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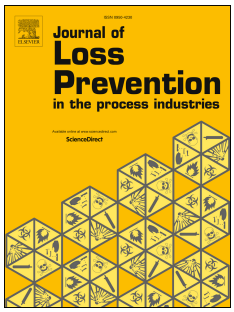

Effects of the environmental temperature and heat dissipation condition on the thermal runaway of lithium ion batteries during the charge-discharge process

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Effects of the environmental temperature and heat dissipation condition on the thermal runaway of lithium ion batteries during the charge-discharge process

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ABSTRACT: Fires and explosions due to thermal runaway are the main hazardous characteristics of lithium ion batteries. This paper focuses on the thermal behavior of lithium ion batteries during the charge-discharge process under different environmental temperatures and heat dissipation conditions. An electric heating testing apparatus has been set up to perform a series of experiments with 2600 mAh Sanyo 18650 batteries. The results show that the critical temperature of thermal runaway is between 40℃ and 60℃ under a 7.8 A charging current. Meanwhile, the average heating rate the of battery rises with the increase of environmental temperature. The initial thermal runaway temperature of batteries under environmental temperatures of 60℃, 80℃, and 100℃ is nearly 127℃. The critical charging current of the thermal runaway also declines with the increase of the environmental temperature. The average heating rate of batteries at 20℃, 40℃, and 60℃ are basically equal, but the average heating rate of a battery at 100℃ is higher than that at 80℃ during the discharging process. During the charge-discharge process, a better heat dissipation condition can ensure the lower heating rate of a battery. These results can provide an important basis for the safety design and storage of batteries to prevent fire and explosion accidents.

Keywords: Lithium-ion battery; Thermal runaway; Environmental temperature; Heat dissipation condition; Charging-discharging

1. Introduction

Lithium ion batteries are widely used in various types of electronic components, such as laptops, cameras and mobile phones, due to their efficient gravimetric and volumetric energy density, high power density, long service life and pollution-free use. (Scrosati, 2000; Omara et al, 2014). In recent years, lithium ion batteries have also been used to make large and medium-sized energy storage devices, such as in electric vehicles, renewable energy sources, backup power of communication networks and military reserve power. (Darcovicha et al., 2013; Waag et al., 2013).

With the popularization of lithium ion batteries in everyday life, some complicated situations and special environment conditions have become frequent, for example, high temperature and charge-discharge at high rates or short circuits. The security problems of lithium ion batteries, which are one of the main restrictions on the development of lithium ion batteries, must be solved. Among all safety issues of a lithium ion battery, thermal runaway is

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