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CALCIUM PRODUCTION AT BITTERFELD

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By *[Signature]*
For the U. S. Army Research and Development Administration

JUN 30 1948

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I. INTRODUCTION

In view of the ~~growing~~ interest which the Russians have shown in rehabilitating and expanding the production of calcium metal at Bitterfeld, and of the virtual certainty that this metal is intended for the reduction of uranium or thorium compounds to metal, it has been thought advisable to make a general review of the situation, the processes involved, and the production statistics up to 31st December 1947.

A previous report from this office ("Calcium Production at Bitterfeld" 27th May 1947) gave the early history of the subject and estimated the total production to 1st May 1947 as 160 tons. In this report it is intended to deal in more detail with the processes and materials used in the production of the metal. The production figures will be based more on definite information than on estimates of the rates of production only.

u.s. R. & D. Admin

II. RAW MATERIALS AND INITIAL PROCESSING

The primary raw materials used in the production of calcium are calcium carbonate, in the form of limestone, and hydrochloric acid. Both of these materials are normally available in adequate quantities, although it may be noted that there are several demands for hydrogen, which is used for making the acid. Shortage of hydrogen has resulted in a temporary slowing down of another stage in the process in which hydrogen is used.

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The limestone is quarried at various places, the chief of which are Ruebeland, Elbingerode and Ruedersdorf. From Ruebeland the material is shipped to Bitterfeld by rail via Halberstadt and Halle. At Bitterfeld a dump of limestone, located outside Building 169, is kept at approximately 2,000 tons. Typical analyses of the CaCO₃ are said to be as follows:-

	<u>Ruebeland</u>	<u>Elbingerode</u>
CaO	54.8	54.6
Loss in heating	43.2	43.5
SiO ₂	0.6	0.5
MgO	0.2	0.55
SO ₃	0.08	0.06
Al ₂ O ₃	0.3	trace

The hydrochloric acid is made in the plant by burning the chlorine in hydrogen and absorbing the gaseous HCl in water. The maximum capacity of this process is estimated at 65 tons daily of HCl of 20% strength.

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The limestone is converted into a 38% CaCl_2 liquor by solution in the acid and then dehydrated. Briefly the steps are as follows:-

- (a) Solution in HCl.
- (b) Filtration.
- (c) Neutralisation.
- (d) Dehydration to 90-95% CaCl_2 (Nubilosia).
- (e) Dehydration to 99-100% CaCl_2 (Kryptolofen).

The limestone is treated in 4 ton batches, in percolators containing about 2 cubic metres; the treatment being with a calcium chloride mother liquor to which concentrated HCl is added. The maximum capacity of this process is estimated at 30 tons per day of 100% CaCl_2 (80 tons of 38% lye) corresponding to a requirement of 30 tons daily of limestone and 65 tons daily of 20% HCl. The final lye, 38-40% CaCl_2 , is made approximately neutral by the addition of CaCO_3 , CaO or $\text{Ca}(\text{OH})_2$. Filtration is by means of conventional filter presses. Analysis of the lye is given as:-

CaCl_2	=	38%
MgO	=	0.55%
$\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$	=	0.3%

while analysis here of a sample gave the figures :-

CaCl_2	=	36.6 W/V
Mg	=	1.36 W/V.

Dehydration to 90-95% is carried out by feeding the 38% liquor into a Nubilosia plant which is essentially a hot air cyclone dryer, running at a temperature of around 250°C. The plant is made by Nubilosia, Meissen (Sa). A diagram of the plant yields the following figures:-

30 tons per day of 92% chlorine together with 1150 cubic metres per hour of hydrogen give a 36% HCl which with 30 tons per day of 98% CaCO_3 yield the 38% lye which is finally dehydrated to give 16.5 - 17 tons per day of 91-95% CaCl_2 . This finished material is in the form of a fine powder. Average figures for the analysis of this material in documents received are:-

Ca	=	35.46%
Cl_2	=	63.0%
CaO	=	0.35%
MgO	=	0.03%
SiO_2	=	0.05% (max.)
$\text{Fe}_2\text{O}_3 + \text{Al}_2\text{O}_3$	=	0.04%

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An analysis made here of a sample received gave:-

CaCl ₂	=	91.22%
H ₂ O	=	8.55%
B	=	0.55 ppm.
Fe, Mn, Mg, Cu	=	trace.

Final dehydration to 100% CaCl₂ is achieved by melting this material in an electrically heated crucible (the Kryptolofen), which is run at a temperature of approximately 1000°C. The maximum capacity of this process is said to be 13 tons daily of CaCl₂ of 99-99.5% strength. The melting point of the material is stated to be 850°C and its electrical resistivity is 1.78 ohms/cc at this temperature.

III. ELECTROLYSIS OF CALCIUM CHLORIDE

Two methods are used in the production of metallic calcium by the electrolysis of molten calcium chloride. They are the carrot process and the copper calcium process.

(a) The Carrot Process

This is the conventional process in which the cathode, an iron rod, possibly water cooled, dips into the electrolyte contained in a carbon crucible which acts as the anode. As the metal is deposited on the cathode, the latter is slowly raised so that the calcium builds up in the form of a rod or carrot. Considerable skill is required in the raising of the rod in order to maintain the reaction, and at the same time avoid picking up too much chloride in the metal. A small amount of KCl is added to facilitate the start-up of the bath. Electric power at 22 volts D.C. and between 800 and 1800 amps. is provided for the electrolysis. The power consumed per Kg of metal produced is stated in one place to be 36 Kwh and in another 55 Kwh. Approximately 10 tons of CaCl are required for a yield of 0.4 to 1 ton of calcium metal. Other figures are that 8 tons of melted CaCl₂, 550 Kgs of graphite electrodes and 80,000 Kwh are required to produce 1 ton of metal. Maximum capacity of the plant is around 1 ton metal per day. The process is however highly dependent on the atmospheric conditions of temperature and humidity; in the summer months the working of the plant is difficult. In addition a content of SiO₂ greater than 0.08% is said to be deleterious since it reduces the surface tension of the melt.

Purity of the calcium produced by this process in the first place was, on the average:-

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Ca	95	- 96%
Si	0.01	- 0.015
Fe	0.1	- 0.2
Al	0.1	- 0.15
Mg	0.02	
Mn	0.005	- 0.01
Cl ₂	0.8	- 1.5
N ₂	1.0	- 1.5

The initial Russian specification for the metal was met by this analysis except for the Cl and Fe contents, for which the Russians wanted 0.3 and 0.2 respectively. The Fe content in the material produced fluctuates considerably.

Attempts were therefore made to improve the metal by vacuum distillation. This raised the calcium content to the order of 99% and decreased the Fe content but had little material effect on the chlorine. Even a double distillation failed to effect any improvement. The distillation processes will be discussed in more detail later.

About November 1946 the Russians issued a new specification as follows:-

Ca	97 - 98% minimum
Si	0.01
Fe	0.005
Mn	0.0005
Ni	0.0005
N ₂	0.001
Cl ₂	0.03

The average analysis after double distillation was given as:-

Ca	99%
Mg	0.01
Si	0.01
Fe	0.001
Al	0.01
Mn	0.0005
Cu	0.0005
N ₂	0.001 - 0.002
Cl ₂	0.3 - 0.4
Si, B, Co, Ni,)	
As, Ag, Cd, Gd)	-

This shows that the required purity in respect of chlorine was completely unobtainable, and that consideration had been given to B, Cd, Gd, etc. which are of fundamental significance in the materials for an atomic pile.

The Germans therefore set out to improve their product and to this end developed the copper calcium method of electrolysis.

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(b) The Copper Calcium Process

In this process the calcium is deposited in a molten copper-calcium alloy in the bottom of the bath, which forms the cathode, the anodes being carbon blocks projecting into the top of the electrolyte, which is as before the molten, dehydrated CaCl_2 .

The baths are of cast iron, 220 cm long, 130 cm wide and 80 cm deep, the walls being 3.5 cm thick. Operation is at 7-11 volts and 13000 to 15000 amps.

A small amount of KCl of the order of 20% is again used in starting the bath.

Electrolysis is continued until the Cu.Ca alloy has the proportions of 40:60. A greater content of Ca lowers the density and allows the alloy to mix with the electrolyte.

The bath is tapped by pushing through the electrolyte a crucible which has a fusible plug of the same alloy. By this means the crucible is filled with alloy uncontaminated by CaCl_2 . Alloy is removed from the crucible by means of a ladle.

Free metallic calcium is obtained by vacuum distillation of this alloy. Distillation is continued until approximately half of the calcium in the alloy has been distilled off. The residue, a 40:30 Cu.Ca alloy, is then returned to the vats to act as cathode in further electrolysis. It is thus apparent that impurities will build up in a cathode; it is stated that the cathode material has to be replaced every three months on this account.

The requirements for this process are 3 tons of CaCl_2 to produce one ton of Ca metal, and between 15 and 30 Kwh per Kg. Maximum capacity of the installed plant is given as 1.5 tons Ca metal per day. This is however limited by the installed distillation plant which can only produce 0.5 tons per day from this alloy although it can handle 1.5 tons per day from the carrot process.

The melt in each bath is tested daily for CaCl_2 and KCl contents, while the alloy is tested twice a day for its Ca content.

The advantages of this method of electrolysis are:-

- (i) CaCl_2 requirement is some 50% less per ton of Ca
- (ii) Energy requirement is lower by an appreciable fraction
- (iii) Less man power needed
- (iv) Capital investment is less
- (v) Baths have a much larger capacity, of the order of 200 Kg

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(vi) Improved purity - particularly in respect of Cl_2

(vii) Insensitivity to atmospheric conditions.

The principal disadvantages are:-

- (i) Distillation is essential
- (ii) Distillation rate is reduced due to large Cu content of the charge.

IV. DISTILLATION PROCESS

Distillation is carried out in a vacuum furnace at a temperature between 900 and 1050°C. The furnace is a cylindrical structure, 2500 mm high and 1350 mm in diameter. It is electrically heated by means of three sets of spirally wound resistance wires, made of sicromal 12 (a high temperature alloy of Si, Cr, Fe, Al). The wires are mounted on the inner fire-clay walls. The retort within which distillation takes place is made of a nickel chromium steel (V2A) or welded sicromal and supported centrally inside the furnace. The collector is a water-cooled tube projecting centrally downwards into the retort. Both the furnace and the retort are separately evacuated. The furnace operates at a pressure of 0.6 mm Hg and the retort at 0.2 mm Hg. The three sets of windings are energised by voltages of 130-150 and currents between 40 and 140 amps. The voltages are so regulated that the temperatures are as follows:-

750 - 800°C in the upper set
 950 - 980°C in the middle set
 1060 - 1100°C in the lower set.

Pumps used in this plant are by the following makers:-

- (i) Dehne, Halle - 350 cb.m.p.h.
- (ii) Pfeiffer, Wetzlar - 300 cb.m.p.h.
- (iii) Siemens.

Much trouble is experienced with failures in the lower set of heating windings. It is said that difficulty is experienced in obtaining heater wire, for which, in addition to sicromal, one could use tungfram, megapyr or kanthal (Swedish), if they were available. The main sources for these are outside the Russian Zone. Failure of the retorts due to long periods at 1100°C is another source of trouble.

Maintenance of the pumps and vacuum seals is also a source of considerable trouble. The principal pumps are said to be those made by Pfeiffer, who are located in the U.S. Zone.

The charge per oven is of the order of 80-100 kg of Cu.Ca from which it is possible to distil off some 25-30 kg Ca, while from a charge of 25-30 kg of carrot

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process calcium it is possible to distil off approximately 85%.

With this type of still it is possible to distil 70-80 kg of carrot process Ca in 8-9 hrs, but only 30 kg is produced from the Cu.Ca alloy in the same time. In handling this latter material, considerable spluttering is experienced so that a grid has to be introduced to catch the splashes. This results in some lowering of the efficiency.

It is stated that the efficiency of distillation of carrot Ca is 80-85% which could possibly be increased to 90-92% by suitable modification while the corresponding figures for the Cu.Ca process are 75-80% and 85-90% respectively.

Reports have been received that consideration has been given to improving the efficiency by modifications to the retort and the condenser to allow a larger charge to be handled and a large distillate collected per cycle, but no indication has been received that these proposals have been adopted.

A source of delay in the distillation process is the period which has to be allowed for the retort to cool before it can be opened and the Ca billet removed.

The theoretical value of the power consumed in distillation is given as 1.4 Kwh/kg of Ca, but the figure obtained in practice is 12 Kwh/kg.

V. PRODUCTION STATISTICS

Up until 1945 production of electrolytic Ca was only on a small scale, with about 5-10 cells operating in the cold season of the year only.

After commencing dismantling the plant, the Russians reversed their decision and began to rehabilitate it. By August 1945 between 10 and 25 cells were operating in the North Works and producing 220 Kg crude calcium per day.

In the ^{Apr-July} spring of 1946 a further 96 carrot process cells were planned for the South Works of which some were to be used as reserves. The first of these worked by September 1946 and all are said to have been in commission by October 1946, although another report suggests that 10 of the furnaces did not come into commission until January 1947. The planned capacity was 750 Kg per day. Actually the plant was said to produce about 1000 Kg per day in winter and 200 per day in the summer of 1947 when only 40 baths were working due to the atmospheric conditions.

It was about October-November 1946 that the Russians made the purity specification more rigorous and forced the Germans to adopt distillation and the Cu.Ca process. As has been mentioned previously these baths were much larger.

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Approximately 14 baths were planned of which two were to be kept in reserve. The set-up was designed to produce 300 kg Ca per bath per day in the form of alloy, that is about 150 kg of free Ca metal. By the end of August 1947, only 4 of these vats were in operation, although the successful trials were made in April-May 1947.

In view of the success of the Cu.Ca process, it was reported that all production was being turned over to this method. However distillation is the principal bottleneck, and although the capacity of this plant is theoretically of the order of 500 kg Ca metal from Cu.Ca daily, production fell in September 1947 to between 100 and 300 kg daily. It has been stated that on account of this Moscow had ordered that crude calcium from the carrot process should again be made and sent. The reason for the fall in production was partly the lack of vacuum pumps, and partly the purity specification; the material, although now satisfactory in Cl₂ content (< 10%) had a nitrogen content greater than the desired figure. The reason for the increase in the nitrogen had not been elucidated; it was thought that it arose in the Cu.Ca electrolysis. The lack of vacuum pumps meant that several stills had to be connected to one pump so that failure of one pump caused stoppage of all stills. One report states that the erection of 28 stills was planned for an output of 2 tons per day, and begun in March 1947. All were said to be in operation by July 1947 although this appears unlikely in view of the slow rate of production of distilled Ca in the latter part of that year. They cannot have all been operating at the same time.

The following statistics have been compiled from various sources on the production of CaCl₂ and metal. The production of lye can be taken as starting in April 1946; the installed capacity being 500 tons per month of 100% CaCl₂, i.e. 1300 tons per month of 38% lye.

Actual production figures of lye are, giving the lye both in tons of 38% liquor and in tons of contained CaCl₂:-

Period	38% Liquor	CaCl ₂ (100% or 95%)
April 1946	?	?
May 1946	?	?
June 1946	145	55
July 1946	308	117
August 1946	436	166
September 1946	721	274
October 1946	?	?
November 1946	?	?
December 1946	?	?
January 1947	?	?
February 1947	?	?
March 1947	?	?
April 1947	?	?

2750 tons

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May 1947	716	272
June 1947	714	271
July 1947	663	252
August 1947	750	285
September 1947	858	326
October 1947	920(?)	350(?)
November 1947	806	307
December 1947	1100	440
<u>Total</u>	9277 tons	2603 tons

Of the total lye production a considerable proportion is used for other purposes. A figure quoted for this is 500 tons per month of lye; a definite shipment of 580 tons was made in early November, while another of 225 tons lye later on in November, and 68 tons in December. The rate of production increased at the beginning of December to 45 tons lye per day. It is said to have stopped entirely about 27th December, but to be going again on 8th January 1948 at the same rate (45 tons per day).

The production of metal in the three plants is as follows, in tons:-

	<u>South Works</u>	<u>North Works</u>	<u>Dist^d</u>	<u>Cu.Ca</u>	<u>Dist^d from Cu.Ca</u>
April to Aug. '46	-	20	-	-	-
Sept. to Dec. '46	66.5	20	-	-	-
Jan. to Sept. '47	156.5	40	57	(42)+	19
October '47	20	7	-	(26)+	13
November '47 (Estimated)	20	7	-	(28)+	14
December '47 (Estimated)	20	7	-	(18)+	9
<u>Total</u>	283	101	57	-	55

+ Actual content of Ca in 40:60 Cu.Ca.

Hence total Ca metal (undistilled) = 337 tons
and total Ca metal (distilled) = 112 tons.

These figures are thought to be highly reliable being based on several reports which are in essential agreement both in quantities produced and in rates of production. It will be seen that the production figures are in good agreement with the earlier and more tentative estimate made by this office. It will be noticed also that distillation is now undertaken only for the material from the Cu.Ca process and that some 112 tons of distilled calcium has been produced. Only this material is considered to be useful for the production of uranium.

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VI. DESTINATION OF THE MATERIAL

Reports on this subject have been varied. Some say that the material is being flown to Russia, others that it is going by rail.

A Russian order dated 2nd January 1947 from the U.S.S.R. Abteilung fuer Reparationen und Lieferungen der S.M.A. in Deutschland to the Minister Praesident der Provinz Sachsen/Halle demands 75 tons of Ca metal to be consigned to W/O Rasnoimport. The specification of this material is interesting, since this is almost the time when the Cu.Ca process was first being considered; it is as written:-

Ca \downarrow 95%

The following not to exceed:

*Total Fe, Al, Si and Mg	0.4000%
P	0.0100%
N ₂	0.0300%
Cl ₂	0.3000%
Mn	0.0100%
As	0.0200%
Ni	0.0200%
Co	0.0040%
Ag	0.0020%
Li	0.0000%
Cd	0.0000%
B	0.0000%
Rare minerals	0.0000%

(Note the contents of B, Cd, Li, Ag and Co and other rare minerals will be determined by spectrum analysis) (Sic) A full report of this method of analysis has been received.

This material had to be packed in hermetically sealed boxes.

This specification should put the intended use of this material beyond any shadow of a doubt.

Another report says that the material was packed in bags and then in boxes filled with CaF₂ or CaO and consigned to:-

Elektrostalwerk Moskau,
Eisenbahn Bezirk Kursk,
Postfach 3.

The shipments are sometimes in the form of pellets or coarse granules and sometimes in the form of the original billets. Experiments have been carried out to determine an efficient method of breaking up the billets into the small granules normally used in a uranium reduction process. So far no satisfactory method has been developed. This is referred to as the "shaving" process.

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VII. POSSIBLE CALCIUM PLANT IN RUSSIA

Much of the data in this report has been obtained from plans drawn up by the Germans for a plant similar to that at Bitterfeld but to be located in Russia. The intended location is not known, but among the places mentioned are Kiev, Dzerzhinsk and Samarov. Two German technicians, Drs. Springmann and Krassel, capable of supervising the erection of such a plant have written letters from Dzerzhinsk which is located on the river Oka between Moscow and Gorki, which weights the evidence in favour of that locality.

It would however take a considerable time to put such a plant into operation.

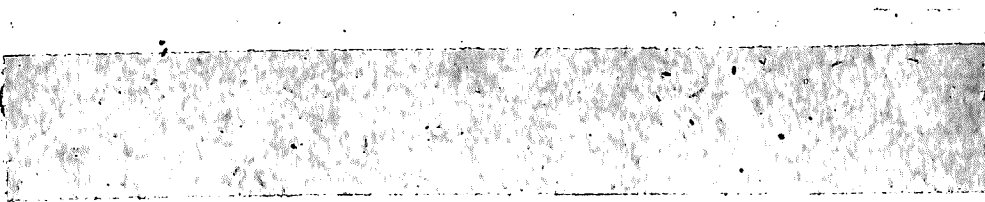
The section of the scheme which deals with the making of CaCl_2 is known as Research Project No. 132.

VIII. SUMMARY AND CONCLUSIONS

An attempt has been made to review the processes used for the production of calcium metal at Bitterfeld on behalf of the Russians.

It is concluded on the basis of the analytical specifications presented by the Russians to the German Directorate of the plant, that the calcium is intended for an atomic energy project beyond any shadow of a doubt. The best evidence available indicates that from April 1946 to December 31st 1947, 337 tons of undistilled calcium were made and 112 tons of distilled calcium, of which approximately half came from the Cu.Ca process and would have therefore a reasonably satisfactory purity.

In Appendix I to this report there is given a note on the organisation at Bitterfeld and the personnel concerned with the process at some time in the last 20 months. Appendix II contains some comments and deductions which can be made on the data presented in this report.

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APPENDIX 1

ORGANISATION & PERSONNEL

The former I.G. Farben Industrie at Bitterfeld has been recently renamed; Abteilung der Sowjetischen Staatlichen Aktien Gesellschaft, "Kaustic" in Deutschland, previously called the Electrochemische Kombinat.

The factory has a Russian Directorate and a German Directorate. Instructions are issued by the Russians which the German Directorate are responsible for carrying out. Only the German Directorate deals with the German staff. Under the German Directorate is the German Management which is composed of German engineers and chemists. Each German specialist, however, is surrounded by at least 2 or 3 Russian engineers who keep him under close surveillance and at the same time try to pick up as much technical knowledge as possible.

RUSSIAN DIRECTORATE

Dr. (Col?) V.V. BELAJEFF Director General of Kombinat Bitterfeld until late July. He replaced a Col. Margolin (phonetic). BELAJEFF is a chemist by profession and well versed in chemical matters. He is about 50 years old. He returned to Russia in August 1947 and has not been replaced.

Major JOFFE Second in command to Dr. Belajeff takes a very close interest in the calcium production and in all development work at Bitterfeld.

Lt. Col. PROZENKO Officer in charge of loading the finished material.

L.A. ACHNASAROV Deputy to Belajeff at one time and chief engineer of the plant.

G.M. POLORZEFF Deputy of Managing Director.

S.P. STAROSTIN Head of Technical Production Department.

V.S. KOROLIOV A Chief Engineer of Technical Production Department.

D.A. LOGINOV A Chief Engineer of Technical Production Department.

K.M. TSCHERNOV A Chief Engineer of Technical Production Department.

L.I. MARKOV Head of Planning Department.

V.T. IVANOV Head of Power Plant.

D.M. MUCHIN Chief Engineer of Power Plant and responsible for power supply to whole plant.

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GERMAN DIRECTORATE

Dr. Ing. Adolf BECK Director General (German) of Kombinat Bitterfeld. He was a leading I.G. Farben director for many years. He is not a scientist, but a self made technician with highly developed skill in solution of technical problems. Regarded as a political chameleon and presently very pro-Russian and is treated very well by the Russians. He has re-established his former wealth and advises members of his staff to go to Russia when they receive offers and has indicated his own readiness to go. He is a member of SED and a protagonist of all matters Russian.

Dr. HORNCKE Second in command to Dr. Beck and head of the Works in all chemical matters. He is also the head of the South Works. He is pro-Russian.

Dr. SELIGER Head of the distilling section in the South Works. Developed 'Shaving' process and also the distillation process for the purification of calcium. He was trained at Freiburg University, is a chemist and is politically neutral. Later, stated that he has been made head of the electrolytic section also.

Dr. SCHAUFLE Deputy to Dr. Seliger in the distilling section of the South Works. Left the works in October to take an appointment with some Württemberg chemical firm. Now in Stuttgart.

Dr. JAENCKNER Head of the electrolytic sections in the South Works.

Dr. FORST Deputy to Dr. Jaenckner in the electrolytic section of the South Works. He is a chemist and originally from Mainz. He was a Nazi but is now a political convert. Responsible for calcium production.

Dip. Ing. WINKLER Head of the calcium electrolysis section in the North Works.

Dr. HEYMANN Deputy to Dr. Winkler in calcium electrolysis section in the North Works. Is head of the copper-calcium electrolysis section in the North Works.

Director ROCKE Head of the engineering department of Bitterfeld. Directly concerned with installation of the new calcium section in the South Works. Installation started in January 1947.

Director MAINZER Head of the electro-technical department and associated with Röcke on installation of calcium section in South Works.

Dr. SCHILLER Chemist and engineer specialist for the erection and operation of equipment. Ex-Nazi party member. Lived many years in Manchester.

Engr. SEDLACEK Head of the copper-calcium electrolysis section in the South Works. He is a Sudeten German and was with the Skoda Works, Plzen, Czechoslovakia, during the war.

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Engr. EHRLICH Expert on development of distillation equipment for the purification of calcium. Reported to have left Russian Zone and returned to Hannover.

K.E. MANN Former director of Light Metal Foundry at Bitterfeld.

Dr. NACHTIGALL A chemist formerly at the Bitterfeld works and involved in the production and testing of the calcium. Now at Metallwerk, Plansee, Reutte.

Dr. SPRINGEMANN or SPRINGMANN A technician formerly at Bitterfeld, and part author of a report on the production of CaCl_2 from limestone. Now believed to be at Dzerzhinsk, nr. Gor'ki.

Dr. KRASSEL Technician formerly at Bitterfeld and now believed to be at Dzerzhinsk.

Dr. WEIDENDORF A phosphorus expert at Bitterfeld, and anxious to escape to the Western Zone.

Dr. HEYDER Technician at Bitterfeld and part author of the report on CaCl_2 production.

Dr. VORLANDER Technician at Bitterfeld and author of a report on an underwater burner used in the process for concentration of CaCl_2 liquor.

ZIEGLER German responsible for administration and sales of light metals.

Dr. SCHICHEL Chemist now believed to be in charge of the analytical section.

HOLLUM Analyst previously under Nachtigall and now under Schichtel.

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It is not clear to us why the specification insisted on low chlorine content, other than a tentative suggestion that the presence of chlorine would interfere with the keeping properties of the metal in storage. Chlorine does not affect the conversion process.

2. Low Nitrogen Content.

The increased rigors of the Russian specification for nitrogen content may have been due to a lucky guess on their part, or a knowledge of other countries' work, or fairly advanced experiment: we can form no judgement between these possibilities.

In the British process, at least, the presence of nitrogen interferes seriously with the uranium reaction, and nitrogen must be kept low. The reason for the comparatively high nitrogen content in the Bitterfeld distillation is thought to be that the oven is opened to the air at 800°C, at which temperature nitrogen reacts with the calcium both in the koenig and in the bath. That in the koenig is only a surface reaction and does not matter very much, but that in the bath is cumulative, and passes over in distillation, so that the whole koenig has an over-high content, and becomes progressively worse as the process is speeded up in an attempt to increase production.

Another source of trouble in the German distillation process, incidentally, is that, the flow of coolant inside the condensing rod is insufficient to lower the surface temperature of the koenig, while it is being formed, below 450°C. At this temperature the alpha form of Ca is produced, while at a lower temperature gamma-Ca is formed. Gamma-Ca is friable and is therefore easy to break into pellets as required in the U-crucible, while the alpha form is malleable and must be shaved or cut, resulting in a loss of several per cent.

3. Elements of High Capture Cross-section.

The significance of the zero figures in the Jan'47 specification quoted for Li, B, Cd and TR is obvious: but it is less obvious that the other allowed values are in proportion to their capture cross-section.

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