LEAD INDUSTRIES ASSOCIATION

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CONFIDENTIAL
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SUBJECT: Report of Third Annual Signal Corps, Battery Branch, Research and Development Conference

To Members of the Lead Industries Association:

The Third Annual Battery Branch Research and Development Conference sponsored by the Battery Branch of the U. S. Army Signal Corps was held May 11 and 12, 1949 at the Molly Pitcher Hotel, Redbank, New Jersey and the Signal Corps Engineering Laboratory, Fort Monmouth, New Jersey. The purpose of the conference was to gather together representatives of the battery industry to discuss special battery problems relative to military requirements. The Lead Industries Association was invited to be represented. Confidential reports were presented by those companies and universities under contract to the Signal Corps for the purpose of conducting original investigations on specific battery problems.

The following are abstracts and comments of those reports presented which may be of specific interest to members of the Lead Industries Association.

Low Temperature Storage Batteries by Hyman Mandel, Battery Branch

Purpose: The need for operating military equipment powered by lead-acid batteries at sub-zero temperatures has made necessary the improvement of the low temperature performance of lead-acid storage batteries. Accordingly, this project was undertaken to develop lead-acid batteries which will have satisfactory discharge and charge characteristics at temperatures down to -65° F.

Experimental Work: Experimental work has included the following:

1) Investigation of the fundamentals of the chemistry of lead-acid storage battery reactions at low temperatures.

2) A detailed study of the behavior of the components such as oxides, expanders, plates, separators, etc.

3) Extensive experiments with acids of different specific gravities, varying plate thicknesses, varying plate combinations, etc.

4) A lead-acid storage battery was designed that is capable of engine cranking at -65° F and with improved low temperature operation under other discharge conditions.

Future: Future investigations will include:

1) Continuation of the above lines of investigation until more complete data is obtained.

2) A detailed investigation of the chemical and physical changes taking place in the battery during low temperature charging.

3) A full evaluation of all data obtained and the incorporation of pertinent portions thereof into specification requirements for military low temperature batteries.

Comments: This investigation showed that by increasing the number of plates and using thinner plates in conjunction with finer oxides and thin micro-porous rubber separators, the low temperature performance of the lead-acid battery was improved to the extent that it would serve satisfactorily at -65° F. Tests indicated the optimum battery to be one in which the number of plates was increased from 17 to 27 with the thickness of a typical plate at 0.052 inch. Eagle-Picher No. 30 sublimed oxide was used in the preferred cell along with micro-porous rubber separators which were 0.0047 inch thick. Upon questioning, the investigator stated that without benefit of actual calculations he felt that the increase in the number of plates coupled with the reduction in thickness would have no material effect on the quantity of lead used per battery as compared to the usual lead-acid battery of equal capacity.

New Storage Battery Systems by L. L. Carrick, University of Michigan

Purpose: The purpose of this study is the development of a storage battery for military use employing lead coated aluminum grids with the objective of improving battery performance and conserving weight.

Experimental work: Experimental work has included:

1) Application of modern plating techniques to provide an adherent impervious coat of lead on aluminum and to eliminate the danger of local action.

2) Construction and testing of cells using lead plated aluminum grids. These experimental cells have shown excellent performance at room temperature and at extreme low temperature.

Future: Future plans include:

1) The testing of 6, 12, and 24 volt batteries constructed using lead plated aluminum grids.

2) A plant study of production methods.

3) Investigation of suitable paste formulae, separators, etc, and the establishment of specifications for batteries using lead plated aluminum grids.

Comments: After investigating a number of possibilities, the grid possessing the optimum electrolytic and physical characteristics consisted of an aluminum grid plated with 0.0005 inch each of copper and nickel as undercoats followed by electro-deposition of pure lead in the range of 0.010 to 0.015 inch thick. The plating time is approximately one hour and five minutes. The principle advantage of this type of cell construction is a saving of one-third to one-half of the grid weight in comparison with a normal 8 per cent antimonial lead grid. It was felt that the use for this particular type cell was limited primarily to the military where cost is relatively secondary and where weight is critical, such as in some types of military aircraft and airborne ordnance. Its use over a period of time was questioned because the normal cell reaction in the lead-acid battery would tend to penetrate the lead on the positive plate and eventually attack the aluminum. The negative plate should remain unattacked. This may be compensated for by a compromise: use positive plates constructed in the conventional manner and negative plates made by lead plating aluminum grids. Of course, this would sacrifice some of the weight advantage.

Fundamental Studies of the Lead-Acid System by E. J. Ritchie, Eagle-Picher Co.

Purpose: The purpose of these studies is to correlate the crystal chemistry of the lead compounds, particularly the oxides and sulfates, with the performance of the batteries in which they are used. Since the actual active material is made from the oxides and sulfates by the electrochemical process, the studies become an attempt to relate the crystal chemistry of the starting materials with the crystals of the electrolytically produced active materials.

Experimental work: Experimental work is following these four major lines of investigation:

1) Development of analytical methods for the precise determination of lead/oxygen ratio in lead oxides.

2) Development of analytical methods for the determination of trace element impurities.

3) The preparation of reference lead compounds of unquestioned integrity.

4) The testing of the electrochemical characteristics of such compounds.

Future: Future plans for the project call for a continuation of the above items with more emphasis on testing of the electrochemical characteristics of the oxides and the electrodes prepared for them. It is also planned to investigate the possible application of radio-active isotope tracers in:

1) Lead compound crystal chemistry studies.

2) The determination of impurities of very low concentration.

3) Battery reactions in general.

Sintered Plates for Nickel-Cadmium Storage Batteries by A. Fleischer, Nickel-Cadmium Battery Corp.

Purpose: Investigations have been conducted on the sintered plate nickel-cadmium storage battery with the aim of developing alkaline storage batteries for certain military applications.

Experimental work: Experimental work has included:

1) Construction of sintered plate nickel-cadmium batteries with capacities from 10 to 120 ampere hours. These batteries have been assembled using plates of various thicknesses (0.039 inch or 1 mm to 0.156 inch or 4 mm) and using a variety of plate combinations.

2) Promising results have been attained on discharge tests at temperatures from 80° F to -40° F.

Future: Future plans will include:

1) Results of present fundamental studies will be evaluated and the resultant knowledge applied to the design of military nickel-cadmium batteries.

2) Specifications for military nickel-cadmium batteries will be established.

Comments: The Signal Corps is interested only in developing the nickel-cadmium battery for uses in which the lead-acid battery is inadequate or inadvisable. (They did not wish to provide specific examples of such applications.) Carbonyl nickel powder is sintered on 16 to 18 mesh nickel wire cloth to make the battery grid. Both nickel powder and cadmium, the primary constituents of the nickel-cadmium battery, were highly critical materials during the past war. Indications are that that condition will not be materially altered in the future.

Conclusions: The primary objectives of the Signal Corps Program with respect to secondary batteries as reviewed by director of program, Grenville Ellis, are as follows:

1) Fill the need for a high capacity battery operable at low temperature.

2) Be able to charge such a battery at low temperature.

3) Improve the ampere-hour capacity per pound of military storage batteries.

4) Try to develop batteries which will not be constructed of materials critical in wartime.

Other papers presented at the Conference were as follows:

Studies of Manganese Dioxide, Charles H. Clark, Battery Branch

Electrolytic Manganese Dioxide, Dr. G. H. Kissin, Georgia School of Technology

The Use of Furnace Black in Dry Cells, R. H. Secord, Godfrey L. Cabot, Inc.

Magnesium Dry Cells, Dr. Roy Kirk, Dow Chemical Company

Standardization of Dry Cell Batteries, Frank P. Schiro, Battery Branch

Fundamental Studies on Electrochemical Systems, Dr. W. C. Vosburgh, Duke University

Low Temperature Primary Batteries, Dr. A. B. Garrett, Ohio State University

Low Temperature Alkaline Primary Batteries, T. C. O'Neil, P. R. Mallory & Co.

Low Temperature Dry Cell Batteries, Dr. C. V. Morehouse, Olin Industries

High-Rate Primary Batteries, Dr. A. Fischbeck, Battery Branch

Very truly yours,

Secretary