

Current State and Future Development of Iron-Ore Industry in Ukraine

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A place and role of Ukraine in the world market of iron-ore raw material is described. Performance indexes of mining enterprises for 1999-2009 years are analyzed. Problems, caused by specific character of mining production are covered. Priority directions for solution of upcoming problems, the most important of which is development of a single technical economic and ecological policy determining the prospects of ore mining industry development are suggested.

Keywords: DEVELOPMENT OF PRODUCTION, MINING ENTERPRISES, IRON-ORE PRODUCTS, QUALITY OF METALLURGICAL RAW MATERIALS, LAND ALLOTMENT, STORAGE OF WASTES

Introduction

Unique iron ore deposits are raw-material base of iron-ore industry of Ukraine. Ukraine takes the first position in the world for the known reserves. Balance reserves of iron ore registered in the State Fund of Resources of Ukraine by classes A+B+C₁ and valued in 35 billion tons. During period of maximum development of iron-ore branch, Ukraine ensured 14 % of the world payable iron ore satisfying demands of domestic factories and exporting in the countries of Eastern Europe to 40 million tons per year.

Results and Discussion

Dynamics of performance indicators of iron-ore industry during 1999-2009 is shown in **Table 1**.

It is necessary to mention production growth of crude iron ore, concentrates and prepared raw materials (sintered ore and pellets) till pre-crisis 2007, in which the maximum level of iron-ore products production was achieved. It is confirmed by graphs in **Figure 1**.

The world financial and economic crisis inhibited the complete recovery of output after 2007. Production started dropping in 2008 after seven years of steady growth of iron ore industry.

As a result, in 2009 iron ore production of

Ukraine was at the level of indexes in 2004-2005. At the same time, increase in overburden excavation in more than two times - from 42.7 million m³ in 1999 to 80.2 million m³ in 2005 and 89.4 million m³ in 2009 is positive for future development of mining. Higher-than-anticipated growth of overburden amount in comparison with crude ore extraction is a basis for increase of iron-ore raw material production.

There were essential structural changes for the last ten years. So, output of pellets increased considerably (from 9.6 million tons in 1999 to 20.4 million tons in 2009) as well as their specific gravity in the prepared metallurgical raw materials (from 50.8 to 74.7 %). This factor along with increase of iron content by 2.03 % in pellets and by 0.46 % in sintered ore predetermined increase of iron average content in agglomerate by 3.29 % for ten years - from 57.62 to 60.91 %.

According to technological instructions on blast-furnace process, coke saving due to this factor is more than 3.5 % or 17 kg/t of pig-iron [1]. Significance of this factor for metallurgy is confirmed by coke cost that was 1.52-1.98 thousand UAH/t in 2008 for a number of integrated iron & steel works and increased in 1.7-2.0 times in comparison with the previous year [2]. Simultaneously, the content of breeze coke (class - 5 mm) reduced both in sinter and pellets. For example, this index is 3.2-3.3 % in pellets of JSC

Ore Mining

Table 1. Basic performance indicators of iron-ore industry during 1999-2009

Item	Years				
	1999	2000	2001	2002	2003
Crop of crude iron ore, mln. t	102.7	118.6	114.8	122.8	132.3
including:					
opencast mining	89.2	103.5	99.8	107.3	116.1
underground mining	13.6	15.3	15.2	15.8	16.5
Amount of opencast mining, %	86.9	87.3	86.9	87.3	87.7
Overburden excavation, mln. m ³	42.7	53.3	56.4	54.9	58.2
Mined rock:					
mln. m ³	66.1	79.8	86.2	85.3	88.2
mln. t	201.3	242.8	253.1	256.0	267.0
Overburden ratio, m ³ /t	0.480	0.516	0.573	0.508	0.507
Production of salable iron ore, mln. t	47.5	55.7	54.7	58.9	62.5
including:					
rich ore	11.6	13.3	13.4	14.2	14.9
concentrated ore	35.9	42.4	41.3	44.7	47.6
Amount of ore concentrate in salable iron ore, %	75.7	76.1	75.6	75.8	76.1
From total amount ore concentrate with iron content:					
65% and above	3.7	10.0	25.7	25.5	26.6
67% and above	0.0	0.0	0.0	0.0	0.4
Production of prepared metallurgical raw materials, mln. t	18.9	22.3	22.9	23.8	24.7
including:					
pellets	9.6	12.3	12.0	13.5	15.0
sintered ore	9.3	10.0	10.9	10.3	9.8
Amount of pellets in prepared raw material, %	50.8	55.2	52.3	56.6	60.5
Iron content in produced crude ore, %	36.53	36.46	36.74	36.37	36.02
including:					
in crude rich ore	56.80	56.74	57.27	57.16	57.22
in ore for dressing	33.38	33.40	33.55	33.21	32.91
in salable ore	63.24	63.20	63.50	63.35	63.19
including:					
in naturally rich ore	59.01	58.48	59.22	58.79	58.73
concentrated ore	64.59	64.68	64.88	64.70	64.61
in prepared raw material	57.62	57.96	57.88	58.32	58.71
including:					
in pellets	61.05	61.17	61.59	61.65	61.55
in sintered ore	54.06	54.00	53.82	53.98	54.36

Item	Years					
	2004	2005	2006	2007	2008	2009
Crop of crude iron ore, mln. t	137.7	144.3	152.8	163.7	149.5	143.0
including:						
opencast mining	120.3	125.8	134.2	144.9	133.4	131.0
underground mining	16.9	17.0	17.3	17.3	16.1	12.0
Amount of opencast mining, %	87.4	87.2	87.8	88.5	89.2	91.6
Overburden excavation, mln. m ³	70.3	80.2	81.3	93.1	94.7	89.4
Mined rock:						
mln. m ³	100.6	117.2	121.3	146.8	144.7	138.3
mln. t	304.1	327.3	361.7	450.0	443.6	423.9
Overburden ratio, m ³ /t	0.579	0.630	0.600	0.636	0.710	0.682
Production of salable iron ore, mln. t	65.9	68.9	73.1	77.2	71.9	65.8
including:						
rich ore	15.1	15.6	16.3	16.3	15.0	11.0
concentrated ore	50.9	53.3	56.8	60.9	56.9	54.8
Amount of ore concentrate in salable iron ore, %	77.1	77.4	77.7	78.8	79.1	83.3
From total amount ore concentrate with iron content:						
65% and above	31.7	34.1	37.0	39.6	36.4	35.9
67% and above	6.6	7.0	8.0	8.5	7.5	6.8

Table 1. Basic performance indicators of iron-ore industry during 1999-2009 (continued)

Item	Years					
	2004	2005	2006	2007	2008	2009
Production of prepared metallurgical raw materials, mln. t	27.0	28.3	33.5	35.8	30.9	27.3
including:						
pellets	16.3	17.5	20.9	22.4	20.4	20.4
sintered ore	10.6	10.8	12.6	13.4	10.5	6.9
Amount of pellets in prepared raw material, %	60.6	61.8	62.4	62.5	66.1	74.7
Iron content in produced crude ore, %	35.88	35.78	35.83	35.58	35.93	35.53
including:						
in crude rich ore	57.50	57.56	58.08	58.00	57.69	58.88
in ore for dressing	33.00	33.22	33.34	33.28	33.30	33.40
in salable ore	63.27	63.64	63.75	64.09	63.84	64.32
including:						
in naturally rich ore	58.75	58.90	58.69	59.01	58.45	59.37
concentrated ore	65.02	65.04	65.21	65.22	65.27	65.31
in prepared raw material	58.74	59.35	59.02	59.48	59.83	60.91
including:						
in pellets	61.69	62.44	62.25	62.64	62.67	63.08
in sintered ore	54.20	54.37	54.30	54.21	54.30	54.50

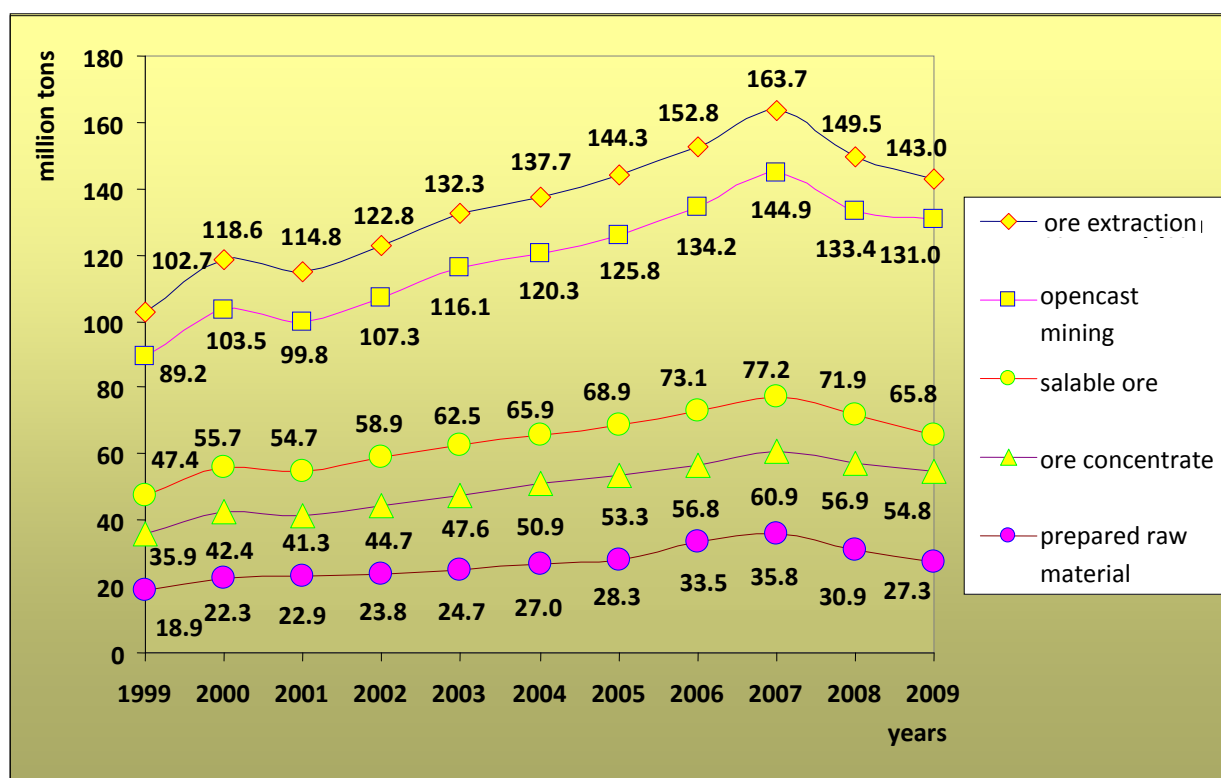


Figure 1. Dynamics of crude iron ore extraction and manufacture of iron-ore products in 1999-2009

“Severnny Mining-and-Processing Integrated Works”, JSC “Poltava Mining-and-Processing Integrated Works” – 2.5-2.9 %, JSC “Tsentralny Mining-and-Processing Integrated Works” – 1.4-1.95 %. Concentrates with iron content 67 % and above have been produced since 2003 for the first

time in history of Ukrainian iron-ore industry. Such concentrates are made by means of magnetic-flotation concentration of ordinary concentrates with iron content 63.7-63.9 %.

Production of concentrates with iron content 67 % and above in Ukraine increased from 360

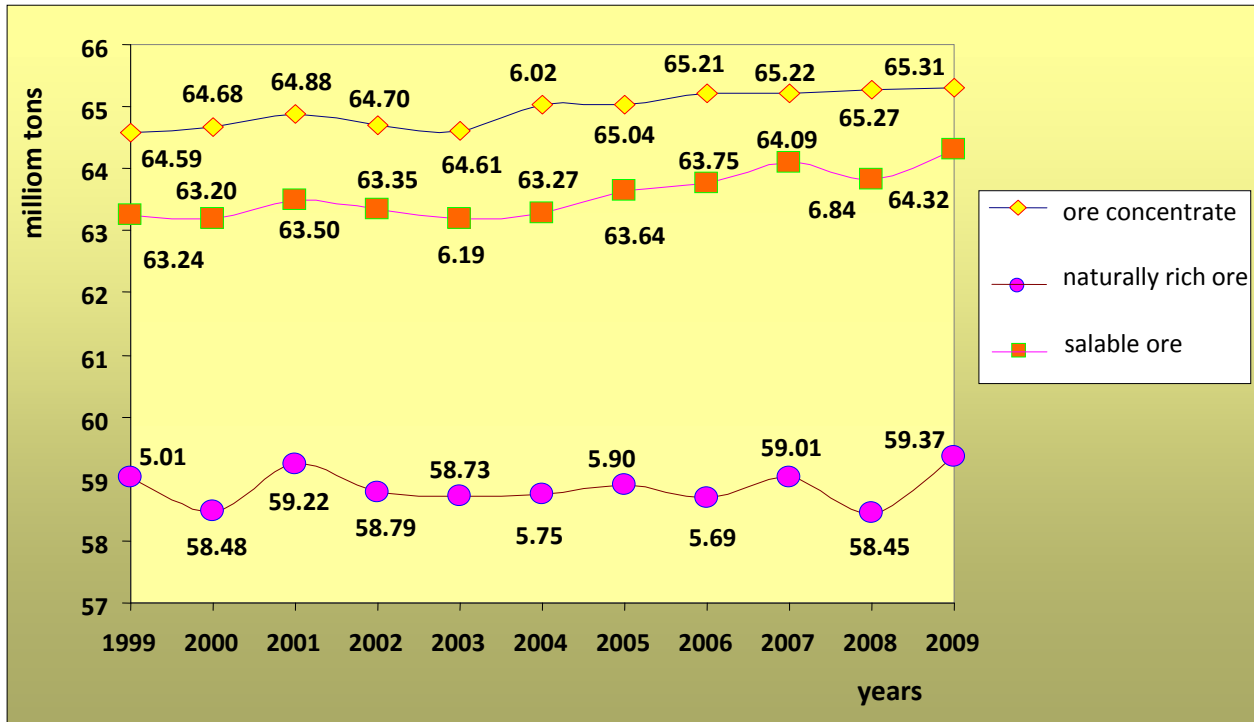


Figure 2. Dynamics of iron content in salable ore in 1999-2009

thousand tons in 2003 to 6.8-8.5 million tons in 2007-2009. It is remarkable that production of concentrates with iron content 65 % and above during 1999-2009 increased in ten times - from 3.7 to 35.9-39.9 million tons. Drop in production of iron-ore raw materials in 2008-2009 by 11.4 million tons was caused by severe reduction of demand owing to crisis phenomena in economics. At the same time, crisis aftereffects were softened as a result of export increase. Mining enterprises discovered new niches in the world market under conditions of crisis. The last

years are characterized by great increase of iron ore export to China. The volume of export to this country raised for last year from 4.94 to 13.72 million tons or in 2.78 times, including concentrate export from 2.63 to 9.54 million tons - in 3.6 times, pellets - from 2.05 to 3.77 million tons in 1.84 times. The total export of iron-ore products of Ukraine in 2009 was 28.71 million tons (**Figure 3**) and has rather stable positive tendency.

Substantial amount of iron ore products, first of all, from Russia (from mining-and-processing

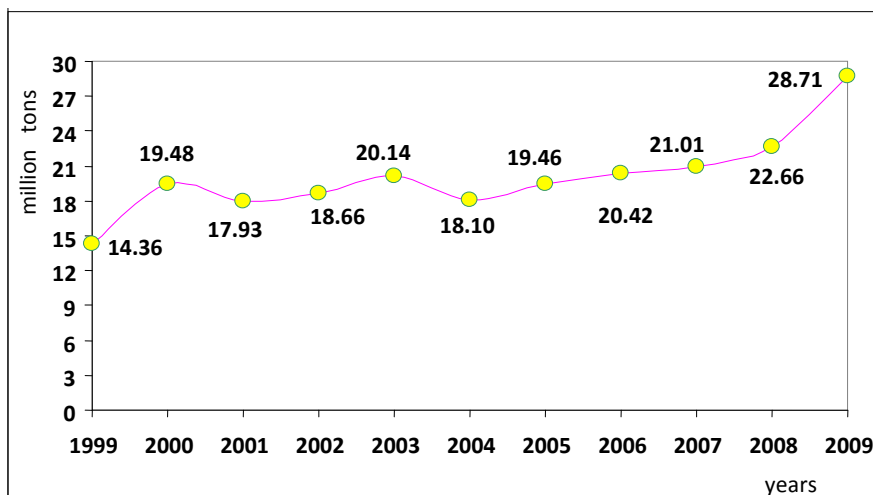


Figure 3. Export of iron-ore products

integrated works KMA, Kola Peninsula, Ural) and even ore from Brazil (90 thousand tons) are being imported at decline in production in Ukraine.

In 2009, import from Russia was 3.8 million tons, including 1.54 million tons of concentrate and agglomerated ore from Stoylensk Mining-and-Processing Integrated Works, 0.52 and 1.21 million tons from Lebedinsk Mining-and-Processing Integrated Works and Kovdorsk Mining-and-Processing Integrated Works respectively. As compared to 2000, import of Russian iron-ore raw materials to Ukraine reduced by 3.61 million tons, which is almost twice. Analysis of iron-ore industry state points to the principal features of its development during the last decade:

- constant increase in output with recession only in 2008-2009 because of the crisis;
- gradual increase of iron content in salable ore and in the concentrate from open-cast mining ores and in naturally rich ore of underground mining;
- diminution in demand for naturally rich ore with iron content less than 58-59 %;
- essential reduction in demand for a sintered ore of ore-mining enterprises in conjunction with primary use of own production potentialities of sintering plants;
- occurrence of high-quality concentrates containing 67 % iron and above in the home market;
- increase in export of concentrate and pellets, growth of concentrate export to China;
- iron-ore products import to Ukraine, first of all, from Russia despite it is possible to satisfy demands of domestic plants.

The specified features and trends are to some degree a basis for forecasting future development of iron-ore industry. The prospect of development of the world market and metallurgical manufacture of Ukraine should be considered also.

The primary task of mining enterprises in 2010-2011 is overcoming crisis phenomena. During this period it is necessary to recover output of raw materials at the level of 2007. Premises for solving this problem are available.

Active business activity on the world steel market and Ukrainian market is expected in 2010. According to the World Steel Association (WSA) data, stabilization of global demand in 2010 is expected. During the current year, the volumes of metal products consumption in the world will grow by 9.2 % [3], which will favorably affect the demand for Ukrainian metal products and iron-ore raw materials. It is expected that steelmaking

will increase by 16 % in Ukraine in 2010.

Inguletsk Mining-and-Processing Integrated Works is planning to increase concentrate production to 15-16 million tons at 13.7 million tons in 2007.

Severnny Mining-and-Processing Integrated Works produced 13.76 million tons of concentrate in 2009 at 13.4 million tons in 2007 and plans to reach 15 million tons by means of restoration of "Pervomayskaya" mine and increase of opencast productivity.

Tsentralnyy Mining-and-Processing Integrated Works is planning a substantial growth of concentrate output in view of limited capacities of opencasts. It is provided to increase concentrate production to 6.5 million tons at 5.94 million tons in 2007.

Yuzhnyy and Poltava Mining-and-Processing Integrated Works do not plan increase in concentrate production in the nearest future. The main task of these enterprises is to maintain output at the level achieved in 2007.

JSC "ArselorMittal Kryvyy Rih" is planning to increase capacity of Mining-and-Processing Complex up to 10-11 million tons due to development of mining operations in opencasts and technical re-equipment of dressing plant.

Underground mining enterprises do not plan to increase output. They also have to maintain capacity.

In the long term, output growth also will be ensured because of start-up of Kryvyy Rih Mining-and-Processing Integrated Works of Oxidized Ores and construction of the new enterprises - Vasinovsk and Priazovsk Mining-and-Processing Integrated Works in Zaporizhzhya region.

The start-up of Kryvyy Rih Mining-and-Processing Integrated Works of Oxidized Ores will solve a number of problems of national value and directly JSC "ArselorMittal Kryvyy Rih". The problems are following:

- satisfaction of domestic metallurgical enterprises' needs in iron-ore raw materials and maintenance of export potential of Ukraine;
- rational use of iron ore reserves;
- improvement of ecological situation in Kryvyy Rih;
- creation of more than six thousand new working places;
- possibility of linked settlements with countries participating in building of Kryvyy Rih Mining-and-Processing Integrated Works of Oxidized Ores.

Capacity of Kryvyy Rih Mining-and-Processing Integrated Works of Oxidized Ores is

10.2 million tons of iron-ore pellets per year. Privatization of Ukrainian share of Kryvvy Rih Mining-and-Processing Integrated Works of Oxidized Ores and financing of integrated works further construction at the expense of potential investor is reasonable.

As a result of Vasinovsk Mining-and-Processing Integrated Works construction on the basis of Vasinovsk deposit (Zaporozhzhya region), capacity of integrated works on underground extraction of magnetite quartzites should be 8.0 million tons per year, on iron-ore concentrate production – 3.0 million tons with iron content 69-70 %. Underground ore mining will allow reducing necessity of the works in land allocation in several times.

Construction of integrated works is caused by necessity to supply needs of metallurgical enterprises in iron-ore raw materials in the future. The feature of this deposit is reserves of free-milling ferruginous quartzites. The concentrate made from them is suitable for production of raw materials for iron direct reduction - metallized pellets or briquettes, which will enable to save annually up to 1.0 million tons of scarce and high-priced coke.

As a whole, iron-ore raw materials production is expected to grow by 18-20 million tons per year in the proximal decade as a result of maintenance and increase of current and new mining enterprises capacity.

The future development of iron-ore industry will depend on timely solution of problems featured for almost all mining enterprises and predetermined by specific features of ore-mining industry.

Specific features of mining enterprises is a constant increase in depth of open pits and shafts in the process of ore deposit development. Today, the depth of certain open pits reaches 350 m, shafts - 1300-1400 m. In the future, depths of open pits and shafts will reach such values at which ore crop will make no economic sense at traditional mining methods.

Definition of maximum allowed depth of open pits and shafts and searching for solutions preventing closing of mining enterprises are necessary. Crucially new opening schemes and shovel and truck methods should be found for open pits, or adoption of open-underground mining method is necessary.

Waste storage became the most serious problem for mining-and-processing integrated works. The situation that can cause the negative phenomena because of the absence of capacities

for such storage is about to appear. This problem is common for all enterprises, and requires a complex solution. A paradoxical situation: huge artificial capacities were formed around the mining enterprises as a result of long mining of iron-ore deposits. At the same time, there are no capacities for waste storage and areas for overburden storage. Engineering solutions allowing using these artificial formations for storage of both washery refuse and overburden are required.

The operation feature of mines focused on the underground extraction of naturally rich ores consists in the constant increase of depth of mining operations.

Iron ore reserves in Krivbass mines are evaluated to depth 1500 m, though ore is available even deeper. Currently, the actual depth of mines reaches 1300-1400 m. All hoisting plants of mines are meant for ore hoisting from the depth to 1500 m. The second degree of ore hoisting is required to extract ore from the depth below 1500 m. Ore reserves to depth 1500 m will be depleted during 10-15 years. Depletion of reserves on the depths below 1500 m can appear to have no economical sense. It is one of the most important problems of mines specialized on rich ore extraction.

Timely decisions regarding areas of mine operation in the future will prevent premature closing and liquidation of mines.

Competitive strength of home products is insufficient. Iron content in agglomerate ores is lower by 1-2 %, and in concentrates - by 2-3 % than in the products of foreign manufacturers, which creates considerable difficulties in saving traditional distribution areas. Significant capital investments are required for improvement of product quality and its competitive strength. And this is a real necessity under market conditions.

Price policy is also important for mining enterprises. There is no common price policy today. Analysis of product prices shows that price ratio between them does not correspond to customer value. In Europe, the price leader on iron-ore raw materials is Brazil. Ukraine as the largest supplier of raw materials in countries of Eastern Europe does not participate in pricing on the market. Each enterprise makes the product price together with consumers.

The considered specific features and problems require a uniform technical, economic and ecological policy defining the future development of ore mining industry.

The large technical problems related to branch control and predetermined specificity are

caused by the absence of uniform technical policy of ore mining industry development. At the same time, the absence of scientifically-grounded industrial and technical policy can lead to negative consequences.

The policy should define the areas of development of mining operations at the enterprises taking into account impending large problems.

Conclusions

1. Stable growth of iron-ore raw materials output in Ukraine was revealed during the last decade, and only in 2008-2009 there was a recession of commodity ore production by 11.4 million tons as a result of crisis phenomena.

2. Decline in production in 2008-2009 was temporary. Restoration of output volumes to the level of 2007 can be ensured already in 2010-2011.

3. Growth of iron-ore raw materials production is expected in amount of 18-20 million tons till 2020.

4. Iron content in salable ore has been increased for ten years. There were positive structural changes. Production of concentrates with iron content 67 % and above was started for the first time in history of Ukrainian ore mining industry since 2003. Production of concentrates with iron content 65 % and above during 1999-2009 increased in ten times and made two thirds of its common output. The concentrate fraction in salable ore increased from 75.7 to 83.3 %.

5. Mining enterprises have serious problems caused by specific features of ore mining industry. There are difficulties when carrying out mining operations in open pits and mines below the limiting depths. Waste storage became rather actual problem for ore-dressing plants due to the absence of unoccupied land for disposal of overburden and capacities for washery refuse storage.

6. Specific features and problems require a uniform technical, economic and ecological policy defining the future development of ore mining industry.

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Современное состояние и перспективы развития железорудной промышленности Украины

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Представлена характеристика современного состояния и перспективы развития железорудной промышленности Украины за период 1999-2009 гг.