White Paper

Effects of Impurities on Lead-Acid Batteries

Introduction

The overall functioning of a storage battery is largely dependent upon the physical and chemical properties of the electrolyte. Considering the diversity of the service that they must perform; it is increasingly important that the physical and chemical properties of the electrolyte should receive more extended study. Extended months of experiments are in progress at the Bureau of Standards to determine the quantitative effects produced by various impurities on the rate of sulphation of storage battery plates. The method involves determination of weight of the plates while suspended in the electrolyte solution.

> This whitepaper will help you in understanding how impurities can affect the working of any battery and what can be done to ensure to keep these impurities out while making sure of optimum performance.

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Various impurities were added to the pure electrolyte and effects produced were judged by the weight alteration of the plates. Impurities may be divided into two general classes.

- The first class includes those which do not attack the separators or grids, but merely cause internal self-discharge.
- The second class includes those which attack the grids or separators.

Impurities causing Self-discharge

This includes metals other than lead. If these metals are in solution in the electrolyte, they deposit on the negative plate, during charge, in their ordinary metallic state, and form small cells with the spongy lead. These small cells discharge as soon as the charging circuit is opened, and some of the lead is changed to lead sulphate. This of course, causes a loss in capacity.

Free hydrogen is given off by this local discharge, and so much of it is at times given off that the hydrogen bubbles give the electrolyte a milky appearance.

Silver and iron are the most active in forming small local cells. These metals form local cells which have high voltages to some extent and drain a large portion of a cell's energy.

Iron also forms local cells which results in the loss of a substantial portion of cell capacity. This may be brought into the cell by impure acid or water. Iron remains in solution in the electrolyte and is not precipitated as metallic iron. The iron in solution travels from the positive to the negative plate, and back again, causing a local discharge at each plate.

Moreover, it is strenuous to remove the iron, the only exception is to drain out all the electrolyte. The behavior of Manganese is similar to iron.

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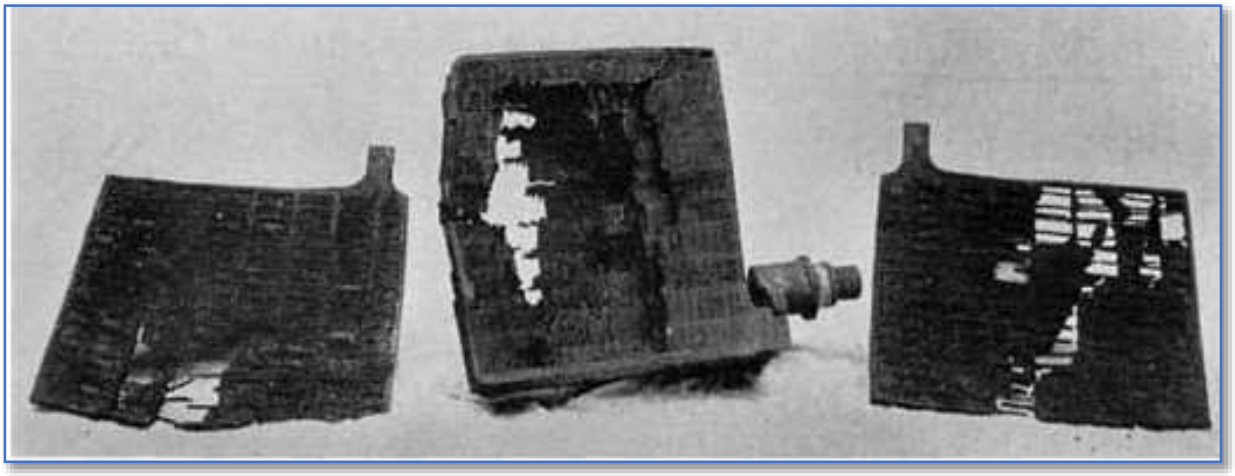
Impurities causing attack on the Plates -

The impurities that affect the plates can be divided into two categories:



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The first category includes acids except sulphuric acid, compounds formed from such acids or substances which will readily form acids by chemical action in the cell. Nitric acid, hydrochloric or muriatic acid and acetic acid belong to this class of impurities. Organic matter in a state of decomposition attacks the lead grids promptly.

Impurities in the second category dissolve the lead grids resulting in plate disintegration and breakdown since its vertebrae is damaged. When a battery containing these impurities is opened, it will be found that the plates collapse and fall apart at the slightest touch. Untreated separators attract acetic acid into a cell**.** This acid attacks and corrodes the lead, especially the luge above the electrolyte and the plate connecting the bandages. Normally, the plates will be found broken from the connected strap, with the plate lugs broken and crumbled.

There is hardly anything that can be done to rectify this. Impurities in the first category merely decrease the battery capacity. If the battery is fully charged, and the negative washed thoroughly, some of the impurities may be safeguarded. Impurities of the second category usually cause irreversible damage to the plates by the time they are discovered.

The prime focus should be to keep impurities out of the battery. Using distilled water, which is known to be completely free from minerals should be used.

Impurities existing in the separators or acid cannot be detected easily, but in case of battery repair, separators supplied by reliable battery manufacturers should be used. Usage of pure acid is also recommended. This means that only chemically pure, battery acid should be used. Ensuring proper handling of acid in the shop, it should always be kept in its glass bottle and should be poured only into a glass, porcelain, earthenware, lead, or rubber container. Usage of any other vessel or material type is not recommended.