Carbon Nanofibers: new additive for the Negative Active Material of Lead Acid Batteries

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Abstract

Lead Acid Batteries (LABs) are in continuous upgrade in order to supply the necessities of the current automotive industry. One of their main objectives is to work in the Micro Hybrid vehicle as power supply source, where LABs must be able to accept the charge of the regenerative braking and to work in High Rate Partial State of Charge (HRPSoC) conditions. In this condition, LABs progressively accumulate lead sulphate ($PbSO_4$) crystals on the negative plates, so their internal resistance increases, causing the battery failure. Addition of carbon materials to the negative plate was one strategy used in order to avoid this sulfation[1,2].
In this study, Carbon Nanofibers from Grupo Antolin (GANF), previously dispersed, have been used as additives for the negative plates of Lead Acid Batteries (LABs). Four Negative Active Material (NAM) mixtures were prepared: 1 reference mixture (NAM Control) and 3 GANF mixtures (S1, S2 and S3) with different GANF concentrations. These mixtures were used to prepare four types of negative plates, and so 2V/1Ah Lead Acid test cells. Electrical performance of the cells was testing. Capacity, cold cranking ability, charge acceptance, Hydrogen Evolution Reaction (HER) and Partial State of Charge (PSoC) cycle life were analysed among others. Different physicochemical analysis, X-ray diffraction and Scanning Electron Microscopy were carried out for the negative plates.

As a result, carbon nanofibers slightly improved the charge acceptance of the negative plates. Water consumption studies revealed that the selected grade of carbon nanofibres increased HER rate by lowering its overpotential, and its dispersion played a key role in this reaction. However, this gassing increase was lower for GANF in comparison with other carbon materials that are currently used in flooded LABs[3]. Selected GANF increased NAM conductivity during PSoC cycles, leading always to the performance of more than 1000 cycles.

References

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