EV Model Battery Calculations

Project synopsis submitted in partial fulfilment

for the Award of

CERTIFICATION

in

Electric Vehicle Course

by

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CHAPTER 1

List of Figures:

CHAPTER 2

PROJECT DESCRIPTION

Objective

The main objective of the Project is to develop a battery system for a new electric vehicle which satisfies the given range in a single charge, motor power with the help of given values of energy consumption, nominal voltage and nominal capacity of each cell and battery pack voltage.

Expected Result

Through this project we have to find the following parameters by performing some calculations:

- Battery Capacity needed to provide sufficient power and range
- Number of series cells needed to achieve the battery pack voltage
- Number of parallel cells needed to achieve the battery pack capacity

Pre-requisites

For completing this project we have an idea about the following topics:

- Basic knowledge on battery pack terminology
- Idea about series and parallel connection
- Basic mathematics
- Basic knowledge on EV and EV Battery

CHAPTER 3

REQUIRED INPUT PARAMETERS AND CALCULATIONS

Input Parameters

The Input Parameters considered for this Project are:

- The Vehicle will have a Range of 250 miles on a single charge
- The Motor Power is considered as 120 KW

Assumptions

- The Energy Consumption of the Electric Vehicle is 0.2 KWh per mile
- The Nominal Voltage of each cell is 3.7 V
- The Nominal Capacity of each cell is 2.5 Ah
- The Nominal Battery pack Voltage is 350 V

Calculations

Battery capacity = Energy Consumption per mile x Given Range

= 0.2 x 250

= 50 KWh

Therefore, the desired Battery Capacity to satisfy the given range on the single charge is 50 KWh.

To find the Battery Capacity in Ampere hour,

Battery Capacity (Ah) = Battery Capacity (wh) / Pack Voltage

= 50000/350

= 142.85 Ah

Number of Cells in Series, N_{Series} = Pack Voltage / Nominal Voltage

= 350/3.7

N_{Series} = 94.6 = 95 Cells

Therefore, the Number of cells should have to arrange in Series are 95 Cells.

Number of cells in Parallel $N_{Parallel}$ = Pack Capacity / Nominal Capacity

= 142.85 / 2.5

$N_{Parallel}$ = 57.14 = 57 Cells

Therefore, the Number of cells should have to arrange in Parallel are 57 Cells.

Total Number of Cells in the Battery Pack = $N_{Parallel}$ x N_{Series}

= 95 x 57

= 5415 Cells

Therefore, the Number of cells should have to arrange in Battery Pack are 5415 Cells.

Since, we have to Satisfy the Motor Requirements

Power of Motor (W) = Pack Voltage (V) x Current (I)

120000 = 350 x I

Current (I) = 120000 / 350 = 342.85 A

Therefore, the Current required to produce the power for motor is 342.85 Amperes.

To find the Number of parallel cells we can also use,

$N_{Parallel}$ = Current required for motor / Maximum Discharge Current

57 = 342.85 / Maximum Discharge Current

Maximum Discharge Current of a cell = 342.85 / 57 = 6.01 Amperes

Therefore, the Maximum Discharge Current of a cell should be 6.01 Amperes.

CHAPTER 4

OUTPUT PARAMETERS

The expected Output Parameters calculated based on the given range and motor power from the Project are:

- **The Battery Capacity to achieve desired range on a single charge**

  It defines that the amount of energy required to extract from the battery of an Electric Vehicle to achieve the desired range when the battery is charged for a Single time.

- **Number of series cells required for the battery pack**

  It defines that the number of cells required to arrange in the series manner where the total voltage is equal to the sum of all voltages of individual cells and total capacity is equal to the individual cell capacity to achieve the battery pack voltage.

- **Number of parallel cells required for the battery pack**

  It defines that the number of cells required to arrange in the parallel manner where the total capacity is equal to the sum of all capacities of individual cells and total voltage is equal to the individual cell voltage to achieve the battery pack voltage.

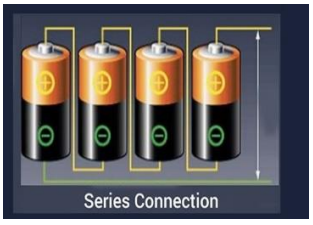

Fig-1

Fig-3

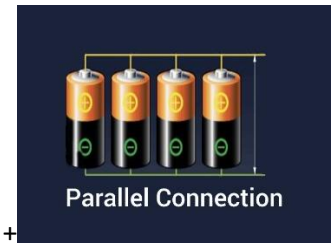

Fig-2

CHAPTER 5

RESULT

Since, we have calculated all the required parameters of a battery pack as mentioned above in the project by using some basic standard formulae. We have calculated the capacity of a battery to achieve the given range of 250 miles and also for motor power of 120 KW and also calculated the number of series and parallel cells required in a battery pack to achieve the battery pack voltage. The Results are tabulated below.

S.No	**Parameter to be Calculated**	**Result obtained by Calculation**
1.	Battery Capacity for range and motor power	50 KWh
2.	Number of cells in Series	95
3.	Number of cells in Parallel	57
4.	Current required for motor to produce power	342.85 A

Fig-4

From the above table we can clearly say that the battery capacity of a given electric vehicle should be 50 KWh to achieve the desired range of 250 miles in a single charge and to generate motor power of 120 KW. The battery pack should consist of 5415 cells in which 95 are should be in series and 57 are should be in parallel to achieve the battery pack voltage of 350 volts. The amount of current required to generate the Motor power of 120 KW is 342.85 Amperes when the voltage of a back is 350 volts.

CHAPTER 6

OBSERVATIONS & CONCLUSION

From the Observation of the results mentioned in Fig-4 we can conclude that to manufacture of an Electric Vehicle which will have the range of 250 miles on a single charge and a motor power of 120 KW with an energy consumption of 0.2 KWh per mile, with nominal voltage of 3.7 V, nominal capacity of 2.5 A and with a battery pack voltage of 350 V, the battery capacity should be 50 KWh, Number of cells in series and parallel should be 95 and 57 respectively with a total number of 5415 cells.

By performing these calculations, we designed a battery system that is able to meet the desired range on a single charge and Power requirements of a Motor that offer significant benefits.

References

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https://x-engineer.org/ev-design-battery-calculation/

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