Reducing Condensation in Tissue Culture (CU) Chambers

The Cause of Increased Condensation in CU Chambers

Condensation on Petri dishes is a common issue that can cause contamination and skew results in biological and agricultural experiments conducted in CU chambers. As the research chamber industry evolved from warm-running fluorescent lighting to LEDs that emit less heat, condensation became a more significant challenge.

How Condensation Forms on Petri Dish Lids

Condensation occurs when warm, humid air is trapped inside the Petri dish and condenses on the cooler surface of the lid. This typically forms at the start of the night cycle, as the lights no longer heat the lid.

Percival Scientific Solved the Condensation Problem With PetriClear® Lighting

Percival developed a groundbreaking combined channel system of white LEDs and infrared lights that raises the surface temperature of unstacked Petri dish lids just enough (less than 1°C) to be slightly above the dew point, eliminating condensation.

Behind-the-Scenes Engineering to Develop PetriClear

Solving the condensation problem was no easy task. Percival engineers needed to integrate infrared LEDs into the company's existing SciWhite® lighting system while ensuring that temperature uniformity, light intensity and spectral uniformity were maintained throughout the chamber. This required a delicate balancing act involving careful engineering of wattages and light positions through extensive trial and error to achieve the ideal results.

PetriClear Proven to Eliminate Condensation on Lids of Unstacked Petri Dishes

Percival Scientific performed a comprehensive analysis of the best methods for reducing condensation on Petri dish lids inside CU chambers. The primary goal was to test the effectiveness of the new PetriClear lighting in reducing condensation compared to fluorescent and SciWhite lighting.

The engineers discovered that PetriClear lighting performs as well as, and in some cases better than, fluorescent lighting in eliminating condensation, making it the most preferred lighting for CU chambers. No condensation formed on unstacked Petri dishes under PetriClear lighting in the temperature range of 20-28°C with a light intensity of 50-140 µmol m^{-2} s^{-1} under different loading conditions.

More Recommendations for Reducing Condensation

During their comprehensive analysis, the Percival engineers controlled independent variables of light, dish stacking, chamber load, dish placement and temperature cycling to observe their effects on the amount of condensation that formed under the different lighting systems. They also tested general ways to reduce condensation without the benefit of PetriClear® lighting. The following recommendations are based on the resulting data.

Leave Dishes Unstacked to Reduce Condensation Under Any Lighting

Stacking dishes significantly increased the amount of condensation that formed on dish lids at the bottom; however, the percentage of condensation on bottom dishes under PetriClear lighting was still less than that observed under SciWhite® or fluorescent lighting and dissipated in a shorter time (Fig. 1). To reduce condensation on lids, Percival does not recommend stacking dishes under any lighting conditions.

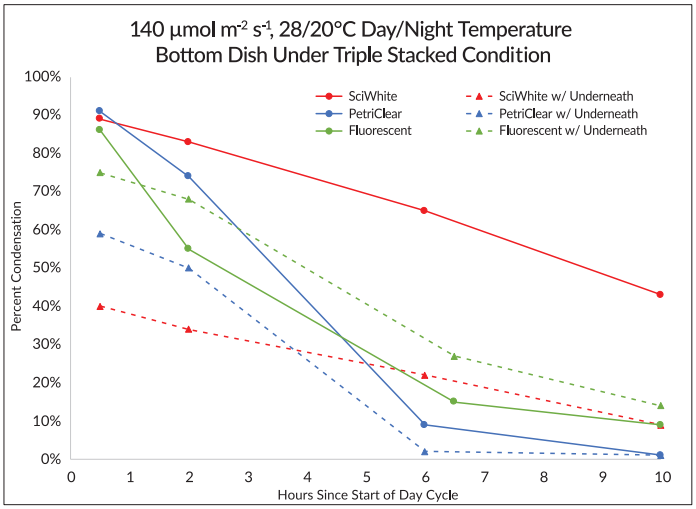

Figure 1: Condensation throughout the day triple stacked. Under 140 µmol m^{-2} s^{-1}, 28/20°C

An Empty Petri Dish Can Help With Stacked Dishes Under PetriClear and SciWhite

Placing an empty Petri dish beneath stacked Petri dishes significantly reduced condensation under PetriClear and SciWhite lighting. This allowed fresh air from the plenum to warm slightly before contacting the surface of the Petri dishes, thus reducing condensation. However, placing empty Petri dishes beneath stacked dishes is not advisable under fluorescent lighting, as it caused an increase in condensation (Fig. 1). Additionally, placing an empty whole or half Petri dish on top of the stacks slightly reduced condensation, but not enough to recommend it to customers.

Ramp Slowly Between Day and Night Temperatures

Researchers commonly use temperature differentials between day and night cycles within chambers; however, these can significantly increase the condensation that forms on Petri dish lids because the chamber cools down much faster than the inside of the Petri dishes.

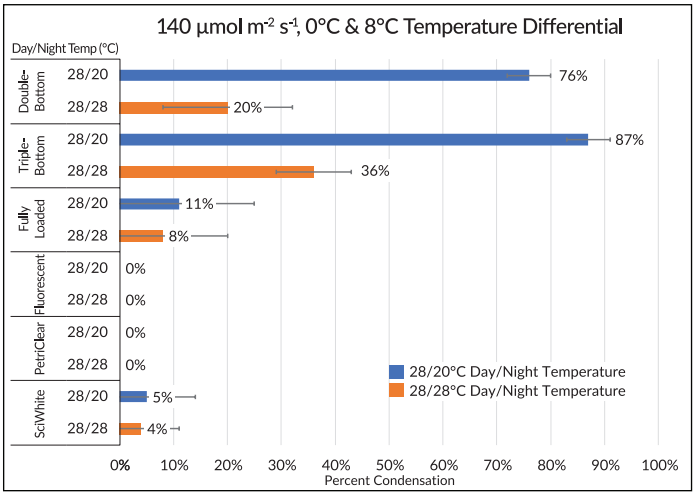

Figure 2: Condensation under 140 µmol m^{-2} s^{-1}, 28/20 and 28/28°C day/night temperatures

When there was an 8°C difference between the day and night cycles, condensation on unstacked Petri dishes under SciWhite lighting increased around 10%. This increase was much greater in stacked dishes under SciWhite lighting, with condensation increasing from 36% to 87% on the bottom dish. PetriClear lighting matched the results of fluorescent lighting, and no condensation formed on unstacked Petri dish lids in either condition during the temperature change (Fig. 2).

Ramping the temperature difference between day and night cycles by one-percent increments over two hours was shown to reduce condensation levels under SciWhite® lighting by about 5-10%. Although this won't completely eliminate condensation, it often results in improvement. Percival CU chambers offer easy-to-use programming for ramping temperatures.

Place Petri Dishes Toward the Back and Don't Overload Chamber

Petri dish placement within the chamber significantly impacted the amount of condensation (Table 1). The front of the chamber consistently had the same amount or more condensation than the back. This occurs because warm air is drawn forward and upward in the chamber as cool air enters from the back, exposing the front few rows of Petri dishes to additional temperature swings and causing condensation. Placing Petri dishes toward the back of the chamber can potentially improve condensation issues. Most labs and researchers are likely utilizing most, if not all, of the shelf space, so some condensation is expected in those situations. Overloading the chamber (100% vs.70%) was also tested and increased the amount of condensation by 1-5%.

Distance from Left Hand Corner (in)		3.5	7.5	11.5	16	21	25.5		
		A	B	C	D	E	F	Average	S.D.
3	1	0%	0%	0%	0%	0%	0%	0%	0%
7.5	2	0%	0%	0%	0%	0%	0%	0%	0%
12	3	0%	0%	0%	0%	0%	2%	0%	1%
16.5	4	0%	13%	11%	36%	29%	3%	15%	14%
20.5	5	28%	30%	16%	27%	14%	11%	21%	8%
25	6	19%	11%	16%	14%	0%	0%	10%	8%
	Average	8%	9%	7%	13%	7%	3%	8%	
	S.D.	12%	12%	8%	16%	12%	4%		11%

Table 1: Percent condensation based on Petri dish placement inside the chamber. Under 50 µmol m^{-2} s^{-1}, 28/28 °C

Take Data Late in the Day Cycle

In all trials, condensation decreased throughout the day cycle. As the day cycle continued, excess heat produced by the lights reduced the amount of condensation that had formed overnight on the Petri dish lids. As a result, Percival advises taking data as late in the day cycle as possible to minimize the amount of condensation present. Using Percival's Intellus system, the starting times of the day/night cycle can easily be adjusted to fit the time constraints of data collection.

For more information, visit **percival-scientific.com**, contact us for a **free consultation** or call **800.695.2743**.

Data Supplied by Nathan Lewis and Isaac Bradford, Percival Scientific

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