

# GERMAN ALKALINE ACCUMULATOR INDUSTRY

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BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE

GERMAN ALKALINE ACCUMULATOR INDUSTRY

Investigator - H. B. Lunn

Reparations Assessment Team No. 105

BIOS Target Nos:

C31/737	C22/1430	C22/1236
C31/104	C22/3595	C31/1255
C22/517	C31/3340	C31/825
	C22/4429	

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Alkaline Accumulator Section

Title of Target - Accumulators - Fabrik A.G. Werk Hagen.

Date of Investigation: 10/17th January, 1946, by H. E. Lunn.

Condition of Target: 50% operable.

Departments damaged - All Active Material manufacture, except cadmium negative by chemical precipitation.

Personnel seen: Herr Bischof (Director)  
" Katz (Works Manager - Battery Assembly)  
" Wisser " " Active Material)  
Prof. Baras (Chief Chemist)  
Herr Hugsphil (Works Manager - Letmathe)

Commercial. Herr Bischof gave the following particulars on the output of the Hagen alkaline battery plant:

In 1931, batteries equivalent to 5,000,000 ampere hours were sold. This output gradually increased until in 1938 14,000,000 ampere hours were sold, of which 90% were of the tubular type destined for Russia for mine traction use. This was exceptional; tubular only usually accounting for 30 to 40% of the total turnover. Their export business was said to be 10% of the total produced. During the War the turnover was 26,000,000 amp. hours annually and this was very largely of the flat plate type and not tubular.

Raw Materials. Ample supplies of the metals nickel cadmium iron and copper appear to have been available throughout the War. Battery production had just been restarted with active material made prior to the damage to the active material plant in 1943/1944. A separate factory known as No. 6 factory was discovered situated some 300 yards along the Wuppertal road from the main factory where a nickel and copper recovery process had been carried out. The nickel and a certain amount of the copper recovered were used in alkaline battery manufacture. The remainder of the copper produced was sold.

Active Material: They had used the Edison type process for the manufacture of nickel hydrate for tubular cells and although changes from this method had been tried, they had reverted to the original instructions given by Edison when the plant was installed originally.

Nickel hydrate for the flat plate type which formerly was made exactly like the tubular hydrate was now a separate process using in addition Madagascar graphite as conducting medium. This had been found to be superior to Bavarian graphite even after the latter had been treated at

5000 with dilute sulphuric acid to remove aluminium oxide. They had also tried fusing with caustic potash to remove impurities.

Iron Masse for the negative plate was now no longer used. The plant had been dismantled and the separate units were found in a blitzed Tramway Depot in the town. The individual items were in a bad condition, the whole having been scrapped. It was understood that A.S.A. did not intend to make iron masse in future.

So far as could be discovered by interrogation the process was in accordance with Edison patents which have now expired and are well known.

Cadmium Iron Masse had been made by both the electrolytic process and the precipitation process. The electrolytic plant had been completely destroyed but the process appears to have been in accordance with the patents (now expired) taken out by Estelle of Sweden.

The precipitation plant was still in working order, although the process contained nothing novel, involving the precipitation of cadmium hydroxide, followed by washing, drying and igniting to cadmium oxide when it was mixed with finely divided iron scale. This was the original cadmium negative process and it was the forerunner of the electrolytic process.

A third cadmium negative material known as No.7 Masse had been developed incorporating nickel in place of the usual iron addition, the idea being to reduce still further the very slight loss on open circuit which occurs with the ordinary cadmium iron negative. The use of this No.7 material was said to give a cell which could be stoppered down immediately after charge but the material was alleged to be inferior as regards cell life so that it was not proposed to adopt it generally.

Nickel Flake of 0.001 mm thickness for the Edison type tube had been made by the Edison process until 1944 when the plant was completely destroyed. This process was based on the electro chemical deposition of alternate layers of nickel and copper onto rotating drums, 200 layers of each were deposited using an automatic plating plant, after which the composite sheet was stripped off, cut into 1/16" squares and the copper extracted by either a copper chloride and copper sulphate mixture or alternatively an ammoniacal copper sulphate solution.

No. 6 Factory. This was a subsidiary factory devoted to metal and chemical recovery processes.

- Products:
1. Copper powder for (a) sintered plates  
(b) resale
  2. Nickel Sulphate
  3. Nickel carbonate
  4. Zinc oxide
  5. Manganese salts
  6. Cadmium hydroxide
  7. Nickel hydroxide
- ) by products from the  
) nickel copper scrap used.  
) recovery from  
) sintered plate scrap.

The nickel copper scrap included German silver, foreign coinage etc., which was melted down in a smelting furnace and cast into anodes approximately 3' x 8" x 1½". The anodes then contained roughly 80 parts copper to 20 parts nickel together with zinc, iron and manganese. These were electrolysed in sulphuric acid to give a silty copper deposit, the nickel remaining in the electrolyte. When electrolysis was finished, indicated by a rise in cell voltage, the deposit was pumped from the vat by means of a portable pump, washed with water, dried in a centrifuge to 8% water content, then reduced at 400°C in a muffle with town gas to reduce the copper oxide present. The muffle was allowed to cool outside the furnace and had to be absolutely cold before opening. Gas was passed throughout the cooling period. The copper powder was sieved through a 0.5 mm sieve and then sealed down.

The electrolyte contained largely nickel sulphate and was treated to remove the impurities, viz., copper, iron, manganese and zinc. This part of the plant had been destroyed and there was no first hand evidence of how the purification was carried out. After purification the nickel sulphate was either used in active material manufacture or precipitated as carbonate for transfer to other plants elsewhere.

Letmathe Factory. This was a factory taken over during the War to which the active material plant and battery assembly plant had been evacuated from Hagen during the War. The process notes have been given above.

There was also a considerable amount of sintered plate plant in store here which it was proposed to erect after the R.A.F. had returned certain sheds to the occupiers.

None of the plant was in production but it was hoped that this would commence in the near future.

#### Mechanical Section - Battery Assembly etc.

##### Steel Ribbon Perforation and Plating

Both ribbon for pocket cells and for tubular was roller perforated and this was completed in one machine. The sequence of operations being -

- (1) perforating.
- (2) grinding off the punched out edges using a soda spray.
- (3) re-perforating in the opposite direction to (1)
- (4) washing twice to free from soda.
- (5) drying electrically.
- (6) wire brushed 3 times to clear the perforations.  
(This only applied to tubular ribbon).

Labour required - 1 man per 5 machines.

Ribbon Plating. The ribbon after perforating was nickel plated for

positive plates in a standard Edison type plating machine. The only innovation was the addition of a trichloroethylene degreaser prior to the electrolytic caustic potash bath to improve the cleaning before plating. The rods immersed in the nickel plating bath were made of VHMDCR (polystyrene) said to be better than obsnits since it was more rigid at the bath temperature (50°C).

Annealing of the ribbon and small parts was being carried out in two Junkers electric ovens each of which had 3 Nichrome muffles 7' Long x 24" wide x 12" high (value 3000 RMs each). This equipment had been used before the blitz purely for sintered plate experimental work and had cost 55,000 RMs.

Formerly a continuous annealer had been used and a new A.E.G. continuous furnace with nichrome belt was on the premises but had not been installed.

#### Briquetting and Loose Powder Filling

For plates of medium thickness, briquetting had been discontinued and loose powder filling adopted.

The bottom ribbon (24 mm) was channelled in the usual manner and then passed through a hopper containing the active material. The amount of material carried through was controlled by a single adjustable slide on the outlet side of the hopper. The powder was then compressed somewhat by a wheel riding above it and then a further addition of powder was made by a second hopper exactly like the first. 21 mm ribbon was closed over the ribbon and the whole passed through the usual seaming rolls.

Both hoppers were jerked backwards and forwards by a lever and spring mechanism actuated from a cam working in series with the seaming rolls.

It was noted that the negative line hoppers only were fitted with rotating stirrers in addition to the above motion to regulate the powder feed.

Briquetting Tools. They had a standard die clearance for all materials. The top of the die was 0.15 mm clear of the punch tapering to 0.1 mm where the briquette was formed. It was alleged that there were greater variations in briquetting properties from one batch of the same material to the next than between different materials. The controlling factor was the humidity of the masse - the more moist it was the narrower the clearance.

The die inserts were made of work hardening steel and lasted as follows:-

Cadmium iron masse - 3 weeks at 16 hours per day.  
" nickel " - 4 " " " " " " "

The strips were seamed together as usual and the plate pieces cut off on an automatic guillotine at 60 - 80 cuts per minute, the pieces being

collected on a table which was controlled by a ratchet, falling with each stroke of the guillotine.

The plate pieces were rolled into the side beading using a pre-war method.

The collecting rolls used applied the full pressure required to give the finished plate thickness and plate pressing as a separate press operation was not done.

Plate inspection was carried out - usually for burst pockets alongside the beading, although these were seldom found.

Plate Scrap. A very large stock of this had been built up before and during the War, but it had never been recovered for re-use. It was finally lost in an Air-Raid.

Small Cells. No cells of 1 Ah. or under had been made during the War. (N.B. a 1 Ah. sintered plate cell was made for the V2.)

Period of Storage empty and discharged. They had limited experience of this but they had stored sealed cells up to 6 months, in Roumania.

Hermetically Sealed Cells. Had tried to produce these with a platinum or palladium auxiliary electrode but had failed.

Tubular. A certain economy in tube filling labour had been effected by the following method:

9 tube filling machines were fed with jigs by a canvas conveyor. Each jig found its own filling machine by a lever and peg mechanism. All the jigs were fed to the 9 machines by one man who also returned filled jigs to an unloading bay by a return conveyor. The loading and unloading bay was equipped with a mechanical opening key, a jig brushing machine and a mechanical plunging machine. The latter included eight revolving plungers operating beneath the platform of a small press worked by compressed air. The jigs were closed by hand. This arrangement required a total of 3 men to operate it.

Tube Capacity. 104 mm tube should give 1.60 - 1.80 amp. hours at 55°C at the 5 hour rate.

Tube Separation. The "knob" separator rod had been discontinued because it was difficult to make and involved cutting away a large % of donite to give the "knob".

#### Miscellaneous

Seam Welding - had not been successful. They had better results either with a wheel with a "step" motion or alternatively an intermittent



current on a steady rotating wheel. This had only been used on the tops of the plates - to weld the pockets to the lugs.

Labels. A very good adhesive label was being used consisting of paper impregnated with MIPOLAM (P.V.C.) The adhesive was applied both to the back and the front of the label and was composed of "after" chlorinated P.V.C. dissolved in methylene chloride.

Paper labels impregnated with Igelit (P.V.C. were also claimed to be both acid and alkali resisting.

Plastic Cases. They had used Troclitul (polystyrene) particularly with sintered plates.

Small torpedo cells were made of IGALID (ex I.G.) - a polyamide - said to be both potash and acid resisting although it was alleged to absorb up to 11% water without impairing its electrical characteristics. It was preferred to Troclitul since it was fireproof. The Igalid cells had the terminals cast into the lid when the latter was injection moulded. This material was difficult to mould since it changed rapidly from the solid to the liquid form. Two moulding operations were required for twin cells - a hole had to be left for injection which was subsequently filled by a second injection.

Mercury Unspillable Vent. This was composed of 2 polystyrene porous discs enclosing a few ccms of mercury. Above this was an ordinary baffle plate trap to catch the few drops of electrolyte which would run through when the cell was turned over and before the mercury settled down. This had been discontinued as a failure because (a) the mercury finally ran through the bottom disc and attacked the plates and (b) the top disc gradually "carbonated" causing a dangerous pressure to be generated inside the cell. A modification comprising one disc only was now being used. This was packed with glass wool above the disc. It was not unspillable immediately after charge.

An unspillable vent similar to the Davis vent and known as the Kammerhoff ventel was used in Germany.

Glands. To avoid the burning of the bottom gland piece (usually ebonite) when welding in the lid, a special heat resisting porcelain bottom gland was used known as CALMIT (masur). This was used on cells up to about 50 a.h. and was not considered necessary on the larger types. This material was also used for solid stoppers.

Cell Insulation. Perforated sheet was used in miners lamp cells, porosity 60%. The material appeared to be a form of P.V.C. (up to 51% Cl).

The wrapping round the groups in miners cells was a yellow form of P.V.C. (Igelit) and was very tough - much more resistant to fracture than ebonite sheet.

Gottfried Hagen - Cologne

Officials seen Herr Osterspey  
Herr Schucht

Both flat plate and tubular cells were made on a comparatively small scale. The whole of the alkaline plant, except one repair shop, was destroyed.

Business done in the alkaline section -

1931	20,000	RMS.
1932	54,000	"
1933	173,000	"
1934	200,000	"
1935	200,000	"
1936	440,000	"
1937	600,000	"
1938	331,000	"
1939	650,000	"
1940	840,000	"
1941	823,000	"
1942	1035,000	"
1943	808,000	"

Green nickel hydrate and cadmium negative masse were formerly made on the premises by a Dr. Kieselbach who it was alleged was no longer in the employ of the Co.

Instructions as to the methods of manufacture were not available but they were endeavouring to obtain them from Kieselbach.

Cadmium negative was alleged to have been made electrolytically (the remaining anodes were produced as proof) with a caustic soda electrolyte.

The only interesting item of plant shown was one tube filling machine of much more robust construction than Edison Original, made by Hagelucken & Dietzel, Hagen - Haspa.

January 21/26, 1946.

Target:

A.F.A. Hanover - Stocken. Alkaline Section.

Personnel seen: Herr Quandt - Director.  
Herr Desenius - Alkal. Section Manager.

Durac process (Sintered plates). Hanover had only made Sintered plate batteries during the War.

Durac Plates are constructed to a new design which has not been applied commercially to alkaline cells in this country.

The I.G. Farben and A.F.A. in Germany have patented the plate design which is namely that, instead of the usual steel pocket or steel tube construction the plates consist of a thin block of highly porous metal impregnated with active material. The plate has a thin wire centre mesh enclosed by a suitable light steel frame. The positives are made from a porous nickel block impregnated with nickel hydroxide and the negatives of a porous copper/nickel block impregnated with cadmium hydroxide.

Separators. The method employed to separate the plates was to wrap round the negatives several turns of a strand of PVC. This replaces the usual alkaline separation which is either ebonite rod or perforated sheet.

Manufacture. The basis of this new construction is the metal powders for the sintered base.

(a) Nickel powder supplied by I.G. Farben, Oppau.

Price throughout the War - 2 RM/45 Pfg + 40 Pfg  
surcharge per Kilo.

Nickel powder purchases by A.F.A. from I.G. throughout the War -

Periods of 6 months	Kilos.
1942 first	less than 980
second	" " 8,800
1943 first	26,000
second	23,453
1944 first	30,000
second	less than 30,000 (papers lost by Air Raid)

Maximum consumption in any one month was 4000 Kilos representing an approximate battery production of 500,000 amp. hours.

Copper Powder. Made at Hagen by A.F.A. in a copper nickel recovery plant where copper nickel scrap was treated by an electrolytic process from German Silver, etc.

Price 1<sup>16</sup> RM per Kilo.

Plate Manufacture. The metal frame including the steel gauze was made up as follows:-

1. Weave gauze on a loom.
2. Cut gauze in long lengths to the width of the lug to be used.
3. Fit gauze into beading and press the beading on.
4. Cut to the required height of the plate.
5. Fit steel lug and bottom length of beading.
6. Spot weld the four corners in one operation with a 4 point spot welder.
7. Line-weld the gauze to the lug and bottom with a "fish-tail" welding tool.
8. Grind off all sharp edges.

Annealing and plating of the metal frame

The metal frames including the gauze were assembled into small metal boxes approximately 10" x 6" x 3" and passed through an electric furnace on a conveyor at a temp. of 860°C in a reducing atmosphere.

Furnace - Junkers 50 KW No. 10740  
Conveyor Speed - 1 metre per 16 minutes.  
Time in furnace - about 2½ hours.

It was preferable to use these annealed frames immediately but after the above treatment they could be left 24 hours before rusting commenced. The A.E.G. furnace, which was in stock but had never been used, was preferred to the Junkers oven in use.

Plating. The frames were assembled on a large insulated frame for nickel plating in a continuous plating plant.

Plating time was 30 minutes followed by a cold swill, a hot swill and drying in an electric oven incorporated with the plant.

Selenium rectifier fitted giving an output of 600 amps. at 8 volts (from a 500 volt supply).

Plant dimensions:

Annealing 45' long x 7' high.  
Plating 50' long x 12 - 14' high.

Annealing: After plating the frames were again annealed as above although this was said to be not absolutely necessary.

Pressing: Frames were pressed to make absolutely flat and also depress the gauze so that it would be in the centre of the plate subsequently.

Sintering: In brief this part of the process is as follows:-

The metal frames were laid on carbon blocks and enclosed by a steel surround. This assembly was weighed and then passed by conveyor under a hopper holding the metal powder which was blown on to the assembly by compressed air through a slit in the side of the hopper. The excess powder was removed by a scraper and the whole assembly again weighed. A 1/4" iron plate was laid on the powder to consolidate it and then the steel surround was carefully removed and the block assembly built up into tiers of 3 on the nichrome conveyor for passage through the furnace. The furnaces in use had burnt coal gas atmospheres at each end and hydrogen atmosphere in the centre. The heating portion of the furnace was 3 metres 60 cms long and was wired in 2 sections, the first element giving more heat than the second. Both sections were under pyrometric control. The issuing sintered plates were cooled down first by air and then by water.

Notes from Interrogation:

1. Heavy powder sintered better than light.
2. Adhesion of powder to metal gauze centre - they had tried to improve this by drying on the following before sintering -

- (a) Sodium hydroxide
- (b) Sulphuric acid
- (c) Borax

All had been abandoned although sulphuric acid made the sintering very rapid and very hard.

3. 3 tier blocks gave a plate on the middle tier which was slightly less sintered than the top and bottom plate but the difference was negligible.

4. A well sintered plate could be bent into a complete circle before the sintered base cracked from the gauze. A bad plate cracked off in large pieces particularly if air had been entrapped before sintering.

5. Physical Sintering Tests

(a) A modified Brinell apparatus incorporating a 4 to 5 mm ball and using a 5 Kgm load had been used. Load applied for few seconds only. This had been destroyed together with the results.

(b) A similar apparatus reading on to an arbitrary scale but

using a 2 mm diam. rod tapering almost to a point had also been used. Apparatus and results lost.

Negative Plate. A metal powder mixture composed of copper and nickel was used. Care must be taken to ensure that all sulphur gases are absent from the reducing atmosphere in the furnace. Sintering was practically identical with that of the positive plate.

Positive Impregnation. Nickel plated iron baskets with hollow sides were provided to hold 75 plate assemblies each. These were fitted into slots into the 3 chambers of the basket.

2 baskets were placed in a vacuum chamber, the lid closed and the chamber evacuated to 740 - 750 mm vacuum. The latter sucks in the cold nickel nitrate solution. All the above was automatically controlled. At the end of the soaking period the vacuum was released and the baskets removed to a draining board above a solution trap for a few minutes.

Electrolysis. The plates were then assembled in a rack alternately with sheet nickel anodes above a hot caustic soda bath which was fitted to a platform operated from beneath by a compressed air cylinder. When completed the caustic soda bath rises to enclose the plates and the electrical circuit closes to cathodically polarize the plates immediately they entered the solution. This, together with the high current density used prevented the clogging of the outer pores of the plates by the precipitated hydrate.

The plates were then returned to the baskets and sent for washing in a continuous conveyor washing tank. This was a single tank with large overhead conveyor and it was filled with hot softened water supplied from the boiler plant. The wash water flowed counter current to the conveyor. The baskets were removed at the outlet end of the plant.

After washing plates were brushed to remove any superficial hydroxide and then returned to the baskets for drying.

Drying carried out in a steam heated hot air circulating oven.

The complete impregnation, electrolysis and washing was repeated 4 times for positive plates. Some trouble was experienced during cold weather due to the insolubility of nickel nitrate at low temperatures and it was found difficult to impregnate sufficient hydroxide under these conditions using only 4 impregnations. This could have been overcome by heating the vacuum chamber.

Labour required - 7 men per line for 3 plates per minute output.

Negative Plate. Impregnation, electrolysis and washing. This was the same in principle as for the positive, except that cadmium salts instead of nickel were used for impregnation. It should be noted that all the

plant listed above was duplicated for the negative plate so that both positive and negative could be made simultaneously.

Waste recovery. There was a special plant for the recovery of nickel hydroxide and cadmium hydroxide from the Durac process - process waste from the washing tanks etc.

Each hydroxide was collected separately, washed by decantation, filter pressed, dried and returned to Hagen for final recovery.

#### Mechanical Assembly

1. 0.8 mm Mipolan string wrapped round the negatives.
2. Assemble the group.
3. Electric weld the bridges to the plates in one special water cooled jib.
4. Press the group into the polystyrene boxes.  
Lids cemented in with a polystyrene/benzene cement.  
Dry the cell at 40 - 50°C for 2 hours to drive off the benzene.
5. Test for seal with 1 atmosphere air pressure below water.

#### Tests

In the case of the 10 amp hour battery ex Luftwaffe the following test was applied:

(a) 19 cells discharged at 50 amps for 5 minutes must give an end voltage not less than 18 - A.F.A. usually obtained 7 - 8 minutes under these conditions.

(b) For the 42 cell 50 volt 1 amp. hour battery - Charged and left on open circuit for 2 months then discharged at 0.3 amp. for 10½ minutes. Voltage range under these conditions must not exceed 52 to 48 volts.

Weight    24 volt 10 amp. hour battery - 12 Kilos.  
              "    "    20    "    "    "    - 24    "

#### High Discharge Rates

Durac alleged to be superior to Lead Acid for starter duties at low temperatures - about -20°C.

#### Technical Development

All the senior officials of A.F.A. expressed dissatisfaction with the negative. This fell rapidly in capacity under service conditions (after about 200 cycles) and also when allowed to stand on open circuit. This fall was about 1/3rd the original capacity of the negative. Treatment recommended was a slow discharge followed by a rapid charge. No reason could be given for this trouble.

A further disadvantage is that they strongly recommend the use of plastic containers.

Also, should the cell be reversed, the copper in the negative oxidised, dissolving in the electrolyte and eventually short circuited the cell.

Commercial results.

Due to the failure to meet war production requirements and also the unsatisfactory negative, the Luftwaffe finally rejected the sintered plate battery and went back to a lead acid type.





B.P. 331,540 - covers the use of ferrous ferric oxide as an insert carrier for the sintered base since it would be cheaper than nickel. I.G. believed that pure  $Fe_3O_4$  might succeed but not if  $FeO$  or  $Fe_2O_3$  were present.

B.P. 332,052 covers sintering at (1) 500 - 650°C then  
(2) 800 - 1200°C for 4 hours.

This was used when the plates were made from oxides which had to be reduced in the furnace before sintering starts. The method was not recommended.

B.P. 361,164 covered an iron sintered plate which was treated with a nickel coating to prevent the electro chemical attack which was the cause of the failure of B.P. 311,141.

A battery truck in the Ludwigshafen factory fitted with these negatives lasted 3 years only after which the negatives failed again.

B.P. 380942 - improves on 331540 and covers an iron negative impregnated with cadmium and 2% mercury. They had no success to report with this.

B.P. 339645 - method of making porous plates using foaming agents such as saponin. These agents generated pores which were too large and the idea was useless.

F.P. 468518 - taken out by A.F.A. - interrogated at A.F.A. This was the paste method of sintering and was abandoned.

B.P. 469,453 - taken out by A.F.A. - interrogation at A.F.A. Covers the formation of nickel peroxide on a solid nickel base similar to the Plante lead plate. The formation electrolyte used was sodium bicarbonate and great difficulty was experienced in controlling the activation.

B.P. 487,607 - I.G. covers cathodic polarisation of the impregnated plate in 30% NaOH at 70°C. This method had been used throughout the war and was particularly advantageous when nitrates were used (reduced to ammonia) and also to keep the surface pores from clogging.

Jan. 28 & 29, 1946.

Seen: INGR POLLIN.

The Swedish process for the manufacture of nickel - cadmium cells was being used.

Plant Capacity - pre war maximum was 400,000 amp hours per month. Actually it varied from 300,000 to 400,000 amp. hours each month. By the end of the war it had fallen to 50,000 amp. hours per month, the plant having been damaged extensively.

Employees: Pre War 140  
Jan. 1946 25

There was still sufficient plant remaining for a very limited output.

Plant: The chief items were as follows:

2 Swedish type briquetting machines and lines.  
These were making strip 5 metres long.

20 Perforating Machines.

1 - 600 ton press - Kiesering & Alrecht, Solingen.

Installed 1931. Storke 100 mms.

Active Material was in short supply and they could not buy enough. They alleged that they were buying cadmium - iron negative masse from Sweden at 14<sup>50</sup> RMS per kilo and this had been the price since 1939.

Positive material they were making themselves from nickel hydrate supplied by Meesane Chemische Fabrik, Sachsen.

Prices: Nickel Hydrate 4<sup>50</sup> RM/Kilo  
Fine Graphite 26 " " }  
Flake 8<sup>50</sup> " " } Source - Saxony.

An edge runner mill had been installed for mixing.

Electrolyte. A small and simple electrolyte recovery plant was present.

Uses: The product was used on the following:-

Thaction, telephones, starter and relays. They alleged that they had had no direct war contracts.