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Determination of Specific Heat Capacity of a Battery

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Introduction:

Specific heat capacity is defined as the amount of heat that must be added to one unit mass of a substance to cause a temperature increase of one unit temperature in the substance. The unit for specific heat capacity is energy divided by both temperature and amount of substance, usually mass (Ex. J/g*C). High specific heat indicates a substance that is less prone to temperature change, whereas low specific heat indicates a material that is prone to temperature change. Specific heat capacity can vary with temperature and pressure, as material properties change.

In order to design and implement safe battery packs and thermal management systems, it is critical to know the specific heat capacity of the individual cells within the battery pack. Specific heat capacity information is not usually given by cell manufacturers, and therefore it must be determined experimentally. Specific heat capacity is a useful parameter because it can be used to predict how much the temperature of the cell will rise when heat is applied to the cell. With this knowledge, steps can be taken to ensure that the cell does not reach its onset temperature. The onset temperature of a cell is the temperature at which the cell begins to self-heat, which can lead to a thermal runaway reaction. If a thermal runaway reaction occurs, the battery pack can ignite which can lead to serious physical and monetary harm.

Belmont Scientific has designed and developed cell specific holders with built in heaters which are then heated inside an Accelerating Rate Calorimeter (ARC®). This method is applicable for various cell sizes and formats like coin cells, pouch cells, prismatic cells, and cylindrical cells. For more information, please contact Dr. Surendra Singh at singh@belmontscientific.com

Results:

Table 1. Experimental Results

	Specific heat capacity (Joules/g*C)						
Sample Description	**30 ºC**	**40 ºC**	**50 ºC**	**60 ºC**	**70 ºC**	**80 ºC**	**90 ºC**
Aluminum (Theoretical)	0.896	0.901	0.906	0.911	0.916	0.921	0.926
Aluminum Cylinder 21700, 65.88g	0.924	0.925	0.926	0.927	0.928	0.929	0.930
Cylindrical Cell, INR, 21700, 4.1V, 69.91g	0.811	0.812	0.813	0.814	0.815	0.816	0.817

** Largest error between theoretical and measured specific heat capacity of Aluminum was 3.2%. Theoretical values were taken from Perry's Chemical Engineers' Handbook, 7th Edition.*

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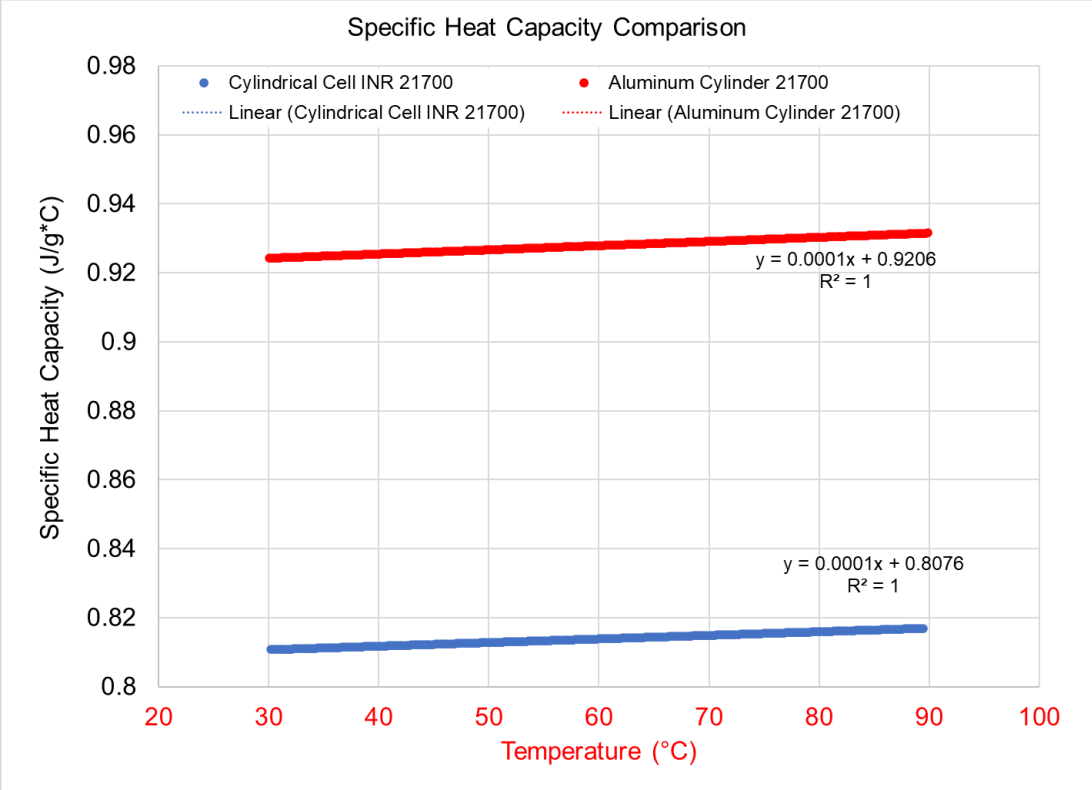

FIGURE 1. PLOT OF RESULTS (CYLINDRICAL CELL AND ALUMINUM CYLINDER)

For more details, please contact Surendra Singh at singh@belmontsceintific.com

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