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Hybrid storage management system consisting of supercapacitors and AHI batteries

Abstract. *(**Hybrid storage management system consisting of supercapacitors and AHI batteries**) The efficient use of energy from renewable sources, especially in the form of photovoltaic panels and wind turbines, requires the use of energy storage. Typically lithium-ion or lead-acid batteries are used to build such systems. The main shortcomings of these solutions are: limited durability, toxicity of relevant electrolytes and components, potential fire hazard and problems with the disposal of used batteries. A new quality solution can be the use of Aqueous Hybrid Ion battery (AHI) that is completely safe for the environment.*

Keywords: Hybrid storage, Aqueous Hybrid Ion battery, Supercapacitor.

Introduction

The efficient use of energy from renewable sources, especially in the form of photovoltaic panels and wind turbines, requires the use of energy storage. Typically, lithium-ion or lead-acid batteries are used to build such systems. The main shortcomings of these solutions are: limited durability, toxicity of relevant electrolytes and components, potential fire hazard and problems with the disposal of used batteries.

A new quality component, that appeared on the market, is the battery commercially denoted as Aqueous Hybrid Ion (AHI) [1] containing salt electrolyte, which is safe during use and from the point of view of protection of the environment. Batteries of this type do not create a fire hazard, and can also be fully recycled. In addition, the AHI battery is marked by significant durability expressed by a large number of charging and discharging cycles. Due to the aforementioned properties, it is suitable for the construction of scalable energy storage, in particular for stationary applications. A drawback of AHI batteries is the relatively high internal resistance, which complicates the design of the storage for large impulse charging and discharging currents. The solution to this problem is a hybrid system containing AHI batteries and supercapacitors (SC). The combination of a chemical battery with a supercapacitor is the subject of many studies [2-5], which indicate the possibility of improving dynamic parameters and extending battery life. There are various configurations of hybrid storage devices due to the way of connecting to the DC or AC bus. In this work, the configuration in which the AHI battery is connected to the DC bus by means of bi-directional DC-DC converters, while the supercapacitor is connected directly to the bus, is considered. The modules containing the AHI battery and the supercapacitor are connected in series to provide the required output voltage. The functions of adjusting the charging and discharging currents of AHI batteries, as well as maintaining voltage balance of the supercapacitors, are implemented on the basis of the microprocessor controller Hybrid Storage Management System (HSMS) installed in each of the modules of the storage. In a multi-module system, these controllers are connected to the CAN communication bus line. Thanks to serial bus communication line data is exchanged with other controllers of the energy storage and superior power monitoring system.

Summary

The paper presents the results of laboratory simulation of an energy storage consisting of two modules connected in series. Each of them contained the S30-0080 type AHI battery and the LSUM 129R6C 0062F EA supercapacitor and the HSMS controller. The article describes the construction of the HSMS device and indicates the areas of its possible applications.

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