ACTIVE TEMPERATURE CONTROL OF LI-ION BATTERY

Project Reference No.: *47S_BE_1776*

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Keywords: EDVs- Electric devices.

1. **Introduction:** This project defining the thermal or temperature management of lithium-ion battery in electric vehicle. The modelling of lithium-ion batteries is fundamentally crucial for thermal management systems, and are progressively becoming compelling in its rudimentary understanding on thermal attributes. The aim of this project is to propose an active temperature control to equalize the distribution of battery. A constant charging and discharging of the battery must escalate the temperature inside the lithium-ion battery. This project provides a review based on the electrical and thermal characteristics of batteries and how they are affected by the operating temperature, analyses the relative merits and specific purposes of different cooling or heating methods to remove the generated heat, and keep the temperature uniform has become a challenge because of the high requirement of gravimetric and volume energy in EDVs. Several cooling methods have been proposed. This project considers direct liquid cooling method and compared the results with static cell temperature. Due to high reliability and cost effectiveness lithium- ion batteries find their widespread use in electric vehicles applications. In this project we are using Water Ethylene Glycol as a liquid media gives the better thermal cooling of the battery cell. Which ultimately results in better cell life, for their high energy density, high efficiency, super conductivity.

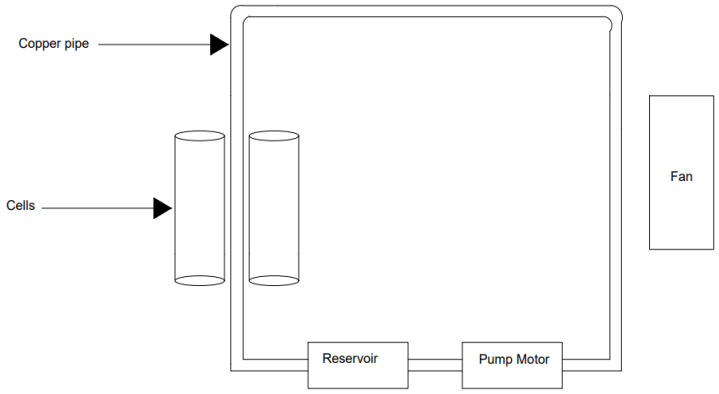
Reference

M. Mohmoud, I. M. and E. H. a. , "A review on recent key technologies of

li-ion battery thermal manegment: External cooling system," *science Direct,* p. 15, 2022.

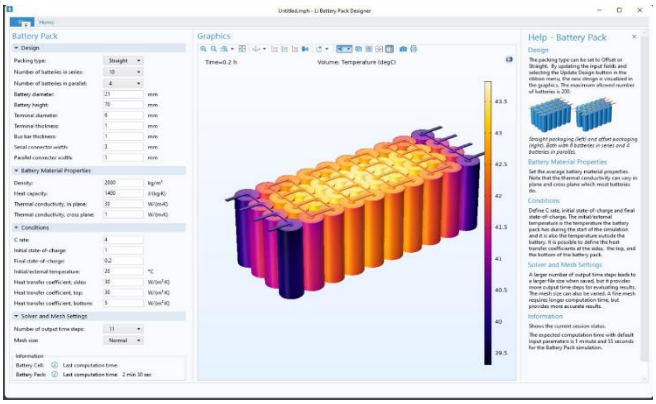
Nivaedita, j. s. and s. m. , "Thermal management of li-ion battery in electric vehicle," *IRJET,* vol. 9, no. 5, p. 4, 2022.

2. **Objectives:** The aim of this project is to control an active temperature and to equalize the temperature distribution of the lithium-ion-battery. Preventing the battery from overheating, which can lead to thermal runaway and even fires or explosions. Optimizing the battery's performance by keeping it within the ideal temperature range, typically between 20-30°C (68-86°F). Prolonging the battery's lifespan by reducing the impact of temperature extreme which can accelerate degradation. and maximizing the battery's energy efficiency by operating it at the idealtemperature.
3. **Methodology:** To ensure longevity and proper functioning of the battery, battery cooling system is implemented. The cooling system maintains the battery temperature below room temperature. The cooling system consists of water and ethylene glycol which act as coolant, 6mm copper pipes, temperature sensor DS18031, PID Controller and DC 12V 0.11A brushless fan combination 12V DC pump motor and a temperature control relay-based module. The copper pipes having a diameter of 6mm is incorporated between the vacant space of battery. Since copper is highly conductive, it helps to dissipate the heat away from the battery. A temperature control module is incorporated into the system to detect when the average temperature exceeds 30 degrees Celsius. When the module detects a temperature above this threshold, it automatically activates the pump motor and coolant will start to flow inside the copper pipe. As the battery cells produce heat during operation, the liquid coolant absorbs this heat through direct contact with the cell modules. The heat is transferred from the cells to the coolant. The coolant then returns to the battery pack, completing a continuous cooling cycle. The process repeats as long as the battery is in operation.

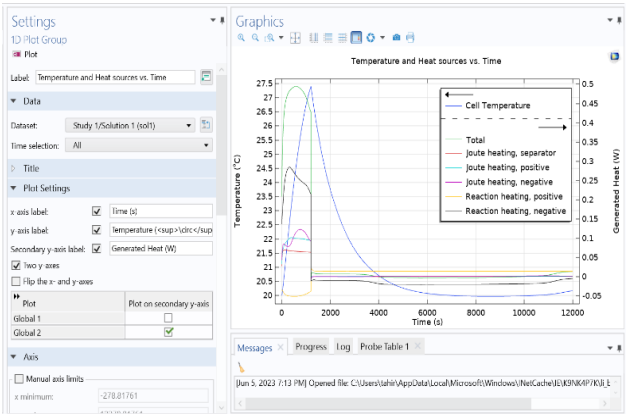


4. Results and Conclusion:

Design of battery pack:



COMSOL Software output:



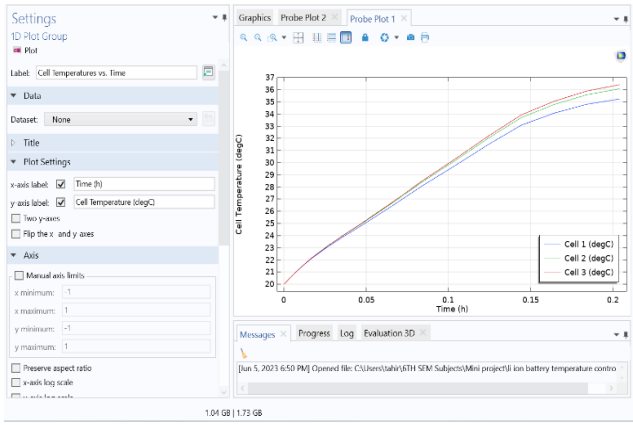
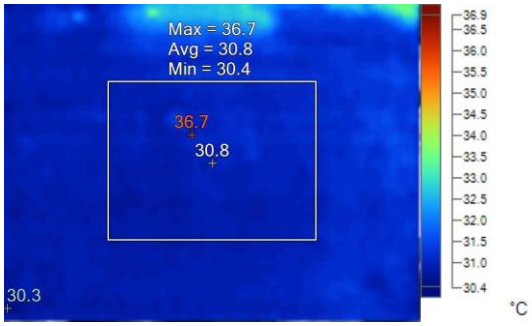


Fig 2.1 Shows graphical representation between temperature and heat source versus time and temperature versus time (h).

Fig 2.2 Shows graphical representation between cell temperature.

Thermography output:

Ethinyl glycol with load:



IR_08879.IS2 **Visible light image**

4/16/2024 4:34:02 PM

Image Information

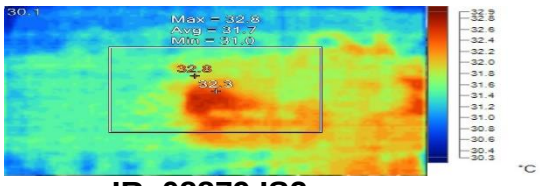
Camera Model	TiS20+ MAX
IR Sensor Size	120 x 90
Camera serial number	TiS20+ MAX-21080031
Camera Manufacturer	Fluke
Image Time	4/16/2024 4:34:02 PM
Distance to Target	1.00m

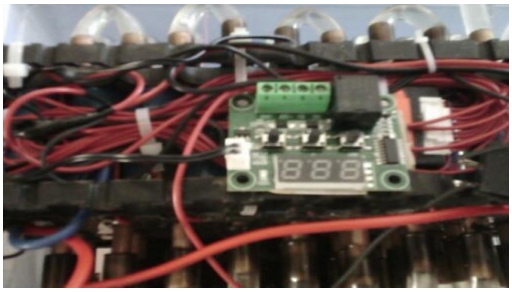
Main Image Markers

Name	Avg	Min	Max	Emissivity	Background
Centerbox	30.8°C	30.4°C	36.7°C	0.95	30.0°C

Name	Temperature	Emissivity	Background
Centerpoint	30.8°C	0.95	30.0°C
Hot	36.7°C	0.95	30.0°C
Cold	30.3°C	0.95	30.0°C

Water with load:





IR_08879.IS2
Visible Light Image
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Main Image Markers

Name	Avg	Min	Max	Emissivity	Background
Centerbox	31.7°C	31.0°C	32.8°C	0.95	30.0°C

Name	Temperature	Emissivity	Background
Centerpoint	32.3°C	0.95	30.0°C
Hot	32.8°C	0.95	30.0°C
Cold	30.1°C	0.95	30.0°C

Conclusion: The temperature control of lithium-ion batteries is crucial for their safety and performance and the lithium-ion batteries should be ideally stored in cool, dry conditions at a temperature of 15°C. By using water ethylene glycol, the whole battery pack is more cooled than water cooling. The cooling capacity of a water solution can be further improved by the appropriate addition of additives. The thermal conductivity of the coolant can be raised by adding a small quantity of liquid metal or nanoparticles. It is particularly advantageous to minimize energy consumption because the system may have the same cooling effect at a lower flow rate because to the improvement in thermal conductivity. To cut costs, more research on liquid metals and Nano fluids should be done in the future.

5. **Innovation:** In this project the innovation is we are using coolant as water ethylene glycol. Water ethylene glycol is more efficient as compare to the water and lifespan of the battery will increase. The main innovation of this project is to give better cooling by using water ethylene glycol. A temperature control module is incorporated into the system to detect when the average temperature exceeds 30 degrees Celsius.

6. **Scope of the future work:** The study can be done if the temperature of the battery lies at 0 degree or less than 0 degree. Battery pack design is modifiable. Different liquid supply lines can be used other than copper pipe. coolants can be used for cooling the battery. We can reduce the weight of the battery pack by changing the battery's specification.