

The Effect on Performance of NCR Battery for Temperature And Rating

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ABSTRACT: To study the properties of NCR batteries, foreign 3.25 AH batteries serve as the research objects. The paper aims to study the median voltage, capacity of the NCR batteries under different ambient temperature and ratings; The cycle life of the battery; the relationship about OCV and SOC of the battery. As a result, the discharging median voltage of NCR batteries has a increasing tendency in a certain temperature range while decreasing tendency with the rating growing. The discharging capacity of the NCR batteries has a rising tendency as the temperature rises. On the contrary, the charging-discharging capacity of the NCR batteries has a decreasing tendency as the rating rises.

Keywords: NCR battery; temperature; rating; properties

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I. INTRODUCTION

The lithium ion battery of ternary material has greater advantage in energy density, discharging voltage and low temperature performance. Gradually, it is widely used in smart phones, wearable devices and electric vehicles. Now, it is recognized and prompted in the field of electrical vehicles about power batteries, Tesla is one of the typical examples^[1]. Recently, the temperature and rating have a great impact on the battery performance, which gets a high attention from people. There are some papers about the type of 18650 batteries which are about LFP and NCR example, the battery's charging-discharging performance will make a decrease in low temperature environment. The charging-discharging performance of batteries will become more poor. It makes a great influence on charging and starting of the electrical vehicles. The lithium ion battery of NCR batteries become more and more popular in electrical vehicles. At the present, the articles about its performance research are less. This paper makes a more detailed research on basic performance about NCR 18650B batteries. On the one hand, it fills the gaps in the study, on the other hand, it provides a reference for the peer. As a result, we can maximize its the performance advantages and extend service life^[3].

II. DESIGN OF TESTING EXPERIMENT

A. Test samples

Select eight samples (3.6V, 3250mAh) which is qualified when it makes out.

B. Test method

Make a charging-discharging plan and observe the changes about median voltage, capacity of batteries under different ambient temperatures and ratings and the relationship of OCV-SOC.

C. Test facilities

- (1) The computer is used to test the setting of program, the running of program and record the data.
- (2) The testing system of LAN DIAN is used to test the current and voltage of the batteries.
- (3) The incubator provides the environment which is used to test the batteries.

D. Test procedures

(1) OCV-SOC experiment: Constant current charging(0.6A), static 1h, Constant current discharging(current is 0.6A, the discharging capacity is 0.3Ah), static 1h, cycle this procedure (Ensure the voltage is full and the discharging capacity is plus 0.3Ah every time until the discharging capacity is 3Ah).

(2) Temperature experiment: static 1h-Constant current charging(3.25A)-static 1h-Constant current discharging(3.25A)-static 1h.

(3) Rating experiment: static 1h-Constant current charging(0.2C, 0.5C, 0.8C, 1.0C, 1.5C)-static 1h- Constant current discharging(0.2C, 0.5C, 0.8C, 1.0C, 1.5C)-static 1h.

III.RESULT OF THE TESTING

A. The relationship on the open circuit voltage and the state of charge for the battery

SOC(%) \ Numbers	1	2	3	Average
100	4.122	4.123	4.118	4.121
90	4.022	4.022	4.022	4.022
80	3.935	3.935	3.931	3.9337
70	3.858	3.859	3.857	3.858
60	3.77	3.771	3.772	3.771
50	3.657	3.656	3.656	3.656
40	3.601	3.599	3.599	3.600
30	3.55	3.553	3.553	3.552
20	3.476	3.471	3.467	3.471
10	3.354	3.356	3.353	3.354

Table.1 The relationship between OCV and SOC

By measuring the data of SOC and OCV at 25°C(0.2C),we make the curve about the relationship of SOC-OCV.By doing some research on the performance of batteries ,the OCV is more sensitive to SOC.

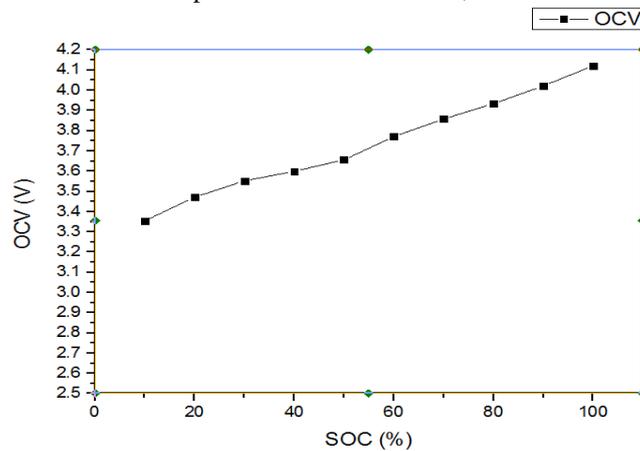


Fig. 1 The picture on SOC and OCV

B. The influence on the discharging median voltage and capacity of batteries at different temperature

Numbers \ Temperature	1	2	3	4	5	Average
0°	3.123	3.142	3.127	3.106	3.091	3.1178
10°	3.213	3.207	3.195	3.182	3.174	3.1942
20°	3.262	3.256	3.247	3.242	3.237	3.2488
30°	3.292	3.287	3.285	3.281	3.273	3.2836
40°	3.326	3.318	3.314	3.312	3.308	3.3156
50°	3.346	3.334	3.344	3.340	3.338	3.3404

Table.2 The relationship between temperature and the median voltage

Numbers \ Temperature	1	2	3	4	5	Average
0°	1.350	1.237	1.097	0.967	0.859	1.102
10°	1.388	1.326	1.249	1.180	1.121	1.2528
20°	1.630	1.584	1.531	1.482	1.440	1.5334
30°	1.777	1.728	1.680	1.642	1.599	1.6852
40°	1.838	1.759	1.721	1.682	1.664	1.7328
50°	1.841	1.820	1.804	1.777	1.761	1.8006

Table.3 The relationship between temperature and capacity

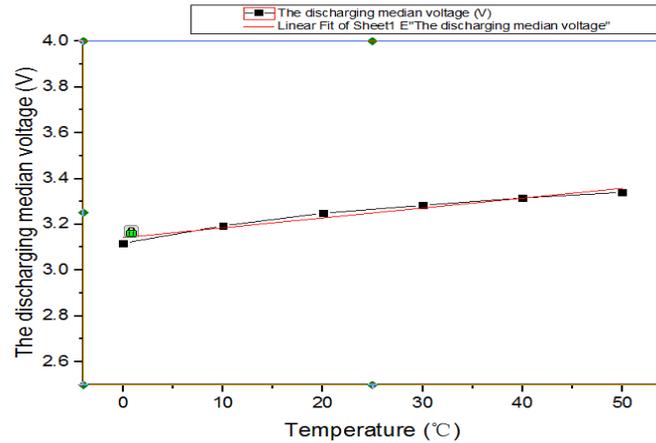


Fig. 2 The picture on temperature and voltage

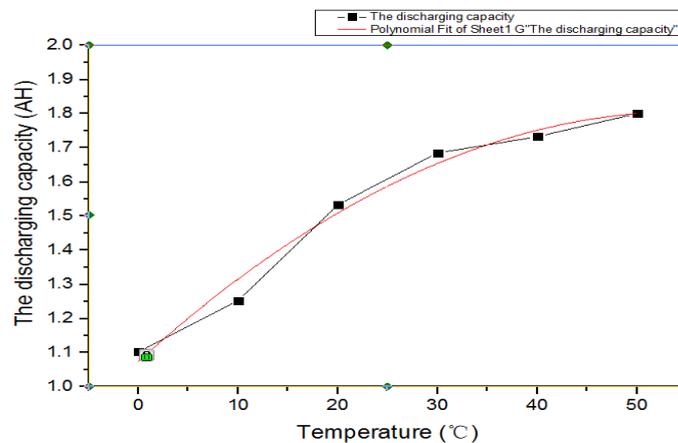


Fig. 3 The picture on temperature and capacity

The discharging median voltage is gradually increasing with the increase of the temperature. The median voltage of the battery has a better stability with the higher temperature within certain range. The temperature has significant influence on the performance of three element battery.

In a certain temperature range, the charging and discharging capacity is lower when the temperature is lower. At 50 degrees, the charging and discharging capacity is almost 2 times of the charging and discharging capacity of 0 degrees. 0 degrees to 30 degrees, the charging and discharging capacity of the battery shows a rapid growth trend; 30 degrees to 50 degrees, the tendency still increases but slower^[5].

C. The influence on the discharging median voltage and capacity of batteries at different ratings

Numbers Ratings	1	2	3	4	5	Average
0.2	3.609	3.609	3.611	3.608	3.609	3.609
0.5	3.523	3.523	3.522	3.524	3.520	3.522
0.8	3.443	3.442	3.442	3.441	3.441	3.442
1.0	3.391	3.388	3.388	3.382	3.385	3.387
1.5	3.270	3.264	3.254	2.252	2.249	3.258

Table.4 The relationship between ratings and median voltage

Numbers Ratings	1	2	3	4	5	Average
0.2	3.097	3.097	3.095	3.090	3.093	3.094
0.5	2.746	2.742	2.745	2.748	2.736	2.743
0.8	2.541	2.526	2.521	2.519	2.516	2.525
1.0	2.371	2.346	2.332	2.308	2.293	2.330
1.5	1.904	1.851	1.799	1.744	1.686	1.797

Table.5 The relationship between ratings and capacity

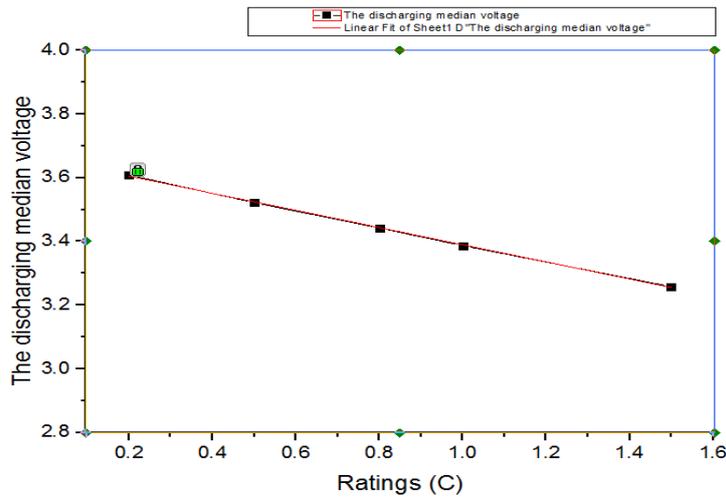


Fig. 4 The picture on ratings and voltage

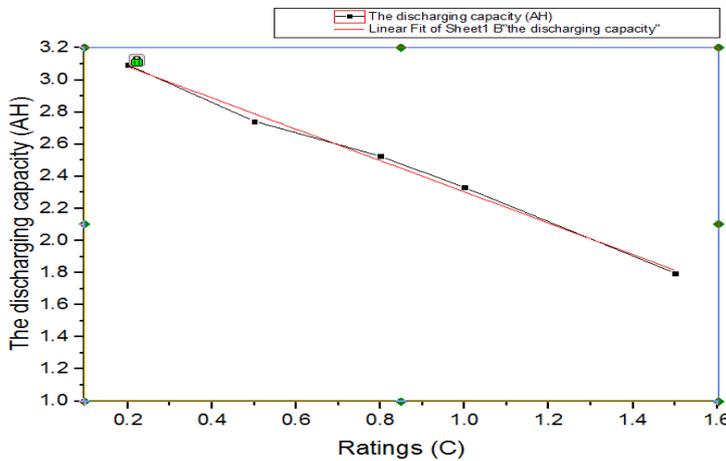


Fig. 5 The picture on ratings and capacity

The discharging median voltage tend to decrease with the increasing rating. The discharging median voltage of batteries has also a decreasing tendency from lowwr ratings to higher ratings. The performance of discharging median voltage is more stable at the lower rating. From 0.2C to 1.5C, the discharging capacity tends to decrease with the increasing rating. Within a certain range, the battery has a better discharging performance at lower the rating.

D. The effect on discharging capacity for cycle life

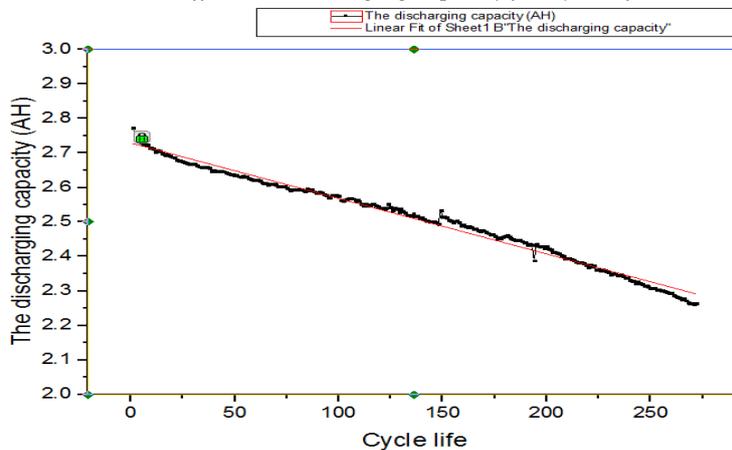


Fig. 6 The picture on cycle life and capacity

The performance of the battery has tendency to decline with the increasing cycle life. The discharging capacity of the battery decreases gradually. From the picture, the SOH of battery is 80% when the cycle life is about 300 times.

IV. CONCLUSION

The three element battery is the energy system as the new energy vehicle. The temperature and rating have a great impact on the efficiency and performance of batteries. Therefore, pay more attention to their impact on the battery when use them and keep them working in an ideal temperature and rating in order to reduce the bad effects on the batteries.

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