Evaporation and Aeration in Shaken Bioreactors

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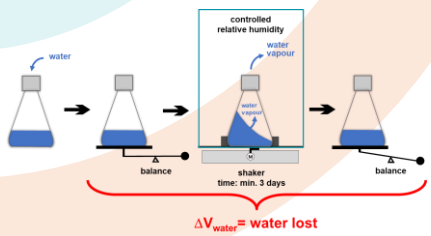
Introduction

pCO2 and osmolality are known to have a significant impact on the growth rate and production formation of a cell cultivation [1,2]. Both parameters are influenced mainly through the transfer processes of ventilation and evaporation. If not taken into account while screening for an optimal clone or media, these processes could lead to wrong decisions.

Materials and Methods

Evaporation-Rate:
Different types of shake flasks were placed in ani incubator (Kuhner Shaker, ISF1-XC, Switzerland) with controlled temperature, humidity and shaking speed. After one day the start weight of the shake flasks filled with water (30% of the nominal volume) were determined. After a minimum of 3 days the water lost was determined.

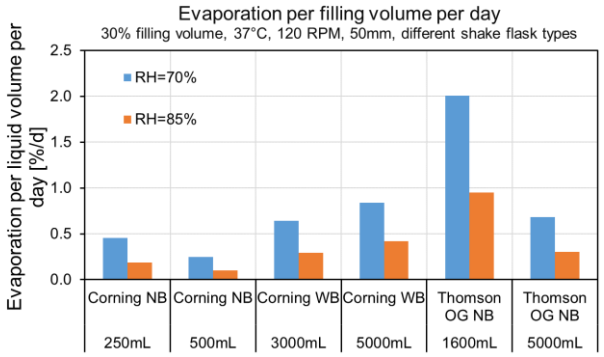
parameter	unit	setpoint
shaking speed	rpm	60 / 120 / 180
shaking diameter	mm	50
temperature	°C	37
humidity	%	70 / 85

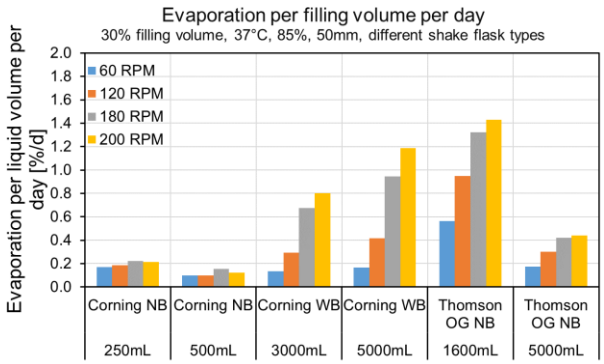


Aeration-Rate:
The gas exchange through the sterile plug is described by an extended model of Henzler and Schedel [3]. Based on this, Mrotzek et al. [4] developed a simulation to obtain the mass transfer resistance and aeration rate of various sterile closures [4]. The removal of volatile compounds from the culture broth due to aeration is defined as ventilation. Tanaka et al [5] have shown, that ventilation is an important scale up factor.

Results and Discussion

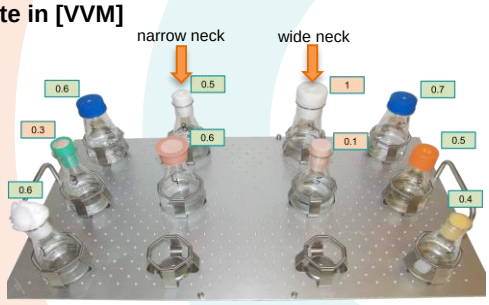
Evaporation-Rate





Impact factors
- neck geometry and filter area
- mixing of the gas phase
- surrounding humidity

Aeration-Rate in [VVM]



- aeration rate depends mainly on stopper type and neck geometry
- Ventilation should be considered as scale up factor

Conclusion

The knowledge of the evaporation rate is essential for reproducible and comparable results. Reducing the evaporation for small shaken bioreactors (microtiter plates) and long-term fermentations (cell culture) by increasing the incubator humidity is advisable.

Literature

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