

AdvanceCore™ Thermoelectric Heating and Cooling System in Helmer Scientific Pro Line Countertop Platelet Storage Systems: Technology and Benefits

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INTRODUCTION

Safe and secure platelet storage is critical for life-saving platelet products. Ensuring temperature-sensitive platelets are appropriately safeguarded and kept in constant motion is necessary to ensure patient safety, support blood bank compliance and prevent economic loss.

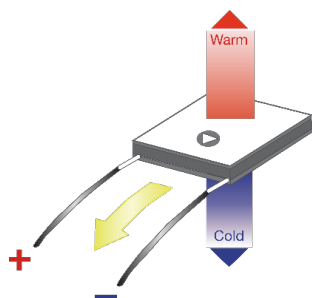
New heating and cooling technology using a solid-state thermoelectric system provides the required performance for high-end platelet storage systems while supporting new environmental standards. This paper explains the technology and describes the benefits for platelet storage using AdvanceCore™ technology in Pro Line Countertop Platelet Incubators and Agitators.

OVERVIEW

Thermoelectric Heating and Cooling Technology

Solid-state thermoelectric cooling systems are an innovative alternative to traditional cooling technology for clinical laboratory equipment. Applications for thermoelectric cooling have been limited by the efficiency of the technology due to the temperature needed (set point) versus the ambient temperature. This is especially important when considering the demanding performance requirements needed for the storage of valuable and life-saving platelet products. With new advancements in materials and manufacturing processes, thermoelectric heating/cooling technology has been proven to be effective and reliable as the cooling system for Helmer Scientific Pro Line Platelet Storage Systems.

Thermoelectric Device History



In 1834, Jean Peltier performed experiments passing an electric current through a closed circuit of 2 dissimilar metals. This work demonstrated that heat energy can be absorbed by one dissimilar metal to create a cooling effect and discharged by the other dissimilar metal to create a heating effect, known as the Peltier effect. These experiments were the foundation of modern thermoelectric technology in which a Peltier device allows electricity to flow through material to allow one side to warm, and the other side to cool. Used as an alternative to compressor-

based refrigeration for cooling applications, thermoelectric cooling devices have had limited use in mainstream medical-grade refrigeration due to expense and efficiency. More recently, applications have expanded for thermoelectric cooling as new materials and methods have become available to create more efficient devices.

AdvanceCore™ Thermoelectric Technology

The Helmer Scientific Pro Line Platelet Storage Systems leverage advances in solid-state thermoelectric heat pump technology to create a system that provides reliable, efficient, variable capacity operation for the storage of platelets. AdvanceCore™ is a specially designed solid-state heating/cooling system that uses thermoelectric heat pump technology with multiple redundant heat transfer pipes to bi-directionally transfer heat from inside the cabinet to the room depending on ambient conditions. A Thermoelectric Module (TEM) consisting of variable capacity Peltier heat pump devices, heat exchangers and heat transfer pipes is used with internal and external fans that create airflow across the TEM to efficiently transfer heat out of or into the unit.

The AdvanceCore™ heating/cooling system is designed to heat and cool only as needed to achieve and maintain the optimal temperature for platelet storage. The external variable speed fans run just enough to match dynamically powered TEM capacity needs to efficiently move the heat needed to maintain the internal set point. The heat is transferred through solid-state Peltier heat pumps and multiple heat pipes that each contain water and are HFC-free, eliminating gases targeted under the US EPA SNAP program, Paris Climate Agreement, Montreal Protocol and EU F-Gas Initiative. Together this creates an increased efficiency temperature control system that reduces energy consumption by up to 80-90% over traditional systems as well as reducing noise levels. The technology has been optimized for countertop platelet storage systems and is the ideal technology for this specific application.

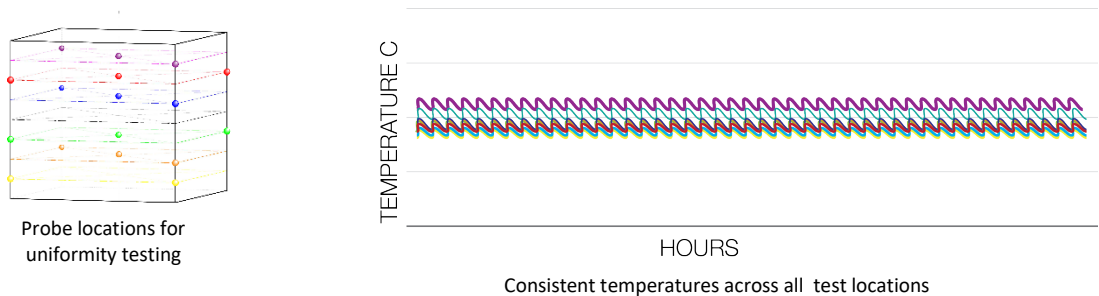
IMPROVEMENTS FOR BLOOD BANK/BLOOD CENTER APPLICATIONS

As refrigeration technology improves, benefits increase for blood bank and blood center staff who are directly using the equipment. Utilizing AdvanceCore™ technology with a solid-state thermoelectric system based on Peltier technology and no hydrofluorocarbons (HFCs) provides multiple performance benefits:

Temperature Performance

Temperature uniformity is the measure of temperature consistency across all usable areas of the cabinet. By providing tight uniformity, a stable storage environment is created that ensures platelet products are safely stored and remain efficacious for successful transfusion. Precise uniformity ensures there are no hot or cold spots within the cabinet that may allow product to go out of range. This can create both safety and regulatory concerns. Therefore, the use of higher quality storage environments is vital. AdvanceCore™ technology used in Helmer Scientific Pro Line Platelet Storage Systems provides temperature uniformity of $\pm 1^{\circ}\text{C}$, confidently ensuring blood bank and transfusion personnel that all storage locations may be used for the storage of these sensitive and precious life-saving products.

Figure 1
PC Pro Incubator Demonstrated Temperature Uniformity
PC900-Pro with PF48-Pro, 22°C set point

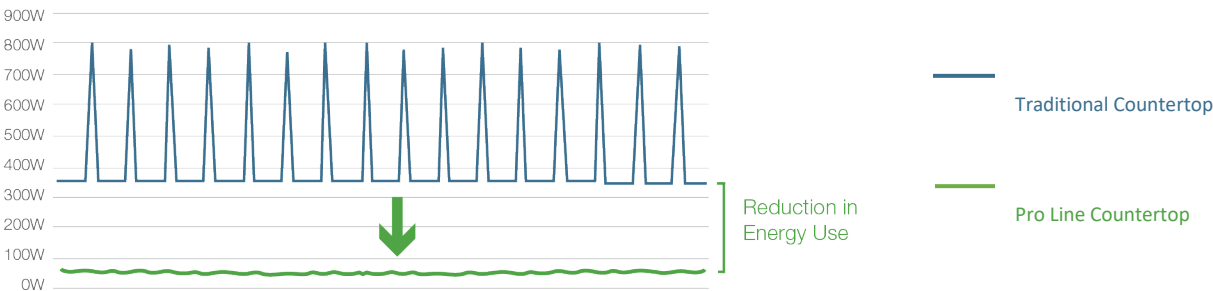


Energy Efficiency

AdvanceCore™ technology automatically heats and cools only as needed to achieve and maintain the optimum temperature for platelet storage. This significantly reduces energy consumption and increases efficiency. Helmer Scientific Pro Line platelet storage systems realize up to an 80-90% decrease in energy use over traditional incubators. For example, the PC900-Pro platelet incubator with the PF48-Pro platelet agitator housed inside was tested in an environmental chamber at specified ambient conditions and at a specified temperature and humidity set point. This protocol challenged the unit over a period of many hours with multiple tests completed.

The results of the evaluation demonstrated that the PC900-Pro incubator with the PF48-Pro agitator only used 1.5 kWh/day of energy, which represents a reduction of 88% in the amount of energy used as compared to a conventional unit of the same size, tested using the same protocol.

Figure 3
Decreased Energy Utilization Between Comparable Platelet Incubator Models



Shows power consumption over time of Pro Line incubator with dynamic power system running AdvanceCore™ technology compared to an incubator using a pulsed on/off compressor.

Sustainability

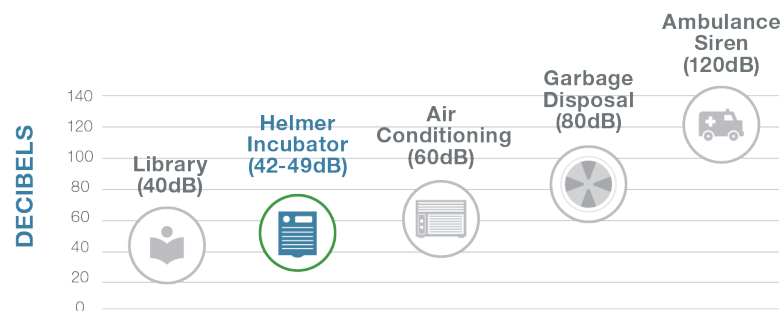
The Pro Line AdvanceCore™ thermoelectric heating/cooling system transfers heat through solid-state heat pumps and water containing transfer pipes, all of which are HFC-free. This eliminates gases targeted under the Paris Climate Agreement, Montreal Protocol, EU F-Gas Initiative and US EPA SNAP program. Foaming components are also non-CFC, non-HFC, environmentally friendly and US EPA SNAP compliant. The Pro Line is future-ready and helps blood banks and blood centers meet current and new environmental standards to reduce the use of HFC refrigerants.

Noise

The reduction of noise in healthcare facilities, especially patient care and staff areas, is a priority. Medical researchers have concluded that the physiological and psychological fallout of noise exposure can slow recovery rates, lengthening hospitals stays. The average noise level in US hospitals has been reported to often exceed 50 decibels and peaks at around 90 decibels (1). This is the equivalent of busy traffic or a power lawnmower. Investing in quieter equipment is one method health care facilities are using to address this concern.

Helmer Scientific AdvanceCore™ technology is designed to reduce the sound profile. The use of solid-state heat pumps which transfers heat through water reduces noise levels. In addition, variable-speed exhaust fans that adjust as needed further reduce noise levels. When evaluating platelet storage systems with AdvanceCore™ technology, noise was reduced by 10 decibels as compared to traditional platelet systems. Every increase of 10dB on the scale is equivalent to a 10-fold increase in sound intensity or 2 times the perceived loudness. Therefore, a 10-fold reduction in noise is a significant benefit to the staff. The Helmer Scientific Pro Line Platelet Storage System noise is equivalent to a quiet library.

Figure 4
Comparison of Noise Output



Reliability

Reliability is routinely cited as the most important attribute in the selection of medical laboratory equipment. Avoiding downtime and unplanned service visits is critical in maintaining efficiency within the facility. The AdvanceCore™ system is designed to leverage

a dynamic power system; redundant, independent heat transfer pipes; dual-AdvanceCore™ solid-state heat pump modules; and dual-exhaust fans to create a highly-reliable product.

Helmer Scientific Pro Line Incubators also include the i.C3® Information Center which provides constant monitoring and real-time information on current operating conditions. The AgiTrak™ agitation performance monitoring system optimizes platelet storage and monitoring compliance and provides diagnostics to monitor trends in performance.

Selecting brands with proven performance improves reliability and total cost of ownership over the life of the product. Helmer Scientific Pro Line Storage Systems have been designed and tested for long-term reliability and performance under ISO 13485 certified, FDA GMP compliant R&D processes. They are safety tested to the IEC60601 CB scheme and are fully FCC and CE certified. These systems carry a 10-year minimum useful life as well as a 10-year service and support commitment.

CONCLUSION

AdvanceCore™ is a specially designed solid-state heating/cooling system that uses thermoelectric (Peltier) heat pump technology with multiple redundant heat transfer pipes to bi-directionally transfer heat from inside the cabinet for the secure storage of platelets. Evaluations of AdvanceCore™ heating/cooling technology have demonstrated temperature performance and reliability, energy efficiency, and noise reduction necessary for the secure storage of platelets at room temperature (+22°C), as well as addressing the rapidly changing global environmental regulations. Helmer Scientific is pleased to offer this technology in Pro Line Platelet Storage Systems.

REFERENCES

1. "High Hospital Noise Levels Lead to Slower Patient Recovery." - The Advisory Board Daily Briefing. Advisory, n.d. Web. 08 July 2016.