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PRIMARY CELLS BY PROF. A. SCHMID

BRITISH INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

LONDON—H.M. STATIONERY OFFICE

PRIMARY CELLS BY PROF. A. SCHMID

Reported by

N.L.Kusters
National Research Council
CANADA

BIOS Target Numbers

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BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE
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TABLE OF CONTENTS

Personnel of Team

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National Research Council
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Target: Laboratories of Prof Alfred Schmid

Location: Konstanz, Alpsteinweg 4

Persons Interviewed:

Dipl. Chem. Wassmuth
Dr. Lauermann

Prof. A. Schmid has a small chemical laboratory employing about five chemists. He moved to Konstanz from Berlin in 1944. The laboratory is engaged in work on plastics and primary electric cells. Only the latter were investigated.

A.S. Primary Cell

The A.S. cell is named according to the initials of its inventor, Alfred Schmid.

Electrodes: Carbon and zinc amalgam

Electrolyte: Called "Galvanol"

H_2SO_4		4 N solution
$Na\ Cl\ O_3$		30%
catalyst	-	trade secret

No load voltage per cell: 1.25 volt

The depolarizing agent is $Na\ Cl\ O_3$ and is in solution in the electrolyte. No gas is formed during the operation so that the cell can be completely enclosed.

The cell is chemically rechargeable by refilling with "galvanol" and replacing the zinc amalgam electrode if necessary.

When not in use, the electrolyte has to be separated from the zinc electrode to prevent self consumption.

The discharge characteristic of the cell is very similar to the lead acid battery characteristic: the vol-

tage stays constant over practically the full discharge time.

The internal resistance can be made very low and is about twice the internal resistance of a lead acid type battery of similar geometrical configuration.

The electrolyte "galvanol" has a capacity of about 100 amp-hours/liter, allowing a voltage drop of 20%. The production cost of galvanol is about 0.20 marks/liter.

The cells can be stored for an indefinite length of time, as long as the zinc and the galvanol are kept separate. Once brought into contact the full capacity of the cell is available immediately.

(a) Applications

The properties of the cell, such as low internal resistance, flat voltage characteristic and the fact that electrolyte has to be separated from the electrodes, seem to indicate that the cell was developed for use in expendable weapons of the German armed forces. A battery of these cells was developed for use in the V1 but never put into service. Although the cell was never used for torpedo propulsion, a battery was built for the propulsion of the beetle tanks. At a competitive race between several of these tanks, powered with different types of batteries, the Schmid powered tank is supposed to have outrun all competitors. Dr. Wassmuth claimed that for such applications (short time: 5 - 10 min, heavy currents) the A.S. cell was only 60% in volume and 50% in weight of the lead acid battery of equal capacity. This claim seems to be greatly exaggerated. (See electrical characteristics of battery later).

Although seemingly unsuited for flashlight applications Prof Schmid has succeeded to produce a very neat lighting unit. It consists of two cells in series and a light bulb. Each cell is about twice the size of the volume occupied by the electrodes, so that by tilting it upside down the electrolyte is separated from the zinc electrode. The unit contains no switch; the tilting provides the switching action.

(b) Electrical Characteristics

(i) Light current cell

Voltage	1.25 volt
Discharge current	0.2 amps
Discharge time (to 1 volt)	11.7 hours
Amp-hours (to 1 volt)	2.25
Watts	0.22
Short circuit current (amps)	2.5
Performance: Wh/100 cm^3	1.5
Ah/100 cm^3	1.33
Wh/100 gr	1.85
Ah/100 gr	1.64
Electrolyte: 50 cm^3 NL	61.25 gr
Weight of cell, full	140 gr
Dimensions of cell	38 x 38 x 120 mm
Zinc electrode surface	8 cm^2
Weight of zinc electrode	12 gr
Carbon electrode surface	35 cm^2

The electrolyte used in this cell is called type "NL". Further research has produced an electrolyte called "K60" which is supposed to give twice as many amp.-h. per liter.

Two of these cells are used for the flashlight mentioned above. The cells are constructed so as to be easily refillable with fresh galvanol when exhausted. At every second filling the zinc amalgam electrode has to be replaced.

(ii) Heavy Current Battery

Voltage	28-24 volt
Discharge current	25 amps
Discharge time	5 min
Amp-hours	2.08
Watt-hours	54.2
Performance W-h/Liter	5.12
Ah/Liter	0.19
Wh/Kg	3.5
Ah/Kg	0.13
Short circuit current	100 amps
Electrolyte (S.S.B.)	3 liters
Weight (full)	15.6 Kg
Volume	10.6 liters
Weight of zinc electrodes	3.26 Kg
Surface of carbon electrodes	5660 cm^2
Weight of carbon electrodes	3.62 Kg

It was this type of battery that was used in the beetle tanks. Three such batteries were used in parallel. A different kind of electrolyte was used however, doubling the output of the battery.

Other Work on Primary Cells

Research work was done on the possibility of powering midget type submarines with primary cells. A first experimental model was built for a steady output of 300 watt. The next model under consideration at the cessation of hostilities was for a steady output of 25 HP.

The type of cell used for this work was different, it was a "Chlorine cell". The negative electrode is zinc. The positive electrode was a hollow porous carbon through which the electrolyte was pumped into the cell. The electrolyte was a HCl solution saturated with chlorine gas, coming from a high pressure tank. Pressures as high as 6-8 Kg/cm^2 were considered. In the tests only 1-2 Kg/cm^2 was used. The chlorine gas acts as a strong depolarising agent and in reality transforms the carbon electrode into a chlorine electrode giving the cell a voltage output of 2 volts. The used electrolyte is drained off. Circulation is obtained by regulating the supply pressure of the chlorine gas over the unused electrolyte. Motors run from such a battery can be controlled by regulating the pressure of the chlorine gas.

Comparative theoretical computations between the relative weight and volume for lead acid batteries and batteries of this type show, that for small amounts of energy storage (about 20 Kw-hours) the lead acid battery is lighter and smaller. For large amounts of energy storage the chlorine cell gains the advantage. This advantage becomes very pronounced for very large energy storage capacities. This development was, and probably will remain, in an early stage.

C.H.&K.