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CRYOSTAT ENERGY CONSUMPTION

IMPACTS OF ENERGY SAVING MODES

ANDY EVANS - GREEN LIGHT LABORATORIES LTD

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INTRODUCTION

Cryostats are used in surgical diagnostic procedures and disease research to cut histological tissue sections. The set temperature employed by the cryostat will vary depending upon the tissue being cut. Typically, the cryostat chamber temperature will be set from -20°C to -30°C .



Figure 1. Bright Instruments OTF7000 cryostat.

TESTING THE UNITS

All units were tested at the MRC Laboratory of Molecular Biology in Cambridge. The laboratory spaces used were air conditioned with an ambient temperature of 23.3°C ($\pm 0.3^{\circ}\text{C}$). This case study used the Logically Wireless Monitoring system utilizing their energy monitors, temperature probes and online platform to record all the data. The energy monitors employed had an accuracy of $\pm 1\%$. Cryostats, like many items of cold temperature set equipment, are left on, rarely switched off.

Cryosectioning requires very precise temperature control; and a cryostat may take 2-3 hours to reach a stable operating temperature, waiting for this point may not be convenient nor practical for end users.



Loading & Inventory

Also, when a cryostat has been in use, a layer of frost can form inside the chamber. If this layer of frost is thawed, the condensation formed often finds its way into the moving parts of the microtome. If this is then re-frozen without proper drying, ice can prevent proper movement of parts & damage the machine. This is often the reason as to why cryostats remain on.

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Two cryostats were energy-monitored to highlight their running costs. Both cryostats had their chamber temperature (CT) set to -25°C and their objective temperature (OT) set to -20°C. The results are shown in figure 2.

Model	Energy Consumption
Bright OTF7000	17.856 kWh/day
Leica CM3050S	18.701 kWh/day

Figure 2. Cryostat energy consumption with CT at -25 °C and OT set to -20°C.

ENERGY SAVING SLEEP MODE

Although cryostats will be left on 24/7, they are seldom used outside of daytime working hours. During non-working hours the Bright OTF7000 cryostat can be set into sleep mode. During this time the cryostat will hold a temperature of -10C(+/-3°C), preventing any thawing of any frost and reducing the energy consumption of the unit. The energy consumption of using this sleep mode was measured and the impact of using this mode under three scenarios is shown in figure 3.

Sleep Mode Program (ON-OFF)	Operational Hours	Energy Consumption	Energy Saved	Saving
7pm-7am (12 hours asleep)	8am-7pm (11 hours)	12.166 kWh	5.690 kWh	32%
5pm-7am (14 hours asleep)	8am-5pm (9 hours)	11.238 kWh	6.618 kWh	37%
5pm-8am (15 hours asleep)	9am-5pm (8 hours)	10.774 kWh	7.082 kWh	40%

Figure 3. Impact of using the sleep mode feature of the Bright OTF7000. There is a one-hour period required to cool down from sleep mode to -25°C CT and -20°C OT. Savings are compared to using the unit for 24 hours without any sleep mode as shown in figure 2.

The sleep mode offers energy saving to end users whilst protecting components from the negative impacts of re-frozen condensation upon moving parts. The energy saved is significant. A tall, ~250L lab freezer, set to -20°C will use approximately 1 kWh/day to operate. The energy saved by the sleep mode could therefore be used to operate 5-7 freezers for 24 hours.



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For further information on this study, or lab sustainability in general please contact **Andy Evans**,
office@greenlightlabs.co.uk, 07833 494727