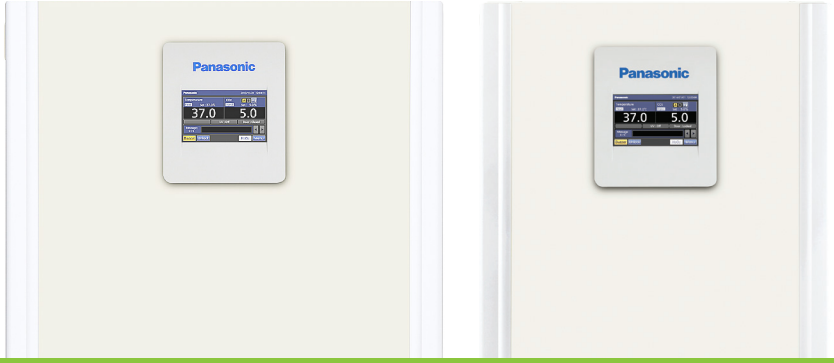
Panasonic

Life Science

Water Jacketed vs. Air Jacketed CO_2 Incubators

COMPETITIVE ANALYSIS



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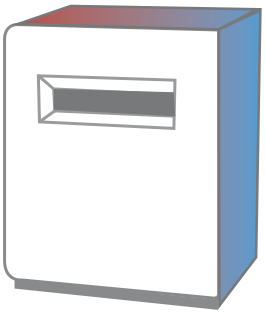
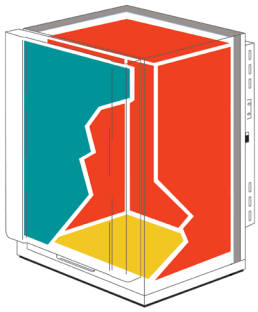


Image 1.0: Water-Jacketed Incubator



Heat Zone Legend

- The main heater provides precise temperature control.
- The bottom heater warms the distilled water and controls chamber humidity with independent control.
- The outer door heater prevents condensation on the inner door and facilitates quick temperature recovery after door openings.

Image 1.1: Air-Jacketed Incubator

Importance of Stable & Uniform Conditions

Cell culture CO_2 incubator technology has evolved in many aspects over the past few decades. One component that has undergone significant development is the insulation of the incubator walls. Incubators have always been predicated on their ability to maintain proper temperature for the cells growing inside them. Keeping the environment warm and well-insulated is crucial to healthy cell growth. A stable 37°C is typically needed for cells to grow properly, which is why temperature fluctuations can be harmful to cell development. Thus, insulated incubators arose as a key technology in delivering proper temperature uniformity.

Water-Jacket Incubator Technology

Water-jacketed incubators were one of the first available insulation methods to arrive on the market in CO_2 incubators. This technology, which still exists to this day, relies on heated water within the incubator's walls to maintain a consistent interior temperature. Water was chosen due to its high heat capacity and its ability to retain temperature. It was no surprise then that water jackets were very popular due to their ability to maintain temperature uniformity and keep the incubator warm even with multiple door openings. However, they suffered from other shortcomings, namely the sheer weight of filling incubators with water, as well as the issue of contamination growth from stagnant warm water. Algae or bacterial growth can easily take place within the water-jacket; the incubator must be drained and cleaned to take care of this problem. Furthermore, if the wrong type of specialized water is used, water-jacketed incubators become more prone to rusting from the inside-out in a short period of time. In many circumstances, this corrosion can extend straight through to the chamber, requiring the need for costly repairs or total disposal.

Air-Jacketed Incubator Technology

Due to concerns with water-jacketed incubators, the air-jacketed incubator emerged as a new technology. Air-jacketed systems were not only lighter than water-jacketed ones, but also provided similar temperature uniformity and faster recovery after door openings. This is due to the fact that air jacket incubators can adjust temperature on/off cycles based on the air temperature inside the chamber following door openings. Water-jacketed incubators cannot do this as they only control the temperature of the water. In addition, there was less worry of contamination from air-jacketed incubators, allowing scientists to worry less about maintenance. Many air-jacketed incubators also offered heating capabilities for the front door of the incubator. This feature provided more consistent heating and temperature uniformity, while facilitating a reduction in condensation. Furthermore, with air-jacketed incubators, traditional decontamination methods, like high heat, or more efficient methods, like ultraviolet light and H_2O_2 vapor, can be used.

With the importance today of GMP compliance and efficiency, air-jacketed incubators are becoming an increasingly popular option. Air-jacketed incubators offer more flexibility and superior performance in many instances when compared to their water-jacketed counterparts. Labs that work with sensitive cultures or frequently use their incubator should consider air-jacketed incubators for their rapid temperature recovery and decontamination methods. Where efficiency and flexibility is key, air-jacketed incubators also excel for their light-weight build and less required maintenance. As incubators evolve, air-jackets are becoming increasingly the norm, as water-jackets become older technology.

SUMMARY OF ADVANTAGES & DISADVANTAGES OF WATER-JACKET VS. AIR-JACKET CO_2 INCUBATORS

	ADVANTAGES	DISADVANTAGES
WATER JACKET	Good insulation and heat retention in the event of long power failure or prolonged door openings. Although CO_2 control is also lost during long power failures.	Very heavy when full of water, which requires a long start-up procedure and need for large amount of distilled water.
	Good temperature uniformity.	Easily contaminated due to stagnant warm water.
		No decontamination method (Heat, UV, H_2O_2) in incubators – reliance on HEPA filter and copper for contamination control.
AIR JACKET	Rapid temperature recovery due to interior chamber temperature sensing.	Can be more prone to condensation formation if not controlled with anti-condensation technology (like Panasonic's dew stick feature available on **cell**/*Q*™ CO_2 incubators).
	Less maintenance and hassle.	
	Light weight, with no water in the walls, allows for faster initial start-up.	
	Able to use effective decontamination methods, such as high heat and H_2O_2.	Heat will be lost faster in an extended power failure due to air's smaller heat capacity. This heat loss can be reduced with today's high efficiency insulation.
	Consistent heating on all sides (some incubators heat the door and water pan).	
	Some air-jackets come with direct heat options for the water pan that also improve on humidity control.	

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