TECHNICAL BULLETIN

OPTIMA X SERIES SOUND & ENERGY EFFICIENCY

Preparative ultracentrifuges are a staple in life science research labs. Beckman Coulter has long been a leader in useful innovations that aid in the discovery process and contribute to meaningful research. This paper details the technologies aimed at improving the laboratory environment.

Brilliance
at every turn.

BECKMAN COULTER

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Optima X Series Sound and Energy Efficiency

Improving the lab environment through thoughtful innovation.

Ultracentrifuges are tools that have long been used for basic and applied research. These tools are often placed in shared locations alongside multiple pieces of equipment used in the research effort. These include centrifuges, refrigerators and freezers, shakers, incubators, and other pieces of hardware. Taken together, they can contribute to a noisy environment and use a great deal of energy.

The next generation Optima X Series (the Optima XE and Optima XPN) ultracentrifuges address these issues in their design to reduce noise and energy use. The effect is an improvement in the overall lab environment. In fact, attention to customer needs for a quieter ultracentrifuge resulted in a Beckman Coulter technical innovation that reduces noise associated with resonant frequencies generated by ultracentrifuge drives. This breakthrough innovation resulted in a patent application (US patent pending). The breakthrough came from the fact that resonance frequencies occur during the operation of the drive. These resonances are often heard as a whining noise during operation. The new design results in significant reduction of these resonances, and thus eliminates much of the noise associated with running an ultracentrifuge.

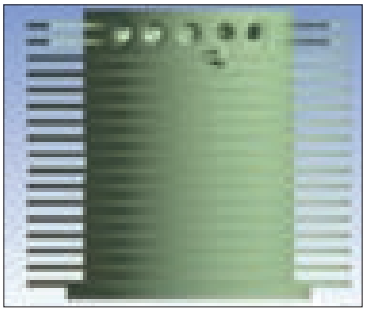

Figure 1: Conventional ultracentrifuge drive design.

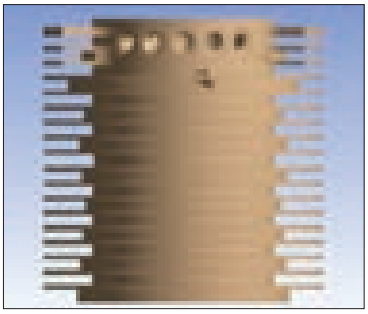

Figure 2: Optimized ultracentrifuge drive design.

High speeds involved in ultracentrifuge drives, and the resulting high rotational speeds of the drive stator, produce heat. Drive housings thus have cooling fins as an integral part of their design. The new Beckman Coulter breakthrough relies on two basic changes to the drive housing to greatly reduce the resonance. First, the structure was stiffened so that all structural resonant frequencies exceed two times the drive's maximum operating frequency: 100,000 rpm, or 3,333 Hz. While this reduced the problem, it was not sufficient in itself to solve the problem. Second, in contrast to the current uniform cooling fin design (see Figure 1), each fin was made a different shape. This gives each fin a unique resonant frequency that results in either no, or at most a very small number of, fins resonating at any given speed. Figure 2 illustrates the new design used to reduce the resonant noise.

Another area of concentration in the design of the Optima X Series is the efficient use of energy for the entire operational state of the ultracentrifuge. This means that power usage is considered in every operational mode, including: acceleration, deceleration, steady state (running), and most importantly, when the unit is powered on but not actually in use.

Let's concentrate on two of the most interesting operational modes. The first occurs when an ultracentrifuge rotor is decelerating to zero rpm from full speed at the completion of a run. The new Optima X Series ultracentrifuges were designed with regenerative braking to capture the energy generated during braking and return power to the grid, reducing the overall energy required to operate the system.

The second, and perhaps most interesting and important innovation, is the amount of energy consumption while the ultracentrifuge is powered on, but not in use (often called idle). This is a typical state for the units, and careful consideration was given to maximizing the energy usage in this state.

The new Optima X Series ultracentrifuges were designed to minimize energy usage while idling. To quantify the efficiency of the new Optima X Series, engineers performed experiments to measure energy consumption of our existing Optima L-100K, Optima L-100XP, and the

Hitachi WX 100. Efficiency was measured as the amount of electricity (measured in watts) consumed while idling. Figure 3 summarizes the findings.

The chart clearly shows the new Optima X Series excels at minimizing power consumption while idling. The Optima X Series is 56% more efficient than the current Optima L-100XP, 23% more efficient than the Optima L-100K, and 33% more efficient than the Hitachi WX 100.

Given the long service life of an ultracentrifuge, the customer will enjoy the benefit of lower operational costs as well as a minimized impact on the environment. Coupled with the reduced energy usage during operation, the benefits quickly multiply.

In summary, the new Optima X Series ultracentrifuges from Beckman Coulter were designed to meet the everyday needs of our customers. The centrifuges were developed using customer inputs, and the innovations were designed to improve the real world operating conditions of our customers.

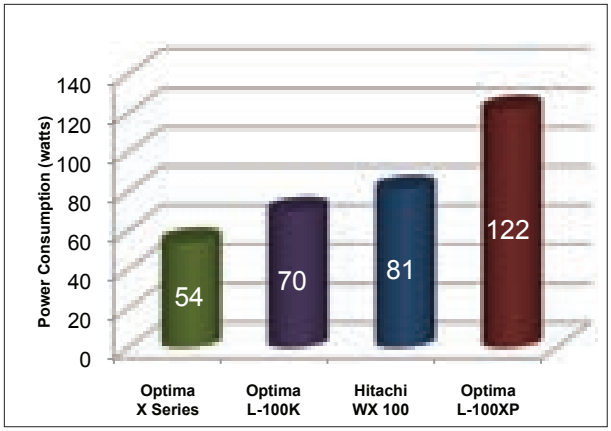

Figure 3: Ultracentrifuge energy efficiency in idle mode.

NOTE: The values shown are actual measured values. The published specification for the Optima X Series is 60 W.

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