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FOREWORD

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ACHIEVEMENTS OF BLAST FURNACE OPERATORS IN THE PEOPLE'S REPUBLIC OF CHINA

Following is a translation of an article in Metallurg (Metallurgist), No. 4, Moscow 1960, pages 9-13.

Below is printed an abridged translation of an article by Comrades Li Kung-ta and Lin Tsung-tsai, "Ten-Year Achievements of Blast Furnace Operators in the People's Republic of China," which was published in the Chinese magazine Steel and Cast Iron (No. 18, 1959). The facts presented in this article are supplemented with information from other Chinese sources.

A literal translation of the article was made by Wang Wen-ts'ung, Ai K'uei-shen, Feng Hua-ts'ung, and Ts'ui Shih-chu, students of the Dnepropetrovsk Metallurgical Institute. I. P. Semik, lecturer at the Dnepropetrovsk Metallurgical Institute, was in charge of the review.

Metallurgy in China has developed since ancient times. However, because of the oppression of feudalism and imperialism, this development came slowly. Only in 1890 was the first blast furnace of modern type built (in Han-yang). Thereafter, several metallurgy factories were built, but the rate of growth of production was low. The maximum annual smelting of cast iron before the liberation of the country reached 1.8 million tons (1943).

After victory over Japan in 1945, the reactionary Kuomintang government not only did not develop the metallurgical industry but destroyed the factories which had been operating. As a result, the production of cast iron sank to 251,000 tons in 1949. Only after the liberation of the country did Chinese metallurgy begin to develop rapidly.

The restoration and reconstruction of old factories were done mainly during the years 1949-1952, particularly the AMK [Anshan Metallurgicheskii kombinat -- Anshan Metallurgical Combine]. Chinese metallurgists began to make wide use of the advanced experience of the Soviet Union and achieved great success: in 1952 there were smelted 1.92 million tons of cast iron for an average yearly k.i.p.o. koefitsiyent ispol'zovaniye poleznogo ob'yema -- utilization factor of the working volume throughout the country of 0.975 (instead of 1.62 in 1949).

During the first five-year plan (1953-1957) the construction of two new metallurgical bases was begun: in Wuhan and in Pao-t'ou, where large blast furnaces were equipped with the newest technology. During the five years 82 blast furnaces were constructed and restored; the total volume of all furnaces in the country grew from 5,172 m³ in 1952 to 15,735 m³ in 1957. This permitted us to exceed in 1956 the smelting of cast iron which had been planned for the last year of the five-year plan. The average annual k.i.p.o. for the whole country was 0.766. In the last year of the first five-year plan 5.94 million tons of cast iron were smelted for an average yearly k.i.p.o. for the country of 0.757. The best record was achieved at AMK, where the average k.i.p.o. for 1957 was 0.71 with a coke consumption of 711 kg/t [kilograms/ton], and in Daye (k.i.p.o. 0.696).

In the first five-year plan, advanced Soviet methods were assimilated and expanded in the following fields: regulation of furnace operating "from above," work with blowing of constant moisture content, the use of a fluxed agglomerate, improvement in the preparation of the charge, and so forth.

The year 1958 was the year of "the great leap forward."
(Reviewer's note: According to information from the magazine Druzhba [Friendship], No. 42, 1959, p. 11, a total of 13.69 million tons of cast iron were smelted in China in 1958, including cast iron of high quality smelted in small furnaces, that is, 2.28 times more than in 1957. There were 9.53 million tons smelted by modern methods, that is, 1.6 times more than in the preceding year.) In conformity with the general party line, a mass "movement for cast iron and steel" began, the result of which was that thousands of small furnaces for smelting cast iron were built. This improved the distribution of ferrous metallurgy throughout the regions of the country. In this same year two of the largest (size 1,386 and 1,513 m³ -- Reviewer's note) blast furnaces (in Wuhan and in Anshan) were put in blast. Thanks to the instillation of advanced work methods, the records of furnace operating were sharply improved.

The technology of smelting cast iron was also perfected before 1958; but because of frequent violations of optimum correlation between the gas penetrability of the charge and the quality of the blowing, incrustations appeared in many furnaces from 1953 to 1954. Therefore, the opinion spread that to increase the daily burning intensity of coke above 1.1 t/m³ [tons/cubic meter] for large furnaces and 1.2 t/m³ for small was unsatisfactory, since, because of this, sticking of the charge and incrustations appeared without fail.

In the first five-year plan much attention was given to achieving a steady, even operation of furnaces and a reduction in coke consumption. In this field Chinese blast furnace operators achieved significant successes. In blast furnaces No. 4, 6, and 7 at AMK in November 1957, the consumption of coke per ton of cast iron was, respectively, 658, 682, and 678 kilograms. But the bulk burning intensity of the coke was not further increased.

In 1958, blast furnace operators of the Chinese People's Republic, inspired by the mass "movement for cast iron and steel," exceeded records of smelting intensity which earlier had been considered unattainable. Thus, in furnaces of large size (about 1,000 m³) the smelting intensity was raised to 1.3-1.4 t/m³; of average size (300-500 m³), over 1.4 t/m³; and in furnaces of less than 55 m³, to 1.8 t/m³. Greatly improved also was the k.i.p.o. Especially significant successes in this respect were achieved in the factories in Pen-hsi and Taiyuan, where the k.i.p.o., which was 0.666-0.625 in the first half of 1958, reached in the fourth quarter in Taiyuan 0.55 and in Pen-hsi 0.46. In addition, the consumption of coke was reduced. The ore load for coke in furnaces of about 1,000 m³ size rose to 2.9-3.0.

In 1959 the work record continued to improve. In Pen-hsi the k.i.p.o. in May 1959 reached 0.411, and the consumption of coke dropped accordingly to 659 kg/t. In furnace No. 3 at AMK, from January through May 1959 the k.i.p.o. improved from 0.594 to 0.46, and the consumption of coke dropped from 772 to 638 kg/t.

It should be emphasized that while the even operation of the furnaces was preserved, the smelting intensity for coke was also significantly increased. Thus, in the factory at Pen-hsi in the fourth quarter of 1958, the intensity was 1.4 t/m³, and in April and May 1959, it was 1.55 t/m³. In furnace No. 1 of the Taiyuan Factory, the intensity was, respectively, 1.45 and 1.51 t/m³. In furnace No. 9 at AMK, it was 1.327 and 1.38.

Simultaneously with the increase in intensity, the temperature was also raised, reaching 900-1,000°. Much practical experience in maintaining even furnace operation at the time of great smelting intensity was accumulated.

Thus, ten years of achievements in blast furnace production are expressed not only in an increase in the smelting of cast iron but also in the improvement of technical-economic records of smelting (Table 1).

The rapid growth of blast furnace production in China is closely allied with the strengthening of design and construction organizations. Standard designs for furnaces have already been created, with serviceable sizes of 3, 8, 13, 28, 55, 100, 255, 620, 1,053, and 1,513 m³, all equipment for which can be made in native factories. A blast furnace with size 1,513 m³ was constructed in four months.

TABLE 1

Production of Cast Iron in the Chinese People's Republic

Year	Increase in production (in % of 1943)	Increase in size of furnaces (in % of 1949)	k.i.p.o.*		Relative consump- tion of coke
			t/m ³	m ³ /t	
1943	100.0				
1949	13.49	100.0	0.617	1.62	
1952	106.80	183.0	1.024	0.975	
1953	124.0	247.0	1,035	0.965	1.008
1954	173.0	334.0	1.080	0.925	0.916
1955	215.0	387.0	1.150	0.870	0.876
1956	268.8	450.0	1.305	0.766	0.808
1957	333.0	587.0	1.321	0.757	
1958	755.0**		1.505	0.665	0.713

* In China since September 1958, the k.i.p.o. has been calculated in tons of cast iron smelted in a 24-hour period in a one-cubic-meter serviceable-sized furnace. In the original article the k.i.p.o. was given for all years in t/m³. Here, for the convenience of Soviet readers, the k.i.p.o. is given also in units accepted in the USSR, along with figures of the original.

** Not entered here is that cast iron smelted in small furnaces, which because of poor quality is useless for use in steel and therefore is not included in the fulfillment of the state plan.

The Growth of Cast Iron Production in Small Blast Furnaces

As a result of the mass "movement for cast iron and steel" which occurred in 1958, very many small blast furnaces were constructed in a short time. In September 1959, the total volume of small furnaces (6.5-100 m³) operating reached 43,000 m³, which almost twice exceeds the total volume of modern furnaces in China.

In 1959 about 10 million tons of cast iron were smelted in small blast furnaces. In the second five-year plan about 55 million tons will be smelted in all; and beginning in 1963, the yearly smelting will exceed 15 million tons.

Thus, the policy adopted by the party, "to walk on two feet," permits for a short period the obtaining of 55 million tons of cast iron without large capital investments -- a fact which plays and will

play a large role in the creation of the most important conditions for a further leap forward in the national economy.

Work in numerous small blast furnaces also promotes the education of hundreds of thousands of worker-metallurgists, who have acquired practical work habits and who have increased their socialist consciousness -- a fact which is very important for the further development of metallurgy in China.

Beginning in the spring of 1959, the "more or less primitive" small furnaces began gradually to be replaced by "more or less present-day" ones; this permitted the quality of cast iron to be improved and the smelting of it to be increased. By October 1959, that portion of conditioned cast iron smelted in small furnaces throughout the country comprised more than 75% of the total smelted.

As a result of the operation of small blast furnaces, there was conducted a series of experiments for the improvement of the preparation of the charge, for use of a large quantity of blowing together with a high temperature, for use of recuperator air-heaters and of packed carbonaceous brick-lining, and for replacement of limestone by baked lime.

In the Li-min Factory in Hunan Province a blast furnace of 7 m³ size operated in November 1958, with a k.i.p.o. less than 0.278 m³/t. In the Yu-sen Factory in the same province, the blowing is heated up to 650-700° by recuperators, although it was earlier supposed that the blast could not be heated above 550° by this method.

In the Tan-shan Factory, as a result of replacement of limestone by lime, the output of a blast furnace of 13 m³ size was increased 67%, and the consumption of coke was reduced 37%. For small furnaces, replacement of limestone by lime is especially important because they usually smelt poor ores from deposits of local importance and therefore use up much flux. The use of lime, because of a significant reduction in the consumption of coke and in the amount of sulfur carried by it, also improves the quality of the cast iron.

For a small furnace it is necessary to use a charge which contains equally fine lumps. When, for example, coke with a coarseness of 5-20 mm and ore with a coarseness of 5-12 mm were used in a furnace of 7 m³ size, the furnace operated evenly. A momentary amount of blowing exceeded by six times the volume of the furnace, and throughout it was evident that the amount could not be further increased even if the flow would permit it. If the coarseness exceeded 20 mm, the furnace would not take care of the ore load. The furnace cooled down, and the output was lowered.

The duration of the campaign for small furnaces is long enough. For example, one of them in the Shen-ts'uan Factory has been operating without capital repairs for about four years. Experience shows that small blast furnaces are fully justified. When the consumption of coke is reduced, the cast iron smelted in them is not inferior in quality to cast iron smelted in modern blast furnaces.

The Speeding Up of Blast Smelting

As was noted above, the volumetric intensity of coke burning has increased greatly in recent years -- without leading to crust formation -- and the consumption of coke per ton of cast iron has not only not risen but has been substantially lowered.

As an example, average monthly figures for 1958 for the factory in Pen-hsi are given in Table 2. In the Taiyuan Factory (figures of the Taiyuan Factory were published in Metalurg, No. 1, 1960 -- Reviewer's note) and in the advanced furnaces at ANK analogous results were obtained.

TABLE 2

Average Monthly Records of Blast Smelting in the Factory in Pen-hsi for 1958 (average for 4 furnaces)*

<u>Records</u>	Months of 1958					
	I	II	III	IV	V	VI
k.i.p.o. t/m^3	1.312	1.435	1.447	1.551	1.786	1.825
k.i.p.o. m^3/t	0.762	0.697	0.691	0.644	0.560	0.543
Volumetric smelting intensity, in tons of coke in 24-hr period for 1 m^3 size furnace	0.996	1.015	1.029	1.066	1.175	1.225
Consumption of coke, t/t of cast iron	0.766	0.717	0.714	0.692	0.662	0.690
	VII	VIII	IX	X	XI	XII
k.i.p.o. t/m^3	1.884	1.934	2.077	2.245	2.139	2.265
k.i.p.o. m^3/t	0.530	0.516	0.481	0.445	0.467	0.441
Volumetric smelting intensity, in tons of coke in 24-hr period for 1 m^3 size furnace	1.248	1.326	1.335	1.399	1.437	1.394
Consumption of coke, t/t of cast iron	0.663	0.677	0.638	0.627	0.707	0.656

* Reviewer's note: This table was not taken from the reviewed article but from another published in an earlier number of the same magazine (No. 13, 1959, Page 509). In the original, the k.i.p.o. was given as t/m^3 . The figures of the second line are added by us for the convenience of Soviet readers.

The main factors which brought about such successes are as follows:

Preparation of Charge Materials for Smelting.

Experience shows that the principle of the relationship of the amount of blowing to the gas-penetrability of the charge is correct. The better the charge is prepared, the higher will be the optimum intensity of the smelting and the lower the consumption of coke. Without preparation of the charge, it is more difficult to intensify the smelting with a simultaneous lowering of the consumption of coke. Therefore, various methods of preparing the charge are used in the Chinese People's Republic.

Neutralization of ores is given great attention in many blast shops in China. In the principal metallurgical centers ore is neutralized throughout the entire processing: from the stope to the bunkers in the blast shop. In the remaining factories ore is neutralized by being stacked in layers and by walling in the layers in the ore bed of the blast shop. In the latter case, the fluctuations of iron content in the ore are $\pm 1\%$.

Grading for coarseness -- The majority of blast furnaces in China work with a graded charge; this is conducive to even operation of furnaces and to an increase in the ore load.

Sifting of the fraction less than 5 mm from the agglomerate gave in the first blast shop of the factory in Pen-hsi a 15% increase in output and in both shops of the factory a 6-8% average increase in output, plus a 4% reduction in the consumption of coke (in the first shop furnaces of average size operate; and in the second, large ones). The grading of coke for coarseness and the separate loading of the various fractional sizes produced in the first shop in 1959 a 6-8% increase in output.

Fluxing the agglomerate -- In many factories and research institutes in China, important research has been conducted to improve the quality of the fluxed agglomerate. The result has been that the solidity of the agglomerate was raised to 1.0-1.2 and in the first blast shop in Pen-hsi to 1.6.

In the year after the liberation of the country the solidity of the agglomerate did not exceed 0.5; it contained many fines. For a long time no success was obtained in making it durable, since the agglomerate charge was coarse-grained and the consumption of coke was large. This caused a strongly fused, nondurable agglomerate to be obtained. By the end of 1957 all factory agglomerate workers in the country had found a method for obtaining a durable fluxed agglomerate.

An increase in the solidity of the agglomerate improved the records of blast smelting. For example, in Anshan when with a 60% agglomerate content in the charge the solidity of the charge was raised from 0.6 to 1.0, the consumption of limestone in the blast

charge was reduced to 60-70 kg per ton of cast iron, the consumption of coke was reduced 5-7%, the operation of the furnace became more even, and the quality of the cast iron improved.

In the first blast shop in the factory of Pen-hsi during work on a charge which contained 95% high-bulk agglomerate, the consumption of limestone was reduced to 15 kg per ton of cast iron.

In Pen-hsi and in Anshan the workers began to put dolomitized limestone into the agglomerate charge, bringing the content of MgO in the agglomerate to 2-4%, which improved the primary slag formation in the blast furnaces and the gas-penetrability of the charge column. Now this arrangement has spread to all factories of the country. The experience of Pen-hsi, where now a 100% agglomerate is used in the charge (except manganese ore), has shown that an increase in a portion of the agglomerate charge for each 10% (above 35%) gives a 1.6-2.4% increase in output and a 1.7-2.7% reduction in the consumption of coke.

Use of Sintered Agglomerate -- In Anshan in 1958, research on the production of sintered agglomerate was conducted and yielded positive results. In the same year, the first plant for production of sintered agglomerate was put into operation. The output of its plated granulator was 1.7-2.0 tons per hour per square meter, and the output of the kiln was 42.42 tons per hour. The quality of the sintered agglomerate was very high: the solidity was up to 1.2 and higher; the yield of fines less than 5 mm after a trommel test was 11.9%; the fines in the ready-made product were small; and the transportability was good.

The use of a 50% quantity of sintered agglomerate in the charge of blast furnace No. 2 of this factory led to a 7% increase in output and a 7% reduction in the consumption of coke.

Since April 1959, a group of factories in Shantung Province, using local fine ores, has produced spherical briquettes on a roll press. The cost of manufacturing them was 60% lower than the cost of making agglomerate. Experience showed that when small furnaces (from 3 to 28 m³ sizes) operated with 100% such briquettes in the charge, the output was increased in comparison with agglomerate smelting. Also, the consumption of coke was reduced, and the quality of the cast iron was improved.

Improvement of the Quality of Ores -- An increase of the iron content in the ores lowered the output of slag and consequently improved the gas-penetrability in the zone of slag-formation; it also lowered the consumption of coke and raised the output of the furnaces.

In the metallurgical factory in Pen-hsi the iron content of the concentrated product was raised from 60% in April to 66% in December 1958. Recently in the Anshan Metallurgical Combine the iron content of the fluxed agglomerate was raised from 50 to 54%, which of course resulted in a marked improvement in the k.i.p.o. of blast furnaces.

Improvement of the quality of coke -- In the Taiyuan Factory from January to December 1958 (that is, during a period of the most intensive operation of the furnaces), the ash content of coke was

reduced from 10.97 to 9.78% and the sulfur content from 0.875 to 0.485%, with a trommel test of 320-340 kg. The quality of coke has also improved in the Shih-chin-shan Factory. (Reviewer's note: However, in the factory in Pen-hsi, where the furnaces operate at the highest speeds, the quality of coke is worse: content of ash 13.5-13.8%, of sulfur 0.75-0.85%, the trommel test about 305 kg.)

Regulation of the Operation of Furnaces "From Above"

Wide dissemination of this method even up to 1958 caused significant improvement in the smelting records. Thus, thanks to the use of it at AMK, the output of furnaces increased 34%; the consumption of coke was reduced from 1.04 to 0.799 t/t; the carbon dioxide content in blast furnace gas rose from 8.3 to 10.8%; and the average amount of sticking was reduced from 0.7 to 0.3 per 24 hours. In furnace No. 2 of the Taiyuan Factory, regulation "from above" yielded a 23% increase in output.

In 1958 the blast furnace operators of China achieved new successes in this field. In the factories in Pen-hsi and Taiyuan a rational distribution of the gas flow was achieved by regulation both "from above" and "from below."

TABLE 3

Change of Average Temperature of Blowing and Relative Consumption of Coke in Two Factories From 1952 to 1958

Factories	Records	Years						
		1952	1953	1954	1955	1956	1957	
Anshan Metallurgical Combine	Average temperature of blowing, °C	590	671	653	763	857	860	More than 900
	Consumption of coke, kg/t	881	918	920	851	737	711	655
Metallurgical factory in Pen-hsi	Average temperature of blowing, °C	698	667	683	780	810	825	More than 900
	Consumption of coke, kg/t	804	807	774	755	823	845	665

When in the factory in Pen-hsi the smelting was speeded up, the distribution of gas flow through a section of the charge was improved by use of a change in the system of loading. But when there was very great

speeding up, regulation "from above" no longer produced a noticeable effect. Then regulation "from below" was used. In furnace No. 2 of this factory the diameter of the tuyeres was increased from 120 to 180 mm: this caused the distribution of gas flow to improve. As a result, the intensity of smelting was raised from 1.338 to 1.542 t/m³.

In furnace No. 1 in Taiyuan when the operation of the furnace was regulated by a system of loading (work "with coke forward") and when the content of the fluxed agglomerate in the charge was gradually increased, the intensity of smelting was raised over 1.4 t/m³ with a simultaneous lowering of the consumption of coke.

The use of this advanced experience also produced good results in other factories.

Increase in the Quantity of Blowing

Improvement of the preparation of the charge materials and the use of regulation "from above" significantly improved the gas-penetrability of the column of materials in the furnace, and this permitted an increase in the consumption of blowing, as a result of which the intensity of smelting was greatly raised (30-40% and more).

In Pen-hsi the even operation of furnaces was not disturbed even when the technical-economic records of work were satisfactory, and now blowing is produced to 3.2-3.4 m³ per minute for a one-cubic-meter serviceable-sized furnace.

The Temperature of Blowing and Its Moistening

Table 3 gives figures which illustrate the rise of the temperature of blowing and the reduction of the consumption of coke for a number of years in two large factories.

In China at the present time the temperature of blowing in large and medium furnaces, as a rule, is not lower than 850° when its moisture content is 20-25 g/m³. In some advanced shops the average temperature of blowing is 1,000° and higher. In the Shih-chin-shan Factory since reconstruction of the heater, a blowing temperature of 1,080° has already been achieved.

However, these achievements do not satisfy the Chinese blast furnace operators. They are initiating measures for further raising the heat of blowing.

Closely connected with the increase in temperature is the moisture of blowing, widely used in China since 1954. This means is used for regulating the thermal condition of the furnace. It permits the temperature of blowing to be held high and constant.

The greatest effect of the moisture of blowing was achieved in the factory in Pen-hsi where the sticking of the charge was considerably reduced. The output of the furnaces increased 39.6%, and the consumption of coke was reduced 38.9%. Of course, these achievements are tied also to improved preparation of charge materials and

increased qualifications of the service personnel, but the use of high-temperature blowing and its moistening has played the main role.

Increase of Pressure on the Throat

In China the first furnace was converted to high pressure in 1956. At the present time five such furnaces are operating. Furnace No. 1 of the Wuhan Metallurgical Combine is operating with a pressure in the throat of 1.4 at (atmospheres).

In Table 4 are given the records of one of the furnaces at AMK which was converted to operation with increased pressure of the throat gases.

TABLE 4

Work Records of One of Furnaces at AMK in 1958

Months of 1958	t/m ³	m ³ /t	Burning intensity of coke, t/m ³	Consumption of coke, t/t of cast iron	Content of agglomerate in charge, %	Pressure on throat in atmospheres	Temperature of blowing, °C
February	1.408	0.710	1.033	0.709	88	0.6	816
June	1.672	0.597	1.142	0.672	100	0.4	821
November	1.859	0.538	1.351	0.705	100	0.8	806

As is evident from the table, from February through November the output of the furnace was increased 30% as a result of an increase in the intensity of smelting, which was aided by the increased pressure of gases.

During the summer and fall of 1959 in two furnaces at AMK operating with increased pressure, the k.i.p.o. remained all the time below 0.5. In one of the furnaces in Pen-hsi after conversion to operation with increased pressure in the third quarter of 1958, the output increased 7.6% and the consumption of coke was reduced 4.5% in comparison with the same furnace when the usual gas pressure prevailed. The problem of dust disposal was lessened.

This experience convincingly showed that operation with increased pressure of gases is an effective method of speeding up blast smelting. Therefore, it will be necessary in the future to use this method more widely.

Perfecting of Equipment

The speeding up of furnace operation revealed defects in mechanical equipment as follows: inadequate power of skip winches, casting machines, machinery of the casting bed, etc. In a number of factories in 1958 these deficiencies were eliminated, and now they do not impede the speed-up operation of furnaces. In addition, equipment for screening the agglomerate and for grading coke was set up in the factory in Pen-hsi.

REDUCTION OF STOPPAGE OF BLAST FURNACES

The Chinese blast furnace operators achieved significant success in reducing stoppages. For example, in the largest factory -- Anshan -- the time of furnace operation with respect to calendar time was 96.51% in 1950, 99.27% in 1956; and at the present time it has reached 99.76%.

Additions and observations of the reviewer: In the reviewed article there are unfortunately no figures concerning the composition of the charge in furnaces which are operating with the greatest speed-up. In particular, there are no figures concerning the consumption of additional metals. Therefore, let us look at a portion of the figures taken from other sources.

In Pen-hsi in August 1958, when the average monthly k.i.p.o. was 0.516 m³/t (Table 2), an almost completely fluxed agglomerate with an average iron content of 53.67% went into the charge. The average consumption of iron for the month was 1.85 t per ton of cast iron. Thus, the quantity of iron brought in per ton of cast iron was $1850 \times 0.5367 = 995$ kg. From this, we see that additional metal did not go into the charge; or if it did, then in an insignificant quantity.

In August 1959, the average composition of agglomerate which went into two large furnaces (917 m³) was follows (%):

<u>Fe</u>	<u>FeO</u>	<u>SiO₂</u>	<u>CaO</u>	<u>MgO</u>	Yield of fraction less than 5 mm after trommel test	Content of fines less than 3 mm
52.59	15.64	9.00	11.26	3.53	19.36	4.10

The coke contained 3.08% of moisture, 0.97% of volatile materials, 13.49% of ashes, and 0.75% of sulfur.

For the same month the average operational records of two furnaces in this shop are given in Table 5.

TABLE 5

Operational Records of Furnaces of the Second Blast Shop in the
Factory in Pen-hsi

Furnaces of Second shop	k.i.p.o. m ³ /t	Consump- tion of coke, t/t of cast iron	Inten- sity for coke, t/m ³	Consump- tion of additional metal, kg/t of cast iron	Yield of slag kg/t	Tempera- ture of blowing, °C	Content of agglom- erate in charge, includ- ing 10% sinter agglom- erate %
1	0.524	0.675	1.29	20.6	518	958	99.52
2	0.497	0.606	1.22	66.7	503	1011	100.0

The records of two smaller blast furnaces of the same combine for the same month and under the same conditions for raw materials are given in Table 6.

TABLE 6

Operational Records of Furnaces of the First Blast Shop in the
Factory in Pen-hsi

Furnaces of first shop	k.i.p.o. m ³ /t	Consump- tion of coke, t/t of cast iron	Inten- sity for coke, t/m ³	Consump- tion of additional metal, kg/t of cast iron	Yield of slag kg/t	Tempera- ture of blowing, °C	% of Fe in agglom- erate
1	0.425	0.700	1.644	49	561	778	53.22
2	0.435	0.676	1.555	18	542	975	53.59

If it is considered that additional metal represented defective cast iron of other furnaces and if on these grounds the additional metal is deducted from the amount of smelted cast iron, the k.i.p.o. of the large furnaces, in this case, is 0.534 and 0.533 and of the small furnaces 0.446 and 0.444. Such were approximately the records also for other months of 1959 when the addition of metal was small (not more, but even less than in August). Whenever the addition of

metal was larger, the records of smelting also correspondingly improved. Thus, in a furnace of 333 m³ size, 176 kg of additional metal per ton of cast iron was expended on the average for September 1959, and the average k.i.p.o. for the month was 0.352. If production is reduced 17.6%, that is, if addition of metal is reduced, the k.i.p.o. is $0.352:0.824 = 0.428$.

In a furnace of 917 m³ size, the average daily k.i.p.o. for October 1959 was 0.45 when the consumption of coke was 574 and the addition of metal was 124 kg per ton of cast iron. After the deduction of additional metal, the k.i.p.o. will be 0.514.

In China now one can hear: "The practice of blast smelting in Pen-hsi outstripped theory." It is impossible to agree completely with such a statement. The theory of the blast process, at least in the account of many Soviet authors, has shown for a long time that further intense speeding up of smelting is entirely possible and will not hinder the flow of all physical-chemical transformations in the blast furnace. The speeding up of only the gas-dynamics factor is limited; and by the improvement of the preparation of the smelting charge or by other means, it is possible to create the conditions necessary for gas flow, thereby improving the smelting records.

If we may judge by the substance of the reviewed article, the Chinese blast furnace operators, working creatively, have been headed in just this direction, so that it will be correct to say: "Blast furnace operators who have not achieved such smelting records as those attained in Pen-hsi are failing to take advantage of those opportunities to which the theory of the blast process has for a long time pointed."

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