

MicroClime™ Environmental Lids Reduce Edge Effects in Multi-Well Plates

Introduction

Edge effects—the tendency of the contents of wells in the outer rows and columns of a multi-well microplate to vary from wells in the interior of the plate—are due to interactions of the contents of the wells of the microplate with the laboratory or storage environment. Evaporation is rapid at the corners and edges while wells near the center are protected from change. Hygroscopic liquids (e.g., dimethyl sulfoxide (DMSO)) can rapidly absorb water from the environment and the tendency towards hydration is greatest at the edges and corners. The gradient between the contents of a plate and the environment is greatest at the edges of the plate and the fastest changes occur at that steep gradient.

MicroClime™ Environmental Lids

Labcyte® MicroClime™ environmental lids can be used to protect the contents of a wide variety of SBS standard microplates. MicroClime™ lids carry a stabilized source of fluid, as shown in Figure 1. As fluid evaporates from the interior of the lid it acts as a vapor barrier against the encroachment of the laboratory environment. The evaporating fluid helps to maintain the status quo of the fluid in the wells of the microplate.

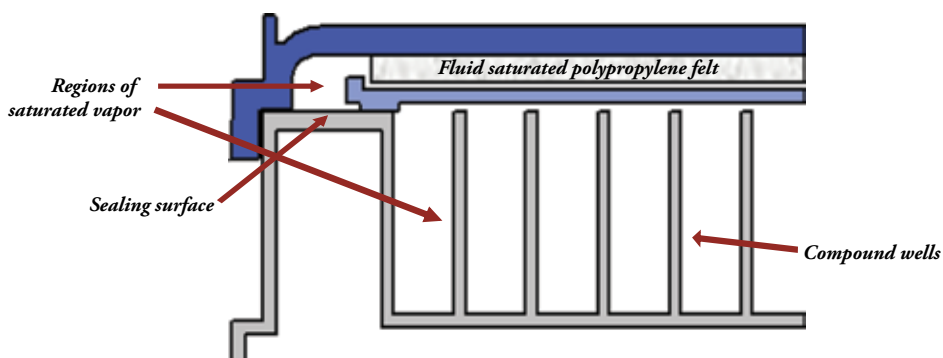


Figure 1. The MicroClime environmental lid holds a stabilized source of fluid. This fluid evaporates to fill the headspace above the wells of the microplate with a vapor-saturated atmosphere. This retards the evaporation of the liquid in the wells and acts as a barrier to infiltration of the headspace by external gases. Any water vapor that enters the headspace will be preferentially drawn into the larger volume of fluid in the lid. All wells are in contact with the same vapor saturated headspace and variation among wells is dramatically reduced.

The gases that escape from the lid into the headspace above the wells minimize difference between wells.

The lids are compatible with standard automated lidded/delidders. They are made of COC (cyclic olefin copolymer) and are compatible with DMSO.

Drop Keeper Applications

Evaporation of small droplets (<200 nL) from wells at the edges of a microplate can be very rapid. Once droplets dry, any solute that was dissolved in the droplets becomes a solid stuck to the bottom of the well. It can be extremely difficult to resolubilize these solids especially with aqueous solutions. Maintaining a fluid drop can be very important.

Figure 2 shows two identical 1536-well microplates in which 5 nL of 70% DMSO were transferred into each well. The plate on the left was covered with a standard lid while the plate on the right was covered with a MicroClime environmental lid. Both plates were left side-by-side in a working laboratory for eight hours and then were scanned with an imager. The presence of a drop in every well is clear on the MicroClime lidded plate while the plate with a standard lid showed significant edge effects with complete evaporation of every well in row A and column 1. Complete images can be seen at www.labcyte.com/plate_comparison.pdf.

Droplets of 5 nL of 70% DMSO in an uncovered 1536-well plate placed in the same environment will completely evaporate in less than one hour.

Moisture-Free Applications

Just as fluid may escape a plate through evaporation to the environment, materials may enter a plate from the environment. Most obvious is the hydration of hygroscopic liquids such as 100% DMSO. DMSO readily absorbs water from the environment and may reach levels of 60/40 DMSO/water within 24 hours in an uncovered vessel. The exact rate of hydration is determined by the temperature and relative humidity of the environment as well as the surface area of the liquid and the depth of the wells.

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Figure 3 shows a strong edge effect for hydration in the plate covered with a standard lid. Many wells had absorbed more than 10% water and the corner wells showed as much as 14% water. The MicroClima lidded plate showed less hydration overall and a significantly less prominent edge effect. Previous experiments with an uncovered plate have shown that under similar conditions every well will hydrate to more than 30% water within eight hours. Reduction of hydration is especially important because hydrated DMSO is a much poorer solvent than dry DMSO. This lack of solvation power means that the dissolved solutes can precipitate from solution and that the supernatant solution may have dramatically lower concentration of compound than anticipated. This can lead to false negatives in a screening assay.

Dehydrator Application

Recent experiments have tested the impact of a MicroClima environmental lid placed on a partially hydrated plate. When the lid is filled with 100% DMSO, the fluid in the lid acts as a desiccant and dries the hydrated DMSO in the wells returning the solution to greater than 95% DMSO. This recovery of sample could extend the lives of library plates that have been exposed to moisture during handling.

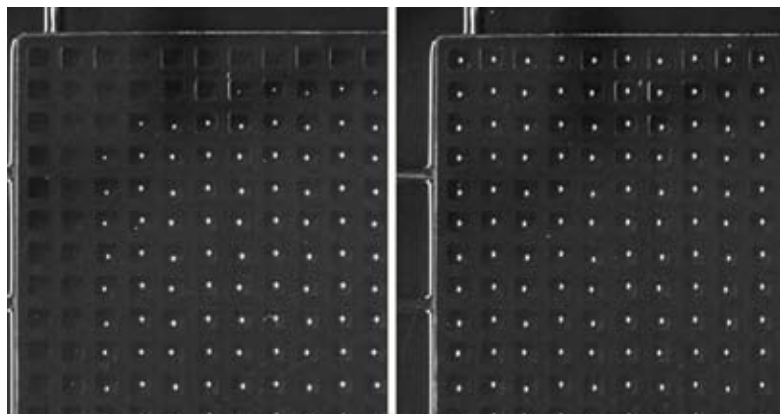


Figure 2. Five nL of 70/30 DMSO/water was transferred to every well of two 1536-well plates. The plate on the left was covered with a commercially available standard plate lid and the plate on the right was covered with a Labcyte MicroClima environmental lid filled with 8 mL of 70/30 DMSO/water. Both plates were left side-by-side in a working laboratory for eight hours. The plates were scanned to visualize the droplets. Edge effects due to evaporation are clearly seen on the plate covered with a standard lid. Droplets remain in all of the wells of the plate covered with the MicroClima lid.

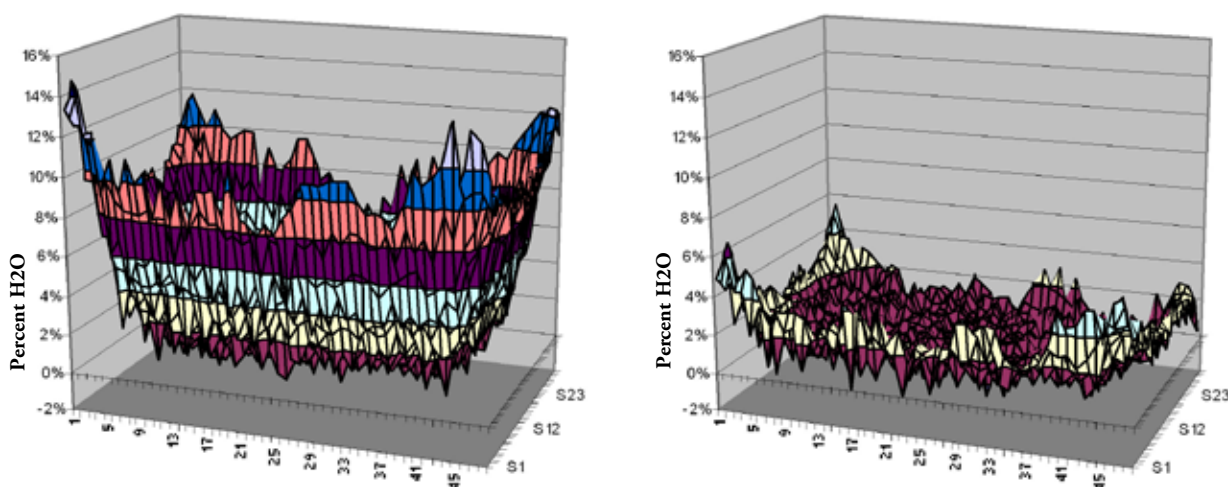


Figure 3. Every well of two 1536-well microplates was filled with 30 μ L of dry DMSO. The plate on the left was covered with a standard lid and the plate on the right was covered with a MicroClima lid. The water concentration of each well was measured acoustically after 24 hours.



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Expanding Beyond DMSO

MicroClime environmental lids may be filled with fluids other than DMSO. For example, as shown in Figure 5, filling the lid with water will reduce the evaporation of aqueous samples from assay plates.

The MicroClime lid enables low-volume aqueous assays to be extended over multiple days by reducing aqueous sample evaporation up to 5-fold over a three-day period. This simplifies procedures for researchers and eliminates the need to seal and peel plates in many instances.

Results

Labcyte MicroClime environmental lids provide researchers with a new tool to reduce edge effects in microwell plates. This can be of particular use when plates are exposed to the atmosphere after they have been peeled and while on a working deck. Cherry picking, plate replication, assay plate preparation or IC₅₀ analyses often require that unpeeled library plates sit on a deck for many hours. During that time they are subject to edge effects even when covered with a traditional lid.

- Reduce evaporation of fluid
- Reduce hydration by greater than 50%
- Automation compatible (no need to peel and reseal)
- Fits most SBS footprint microplates
- Can be used with a wide variety of fluids in many applications

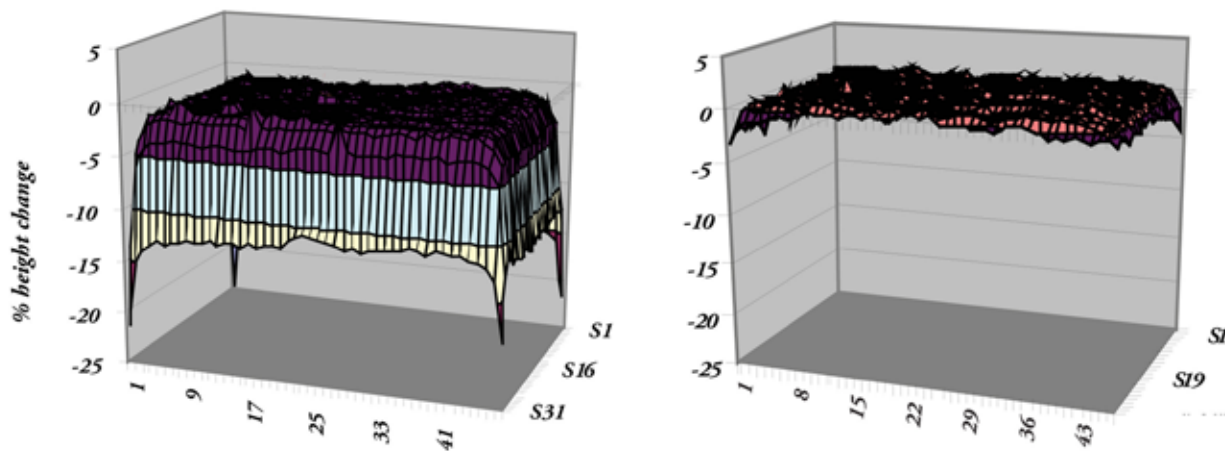


Figure 5. Each well of two 1536-well plates were filled with 10 μ L of water. The plate on the left was covered with a standard lid and the plate on the right was covered with a MicroClime lid that had been filled with water. Graphs show the loss of depth (volume) in the edge wells over a 16 hour period.



Figure 4.

References

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