DARWIN CHAMBERS

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Insect Rearing Chambers

Incubators used in the rearing of drosophila and other biological organisms often presents challenges to typical laboratory incubators. The acids inherent in the rearing of many specimens or their food can quickly corrode a standard refrigeration evaporator, even if they are "epoxy-coated" High humidity exacerbates the issue, as droplets of concentrated acid will collect on the cooling components. Other companies use an evaporator that can have thousands of square inches of vulnerable evaporator surface, where one very small leak will require expensive repair—that may include many other components of the refrigeration system, other than the evaporator itself, due to compromised oil (modern refrigeration oils are very hygroscopic) in the system. Anyone familiar with Drosophila storage, for example, will understand that the propionic acid present in the chamber can render a new, conventional incubator useless in as little as 6 months.

Obviously, the above scenario is a primary concern to any researcher, but there are many other issues to be concerned about. Because most types of incubators are produced for a very wide audience, many of the details are not ideally suited for the needs of the insect researcher. Details that are often overlooked include: ease of cleaning (flies or mosquitoes inside an evaporator are nearly impossible to remove), ability to shut down all heat or cold producing equipment in the event of a malfunction, ability to decontaminate the chamber with high heat, noise levels, ease of programming, overall reliability in a corrosive atmosphere, and many others. Most refrigerated incubators on the market today are based on the exact same technology used in refrigerators for decades, but the truth is, much biological research is never done at temperatures below 15 degrees Celsius, so it stands to reason that the ability to go below that temperature may indeed be more liability than benefit.

Refrigeration systems control temperature in one of two ways: by cycling on and off or by running continuously. Cycling of the compressor leads to one of two outcomes: short compressor life due to short cycling and inadequate oil return or very poor temperature control (on the order of up to +/-6 degrees Celsius actual air temperature), when cycled too long.

Continuous operation of the compressor is the only way to closely maintain chamber temperatures, but for applications anywhere near room temperatures this method is vastly wasteful both in terms of system sizing and energy efficiency. Refrigeration systems in general have the following drawbacks when used for middle temperature incubators: they all entail many moving parts that can fail, they can all discharge refrigerant due to leaks (bad joints, corrosion, fatigue, poor fittings, etc.), they normally are designed for low temperatures, they make considerable noise when placed in a quiet lab, and they require professional service personnel to resolve and diagnose issues in the event of a problem.

Our standard insect rearing incubator solves these drawbacks through the use of thermoelectric, or Peltier, cooling. When designed to operate properly, this system is exceptionally reliable due to solid state construction and no moving parts (except fans). Thermoelectric cooling has been around for many years now, and there are many high-end applications that have proven exceptional reliability—look to the refrigerator on the Space Shuttle or the laser industry for further proof. We do not cycle the Peltier devices, nor run them at their full capacity—this affords a MTBF (mean time before failure) of well over 20 years. We back this statement up with a warranty far longer than anyone else on the actual cooling components. You may wonder what drawbacks there are with thermoelectric devices, and the answer lies in the lower amount of raw cooling they can provide versus refrigeration systems. Most refrigeration-based insect rearing chambers can easily go well below freezing if they continue to cool, whereas our insect rearing chamber will bottom out at a temperature of roughly 12 to 15 degrees Celsius below the ambient temperature.

Our insect rearing chambers incorporate several thermoelectric cooling devices within each chamber to achieve adequate capacity. A side benefit of this feature is that they are semi-redundant, and would allow one cooling unit to control the temperature inside the chamber if another were to fail. Corrosion is simply not an issue as there are no thin areas of metal and the cooling devices are completely separated from the actual interior of the chamber by approximately 3/4" of sealed aluminum. Service to the chamber is almost as simple as replacing stereo components—components can simply be disconnected and sent to the factory or replaced. Control components are all solid state and do not rely on any wearing components. Controllers are non-proprietary and are exceptionally accurate and reliable. Setpoints and alarms are easy to set with a small amount of instruction. Diurnal ramping/soaking/cycling of temperatures is standard.