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CASE STUDY

ENHANCING BATTERY TEMPERATURE PERFORMANCE THROUGH TRIZ

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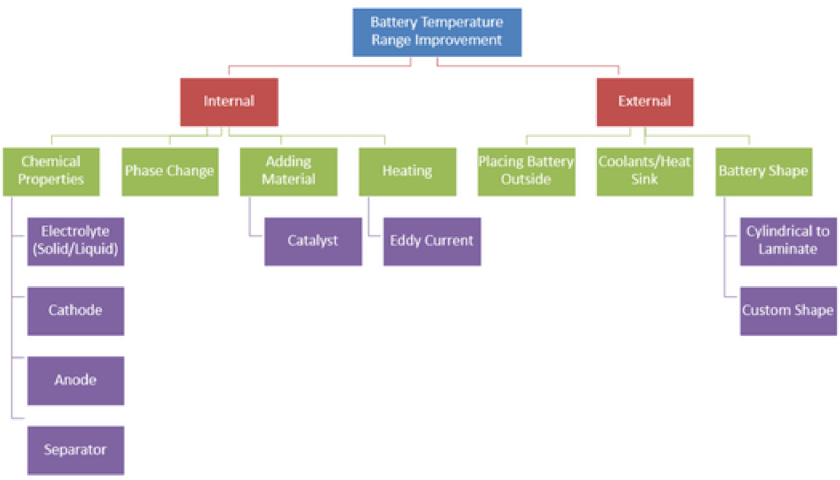
ENHANCING BATTERY TEMPERATURE

TRIZ, Theory of Inventive Problem Solving, is a systematic and structured approach to addressing challenges, equipped with an array of tools. This scientific methodology relies on the analysis of historical patterns of invention and evolution.



CHALLENGE

The challenge was to expand the temperature working range of cylindrical lithium-ion battery packs used in battery-powered tools. These batteries had limitations in both cold and hot temperatures, affecting their efficiency and lifespan. Current battery management systems monitor and control battery temperature but result in limitations on battery usage.

SOLUTION

The solution involved applying the Theory of Inventive Problem Solving (TRIZ) principles to identify and address the issue. Several TRIZ principles were applied:

Segmentation: The battery pack was divided into smaller parts for more effective temperature monitoring. A stepwise segmented charging technique was implemented for lithium-ion batteries, which induced thermal management by low-temperature internal heating.

Moving to a New Dimension: Battery shape and orientation were modified to enhance heat dissipation. Changes in the battery's physical state were explored to optimize temperature regulation.

Transformation of Physical and Chemical States: The study investigated using multi-functional electrolytes that could change physical states to regulate battery temperature effectively.

Use of Phase Transitions: Phase change materials were explored to maintain battery temperature within an optimal range.
Composite Materials: The use of composite materials for battery components, such as electrodes and electrolytes, was considered to improve thermal performance.

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RESULT

Implementing these TRIZ principles led to significant improvements in the battery temperature working range. The batteries could now operate more efficiently in both extremely cold and hot conditions, increasing their overall performance and lifespan. Additional benefits included cost reduction, maintenance of equipment size and shape, and reduced weight.

CONCLUSION

The application of TRIZ principles provided innovative solutions to the challenge of expanding the temperature working range of lithium-ion battery packs. By segmenting the battery, modifying its shape and orientation, and leveraging phase change materials and composite materials, the batteries could perform optimally in a wider range of temperatures. This not only improved the efficiency of battery-powered tools but also offered economic and practical advantages. TRIZ principles proved to be a valuable problem-solving methodology for enhancing battery technology.