumption on copper concentrate second cleaning flotation, kg/t	4-5

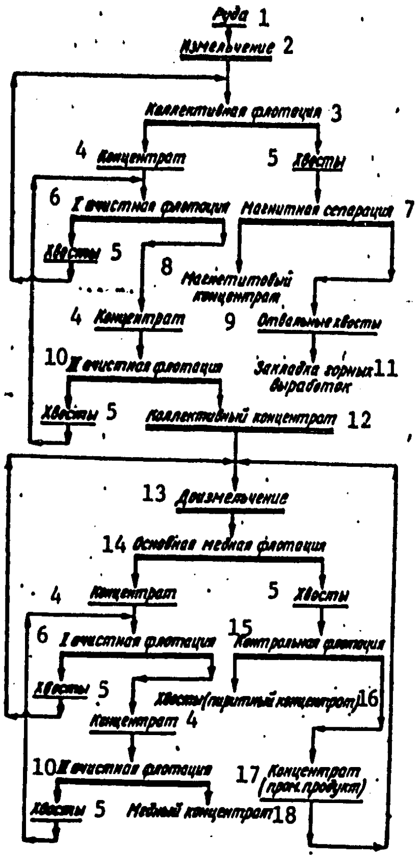


Figure 1. Gumeshevskaya Ore Concentration Process Flow Diagram

Key:

1. Ore
2. Grinding
3. Bulk flotation
4. Concentrate
5. Residue
6. First cleaning flotation
7. Magnetic separation
8. Magnetite concentrate
9. Final rejects
10. Second cleaning flotation
11. Mine backfilling
12. Bulk concentrate
13. Fining
14. Copper rougher flotation
15. Check flotation
16. Residue (pyrite concentrate)
17. Concentrate (intermediate product)
18. Copper concentrate

In order to increase extraction of iron from bulk flotation residue, an improved PBM-PP-90/250 separator (with semicounterflow bath) was installed in place of the existing PBM-2 magnetic separators.

During the period of testing the new process arrangement, the following were obtained from ore containing 1.15% copper, up to 7% sulfur and 3% Fe_3O_4: copper concentrate with 22.6% copper, with 88.25% copper recovery; pyrite concentrate with recovery of >50% S, and iron concentrate, with recovery of >61% Fe.

If we consider that the mill's final rejects are used as cheap mine backfill material, the existing process of concentration of Gumeshevskaya ore may constitute a positive example in the development of waste-free production. The process was adopted without capital outlays and without substantial rearrangement of equipment, which made it possible to put the new process into operation in a very short period of time.

Setting up production of refined nickel sulfate. Prior to adoption of the new process, in the production of copper sulfate nickel was recovered in copper-nickel salts and crude nickel sulfate, which were shipped to nickel plants in the form of production process tailings.

The people at the combine came up with a process of obtaining commercial nickel sulfate of grades NS-1 and NS-0, according to GOST 2665-73, from crude crude nickel sulfate containing (percentages): 18 Ni; 0.5 Cu; 0.1 Fe; 0.2 H_2SO_4.

The process of obtaining refined nickel sulfate (Figure 2) includes the following: washing out crude nickel sulfate from sulfuric acid, dissolving it (concentration Ni 100-110 g/l), cleaning copper and iron from the solution with separated chalk, and solution filtration. Cake from the filters, composition, in percentages: 9.0 Ni; 0.5 Cu; 0.1 Fe; 80 ($CaCO_3$+ CaO_4)) is shipped to nickel plants, and the refined solution, following acidification with sulfuric acid to a concentration of 2-5 g/l, is evaporated (nickel concentration 200 g/l), crystallized (at 26-28°C) and, following centrifuge separation from the mother liquor, is shipped to the customer.

The mother liquor (120-135 g/l Ni), after 20 cycles, is flame-evaporated to obtain nickel salts, which are shipped to nickel plants. Commercial production of refined nickel sulfate began in 1978.

Adoption of an installation for processing refining furnace cobbings by the flotation method. Formerly copper and the noble metals in refining furnace cobbings were shipped as production waste to copper smelters for further processing.

Recovery of copper and noble metals from the cobbings was unsatisfactory, particularly in processing refractory chrome-magnesite cobbings, as a result of difficulty in marketing them.

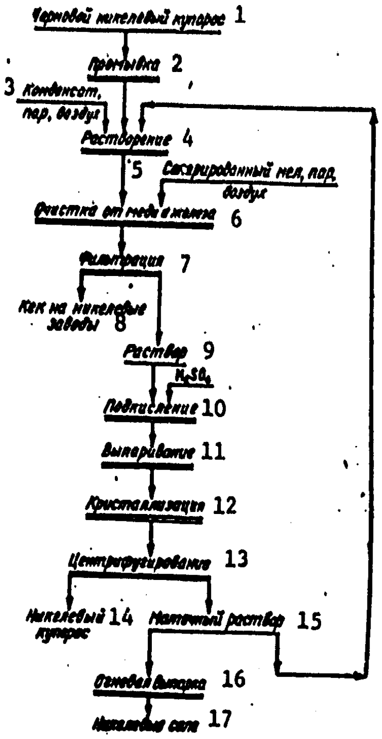


Figure 2. Process Flow Diagram for Obtaining Refined Nickel Sulfate

Key:

1. Crude nickel sulfate
2. Washing
3. Condensate, steam, air
4. Dissolving
5. Separated chalk, steam, air
6. Copper and iron removal
7. Filtration
8. Cake for nickel plants
9. Solution
10. Acidification
11. Evaporation
12. Crystallization
13. Centrifugation
14. Nickel sulfate
15. Mother liquor
16. Flame Evaporation
17. Nickel salts

The people at the combine designed and installed a system of concentrating refining furnace cobbings by the flotation method (Figure 3).

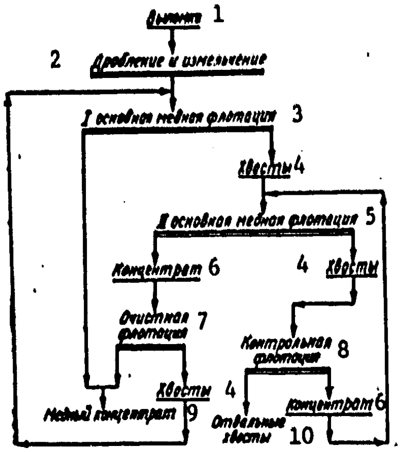


Figure 3. Process Flow Diagram of Concentration of Refining Furnace Cobbings

Key:
1. Cobbings
2. Crushing and grinding
3. First copper rougher flotation
4. Residue
5. Second copper rougher flotation
6. Concentrate
7. Cleaning flotation
8. Check flotation
9. Copper concentrate
10. Final rejects

Following are cobbings flotation reagent and process figures:

Size yield -- 0.074 mm, %	75
Butyl xanthate consumption, g/t:	
first rougher flotation	240
second rougher flotation	180
check flotation	120
Pine oil consumption, g/t:	
first rougher flotation	45
second rougher flotation	30
check flotation	30
Lime consumption in first rougher flotation, g/t	1-2

When the cobbings concentration process was in full operation, the obtained copper concentrate contained >25% Cu with recovery of >90% Cu.

Refining furnace cobbings are presently being processed at the plant on a regular basis, and they are adjusting the process to optimal concentration

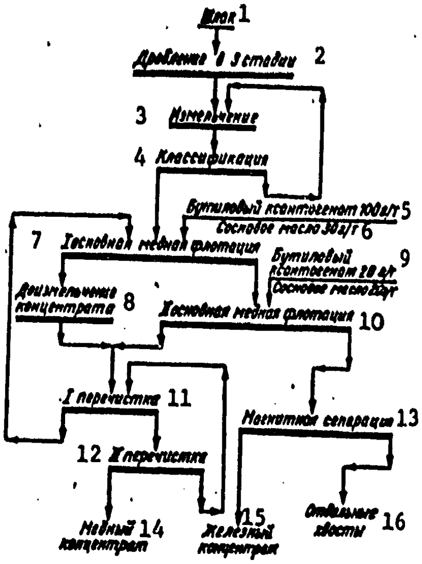


Figure 4. Mednogorsk Converter Slag Concentration Process

Key:

1. Slag
2. Three-stage crushing
3. Grinding
4. Sizing
5. Butyl xanthate, 100 g/t
6. Pine oil, 30 g/t
7. First copper rougher flotation
8. Concentrate fining
9. Butyl xanthate, 20 g/t, pine oil 20 g/t
10. Second copper rougher flotation
11. First recleaning
12. Second recleaning
13. Magnetic separation
14. Copper concentrate
15. Iron concentrate
16. Final rejects

---

conditions. At the same time they are studying ways to process other metallurgical waste material by the flotation method.

Adoption of all the above-enumerated measures at the combine has made it possible to achieve excellent indices in ore concentration, to set up additional production of pyrite concentrate, to increase finished copper yield, and to set up production of refined nickel sulfate.

At the present time savings of more than 400,000 rubles have been achieved from adoption of these measures, and savings will increase to 800,000 rubles when equipment to obtain refined nickel sulfate, etc is producing at full designed capacity.

Of interest are the results of full-scale tests on Mednogorsk converter slag concentration by the flotation method (Figure 4), conducted in 1966 at the Pyshma Concentration Mill.

As a result of these full-scale tests, 745 tons of slag was processed, containing (percentages): 1.5 Cu; 2.2 S; 45.5 Fe.

When the slag was ground to 88% size 0.074 mm, and with a butyl xanthate consumption of 120 g/t and pine oil consumption of 50 g/t, they obtained a copper concentrate containing 12% Cu, with 72% copper recovery, and iron product (without recleaning) at 50.3% Fe, with 42.2% recovery.

It would evidently be expedient to process locally, at concentration mills, metallurgical production waste of this type on hand at enterprises.

3024
CSO: 1821

METALLURGY

UDC: 669.715:621.74

EFFECTIVENESS OF REFINING IN AN MHD TROUGH

Moscow TSVETNYYE METALLY in Russian No 12, Dec 78 pp 66-68

[Article by B. I. Bondarev, I. V. Shvetsov, and V. D. Mishchenko: "Investigation of Effectiveness of Refining in an MHD Trough"]

[Text] Degassing of melts is extensively employed for obtaining semi-finished products of aluminum alloys. However, static (without forced mixing) degassing of large quantities of metal in a mixer is insufficiently effective as a result of the effect of metallostatic pressure.

Employment of active mixing of a melt during degassing in a mixer makes it possible to achieve a substantial decrease in porosity volume. In particular, typical porosity values V_p in D1 alloy 540 mm diameter ingots are equal to 0.2-0.3%, and no appreciable decrease in gas content (G) is observed.

The results of an inspection of ingots cast with employment of static degassing (numerator) and with refining by traditional methods (denominator) are as follows:

(1) Макроструктура, балл	I	II	III	IV
(2) Г, см³/100 г Ме	$\frac{0.13}{0.14}$	$\frac{0.12}{0.12}$	$\frac{0.12}{0.13}$	$\frac{0.12}{—}$
(3) Коэффициент затухания УЗ-колебаний, дБ/см	$\frac{1.9}{2.5}$	$\frac{1.8}{2.25}$	$\frac{1.75}{2.0}$	$\frac{1.65}{1.95}$
$V_п$, %	$\frac{0.52}{0.53}$	$\frac{0.51}{0.47}$	$\frac{0.45}{0.46}$	$\frac{0.40}{—}$
$\delta_{отн}$, %	$\frac{53.3}{58.2}$	$\frac{51.4}{50.8}$	$\frac{53.4}{51.8}$	$\frac{54.5}{—}$

Key:
1. Macrostructure, points
2. G, cm^2/100 g
3. Ultrasonic oscillations attenuation factor, db/cm

Mixing takes place not so much due to an increase in the mass transfer of hydrogen during movement toward the surface by the lower layers of the melt as it occurs as a result of flotation of oxide inclusions containing hydrogen bubbles of a negative radius of curvature. As a consequence of more complete removal of oxides, which include molecular hydrogen, is a sharp decrease in porosity volume as a result of considerably decreasing the number of centers of pore generation.

It was previously shown that in the process of static degassing, oxide inclusions are "activated" in the lower layers of the melt,[1] that is, molecular hydrogen is released in the capillary channels of nonmetallic inclusions. This takes place under conditions of reduced pressure and the decrease in hydrogen solubility caused by it, to values lower than gas content in the investigated melt body. A comparison of hydrogen (H) content, porosity B_p and grain size (d) of ingots obtained with employment of traditional refining methods in a melting-casting unit, static degassing in a mixer and degassing with forced mixing with a gas-dynamic pump (GDN) confirms the phenomenon of "activation" of oxides in a melt during degassing (see table).

Quality of 540 mm Diameter D1 Alloy Ingots Refined by Different Methods (typical values)

(1) Рафинирование	V, т	[H], см³/100 г	$V_п$, %	d, баллы (5)
Традиционное (2) . .	30	0,13–0,14	0,5–0,6	I–II
Статическое вакуумирование (3)	16	0,12–0,13	0,4–0,6	II–III
То же, с перемешиванием ГДН (4) . .	16	0,12–0,13	0,2–0,3	II–IV

Key:

1. Refining
2. Traditional
3. Static degassing
4. Same, with gas-dynamic pump mixing
5. Points

One important consequence of "activation" of oxides is appearance in the melt of additional pore formation centers, which leads to a decrease in the critical hydrogen content values, below which porosity does not develop. With an identical volume of porosity in degassed metal, it is essential to achieve higher degrees of gas removal than in undegassed metal. Porosity of undegassed metal proves to be somewhat greater than degassed metal with identical hydrogen content. It would seem expedient[2] to perform refining in such a manner that additional centers of pore generation do not form in the metal. Dispersed oxides remaining in the melt, which do not contain molecular hydrogen, behave during hot working as normal intermetallide solid phases, and defects are not formed in the ingots and in deformed semimanufactures.

One of the possible ways to improve the quality of castings and deformed semimanufactures is refining in an mhd trough with employment of metallic gas absorbers and multilayer filtration through gauze filters. For comparison with other refining methods we cast 540 mm diameter ingots of D1 alloy at a rate of 26 mm/min at 700°C (ingot mold height 180 mm) with the melt processed in an mhd trough (Figure 1). A gas absorber was placed in the trough channel. Following degassing, the melt is filtered through a gauze filter.

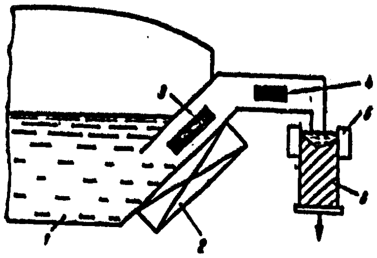
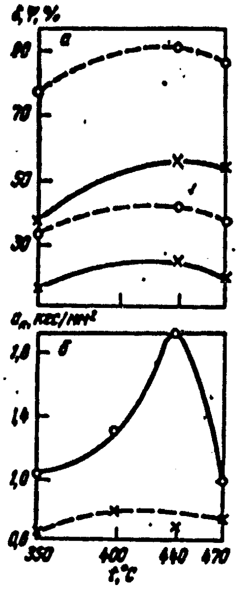


Figure 1. Ingot Casting Diagram

Key:

1. Mixer with melt
2. MHD trough
3. Passage with degassing device
4. Spout with filtering device
5. Ingot mold
6. Ingot

The melt was prepared in a gas furnace, treated with flux in an electric mixer, fed through the mhd trough passage into a spout and then through a spout plug into a distribution screen situated in the ingot mold. The melt's metallostatic head at the level of the spout, provided by the mhd trough, runs to 0.5 m. The trough passage contains a degassing device, the principal component of which is a getter.



a -- relative elongation and reduction,
б -- specific viscosity;
(————) -- refining by traditional methods;
(--------) -- refining in an mhd trough;
o -- δ, x -- ψ

Figure 2. Influence of Refining in an MHD Trough on Plasticity of Ingots at Elevated Temperatures

A peculiarity of the dynamics of movement of the melt in an inclined mhd trough lies in the fact that the lower layers of the melt in the trough are displaced upward by means of electromagnetic forces, while the upper layers displace downward under the effect of gravity; this intensifies interaction between melt and getter due to repeated contact. Redistribution of hydrogen between molten metal and getter ensures extremely low end hydrogen content in the melt. The achieved degree of degassing can be varied across a broad range by the quantity of getter and its surface area. At the same time, as hydrogen passes from the melt into the getter, the latter partially dissolves, with its content in the melt increasing to 0.01%. The degassed melt, under a metallostatic head up to 0.5 m, enters the filter device, the principal component of which is a double-layered gauze filter with 0.6 x 0.6 mm mesh. The results of comparative examinations of ingots attest to the high effectiveness of refining in an mhd trough:

(1) Рафинирование	[H]**, см³/100 г Me	П*, балл (4)	$П_{отн}$, % (5)	Макроструктура (6)
(2) Традиционное	$\frac{0,32-0,37}{0,26-0,32}$	3—4	0,5—0,6	Есть зоны крупного зерна (7)
(3) В МГД-лотке	$\frac{0,17-0,18}{0,12-0,13}$	1	0,2—0,3	Равномерная, глобулярная (8)

(9) * 1 балл — растрава нет; 5 баллов — растрав максимальный.

(10) ** В числителе результаты определения водорода методом первого пузырька, в знаменателе — методом вакуумного нагрева.

Key:

1.	Refining	6.	Macrostructure
2.	Traditional	7.	Large-grain zones
3.	In an mhd trough	8.	Uniform, globular
4.	Points	9.	1 point -- no etching; 5 points -- maximum etching
5.	Relative	10.	The numerator contains results of determining hydrogen by the first bubble method, and the denominator -- by the vacuum heating method

---

One important feature of degassing with a metallic getter is the removal of hydrogen without its transition to a molecular state, which excludes the possibility of "activation" of oxide particles and an increased tendency of the melt toward vaporization. No porosity was detected with deep etching of test ingots. A no less significant advantage of this method is the fact that one obtains a uniform structure which does not require the employment of additional modification with master alloys. The getter, dissolving in the melt, gradually passes into the crystallizing ingot. Thus there occurs continuous modification of the melt, which has greater effectiveness than modification in the furnace and mixer.

In plastic characteristics, at hot working temperature (Figure 2a, b), ingots with refining in an mhd trough possess a clear superiority over traditional methods of refining. The increase in plasticity is connected not only with a decrease in gas content but also removal of oxide inclusions during filtration through a double 0.6 x 0.6 mm glass gauze filter.

Summarizing the above, we can note that refining in an mhd trough by the getter degassing method and multilayer filtration is a promising trend in seeking to solve the problem of increasing metal purity. Refining in an mhd trough is equal in effectiveness to degassing in a mixer and can be recommended for extensive commercial adoption.

FOOTNOTES

1. B. I. Bondarev, I. V. Shvetsov, G. V. Cherepok, et al, in the book "Metallovedeniye i tekhnologiya legkikh splavov" [Physical Metallurgy and Technology of Light Alloys], Moscow, Nauka, 1976, pp 24-29.

2. V. I. Yakovlev, G. A. Balakhontsev, B. I. Bondarev, et al, TSVETNYYE METALLY, No 1, 1974, pp 64-67.

3024
CSO: 1821

METALWORKING EQUIPMENT

FIRST ALL-UNION CONFERENCE ON PRODUCT RELIABILITY

Moscow VOPROSY EKONOMIKI in Russian No 1, Jan 79 p 27

[Article by V. Logachev: "Reliability of Manufacturing Processes and Improvement of Product Quality"]

[Text] The First All-Union Scientific-Technical Conference on the Problem of Reliability of Production Complexes (using the machine building branches as an example) was held in Ufa in September 1978, organized by the All-Union Council of Scientific and Technical Societies, the USSR Council of Ministers State Committee on Standards, the USSR Ministry of Higher and Secondary Specialized Education, the Bashkir CPSU Oblast Committee, the Central Board of the Scientific-Technical Society of the Machine Building Industry, and the Bashkir Oblast Council of Scientific-Technical Societies, at the Ufa Aviation Institute imeni S. Ordzhonikidze.

Papers on the following topics were discussed at the conference: forming of quality and reliability indicators for products and manufacturing processes; reliability of a production complex as a complex dynamic system; standardization in the area of reliability of production systems; comprehensive evaluation of level of technological reliability; methods of quality and reliability control; metrological aspects of the problem of reliability, etc.

The "Principal Directions of Development of the USSR National Economy in 1976-1980" and the law "On the State Plan of Development of the USSR National Economy in 1976-1980" devote considerable attention to improving product quality and reliability and increased production efficiency. Production complexes, which are designated for manufacture of products at all stages, should ensure stable formation of all product parameters, that is, possess a high degree of reliability. Soviet science and production have achieved certain results in ensuring reliability of technological or production complexes. Advanced manufacturing processes are extensively utilized, various types of control and monitoring of production are used to improve quality and stability of manufacturing processes, and automated production control systems as well as comprehensive product quality control systems are being incorporated. New areas have been developed: evaluation of technological reliability of equipment, strengthening technology, and technological succession.

Nevertheless much still remains to be done in this area. The manufacturing process as a complex dynamic system has not been examined from the position of reliability. There is a lack of methods of optimization of this process, and frequently costs rise when securing a high degree of reliability of manufactured products. Methods of determining standards and predicting reliability indices for process equipment have been insufficiently elaborated, methods of testing production complexes have been standardized, and there is no elaborated system of manufacturing process reliability control.

The conference considered the following essential for successful accomplishment of the tasks of speeding up scientific and technological progress and on this basis increasing productivity, improving quality and reliability of machine building products: in determining principal directions in the area of increasing reliability of production complexes, a recommendation should be given to the USSR Academy of Sciences, USSR Council of Ministers State Committee on Standards and the State Committee of the USSR Council of Ministers on Science and Technology, branch ministries and agencies to perform research studies for the purpose of optimal resolution of scientific and technical problems in the area of reliability; it should be recommended that the USSR Council of Ministers State Committee on Standards draft directive materials and methods recommendations determining elaboration and adoption of standards on reliability of production complexes in machine building. Branch ministries and agencies, base organizations and leading institutes, with participation of reliability services at enterprises and scientific-technical society organizations should be instructed to draw up a set of standards and technical-standards documents pertaining to calculation and evaluation of the reliability of production complexes in developing new manufacturing processes and operations; optimization of engineering decisions on the basis of criteria of reliability of production complexes and product reliability; production complex reliability control; prediction of reliability of manufacturing process equipment and production complexes; evaluation of the physicochemical state and stresses on surface layers of machine parts; standardization of tests for reliability of production complexes; strain hardening in machine building; collection and processing of information on operational reliability of production complexes and produced items, etc.

3024
CSO: 1821

END