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ECONOMIC INTELLIGENCE REPORT

CALCIUM CARBIDE INDUSTRY OF THE USSR

CIA/RR 20

27 February 1953

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CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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FOREWORD

Calcium carbide has been a standard product of the chemical industries of most countries since the early part of the twentieth century. For many years its principal uses were for the welding and cutting of steel and for illumination.

In the years immediately preceding World War II, however, practical recognition was given to the fact that acetylene, derived from calcium carbide, was an organic building block from which many useful products could be synthesized. The results of intensive research in acetylene chemistry were translated into commercial production of synthetic rubbers, plastics, chlorinated solvents, chemical warfare agents, explosives, pharmaceuticals, and many other products essential to modern industrial economies. Thus calcium carbide assumed a vital role as the parent chemical in a new and highly significant branch of organic synthesis, and today, in most countries, chemical uses for calcium carbide have surpassed its uses for the welding and cutting of steel and for illumination.

The purpose of this report is to present the outstanding features of the calcium carbide industry in the USSR and to point out the capabilities and vulnerabilities of this industry. It is believed that these data will assist in accurately evaluating Soviet industrial and military strength.

It should be emphasized that this report is based on information available as of July 1952 and that it is subject to revision as additional information becomes available.

CONTENTS

Appendixes

CIA/RR 20

S-E-C-R-E-T

SECURITY INFORMATION

THE CALCIUM CARBIDE INDUSTRY OF THE USSR*

Summary

Calcium carbide is important principally because, when reacted with water, it generates acetylene, a gas universally used for the welding and cutting of steel; for special-purpose illumination; and for the production of synthetic rubbers, plastics, chemical warfare agents, explosives, pharmaceuticals, and many other chemical intermediates and end products. It is widely used also for the manufacture of fertilizer, for the processing of ores and metals, and for other less important purposes.

Calcium carbide has been a product of the Soviet chemical industry since before World War I, and at the outbreak of World War II, in 1939, production reached an estimated 100,000 tons,** equivalent to about 66 percent of US calcium carbide production in that year. The extent of wartime damage in this Soviet industry is not known, but Lend-Lease shipments of calcium carbide, in addition to Lend-Lease shipments of large quantities of fabricated steel and other products requiring acetylene in their manufacture, give testimony to the shortage of this chemical during World War II. The postwar status of calcium carbide production is obscure because the USSR has published no information of significance concerning the output of this industry since 1935. Analysis of Soviet requirements for calcium carbide, combined with analysis of plant information and trade information, has, however, indicated a 1952 production of about 300,000 tons (probable range, 260,000 to 330,000 tons), equivalent to about 38 percent of estimated US production in 1952.

Soviet technology in the manufacture of calcium carbide is comparable to that in the US and other highly industrialized countries, although Soviet specifications concerning quality are lower than corresponding US specifications, indicating that the quality of Soviet calcium carbide is lower than that of US calcium carbide.

* This report contains information available to CIA as of 1 July 1952.
** Throughout this report, tonnages are given in metric tons.

The primary input requirements of the Soviet calcium carbide industry in 1952 are estimated at about 270,000 to 288,000 tons of lime, 135,000 to 146,000 tons of coke, 6,000 to 12,000 tons of carbon electrodes, and 840 million to 900 million kilowatt-hours (kwh) of electricity.

The plants producing calcium carbide are well dispersed throughout the USSR, the major regions* of production being the Transcaucasus, Central European USSR, and Kazakh SSR.

Although information concerning stockpiling of calcium carbide is entirely lacking, large reserves are improbable because of the fire and explosion hazards involved. The total inventory at producing and consuming plants probably does not exceed several months' requirements, at the very maximum.

Soviet net imports of calcium carbide in 1952 are estimated at 35,000 tons, most of which were to be supplied by East Germany, with Poland and, possibly, Rumania supplying relatively small quantities.

Soviet requirements for calcium carbide in 1952 are estimated broadly at 321,800 tons, allocated as follows: about 90 percent for the manufacture of synthetic rubber, chemicals, and plastics and for autogenous welding; and 10 percent for the manufacture of fertilizer, for illumination, and for other miscellaneous uses.

The total supply of calcium carbide available to the USSR in 1952, consisting of production and net imports, but excluding the inventory, is estimated at 335,000 tons (probable range, 285,000 to 370,000 tons), which is considered to be sufficient to meet all of the principal requirements. Should a general war in the near future cause an increase in calcium carbide requirements beyond this level of supply, large quantities could be made available from East Germany, Poland, and Czechoslovakia by a decrease in the production of these Satellites of calcium cyanamide fertilizer and other nonessential production involving calcium carbide. If the effects of wartime destruction are ignored, the supply of calcium carbide actually and potentially available to the USSR is adequate to sustain a prolonged military effort of major proportions.

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The Soviet calcium carbide industry is not vulnerable to economic warfare, and effective restriction of supplies can be achieved only by actual destruction of the producing plants or their power plants. Although the size of the inventory is not known, effective restriction of calcium carbide supplies probably would reduce, within a few months, Soviet capacity to manufacture essential military products.

A decrease in production of calcium cyanamide or a reduction in allocations of this product for fertilizer use would be fairly good indicators that increased quantities of calcium carbide and calcium cyanamide were being allocated for more essential uses, such as synthetic rubber and rubber products, armaments and implements of war, chemical warfare materials, and explosives and plastics, all of which would be needed in large quantities for the prosecution of a major war.

Table 1 presents the figures for total supply and requirements of calcium carbide in the USSR.

Table 1

Estimated Total Supply and Requirements
of Calcium Carbide in the USSR
1952

	Tons
Production	300,000
Imports	35,000
Total Supply	335,000
Requirements	321,800

Table 2* presents the figures for the input requirements of the calcium carbide industry in the USSR.

* Table 2 follows on p. 4.

Table 2

Estimated Input Requirements of the
Calcium Carbide Industry in the USSR
1952

Lime (Tons)	270,000 to 288,000
Coke (Tons)	135,000 to 146,000
Anthracite (Tons)	40,000 to 50,000
Carbon Electrodes (Tons)	6,000 to 12,000
Electricity (Kwh)	840,000,000 to 900,000,000

I. Introduction.

Calcium carbide is produced in the form of a grayish-black material having the appearance of crushed stone and weighing about 138 pounds per cubic foot. In the US, the crude commercial product contains about 83 to 85 percent calcium carbide; 14 percent lime; 1 percent carbon; and small amounts of silicides, phosphides, and sulfides. The indications are that the quality of calcium carbide produced in the USSR is lower than that produced in the US. 1/*

Calcium carbide is important principally because, when reacted with water, it generates acetylene, a gas universally used in the welding and cutting of steel; for special-purpose illumination; and for the production of certain types of synthetic rubbers, chemical warfare agents, explosives, plastics, rayon, alcohols, glycols, solvents, synthetic lubrication oil, and many other chemical intermediates and end products.

Calcium carbide also is used in producing calcium cyanamide, which is used as a fertilizer; in the casehardening of steel; in the manufacture of explosives, cyanides, plastics, dyes, synthetic rubbers and fibers; and in accelerators for the vulcanization of rubber.

In addition, calcium carbide has a few small-volume, direct uses. It is used as a dehydrating agent for alcohol and foods, as an agent

50X1

for ripening fruits, as a deoxidant in the processing of copper and steel, and as a reducing agent in processing metallic ores.

II. Technology.

At the present time there is only one accepted economical process for the production of calcium carbide. This process consists in reacting lime and coke, or another form of carbon such as anthracite or charcoal, in an electric arc-resistance furnace, where, in the intense heat of the electric arc (2,000°C or higher), the lime is reduced to metallic calcium, which unites with the excess of carbon present to form calcium carbide.

Two types of electric arc-resistance furnaces, the ingot furnace and the tapping furnace, are used to produce calcium carbide. The ingot furnace is similar to that used for the production of fused aluminum oxide, the most widely used synthetic abrasive. A carbon electrode is lowered into a carbon-lined steel furnace on a car and strikes an arc with the bottom. The charge is added from time to time, and the electrode is raised until the furnace is full. The furnace is disconnected and cooled, and the ingot is removed. The tapping furnace consists of a steel shell lined with carbon, which is about the only refractory material capable of withstanding the extremely hot, alkaline conditions encountered in this process. The arc is generally produced by three electrodes connected to three-phase electric current. The lime and coke are charged continuously, and the molten calcium carbide at about 1,800°C is tapped either intermittently or continuously, depending on the size of the furnace.

The solidified calcium carbide from either type of furnace is broken into pieces and graded for size in an atmosphere of nitrogen to prevent the possibility of explosion from any acetylene that may have been formed.

This process has been used commercially for many years, and Soviet technology in this industry is comparable with that in the US, Germany, and other highly industrialized countries.

The US Government specification for calcium carbide requires a minimum purity of 80 percent calcium carbide, and the technical grade sold in the US averages 83 to 85 percent calcium carbide.

Information in Soviet literature refers to the State All-Union Standard (Gosudarstvenny obshchesoyuznyy standart /GOST/) for calcium carbide (GOST 1460-46) and quotes specifications for yields of

acetylene from certain grades of calcium carbide. 2/ This information indicates that three different grades of calcium carbide are used in the USSR. The specifications for the first grade state that the yield of acetylene per kilogram of calcium carbide, depending on the size of the calcium carbide lumps, must be not less than 250 to 280 liters at 20°C and 760 millimeters of mercury pressure, which is equivalent to a product containing 65.6 to 73.5 percent calcium carbide. The specifications for the second grade state that the yield of acetylene per kilogram of calcium carbide must be not less than 230 to 260 liters, equivalent to a product containing 60.3 to 68.2 percent calcium carbide. Specifications for a third grade of calcium carbide also are given in this source, which states:

> "For factories equipped with low-power furnaces (up to 1000 kw) and operating on local, low-grade raw materials, an output of calcium carbide with an acetylene yield of not less than 220 liters per kilogram (for all lump sizes) is permitted." 3/

Thus a product containing only about 57 to 58 percent calcium carbide would be acceptable as third-grade calcium carbide. The proportionate production of the various grades of calcium carbide in the USSR is not known, but, considering the above specifications and other information concerning the allowable impurities in raw materials, it is doubted that the average purity of Soviet calcium carbide exceeds the minimum specifications for the first grade, about 65 to 74 percent.

Also, in contrast to US practice, in which petroleum coke is the preferred source of carbon because of its low ash content and high resistivity, the Soviet calcium carbide industry reportedly uses hard coal* coke and anthracite as the principal sources of carbon. Petroleum coke and charcoal are more rarely used. 4/

A new method of producing calcium carbide without using electrical energy is claimed by Soviet scientists. A blast furnace is charged with a mixture of chalk and coke, and a blast of air enriched with oxygen (60 to 70 percent) is introduced in order to secure a temperature of 2,200°C to 2,400°C. 5/ Successful development of this process has not been confirmed, and there are no indications that it is being used on a commercial scale.

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* This so-called "hard coal" would be known as bituminous coal in the US.

III. Input Requirements.

1. Primary Raw Materials.

The following is a translated extract from a book recently published by the USSR concerning its calcium carbide industry:

> "In plant practice it has been established, that if the composition of the raw materials satisfies the specifications given on pages 53-60, then on the average for one ton of carbide, one kilogram of which will yield under normal conditions 250 liters of acetylene, it is necessary to expend:
>
> | | |
> |---|---|
> | Lime | 900 to 960 kilograms |
> | Coke | 600 to 650 kilograms |
> | Electrodes | 20 to 40 kilograms |
> | Electrical Energy | 2,800 to 3,000 kilowatt-hours |
>
> If the fusion is carried out with anthracite instead of coke, the consumption of it (anthracite) will be equal to approximately 580-620 kilograms." 6/

Using this information as a basis, the estimated quantities of primary raw materials required by the USSR in 1952 for the manufacture of about 300,000 tons* of calcium carbide, having an average purity of about 65 to 74 percent, are presented in Table 3.**

2. Electric Power.

Calcium carbide is produced by an electrothermal process requiring large quantities of electricity. Recently published Soviet information states that the consumption of electrical energy per ton of calcium carbide, 1 kilogram of which yields 250 liters of acetylene under normal conditions, is 2,800 to 3,000 kilowatt-hours (kwh). 7/ Therefore, based on an estimated production of 300,000 tons of calcium carbide, having an average purity of 65 to 74 percent, the consumption of electricity by the Soviet carbide industry in 1952 is estimated at 840 million to 900 million kwh.

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* Throughout this report, tonnages are given in metric tons.

** Table 3 follows on p. 8.

Table 3

Estimated Raw Material Requirements for the Manufacture of Calcium Carbide in the USSR
1952

Tons

Raw Material	Amount
Lime	270,000 to 288,000
Coke	135,000 to 146,000
Anthracite	40,000 to 50,000 a/
Electrodes	6,000 to 12,000

a. An estimated 25 percent of the total carbon requirement is in the form of anthracite.

3. Fuel.

In the manufacture of calcium carbide, fuel is required as the source of carbon in the electric arc-resistance furnace reaction; for the manufacture of the raw materials, lime and coke; and for the generation of electricity in thermoelectric power plants servicing the calcium carbide industry. The latter requirement is not considered in this report. The estimated fuel requirements for the first two purposes follow.

a. For the Source of Carbon in the Electric Arc-Resistance Furnace Reaction.

It is estimated that about 25 percent of the carbon required in the electric arc-resistance furnace reaction for the manufacture of calcium carbide in the USSR is supplied by anthracite. The balance of the carbon is in the form of hard coal coke. Since the estimated total carbon requirement is 180,000 to 195,000 tons, and since slightly less anthracite than coke is required for this reaction, the 1952 anthracite requirements of the USSR are estimated at 40,000 to 50,000 tons.

b. For the Preparation of Raw Materials.

The fuel requirements for the preparation of raw materials for the calcium carbide industry consist of anthracite coal and hard coal. The anthracite coal, according to published Soviet information, is used as a source of heat in converting limestone to lime. Hard coal is used for the manufacture of coke, which in turn serves as the principal source of carbon in the electric furnace reaction.

Estimates of the fuel requirements for the preparation of lime and coke for the Soviet calcium carbide industry in 1952 are given in Table 4.

Table 4

Estimated Fuel Requirements for the Preparation of Raw Materials for the Calcium Carbide Industry in the USSR 1952

Tons

Raw Material	Amount of Raw Material	Type of Fuel Required	Amount of Fuel Required
Lime	270,000 to 288,000	Anthracite coal	37,800 to 40,300 a/
Coke b/	135,000 to 146,000	Hard coal	185,000 to 200,000 c/

a. With respect to the fuel used in the preparation of lime for the manufacture of calcium carbide, recently published Soviet information states that the temperature in the lime kiln is usually provided by burning anthracite coal dust and waste gases from calcium carbide furnaces. These waste gases contain about 60 percent carbon monoxide. The stated consumption coefficients for the manufacture of one ton of lime are 130 to 150 kilograms of anthracite and 600 to 700 cubic meters of furnace gas. 8/
b. It is assumed that 75 percent of the carbon used is in the form of hard coal coke and 25 percent is in the form of anthracite, and that all the coke is derived from hard coal and none from petroleum.
c. These figures are based on an estimated 73-percent yield of coke from coal that has been washed in preparation for the coke oven.

IV. Supplies.

1. Production.

Before World War I, calcium carbide was manufactured in Russia only in the Perun plant in St. Petersburg (now Leningrad) and in a plant in Slavyansk. The first named plant could produce 4,000 tons of calcium carbide a year, whereas in Slavyansk only an undetermined amount for use in the area was manufactured. 9/

From World War I to 1927, Soviet production of calcium carbide is not known but probably was insignificant, since annual production in 1927-28 has been reported as 3,351 tons. 10/ It is probable that this production originated in the plants at Leningrad and Slavyansk, although there is some indication that a plant in Kirovakan was operating in 1927. A plant in Dzerzhinsk was put into operation in 1928 but probably contributed little or nothing to the production reported for 1927-28.

The First Five Year Plan (1928-32) saw substantial progress made in this industry, and production in 1932 has been reported as 29,230 tons. 11/

During the Second Five Year Plan (1933-37), expansion of calcium carbide capacity continued. The first unit of a 70,000-ton plant at Yerevan was put into operation; the plant at Kirovakan was put into operation or, at least, the second unit of this plant was started; and a unit containing three electric furnaces reportedly was built at Voroshilovgrad. 12/ Undoubtedly, other plants were built or expanded during this period, but further information is lacking. By 1935, output had risen to 45,760 tons, an increase of 57 percent over 1932 production. 13/ Production in 1936 and 1937 is not known, but one source has stated that "output is supposed to have increased by 1937 to about 60,000 tons." 14/

With respect to calcium carbide, the Third Five Year Plan (1938-42) stated only that "an expansion of calcium carbide production for autogenous welding and for acetylene and products derived from acetylene is foreseen." 15/ The 1941 State Plan, however, visualized a production of 145,200 tons for that year. 16/ Assuming that the production of 60,000 tons estimated for 1937 is accurate and that the 1941 planned output of 145,200 tons was realistic and would have been attained had not the German invasion interrupted production in many

of the plants, output of calcium carbide in the intervening years, as determined by interpolation, probably was as given in Table 5.

Table 5

Estimated Production of Calcium Carbide in the USSR
1938-40

Tons

Year	Production	Probable Range of Production
1938	80,000 a/	70,000 to 100,000
1939	100,000	90,000 to 110,000
1940	120,000	100,000 to 130,000

a. [redacted] estimate 1938 production at 100,000 tons. 17/ 50X1

Production of calcium carbide during the war years from 1941 to 1945 is not known and is almost impossible to estimate, because of the inadequacy of the plant information concerning that period. Loss of plants because of occupation and bombings undoubtedly reduced capacity considerably, but the actual tonnage lost is not known. Lend-Lease shipments of 775 tons of calcium carbide, as well as Lend-Lease shipments of large quantities of fabricated steel and other products requiring acetylene in their manufacture, give testimony to the wartime shortage of this chemical. 18/

The Fourth Five Year Plan (1946-50), as published, did not give a goal for the production of calcium carbide and gave no information from which this goal could be estimated. Furthermore, the yearly and quarterly reports concerning fulfillment of the State Plans during this period throw no light on the status of production of this chemical. [redacted] estimate 1949 production at 200,000 tons. 19/ Accepting this as a sound estimate, an attempt has been made to determine production for 1950, 1951, and 1952 by first establishing 1952 output and then interpolating for 1950 and 1951 production. The 50X1

estimates thus made indicate that production of calcium carbide in these years probably was as given in Table 6.

Table 6

Estimated Production of Calcium Carbide in the USSR
1950-52

Tons

Year	Production a/	Probable Range of Production b/
1950	233,000	200,000 to 270,000
1951	267,000	230,000 to 300,000
1952	300,000	260,000 to 330,000

a. The methods used in arriving at the production figures given are explained in Appendix C.
b. The inadequacy of postwar information concerning the calcium carbide producing plants and requirements for carbide necessitates the use of the wide margins listed.

Soviet production of calcium carbide since 1927 is given in Table 7.*

For the purpose of comparison, production of calcium carbide in the USSR and in the US in certain years is given in Table 8.**

2. Locations and Estimated Production of Plants.

The locations and estimated outputs of Soviet calcium carbide plants are given in Table 9.*** It is not certain, however, that all of the plants listed are actually producing calcium carbide, because in some cases the information is not conclusive. Neither is it certain

* Table 7 follows on p. 13.
** Table 8 follows on p. 14.
*** Table 9 follows on p. 15.

Table 7

Estimated Production of Calcium Carbide in the USSR
1927-52

Tons

Year	Production a/	Probable Range of Production
1927-28 b/	3,351	
1928-29 b/	6,911	
1930	21,562	
1931	23,437	
1932	29,230	
1933	29,841	
1934	40,612	
1935	45,760	
1936	N.A.	
1937	60,000	
1938	80,000	70,000 to 100,000
1939	100,000	90,000 to 110,000
1940	120,000	100,000 to 130,000
1941 (Plan)	145,200	
1942-48	N.A.	
1949	200,000	170,000 to 240,000
1950	233,000	200,000 to 270,000
1951	267,000	230,000 to 300,000
1952	300,000	260,000 to 330,000

a. The production figures listed for 1927 through 1935 are figures published by the USSR. 20/ All other figures are estimates, except the 1941 figure, which was the planned goal. 21/

b. It is assumed that the production figures refer to annual production reported on a noncalendar year basis.

Table 8

Estimated Production of Calcium Carbide in the USSR
As Compared with Production in the US
1933, 1935, 1937, 1939, 1949-52

Year	Amount of Production (Tons)		Soviet Production as Percent of US Production
	USSR	US	
1933	29,841	92,000	32.4
1935	45,760	133,000	34.4
1937	60,000	175,000	34.3
1939	100,000	152,000	65.8
1949	200,000	550,000	36.4
1950	233,000	609,000	38.3
1951	267,000	703,000	38.0
1952	300,000	781,000 22/	38.4

that the list includes all of the producing plants nor that the production listed for every plant is factual. Detailed plant studies are attached to this report in Appendix A.

3. Stockpiles.

Calcium carbide is a dangerous material to store, because, if it becomes wet or moist, the acetylene gas which is liberated is an extreme fire and explosion hazard. Normally, because of the risks inherent in storing this material, stocks are kept at minimum levels and, in the US, usually approximate 2 weeks' production. The size of the stocks maintained by the USSR is not known, but the difficulties involved in keeping the metal drums dry, tight, and free of corrosion undoubtedly preclude large stockpiles. Because of these risks and difficulties, it is improbable that calcium carbide is among the chemicals stockpiled in the state reserves of the USSR, although this is not certain. In conformity with Soviet regulations regarding emergency stockpiles of materials at plants, stocks undoubtedly are maintained at producing or consuming plants. These stocks more than likely exceed a normal working inventory, but their sum total is, in all probability,

Table 9

Locations a/* and Estimated Production of Calcium Carbide Plants in the USSR
1952

Tons

Economic Region and City	Plant Names	Production
Northwest (Ia)		
Kirovsk	Calcium Carbide Plant	N.A. b/
Leningrad	Krasnyy Avtogen, No. 1	15,000
Ukraine (III)		
Makeyevka	Calcium Carbide Plant	3,000
Slavyansk	Krasnyy Khimik Soda Plant	N.A. b/
Voroshilovgrad	Locomotive Works	N.A. b/
Zaporozh'ye	Calcium Carbide and Ferroalloys Plant	20,000
Lower-Don - North Caucasus (IV)		
Groznyy	Calcium Carbide Plant	N.A.
Transcaucasus (V)		
Baku-Zykh	Sverdlov Acetylene Factory	10,000
Kirovakan	Myasnikan Chemical Combine	35,000
Yerevan	Kirov Synthetic Rubber Combine	70,000
Volga (VI)		
Beketovka	Chemical Plant, No. 91	N.A.
Kuybyshev	Calcium Carbide Plant	5,000

* Footnotes to Table 9 follow on p.17.

Table 9

Locations a/* and Estimated Production of Calcium Carbide Plants in the USSR
1952
(Continued)

Tons

Economic Region and City	Plant Name	Production
Central European USSR (VII)		
Aleksin	Chemical Combine, No. 100	N.A. b/
Bryansk	Calcium Carbide Plant	N.A. b/
Dzerzhinsk	Kalinin Chemical Combine	20,000
Lipetsk	Calcium Carbide Plant	35,000
Stalinogorsk	Stalin Chemical Combine	50,000
Voronezh	Synthetic Rubber Plant, SK-2	N.A.
Urals (VIII)		
Berezniki	Voroshilov Chemical Combine	N.A.
Karabash	Calcium Carbide Plant	N.A. c/
Kirovograd	Kalata Chemical Combine	N.A.
West Siberia (IX)		
Novosibirsk	Calcium Carbide Plant	N.A.
Kazakh SSR (Xa)		
Balkhash	Calcium Carbide Plant	7,500
Kantagi	Calcium Carbide Plant	N.A. b/
Temir-Tau	Calcium Carbide Plant, No. 727	30,000
Central Asia (Xb)		
Chirchik	Calcium Carbide Plant	N.A. b/
East Siberia (XI)		
Ulan-Ude	Calcium Carbide Plant	7,200

* Footnotes to Table 9 follow on p. 17.

Table 9

Locations a/ and Estimated Production of Calcium Carbide Plants in the USSR
1952
(Continued)

a. Calcium carbide plants have been reported at the following locations, either as under construction, as planned, or as in operation, but production at these plants has not been confirmed: Kadiyevka and Shostka in the Ukraine Economic Region; Gergebel in the Lower Don-North Caucasus Economic Region; Chapayevsk in the Volga Economic Region; Kushkovo in the Central European USSR Economic Region; Chelyabinsk in the Urals Economic Region; Kemerovo in the West Siberia Economic Region; and Petrovsk-Zabaykal'skiy in the East Siberia Economic Region.
b. Probably small.
c. Very small.

relatively small and sufficient for, perhaps, several months' full operation at the very maximum.

4. Trade.

The USSR is believed to be exporting small quantities of calcium carbide to Albania. There are no records of Soviet exports of calcium carbide to any other Soviet Bloc country.

The USSR was scheduled to receive 28,000 tons of calcium carbide from East Germany under the 1951 trade agreement, and it is believed that the entire amount was received. 23/ Smaller quantities also may be imported from Poland and Rumania. In 1949, Rumania reportedly delivered 5,500 tons of calcium carbide to the USSR. No later information is available. Large quantities were imported from North Korea until UN bombings halted production there.

There are no known records of Soviet trade in calcium carbide with non-Soviet Bloc countries.

It is apparent from the trade pattern in recent years that the USSR is a net importer of calcium carbide. Although information for 1952 is not available, Soviet net imports for this year are estimated at about 35,000 tons.

5. Total Supply.

The estimated total supply of calcium carbide available to the USSR in 1952, exclusive of a possible stockpile, is given in Table 10.*

V. Requirements.

Estimated Soviet requirements for calcium carbide in 1952 are given in Table 11.** The requirements for calcium carbide in the Third Five Year Plan, as reported by the USSR, are given in Table 12.*** A comparison of these requirements with the estimated 1952 requirements shows that

* Table 10 follows on p. 19.
** Table 11 follows on p. 19.
*** Table 12 follows on p. 20.

Table 10

Estimated Supply of Calcium Carbide in the USSR
1952

Tons

Source of Supply	Amount	Probable Range
Production	300,000	260,000 to 330,000
Net Imports	35,000	25,000 to 40,000
Total Supply	335,000	285,000 to 370,000

Table 11

Estimated Requirements for Calcium Carbide in the USSR a/
1952

Use	Requirements (Tons)	Percent of Total
Synthetic Rubber	120,500	37.5
Chemicals and Plastics	87,600	27.2
Autogenous Welding	78,000	24.2
Calcium Cyanamide	25,700	8.0
Miscellaneous	10,000	3.1
Total	321,800	100.0

a. The methods used in arriving at these estimates are presented in Appendix C.

Table 12

Reported Requirements for Calcium Carbide in the USSR in the Third Five Year Plan 24/
1938-42

Percent

Use	Percent of Total
Autogenous Welding	49.2
Manufacture of Calcium Cyanamide	11.1
Manufacture of Synthetic Rubber	21.4
Manufacture of Vinyl Resins	10.7
Manufacture of Synthetic Acetic Acid	7.6

synthetic rubber and chemicals and plastics have replaced autogenous welding as the principal uses for calcium carbide, the former uses now consuming almost three times as much calcium carbide as the latter.

VI. Capabilities, Vulnerabilities, and Intentions.

1. Capabilities.

The supply of calcium carbide available to the USSR in 1952 is estimated at 335,000 tons (probable range, 285,000 to 370,000), equivalent to about 43 percent of the estimated US production in 1952. This supply is considered sufficient to meet Soviet requirements in 1952. Should a general war in the near future cause an increase in calcium carbide requirements beyond this level of supply, large quantities could be made available from East Germany, Poland, and Czechoslovakia by reducing the production of calcium cyanamide fertilizer and other non-essential items in those countries. If the effects of wartime destruction are ignored, the supply of calcium carbide actually and potentially available to the USSR is adequate to sustain a prolonged military effort of major proportions.

2. Vulnerabilities.

The Soviet calcium carbide industry is self-sufficient and, therefore, not vulnerable to economic warfare. Imports of this commodity represent only about 10 percent of the total supply and are received entirely from within the Soviet Bloc. Effective restriction of supplies can be achieved only by actual destruction of the producing plants or their power plants. Although the size of the inventory is not known, effective restriction of supplies probably would reduce Soviet capacity to manufacture essential military products within a few months.

About 40 percent of Soviet calcium carbide production capacity is concentrated in three plants, located in Yerevan, Kirovakan, and Leningrad, all three of which are vulnerable with respect to bombing.

3. Intentions.

A decrease in production of calcium cyanamide or a reduction in allocations of this product for fertilizer use would be fairly good indicators that increased quantities of calcium carbide and calcium cyanamide were being allocated for more essential uses, such as synthetic rubber and rubber products, armaments and implements of war, chemical warfare materials, explosives, and plastics, all of which would be needed in large quantities for the prosecution of a major war. Other than this, it is unlikely that any conclusions regarding Soviet intentions could be drawn from the calcium carbide industry, unless detailed information concerning allocations of calcium carbide to Soviet consumers were available.

APPENDIX A

CALCIUM CARBIDE PLANTS IN THE USSR

I. Plants on Which There Is Reliable Information.

1. Calcium Carbide Plant.

a. Location. Kirovsk, Murmansk Oblast (Northwest Economic Region).

b. Estimated Production of Calcium Carbide. Not available - probably small.

c. Production Information. None.

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide.

"February 1944: Authorized to ship one carload of calcium carbide to plant No. 204 in Tambov for February. March 1944: Authorized to ship one carload of calcium carbide to "Donbas-Energo" plant in Gorlovka for March." 25/

h. Comment. Production of calcium carbide at this plant is not conclusive, being deduced only from the above information regarding shipments of calcium carbide.

2. Krasnyy Avtogen No. 1.

a. Location. Leningrad, Leningrad Oblast (Northwest Economic Region).

"This plant is located on the Tarakanovka River, Andreevskaya Ulitsa." 26/

b. Estimated Production of Calcium Carbide. 15,000 tons per year.

c. Production Information.

"This plant produces calcium carbide, oxygen, and acetylene. Plant was in operation in 1946. [redacted] Postwar information is based on personal observations during November and December 1946, contacts with industrial managers, and conversation with Leningrad residents." 27/ 50X1 50X1

"The acetylene shop contained three Russian generators and one wooden German one. The generators were operated as follows ... . Numerous rows of flasks were constantly being filled with acetylene ... . [redacted] several hundred steel flasks were filled per day ... . [redacted] the German generator was installed in 1947. It was of modern construction and permitted the use of carbide* dust for manufacture of acetylene. This dust used to be disposed of by giving it to the workers or selling it, as the Russian generators could only handle small blocks of carbide. [redacted] 40 to 45 tons of carbide were manufactured in a 24-hour period ... . The carbide furnaces melted coal and limestone at a temperature of 3,500°Celsius. The hot fluid was then released from the furnaces into large cast iron buckets holding one ton each. It takes from 15 to 16 hours for them to cool off. The ready-made carbide was then lifted out of the buckets, broken up, and ground ... ." 28/ 50X1 50X1 50X1 50X1 50X1

* "Carbide" and "calcium carbide" are synonymous.

d. Plant Equipment. " ... Six electric furnaces, each four meters high and three meters in diameter. ... Three Russian acetylene generators and one wooden German one ... ." 29/

e. Source of Raw Materials. "This plant receives power from the city power plant ... ." 30/

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide.

"Part of the carbide was utilized for the production of acetylene gas, but larger amounts were despatched by rail to Kiev and Kaliningrad or transported in trucks to Estonia." 31/

h. Comment. [redacted] 50X1
[redacted] the production of 50X1 calcium carbide in 1949 amounted to 40 to 45 tons per 24-hour period which is equivalent to about 15,000 tons per year. Since there has been no information concerning expansion of this plant, it is estimated that production in 1952 will be the same -- namely, 15,000 tons.

3. Calcium Carbide Plant.

a. Location. Makeyevka, Stalino Oblast (Ukraine Economic Region). "A carbide plant is located in the south part of Makeyevka." 32/

b. Estimated Production of Calcium Carbide. 3,000 tons per year. 33/

c. Production Information.

[redacted] 50X1
[redacted] it produces only carbide." 34/ 50X1

d. Plant Equipment.

"The plant has two iron or steel furnaces about 25 meters high." 35/

e. Source of Raw Materials.

"Electric power is transmitted from Zavod imeni Kirova, where the central transformer for industrial installations in and around Makeyevka is located." 36/ This power plant also is located at Makeyevka.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide.

"The entire output is taken to Zavod imeni Kirova, - [redacted] 37/ 50X1

(Note: Zavod imeni Kirova is a large steel plant.)

[redacted] 50X1

4. Krasnyy Khimik Soda Plant.

a. Location. Slavyansk, Stalino Oblast (Ukraine Economic Region).

b. Estimated Production of Calcium Carbide. Not available -- probably small.

c. Production Information.

"Before World War I, calcium carbide was manufactured in Russia only in the Perun plant in St. Petersburg (Leningrad) and in Slavyansk. The first named plant could produce 4,000 tons of carbide a year while in Slavyansk only an undetermined amount for use in the area was manufactured." 39/

[redacted] 50X1

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. The information concerning the installation of a calcium carbide manufacturing plant here is very scant. It is believed that, if a calcium carbide plant does exist at this location, it is a small plant. A large plant in this locality almost certainly would have been observed by PW's in the area and probably would receive at least some publicity in the Soviet press. [redacted] 50X1
[redacted] 50X1
[redacted] no mention of it has 50X1
been seen in Soviet press extracts [redacted] 50X1
[redacted] 50X1

5. Locomotive Works.

a. Location. Voroshilovgrad, Voroshilovgrad Oblast (Ukraine Economic Region).

b. Estimated Production of Calcium Carbide. Not available -- probably small.

c. Production Information. None.

d. Plant Equipment.

"In Voroshilovgrad in the East part of the Ukraine, a locomotive plant built its own carbide unit having three electric furnaces in 1936. Also the necessary electrodes were manufactured in their own plant. Concerning the capacity of this unit there is nothing even estimated. This means that the requirements of the locomotive works must be completely satisfied ... ."41/

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. A small plant supplying calcium carbide principally to the Locomotive Works evidently existed here before World War II. It was probably destroyed during the war, and, although postwar information is lacking, it may have been restored since the war.

6. Calcium Carbide and Ferroalloys Plant.

a. Location. Zaporozh'ye, Zaporozh'ye Oblast (Ukraine Economic Region).

b. Estimated Production of Calcium Carbide. 20,000 tons per year.

c. Production Information. [redacted] 50X1
[redacted] a calcium carbide and ferroalloys plant was built in Zaporozh'ye in 1931-32. Neither the designed capacity nor the annual production of this plant is known. 42/ 50X1

"It has been said that within the borders of the large Dniepr combine in Zaporozh'ye, a carbide plant has been built having a capacity of 20,000 tons per year. How much carbide actually is being produced is unknown." 43/

d. Plant Equipment.

" ... French Miguet furnaces, single phase, 5,000 kw normal capacity. Number of furnaces not known." 44/

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. The above information indicates the existence of a calcium carbide plant at this location prior to World War II. This plant was destroyed during the war, but interrogation of returned German PW's has established that it was reconstructed following the war and is now operating. Lacking quantitative information concerning postwar production, it has been assumed that this plant was restored to its original capacity.

7. Calcium Carbide Plant.

a. Location. Groznyy, Groznyy Oblast (Lower Don-North Caucasus Economic Region).

b. Estimated Production of Calcium Carbide. Not available.

c. Production Information. A translated extract of the Soviet newspaper Trud, dated 24 May 1947, indicates that calcium carbide is one of the chemicals produced in Groznyy. 45/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. None.

8. Sverdlov Acetylene Factory.

a. Location. Baku-Zykh, Azerbaydzhan SSR (Transcaucasus Economic Region).

"The transport address of the factory is Baku-Tovarnaya (freight) Zak, railway station. The telegraphic address is Baku Avtogentrest. The telephone number is 27-06." 46/

b. Estimated Production of Calcium Carbide. 10,000 tons per year.

c. Production Information.

[redacted] 50X1

"1943: Products: Oxygen, acetylene, carbide (10,000 tons per year planned). Carbide factory under construction; start of operation planned in 1943." 48/

"Requires 225 tons of petroleum coke and 135 tons of Donets coke for the production of carbide during the first quarter of the year (1944)." 49/

"This factory produces oxygen, acetylene and welding equipment. It was established in 1914, and is under the All-Union Autogenous Welding Trust (VAT), which is under the Chief Administration of the Machine Construction Industry (Glavmashprom)." 50/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

50X1

9. Myasnikan Chemical Combine.

a. Location. Kirovakan, Armenian SSR (Transcaucasus Economic Region).

50X1

b. Estimated Production of Calcium Carbide. 35,000 tons per year.

c. Production Information.

"Produces calcium carbide and lime ... ." 52/

"Products are primarily carbide made of limestone. Product is shipped by RR in drums weighing 60 to 80 kilograms." 53/

50X1

"A second carbide plant with a capacity of 20,000 tons is located in Kirovakan." 55/

50X1

"Products: Calcium carbide (1942: planned 12,000 tons), cyanamide, silicate, oxygen, acetic acid (1942: 5,000 tons). Planned: explosives." 57/

"Products: carbide. Planned annual production 33,000 tons. Program for 1927 called for 27,000 tons. Oxygen capacity: 800,000 cubic meters. Cyanide capacity: 8,900 tons per year. Also produces acetic acid; oxygen, calcium arsenite, plastics and cyanide ... . Experimental smelting of ferrosilicon undertaken." 58/

d. Plant Equipment.

" ... four large lime kilns which were built about 17 years ago." 59/

"Lime calcining section consists of four fire-brick kilns, each 25 meters high, housed in two wooden sheds ... . New carbide calcining section known as shop 202 equipped with American roasting ovens." 60/

"Workship 20 (carbide factory) ... equipped with three electric furnaces, each about 5 meters in height and 7 meters in diameter." 61/

e. Source of Raw Materials.

"Limestone is shipped in by train from Yerevan." 62/

50X1

"Power is received from the Sevan Power Plant. Power supply is sufficient. Fifteen thousand volt current is transmitted via high tension lines to the transformer station where it is transformed to 350 volt alternating current of 60 amperes." 65/

50X1

g. Distribution of Calcium Carbide.

"Carbide is delivered to Tiflis in 60 to 80 kilogram barrels." 67/

h. Comment. This plant receives considerable publicity in the Soviet press and is one of the best known of the Soviet calcium carbide factories. It is believed that the production of this plant now exceeds the 33,000 tons reported

50X1

10. Kirov Synthetic Rubber Combine.

a. Location. Yerevan, Armenian SSR (Transcaucasus Economic Region).

"The carbide factory is located in the eastern part of town." 68/

50X1

b. Estimated Production of Calcium Carbide. 70,000 tons per year.

c. Production Information.

"The Yerevan Chemical Plant has fulfilled the third quarter plan lowering the estimated production cost by one-half. During the last nine months it has saved 52,000 kwh of electricity. The carbide shop fulfilled its year plan at the end of September, producing 90 percent first-class products, as against the planned 80 percent." 70/

"The Yerevan chemical factory was built before the war. During the war, the factory was engaged in defense work; but after the war it began its own special production again. The factory has three main shops; a carbide shop, a plastic shop, and a glass goods shop ... . The plastic shop produces plastic consumer goods. In 1947, the factory produced over 400,000 articles of various sorts, mainly of a small size. In December 1947, the factory received new pressing molds for plastic goods from Moscow ... . The polyvinyl acetate works is an entirely new factory under the Ministry of the Chemical Industries of the USSR; it is still under construction ... . The factory is to produce plastic articles of polyvinyl acetate for the electrical

industry, mainly insulating equipment. Since the middle of 1947 the plastic shop has been in partial operation with a small number of specialized workers but so far produces only consumer goods." 71/

"Through their own innovations, workers at the Yerevan Carbide Plant are perfecting production, mechanizing labor processes, and increasing the productivity of machines ... . Without stopping the carbide furnaces, workers of the carbide shop did away with the vapor lock. This resulted in great savings. Much iron was saved by changing the design of electrode cases ... . Attachments were produced which give warning when elevator shafts become obstructed or when materials are defective; devices which insure safe operation of crushers also have been developed." 72/

"The Rubber Combine in Yerevan is employing the carbide process (which was taken over from the US DuPont Corp.) and has the largest carbide capacity (60,000 - 70,000 tons)." 73/

"The greatest carbide plant is at Yerevan, part of the "Kirov" synthetic rubber combine. Planned potential capacity 60,000 tons per annum, begun in 1936." 74/

"Synthetic rubber (on the basis of acetylene) planned capacity: 10,000 tons per year. In addition, the following installations belong to the Sovprene plant of the Yerevan combine: carbide plant (planned 50,000 tons); acetylene plant (planned 16,000 tons); chlorine plant (planned 10,000 tons); monovinylacetylene plant (12,000 tons)." 75/

"Carbide furnace shop. There were six carbide furnaces in this shop. But only four of these furnaces were always in operation, for the other two were always defect. The repair of these furnaces lasted four to six months ... . Each furnace had three

chambers ... . One ton of carbide was molten within one hour in one chamber; that means three tons in one furnace ... ." 76/

(Note: Considering four furnaces always in operation, this would amount to about 288 tons of carbide per 24 hours or to about 100,000 tons per year. Normal process interruptions, however, such as reloading furnaces, replacing electrodes, and so forth, would result in a production lower than the 100,000-ton figure calculated. Thus the annual production of 70,000 tons estimated for this plant seems reasonable.)

"Products: Carbide. Planned potential capacity 60,000 tons per year. 20,000 tons were produced the first year of operation (1936) in the first section of this plant. This carbide plant is part of the Kirov synthetic rubber plant." 77/

d. Plant Equipment.

"Carbide factory (6 carbide furnaces); 2 acetylene generators ... chlorine department with three furnaces ... ." 78/

"Carbide furnace shop. There were six carbide furnaces in this shop ... . Such a furnace was made of chamotte stones. It was six meters long, four meters wide, and three meters high. Behind these furnaces there were six chimneys which were made of bricks and which were 30 meters high piercing the roof of the building ... ." 79/

50X1

"The carbide department consisted of about 10 buildings, mostly iron concrete structures, a battery of 8 lime kilns with grinding mills, an installation of 6 carbide furnaces and of accessory carbide-crushers." 81/

e. Source of Raw Materials.

"Limestone from the quarries of Davalu at the Ararat railroad station." 82/

"Lime of good quality is received from the Ararat Lime Factory ... ." 83/

"Coke used to come from the Shcherbinskiy Coke and Chemical Works; but as it had an ash content of up to 22 percent, the carbide produced was of bad quality and did not satisfy requirements. Since November 1947, the factory has received coke with an ash content of not more than 11 percent from other works." 84/

50X1

"The power station with its two diesel engines can only be considered an emergency installation used during power breakdown periods. Its transformers serve to convert the current supplied by the Kanakir Power Plant." 86/

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. Detailed information regarding the distribution of carbide from this plant is not available. It is almost certain, however, that most of the carbide produced here is used within the combine for the generation of acetylene, which is used in the manufacture of Sovprene synthetic rubber and polyvinyl acetate plastic. Small amounts of acetylene are probably bottled for local welding purposes, and small amounts of carbide are probably shipped to other acetylene generating plants.

h. Comment. This is the largest of the Soviet calcium carbide producing plants and, as does the Kirovakan plant, receives considerable publicity in the Soviet press. It is believed that intensification of production in this plant has raised its annual output to about 70,000 tons of calcium carbide.

11. Chemical Plant No. 91.

a. Location. Beketovka, Stalingrad Oblast (Volga Economic Region).

"A new installation was under construction about 1,600 feet south of the main plant. It will be a hydrogenation plant for gasoline synthesis and a carbide plant. Operation had not started in February 1949." 87/

b. Estimated Production of Calcium Carbide. Not available.

c. Production Information.

"Products: Several types of poisonous gases; liquid gas resembling oil; chlorine; acetylene; hydrochloric acid." 88/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

50X1

g. Distribution of Calcium Carbide.

"May 1944 - The Yenakievo Metallurgical Works authorized to receive one carload of calcium carbide from the

Stalingrad Plant No. 91." 90/

(Note: This is probably the Beketovka plant.)

h. Comment. The existence of calcium carbide on the premises of this plant has been confirmed, the production of acetylene has been reported, and the construction of a calcium carbide plant also has been reported. Based on this information and the known production of lime, one of the necessary raw materials, production of calcium carbide at this plant is probable but not conclusive.

12. Calcium Carbide Plant.

a. Location. Kuybyshev, Kuybyshev Oblast (Volga Economic Region).

"Karbit Zavod, a carbide plant, 1 kilometer north of the Samara River and 500 meters southeast of the Aircraft Engine Plant ... ." 91/

"Carbide plant, south part of Bezmyanka, a suburb of Kuybyshev ... ." 92/

b. Estimated Production of Calcium Carbide. 5,000 tons per year.

c. Production Information.

" ... Production - carbide - 10,000 to 15,000 kilograms daily ... . Limestone rocks are burned to lime. Three-fourths of lime and one-fourth of coal and coke are melted in ovens with electrodes for 2 hours, and the finished carbide is then placed in barrels." 93/

" ... Production 200 tons carbide per day. Twenty-five freight cars of carbide shipped each week. Remainder of carbide used in Bezmyanka ... ." 94/

d. Plant Equipment.

"Carbide shop ... contains two ovens with three electrodes, 12,000 amps. each ... . Limestone shop ... contains one gas-operated oven for burning limestone." 95/

"Carbide department had three bow-shaped ovens, one German make, two Russian." 96/

e. Source of Raw Materials.

"Limestone arrives from a quarry in Krasnaya Glinka /Krasnyye Glinki/ (5318N-5012E). Thirty cubic meters are used daily ... . Coal and coke arrive in 3-4 RR cars (60 tons) per month ... . Electric power comes via underground cable from the Bezmyanka Power Plant. An underground gas pipeline leads from the power plant to this installation." 97/

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide.

"Carbide is shipped from here to destinations throughout Russia. Carbide is loaded onto RR cars immediately after it is filled into barrels, not stored in the plant area." 98/

"Twenty-five freight cars of carbide shipped each week. Remainder of carbide used in Bezmyanka." 99/

50X1

13. Chemical Combine No. 100.

a. Location. Aleksin, Tula Oblast (Central European USSR Economic Region).

b. Estimated Production of Calcium Carbide. Not available - probably small.

c. Production Information.

"Factory still in process of being constructed. Source observed manufacture of calcium carbide in one small factory building in area. Calcium carbide production was based on very primitive methods." 100/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. None.

14. Calcium Carbide Plant.

a. Location. Bryansk, Bryansk Oblast (Central European USSR Economic Region).

"Carbide plant - located south of the Desna River. Five kilometers southeast of the Krasnyy Oktyabr Locomotive Factory which is located on an island in the Desna River; 3 kilometers southeast of a cement plant." 101/

b. Estimated Production of Calcium Carbide. Not available -- probably small.

c. Production Information. None.

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. A calcium carbide plant of small capacity is believed to be installed here.

15. Kalinin Chemical Combine.

a. Location. Dzerzhinsk, Gor'kiy Oblast (Central European USSR Economic Region).

" ... Located in Chernorech'ye, at the Dzerzhinsk station, 13 kilometers west of Gorkiy (formerly Nizhni Novgorod) ... ." 102/

b. Estimated Production of Calcium Carbide. 20,000 tons per year.

c. Production Information.

"There is only one calcium cyanamide plant in the USSR. It belongs to the Kalinin Chemical Combine, located in Chernorech'ye, at the Dzerzhinsk station, 13 km west of Gorkiy (formerly Nizhni Novgorod). It possesses a capacity of 6,000 tons per year of nitrogen and was erected with the technical aid of the A.B. phosphate factory of Stockholm. It was put into operation in 1928. Furthermore, a calcium carbide factory, with a capacity of 20,000 tons, as well as an /carbon/ electrode factory, is included in the cyanamide factory. The /carbon/ electrode factory probably serves primarily in the self-sufficiency of the carbide factory." 103/

"The Kalinin (Dzerzhinsk) plant was producing at the time of my visit in 1930, nitric acid, ammonia nitrate, sulfuric acid, chlorine, calcium carbide and ammonia ... ." 104/

" ... Zavod Kalinin - the carbide was packed in rusty metal kegs, 50 kgs., about 1 - 1.2 meters high and about 1/2 meter in diameter. [redacted] 50X1

50X1

"In the shop between Chlorine Tsekh and Foundry probably carbide was produced." 107/

"Carbide production - This was a continuation of the process begun in point 17. (Limestone crushing.) The carbide stones being reduced in their sizes now, were brought over from point 17 to this production shop. The pulverized carbide was filled in tin cans which had two wing bolts as the stopper. A tin can was about 60 cms high and 50 cms in diameter. There was no lettering printed on. Source was very certain that this powder was carbide." 108/

d. Plant Equipment.

" ... Four furnaces - Capacity 20,000 tons yearly." 109/

" ... In 1930 ... four to six carbide furnaces ... ." 110/

" ... The lime burning shop contains three lime kilns in operation ... ." 111/

e. Source of Raw Materials. Limestone is brought to the plant by boat on the Oka River. 112/ The source of this limestone is not known.

" ... Power is furnished by "high line," probably by the TETZ plant several kilometers to the east." 113/

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. The capacity of the calcium cyanamide plant associated with this calcium carbide plant is reported as 17,000 tons yearly. 114/ To manufacture this quantity of calcium cyanamide would require about 16,200 tons of calcium carbide. The remaining calcium carbide (about 3,800 tons) is probably used for the generation of acetylene for the manufacture of vinyl resins and possibly other chemicals and for autogenous welding purposes.

h. Comment. The estimated production of this plant is based on prewar information. It is possible that this plant has been expanded since the original installation in order to meet the increased calcium carbide requirements of the chemical plants in this vicinity, which have expanded greatly since prewar times. No information is available, however, concerning expansion of calcium carbide capacity in this plant.

16. Calcium Carbide Plant.

a. Location. Lipetsk, Voronezh Oblast (Central European USSR Economic Region).

b. Estimated Production of Calcium Carbide. 35,000 tons per year.

c. Production Information.

"A carbide plant with a yearly capacity of 38,000 to 40,000 tons has been built in Lipetsk in Central Russia. The complete operation should have started at the end of 1939." 115/

The calcium carbide production of this plant in 1942 is reported to have been 36,000 tons per year. 116/

[redacted] the 1941 planned capacity of this plant was 20,000 tons of calcium carbide, that the 1942 planned capacity was 40,000 tons, and that this plant was evacuated. 117/ 50X1

d. Plant Equipment.

"The works operates with two furnaces; the equipment was made principally by the domestic machine construction industry. The plant is extensively mechanized ... ." 118/

[redacted] this plant contained 8 furnaces. 119/ 50X1

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. Production of calcium carbide at this plant is not conclusive. No postwar information is available, and it is somewhat doubtful that construction plans for this installation ever materialized. It has been included among the producing plants merely to avoid the dangers of omission and underestimation.

17. Stalin Chemical Combine.

a. Location. Stalinogorsk, Moscow Oblast (Central European USSR Economic Region).

b. Estimated Production of Calcium Carbide. 50,000 tons per year.

c. Production Information.

"Capacity planned for 1932 - 50,000 to 75,000 tons per year. Plant evacuated to Siberia but reported to have been returned." 120/

"Products: Dyes; sulfuric acid; chlorine compounds; calcium carbide; carbonic acid; aluminum compounds; methyl alcohol; aluminum; nitrogenous fertilizers; technical nitrogenous products." 121/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. No postwar information is available concerning this calcium carbide plant. The total lack of publicity in the postwar Soviet press suggests that this plant is perhaps of much smaller capacity than that reported as planned for 1932.

18. Synthetic Rubber Plant SK-2.

a. Location. Voronezh, Voronezh Oblast (Central European USSR Economic Region).

b. Estimated Production of Calcium Carbide. Not available.

c. Production Information.

"Immediately adjacent to Kirov plant a new plant is under construction for the manufacture of synthetic rubber. One part presumably produces Russian type synthetic rubber, while the other is said to be of the same type as that produced at Bunawerke, Schkopau." 122/

[redacted] old plant produced rubber by alcohol, while new plant would use calcium carbide. 123/ 50X1

"Old rubber plant produced rubber from alcohol. New plant is to produce rubber through use of carbide, which was to be more economical and easier to process." 124/

d. Plant Equipment.

"Buna Works, Dept. 15 ... 7 electric arc furnaces ... ." 125/

"Six large furnaces where carbide was burnt." 126/

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

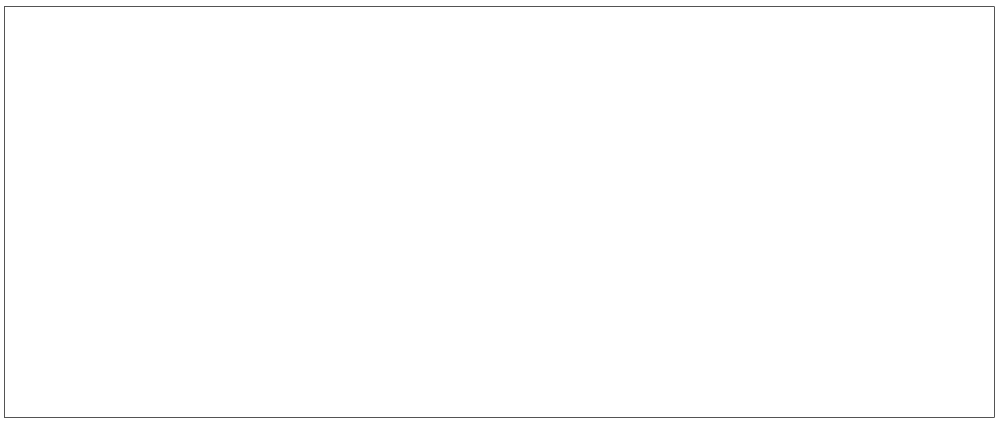
h. Comment. The information concerning the construction of a new synthetic rubber plant based on the calcium carbide process, combined with the information concerning the existence of electric arc furnaces in this plant are fairly good indicators of calcium carbide production. A quantitative production estimate cannot be made, however, until further information is received.

19. Voroshilov Chemical Combine.

a. Location. Berezniki, Molotov Oblast (Urals Economic Region).

b. Estimated Production of Calcium Carbide. Not available.

50X1



d. Plant Equipment. No information.

e. Source of Raw Materials. The sources of raw materials used by the entire Berezniki combine, without specific reference to calcium carbide production, are reported as follows: limestone from Vsevolodo-Vil'va 60 kilometers distant, coal from Kizel, and coke from Gubakha. 129/

With regard to electric power it is reported that "one power plant is located south of the nitrogen plant and uses coal dust as fuel. Built by Borsig, it operates by steam and produced 83,000 kw in 1936 and 105,000 kw in 1941. The other power plant is operated hydraulically (?) and is of most modern construction, consisting of six turbines ... . Branch stations receive their power from the main plant and from the Solikamsk-Gubakha net. Additional power is received from the plant at Solikamsk." 130/

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. Production of calcium carbide at this plant is not conclusive and is deduced from the meager information concerning production of calcium cyanamide. No estimate of calcium carbide output can be made until further information is received.

20. Calcium Carbide Plant:

a. Location. Karabash, Chelyabinsk Oblast (Urals Economic Region).

"The mining administration (in Karabash) maintains a small carbide factory located in a stone building 7 x 7 x 4 meters, northwest of the tsentralny shaft." 131/

b. Estimated Production of Calcium Carbide. Not available -- very small.

c. Production Information.

"Here, in a primitive furnace, by means of an electric arc, carbide is produced from limestone and coke. This factory operated only at intervals." 132/

d. Plant Equipment.

" ... primitive furnace ... ." 133/

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information, but probably for miners' lamps and other illumination purposes in the area.

h. Comment. None.

21. Kalata Chemical Combine.

a. Location. Kirovograd, Sverdlovsk Oblast (Urals Economic Region).

b. Estimated Production of Calcium Carbide. Not available.

c. Production Information.

"Kirovograd, Kalata chemical combine; affiliated installations; sulfuric acid factory; pyrite sulfur factory; fluorine factory; copper factory; calcium factory ... Products include calcium carbide." 134/

"The Soviet regime at one time set up an extensive expansion program for the calcium carbide industry. The production was to be increased to the point where it made possible the manufacture of large quantities of nitrogen of lime after the requirements for autogenous metal processing had been met. These plans then had to be abandoned. The amount of carbide manufactured did not reach the quantity required for acetylene production and consequently there was none available for the production of nitrogen of lime. So far as is known, only one of the few carbide plants is located in the Urals. This is in Kirovograd, in the Sverdlovsk province, and represents a section of the chemical combine located there. Production quantity is unknown." 135/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. Production of calcium carbide at this plant is not conclusive, [redacted] 50X1 50X1

22. Calcium Carbide Plant.

a. Location. Novosibirsk, Novosibirsk Oblast (West Siberia Economic Region).

b. Estimated Production of Calcium Carbide. Not available.

c. Production Information. According to a Soviet press report, the calcium carbide plant in the Ministry of Heavy Machine Building in the City of Novosibirsk, Novosibirsk Oblast, fulfilled the January 1949 Plan 124.1 percent. 136/

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. No other information is available concerning this plant, which is probably of small capacity.

23. Calcium Carbide Plant.

a. Location. Balkhash, Karaganda Oblast (Kazakh SSR Economic Region).

"Located approximately 7 miles east-southeast of the Balkhash RR station and 550 yards from Lake Balkhash." 137/

b. Estimated Production of Calcium Carbide. 7,500 tons per year.

c. Production Information.

[redacted] equal amounts of coal and soda (probably means lime) were placed in a brick oven which measured 2 and 3/4 yards square and fired. Two of these ovens were observed. The molten liquid from these ovens was allowed to harden in crude molds, which were about 50 cm deep and about 50 cm in diameter. About 100 hard, black solids were produced in these molds daily." 138/ 50X1

[redacted] 50X1

d. Plant Equipment.

"Two brick ovens each 2 and 3/4 yards square ... ." 140/

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. From the measurements of the molds given above, it is calculated that each of these molds contained about 480 pounds of calcium carbide. Using the production figure of 100 of these molds daily, the output of calcium carbide would amount to about 48,000 pounds, or 22 tons, per day. Based on 340 working days per year, the annual production of this plant would be about 7,500 tons.

24. Calcium Carbide Plant.

a. Location. Kantagi, South Kazakhstan Oblast (Kazakh SSR Economic Region).

"A carbide plant in one wooden building 80 feet by 65 feet with a galvanized iron roof is reported to be located about one-fourth mile west of the Kantagi RR station." 141/

b. Estimated Production of Calcium Carbide. Not available -- probably small.

c. Production Information. None.

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide.

"The plant processes local carbide ore into carbide which is placed in steel containers and taken to an unknown mine in Kantagi. Some carbide is also sent to Achisay." 142/

h. Comment. None.

25. Calcium Carbide Plant No. 727.

a. Location. Temir-Tau, Karaganda Oblast (Kazakh SSR Economic Region).

" ... Located 25 km northwest of the RR station at Karaganda." 143/

" ... Located in the southern outskirts of Temir-Tau." 144/

" ... Located approximately 220 yards southwest of the Temir-Tau RR station." 145/

b. Estimated Production of Calcium Carbide. 30,000 tons per year.

c. Production Information.

"Carbide plant consisting of two 600 foot by 65 foot brick building, was located 25 km NW of the RR station

at Karaganda. 60 tons of coke and 230 tons of lime were brought daily from Karaganda to this plant. Finished product was shipped at night to an unknown destination. Factory No. 727 which was under construction was believed to be a carbide plant. Carbide production probably about 100 tons per day." 146/

"Carbide is manufactured and the following methods are used: Limestone, which allegedly arrives from Karaganda is burned in furnaces. There are four or five furnaces, in one of two buildings, which make up the carbide plant. The burned mass is then poured into tilt cars, which transport it on tracks into the second building. There it is again poured into one large furnace. After this operation, the original limestone mass comes out in liquid form. It is poured into square forms and transported away in trucks to an unknown destination. The color of the final product is a dark gray ... . Three shift operation ... . A six day work week prevails with Sundays off." 147/

"Limestone, the principal raw material utilized in making carbide, was transported by rail from an unknown source and used at the rate of approximately 300 tons per day. The output of carbide was not known. The plant was equipped with six large brick ovens which together consumed approximately one ton of coke every 24 hours. According to hearsay, this coke was shipped in by rail from Karaganda. The carbide was packed in cans and shipped to an unknown destination on freight cars." 148/

(Note: 300 tons per day of limestone would yield about 160 tons per day of lime, which, in turn, would yield about 148 tons per day of carbide, which is believed to be too high an estimate for carbide production at this plant.)

" ... The resulting calcium carbide was removed from the furnaces, crushed with sledge hammers and placed in iron drums approximately 3 ft. in length and 25 inches in diameter for storage. The weight of a drum of calcium carbide and the production rate of the plant were not known. [redacted] the products of this plant were used in the Temir-Tau area and in Karaganda. Six 60-ton freight cars of limestone and three 60-ton freight cars of coke were brought to this plant every other day." 149/ 50X1

(Note: Based on the stated deliveries of limestone to this plant, the production of calcium carbide would amount to about 100 tons per day.)

d. Plant Equipment. The information concerning the number of calcium carbide furnaces installed in this plant is conflicting; [redacted] from two to five furnaces. 50X1
The number of lime kilns installed is uncertain, but [redacted] 50X1
[redacted] the existence of six furnaces which may be the lime kilns. 150/ The use of conveyor belts for intraplant materials transportation is reported. 151/ 50X1

e. Source of Raw Materials.

"Limestone for the plant was delivered by rail from a quarry approximately 25 miles northeast of Temir-Tau." 152/

"According to hearsay, coke was shipped in by rail from Karaganda." 153/

(Note: There is no coke plant installed at Karaganda, but the rail line to Temir-Tau probably passes through Karaganda. The Kemerovo and/or Chelyabinsk coke plants probably supply coke for the Temir-Tau plant.)

Electric power is probably supplied by a large steam power plant which is reported to be situated in the vicinity of the calcium carbide plant. 154/

f. Storage Facilities.

"These pieces (of carbide) were put into 200 to 220 pound cans which were stored in a wooden warehouse measuring approximately 165 feet by 65 feet. From this warehouse the cans of calcium carbide were loaded by Japanese PW onto 60-ton freight cars, 150 to 200 cans per car and shipped to an unknown destination." 155/

"The plant area also contained a few other buildings including ... numerous warehouses. These warehouses contained carbide products, machine parts, and a considerable amount of German-made synthetic rubber plant machinery." 156/

g. Distribution of Calcium Carbide.

"The finished carbide products were canned in 220 pound cans, 15 inches in diameter and 35 inches high, and shipped from the plant daily on 20- and 30-ton railroad freight cars. An average of two 30-ton freight cars per day were loaded. The actual production and the destination of the finished products was not known. [redacted] the carbide would be used as a raw material for synthetic rubber manufacture in the near future and that the present products were only of average grade." 157/ 50X1

[redacted] this plant was producing carbide to make synthetic rubber; however, during the period he worked here, carbide was being shipped by rail to Karaganda. [redacted] a large plant under construction immediately south of the carbide factory was to produce synthetic rubber when completed." 158/ 50X1 50X1 50X1

h. Comment. Prior to 1946 the town of Temir-Tau was known as Samarkand, and some of the earlier PW reports concerning this plant use the old town name. The consensus of a number of Japanese PW, who were employed at this plant, is that the production of calcium carbide during 1948 was

approximately 100 tons per day. There have been no substantiated reports of expansion of calcium carbide production at this plant, and it is estimated that 1952 production will be about 30,000 tons.

Before 1951 the entire production was shipped out to destinations and for purposes unknown. It is believed that the synthetic rubber plant, which was under construction at this location, was put into operation in 1951, and it is probable that, in 1952, at least half of the calcium carbide production of this plant will be used for the manufacture of synthetic rubber.

26. Calcium Carbide Plant.

a. Location. Chirchik, Tashkent Oblast, Uzbek SSR (Central Asia Economic Region).

b. Estimated Production of Calcium Carbide. Not available -- probably small.

c. Production Information.

[redacted] 50X1

[redacted] Factory was believed to be operated 24 hours a day ... . Rumors among the PW were that this was a carbide factory. 50X1

[redacted] 50X1

"During the period from December 1945 to May 1948, while commuting to work on a train, [redacted] a carbide manufacturing plant located approximately 2-1/2 miles west-southwest of the Chirchik Railroad Station." 160/ 50X1

d. Plant Equipment. No information.

e. Source of Raw Materials. No information.

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide. No information.

h. Comment. The scarcity of information concerning this plant precludes a production estimate. This very lack of information, combined with other information concerning the chemical industry of this locale, indicates that this is probably a small plant.

27. Calcium Carbide Plant.

a. Location. Ulan-Ude, Buryat-Mongol ASSR (East Siberia Economic Region).

> "A carbide plant ... is reported to be located within the compound of the locomotive factory situated 1-1/2 miles east of the Ulan-Ude RR station." 161/

b. Estimated Production of Calcium Carbide. 7,200 tons per year.

c. Production Information.

> "A single-track spur line extends to the plant from the RR station, and PW's believe that about 450 tons of coke and 900 tons of silicon (?) are unloaded monthly ... . An estimated 600 tons of carbide packed in steel cans 4 feet by 2 feet are produced monthly." 162/
>
> (Note: 450 tons of coke per month would produce about 720 tons of calcium carbide, if all the coke were used for calcium carbide production. Some coke, however, probably is used for manufacture of lime, and, therefore, the estimated calcium carbide production of 600 tons per month seems reasonable. Assuming that the silicon referred to is limestone, the production of calcium carbide from 900 tons per month would be about 445 tons. Assuming that the silicon is lime, the production of calcium carbide would be about 830 tons.)

"December 43: Authorized to ship 3 carloads of calcium carbide to the Irkutsk NKRF." 163/

"The (locomotive manufacturing) plant compound covered an area 1,980 yards by 440 yards enclosed by an 8 foot board fence and consisted of 25 brick buildings and 2 wooden buildings, including a new locomotive plant, an iron works, an automobile repair shop, a carbide processing plant ... ." 164/

d. Plant Equipment. No information.

e. Source of Raw Materials.

"Electric power was supplied underground from a thermoelectric power plant located directly south of the plant." 165/

f. Storage Facilities. No information.

g. Distribution of Calcium Carbide.

"Most of the carbide produced at the plant was allocated to local factories." 166/

h. Comment. None.

II. Plants on Which There Is Insufficient Information.

In addition to the foregoing plants, the majority of which undoubtedly produce calcium carbide, some evidence exists concerning calcium carbide production at the installations listed below. These plants are not considered as producers of calcium carbide, however, either because of insufficient information or for the particular reasons stated.

1. Calcium Carbide Plant.

a. Location. Kadiyevka, Stalino Oblast (Ukraine Economic Region).

b. Information. A calcium carbide plant was stated to be under construction here in September 1949. 167/ No

further information. This plant probably is intended to supply calcium carbide to a synthetic rubber plant reported to be under construction here.

2. Chemical Plant or Powder Factory No. 9.

a. Location. Shostka, Sumy Oblast (Ukraine Economic Region).

b. Information. [redacted] in 1930 the Shostka chemical plant produced calcium carbide. 168/ [redacted] Production of calcium carbide at this plant has not been confirmed.

50X1
50X1
50X1

3. Calcium Carbide Plant.

a. Location. Gergebel, Dagestan ASSR (Lower Don-North Caucasus Economic Region).

b. Information. A calcium carbide plant was stated to be under construction in 1937 at Gergebel in Dagestan; capacity to be 240 tons a year. 169/ This information is not confirmed.

4. Calcium Chemical Plant No. 102.

a. Location. Chapayevsk, Kuybyshev Oblast (Volga Economic Region).

[redacted]

50X1

5. Plastics Plant.

a. Location. Kushkovo, Moscow Oblast (Central European USSR Economic Region).

[redacted] 50X1

6. Nitrogenous Fertilizer Factory.

a. Location. Kemerovo, Kemerovo Oblast (West Siberia Economic Region).

b. Information. It has been reported that a chemical plant, located on the bank of the Tom' River and a short distance north of the RR station at Kemerovo, produced ebonite, calcium carbide, hydrochloric acid, sulfuric acid, and alcohol from coal. 173/ [redacted] 50X1
[redacted] 50X1
[redacted] On 50X1 the basis of the information available up to July 1952, production of calcium carbide at Kemerovo cannot be substantiated.

7. Plant Name Not Available.

a. Location. Petrovsk-Zabaykal'skiy, Chita Oblast (East Siberia Economic Region).

b. Information.

"A carbide plant consisting of one steel framed building was located 2.5 miles south of the RR station at Petrovsk ... . Steel containers were used to store the gas produced at the plant." 175/
"Plant which manufactured gas from coal was situated 2.5 miles east of the RR station at Petrovsk ... . Gas produced at this plant was

compressed into steel tanks 2 feet in diameter and 6 feet long." 176/

The possibility that calcium carbide is produced here is admitted. The available information indicates, however, that the plant referred to is more likely to be only an acetylene generator plant.

APPENDIX C

METHODOLOGY

I. Methods Used in Estimating Total USSR Production.

The methodology used in estimating the annual production of calcium carbide in the USSR from 1937 through 1940 consisted in accepting an apparently sound estimate of 60,000 tons for 1937 and in assuming that the 1941 planned goal of 145,200 tons was realistic. Starting with these two figures, production estimates for the intervening years were arrived at by interpolation. The production figure given for 1949 is an accepted estimate [redacted] 50X1 [redacted] The figure of 300,000 tons estimated for 1952 production 50X1 was derived from estimates of plant production and from estimates of Soviet requirements for calcium carbide, taking into consideration the net imports. The plant analyses indicate that 1952 production will be in excess of 300,000 tons, but the many gaps and uncertainties in these data suggest that considerable caution be exercised in using them. Soviet requirements for calcium carbide in 1952 are estimated broadly at 321,800 tons, about 35,000 tons of which will be supplied by imports, indicating that, in order to meet requirements, Soviet production in 1952 must be approximately 286,800 tons. Thus, considering both the plant information and the calculated requirements, it appears that Soviet production of calcium carbide in 1952 will be on the order of 300,000 tons. The production estimates for 1950 and 1951 were derived by interpolating between the estimates for 1949 and 1952.

II. Methods Used in Estimating Soviet Requirements.

1. Synthetic Rubber.

Production of Sovprene synthetic rubber in the USSR in 1952 is estimated at 30,000 tons. 177/ Using an estimated consumption coefficient of 3.3 tons of Soviet calcium carbide per ton of this type of rubber, the calcium carbide requirement in 1952 for the manufacture of Sovprene rubber is estimated at approximately 99,000 tons.

Soviet production of Buna rubber by the calcium carbide process in 1952 is estimated by CIA to be 5,000 tons. Using an estimated

consumption coefficient of 4.3 tons of calcium carbide per ton of Buna rubber, the Soviet calcium carbide requirement in 1952 for the manufacture of Buna rubber is estimated at about 21,500 tons.

The total Soviet calcium carbide requirement in 1952 for the manufacture of synthetic rubber, therefore, is calculated at 120,500 tons.

2. Chemicals and Plastics.

The reported Soviet requirements for calcium carbide in the Third Five Year Plan, as given in Table 12, state that the requirements for the manufacture of vinyl resins and synthetic acetic acid would amount to 10.7 and 7.6 percent, respectively, of the total calcium carbide requirements, presumably in 1942. It is assumed for the purpose of this calculation that the 1940 requirements were approximately the same, percentagewise, as those given for the Third Five Year Plan. Therefore, based on the estimated Soviet calcium carbide production of 120,000 tons in 1940, which is assumed to have been equal to the total requirements for that year, the calcium carbide requirements in 1940 for the manufacture of vinyl resins and synthetic acetic acid probably amounted to a total of about 21,900 tons.

An article in a 1946 Soviet periodical stated that, in 1950, production of plastics, other than phenolaldehyde types, would increase approximately four times over 1940 production. 178/ Assuming the achievement of this goal in 1952 for vinyl plastics and all other acetylene chemicals, Soviet calcium carbide requirements in 1952 for the manufacture of acetylene chemicals and plastics are estimated at about 87,600 tons, equivalent to about 26 percent of US 1950 calcium carbide requirements for these purposes. Obviously, the information upon which this estimate was based is inadequate, but the general level of Soviet industrial production indicates that calcium carbide requirements for these purposes probably are in the range from 50,000 to 100,000 tons.

3. Autogenous Welding.

There is no good basis for computing calcium carbide requirements for autogenous welding in the USSR. There is almost no Soviet information, and the available US data are not broken down adequately for analytic use.

The only Soviet figure on this use is a percentage figure given in the Third Five Year Plan (1938-42). An application of this

percentage figure is likely to lead to a serious overestimate of consumption because of the following reasons: (a) the extent of the impact on the requirements for calcium carbide, caused by increased Soviet utilization of electric welding since 1940, is not known; (b) the growth of the other uses for calcium carbide has caused the percentage figures from prewar years to diminish in reliability.

These Soviet data, however, do offer a possible method for estimating the calcium carbide requirements for autogenous welding. This method consists in using the data given in Table 12, in which the Soviet requirement for calcium carbide for autogenous welding in the Third Five Year Plan was reported as 49.2 percent of the total calcium carbide requirement. Presumably, this referred to the 1942 requirement. The planned goal for 1942 production was not published in the Third Five Year Plan, and the actual quantity of calcium carbide represented by this percentage figure is not known. The 1941 goal for production of calcium carbide was published, however, as 145,200 tons. Therefore, for the purpose of this calculation, it is assumed that the 1941 planned calcium carbide requirement for autogenous welding was approximately the same, percentagewise, as the 1942 planned requirement. Based on this assumption, the Russians apparently planned to use about 71,500 tons of calcium carbide in 1941 for autogenous welding. The planned Soviet steel production in 1941 was 22.4 million tons. Using this calcium carbide to steel ratio and an estimated 1952 steel production of 33.3 million tons, Soviet calcium carbide requirements for autogenous welding in 1952 may be calculated at about 107,000 tons.

Another possible estimate of Soviet consumption of calcium carbide for autogenous welding can be made by assuming that the consumption of calcium carbide for this purpose will vary directly with the steel production. Production of steel in the US in 1950 was about 87 million tons. In this same year in the US, approximately 206,000 tons of calcium carbide were consumed in autogenous welding. 179/ Using this calcium carbide to steel ratio and an estimated 1952 Soviet steel production of 33.3 million tons, Soviet consumption of calcium carbide in 1952 for autogenous welding may be calculated at about 78,000 tons.

The estimate based on US practices seems more accurate than the estimate based on the percentage figure from the Third Five Year Plan for the reasons cited above.

4. Calcium Cyanamide.

Two plants in the USSR are known to be producing calcium cyanamide: one at Kirovakan with a reported capacity of 10,000 tons per year and the other at Dzerzhinsk with a reported capacity of 17,000 tons per year. Production of calcium cyanamide also has been reported at Berezniki, but this is not confirmed. On the basis of the information available, calcium cyanamide production in the USSR in 1952 is estimated at about 27,000 tons. Published Soviet information states that "the practical yield of calcium cyanamide from carbide varies in the range from 83 to 85 percent of theoretical." 180/ Theoretically, 21,600 tons of calcium carbide would be required to produce 27,000 tons of calcium cyanamide. Therefore, 25,700 tons of calcium carbide are required for the production of 27,000 tons of calcium cyanamide in the USSR.

The methods used in arriving at estimates of input requirements and estimates of production of individual plants are fully explained in the text where the estimates are made.

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