GWL/Power technical document

LiFePo4 low temperature discharge test

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Target: To prove that it is possible to discharge LiFePo4 during low temperatures.

Test equipment: Winston 90Ah LiFePo4 cells 4 pc, made in 2011
DC/AC inverter 2500W
Infra heater 3x 400W (load)
Hot air pistol 2000W (load)
Power Log 6S
Fasteners
Foam insulation

Testing conditions: Kitchen freezer, -15 to -27 °C

Testing procedure: 1 – LiFePo4 cells were left in freezer for 3 days, temperature -25 °C
2 – Test process
3 - Cells were charged to 100% SOC and left 3 days in freezer. After 3 days more next tests was proceeded.

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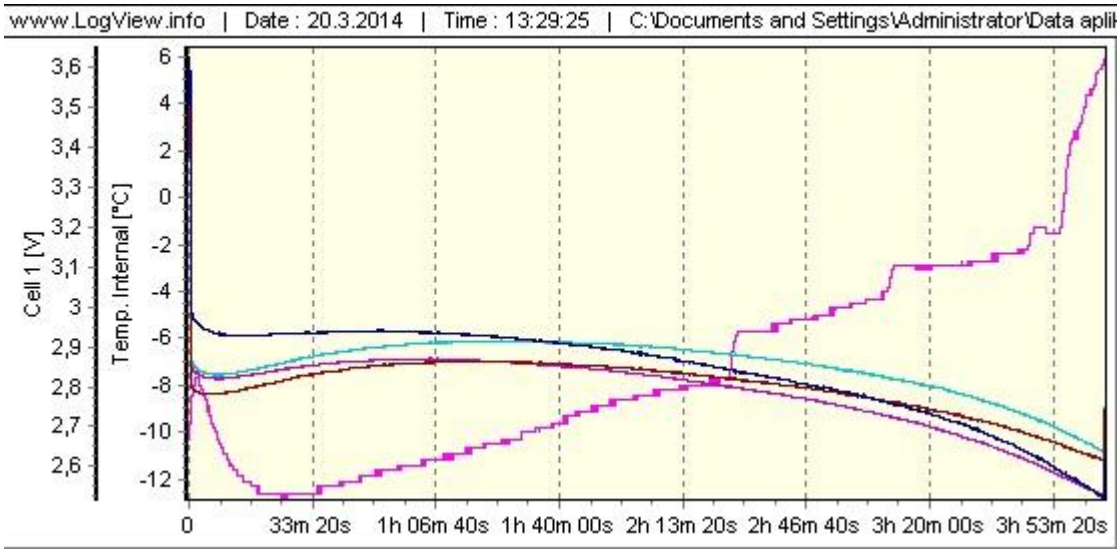
Test 1: Discharge with constant current 0.2C (18A):



Findings: Internal temperature of LiFePo4 cells is rising under the load. Voltage of individual cells rises together with temperature.

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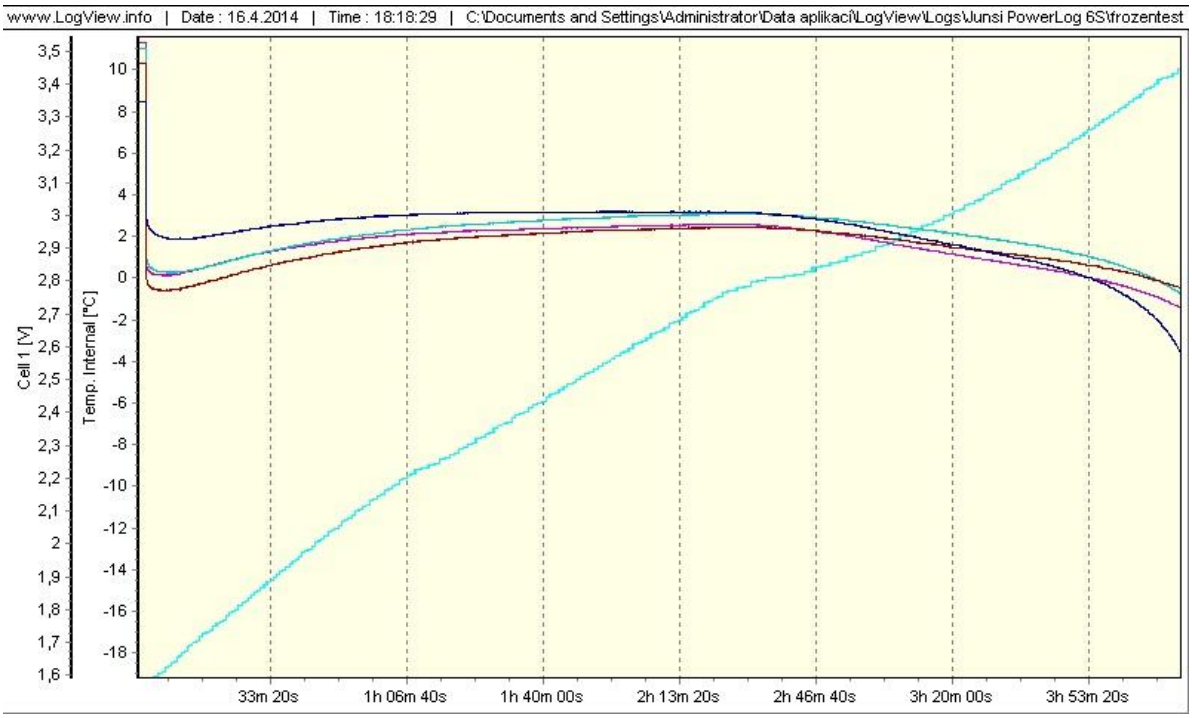
Test 2: Discharge with constant current 0.2C (18A), insulated:



Findings: Internal temperature of INSULATED LiFePo4 cells is rising under the load more rapidly than if insulation is not used. Voltage of individual cells rises together with temperature.

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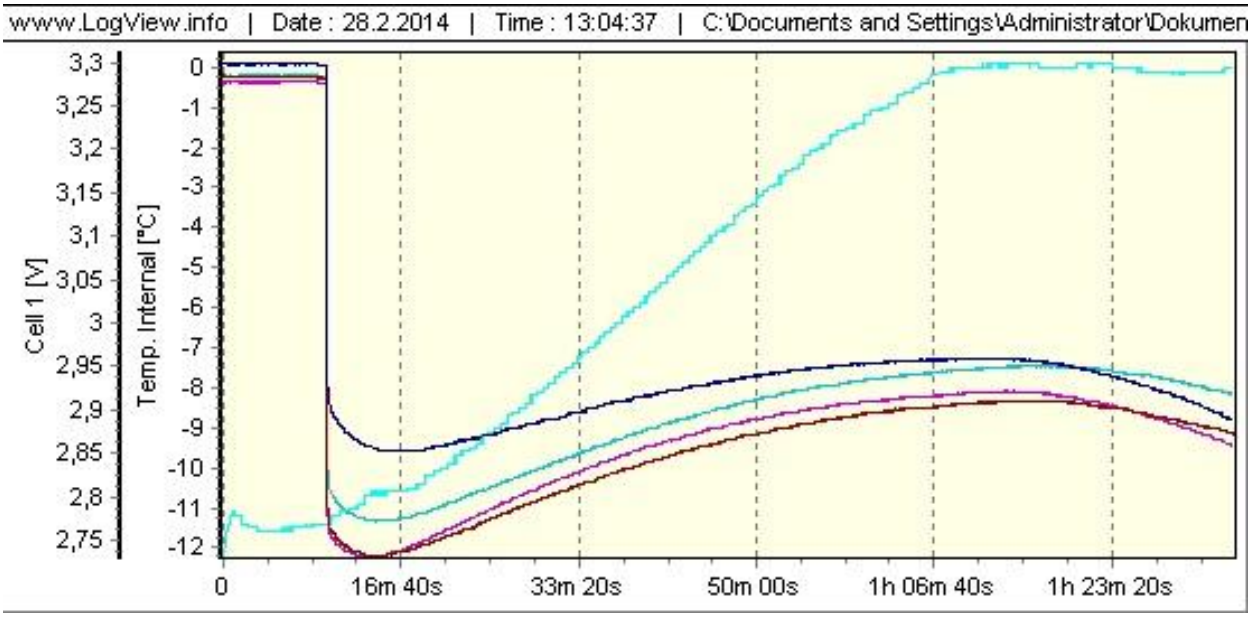
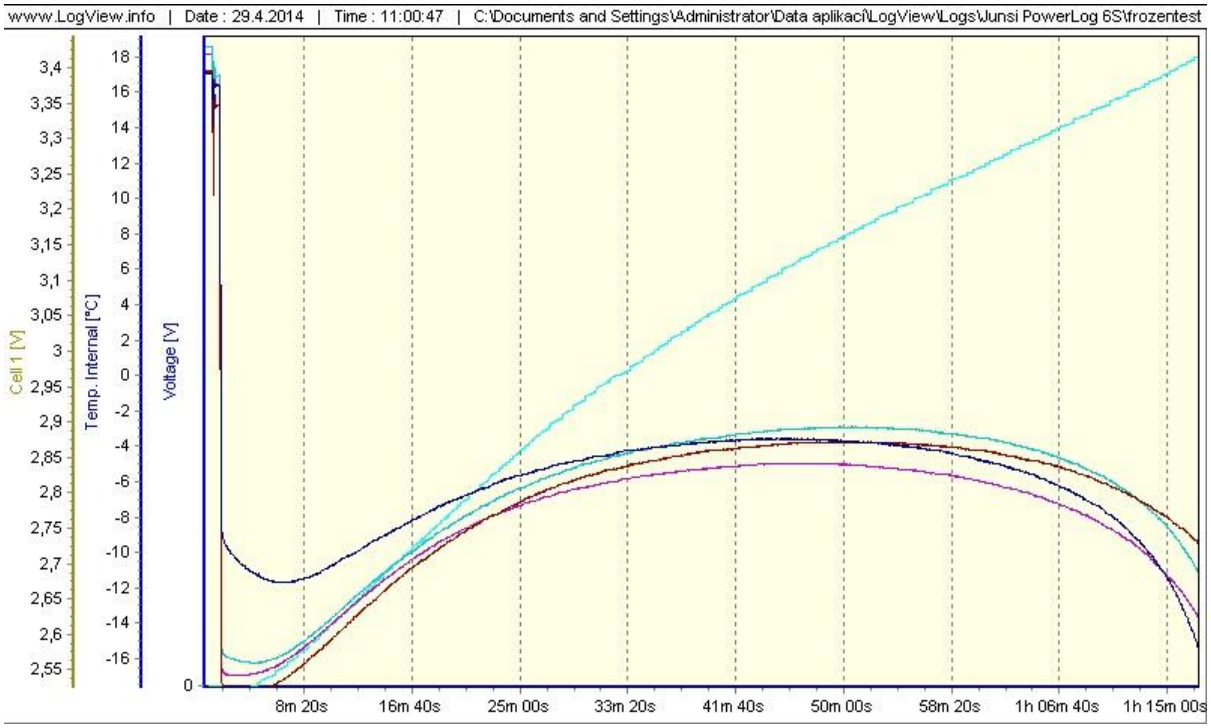
0.2C TESTS RESULTS: Internal temperature of LiFePo4 rises even under very low current. Therefore it is possible to use LiFePo4 cells for low-temperature applications.

Test 3: Discharge with constant current 0.5C (45A):



Findings: Internal temperature of LiFePo4 cells is rising under the load more rapidly than in previous tests. Voltage of individual cells also rises more noticeably.

Test 4: Discharge with constant current 0.5C (45A), insulated:



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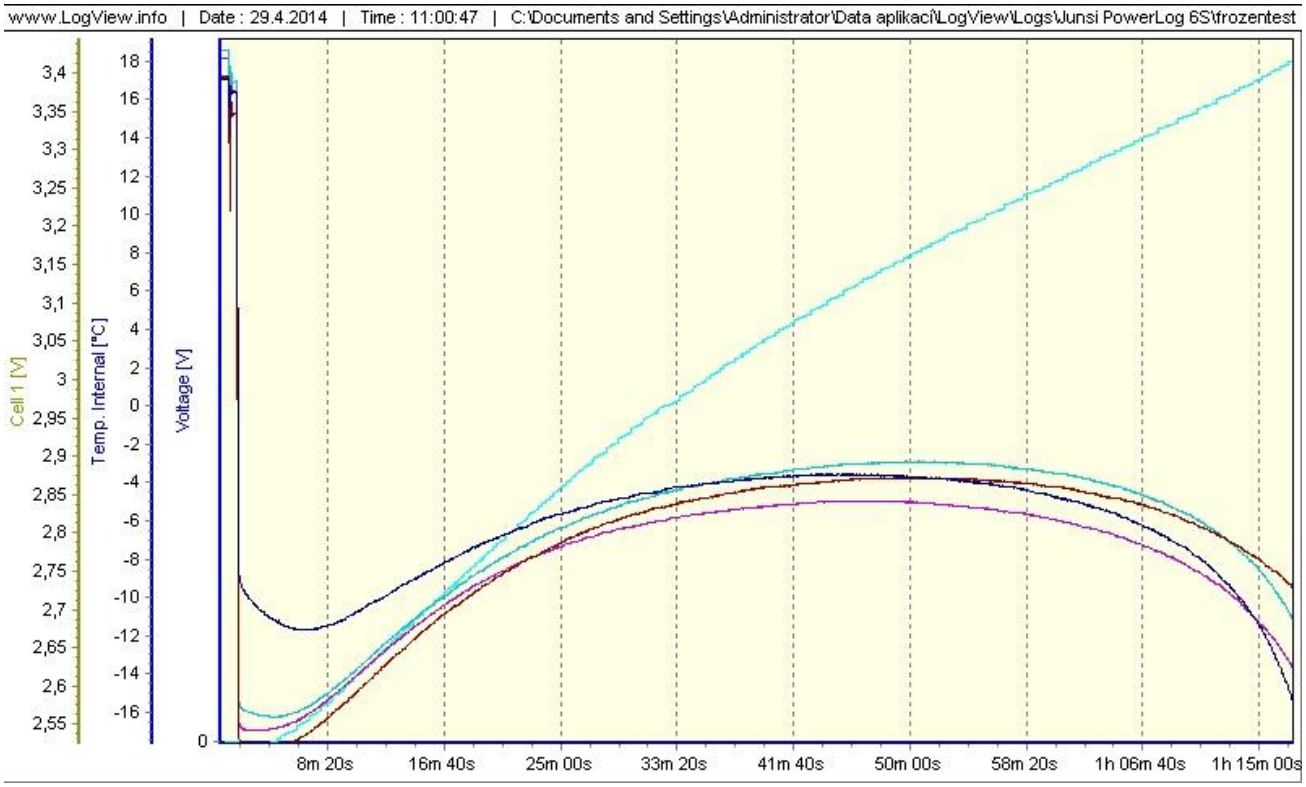
Findings: The influence of the insulation is more noticeable the more current we take from the battery. With higher current battery warms faster. With insulation the results are even better.

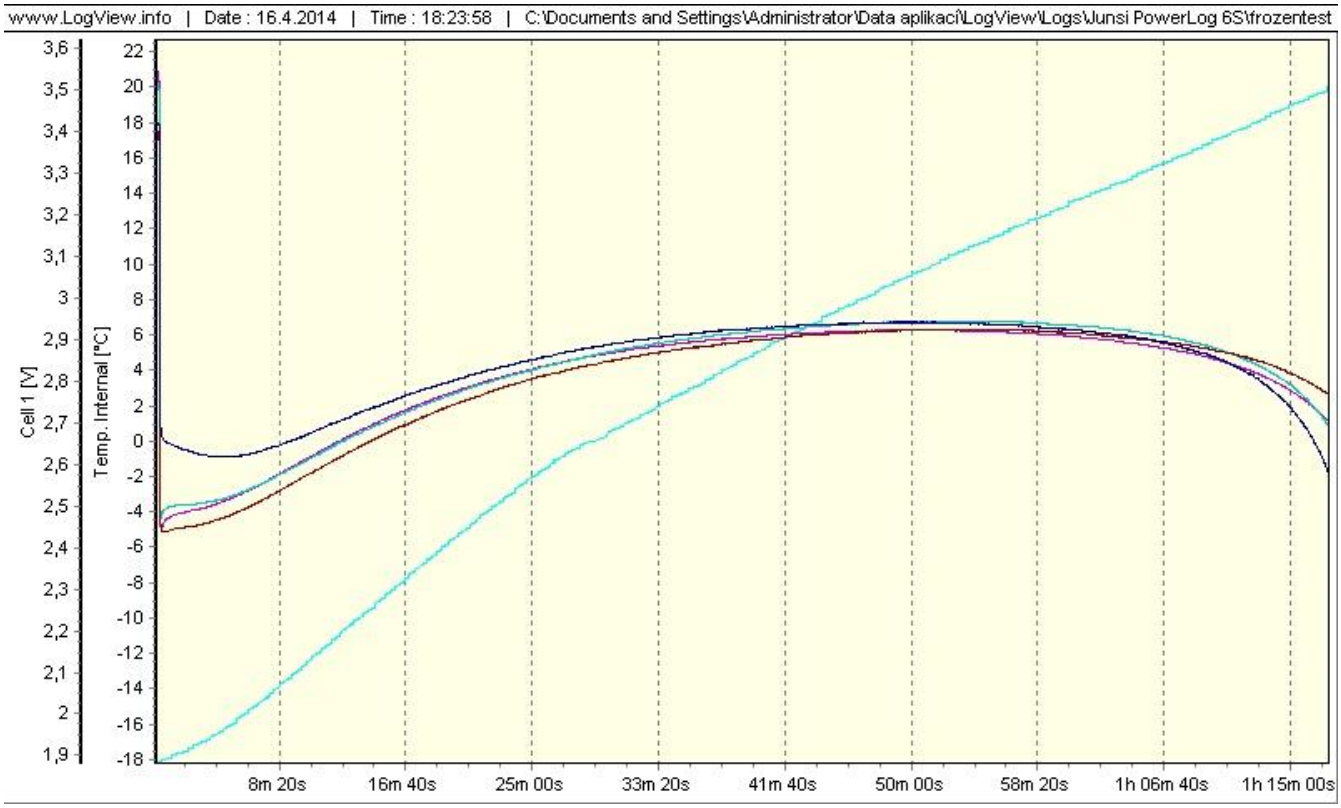
0.5C TESTS RESULTS: With higher current both temperature and voltage of the cells rises more rapidly, but will not go under 2.5V per cell @ 0.5C.

Test 5: Discharge with constant current 0.7C (65A):



Findings: Under 0.7C current the cells heats internally very quickly. Cells reached 0 °C in 33 minutes. This is significantly faster than in previous tests (3 hours, 54 minutes for 0.2C and 1 hour under 0.5C).

Test 6: Discharge with constant current 0.7C (65A), insulated:



Findings: The cells reached 0°C in approximately 33 minutes, which is the same result as in case of non-insulated battery pack. Cells heats up very quickly and the influence of insulations is therefore not so obvious. Under less temperature the insulation influence would started to appear again.
At the beginning of discharging process voltage decreased under 2.5V per cell.

COMPLETE TEST RESULTS:

Under freezing conditions LiFePo4 cells shows **very positive behavior**. The **higher the load** is, the **faster their internal temperature and voltage rises**. Temperature of the LiFePo4 cells rises under the load **no matter how small current** is. If the currents are too low to heat up the cell, it is possible to **improve the results by using insulation**.
Cells used for our tests were 2011 Winston cells with hundreds of cycles behind them. Even new cells are however **not recommended** to be discharged more than **1C**, because even with insulation the voltage will drop below allowed **MIN** voltage level (2.5V/cell). Discharge capabilities under freezing conditions might be **even more improved** by using appropriate heat elements - **heat blankets, heating wires, etc**.

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