

Condensers: Smooth Wall vs Exposed Coil

The condenser captures the vapor that is removed from the product during the freeze drying process. In addition to capturing the vapor, the condenser should prevent vapor from reaching vacuum pump, where it will cause damage.

Two of the most common types of condensers are; Exposed Coil and Smooth Wall.

Smooth Wall

The Smooth Wall Condenser is the least expensive type of condenser available. Refrigeration coils are wrapped on the outside of the cylinder. The wall of the cylinder is cooled and is used as the condensing surface. The claimed advantage is that the condensate forms a hollow cylinder that can be removed in one piece. In actual use this is a difficult if not impossible task. Smooth Wall condensers have several drawbacks that need to be understood.

The first issue is that the temperature of the condenser is measured on the coils outside of the condensing chamber. Sensing at this location provides an inaccurate reading due to temperature loss from the coils through the cylinder wall. This temperature difference is most apparent when vapor is condensing.

The second issue is the limited surface contact for the vapors to condense. Smooth Wall condensers have a tendency for vapor-bypass which results in vapors reaching the vacuum pump and contaminating the vacuum pump oil. The end result is premature failure of the vacuum pump.

The third drawback is that the condensing surface decreases as the condensate builds up. Therefore the condensing capacity decreases dramatically as the run progresses.



Exposed Coil

The Exposed Coil Condenser is a more expensive design. The refrigerant is directly expanded in the coil which is directly exposed to the vapor stream. This design results in the coldest possible temperatures and is the most responsive to condensate vapor loading. In addition, the exposed coil builds up ice on its surface creating a larger surface area as the run progresses, thus making the condensing process more efficient. The one drawback of the Exposed Coil design is a slightly longer defrost cycle, however, most freeze dryers are defrosted overnight and therefore this may not be an issue.



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