# Your Evaporation Guide
## Operation – Thickness of evaporating flask

Achieve higher distillation efficiency when using a rotary evaporator – Impact of thickness of flask


### Summary

The evaporation rate is noticeably greater if the evaporating flask's glass walls are thinner. The simple reason is that thinner glass allows better heat transmission from the heating bath through the glass of the evaporating flask to the solvent. Generally speaking, the glass wall thickness should be selected to be as thin as possible, while still being robust enough to prevent breakages of the evaporating flask even at very low pressures. Concerning both these issues, the optimum thickness for a 1 L evaporating flask is between 1.5 and 2.0 mm.


### Introduction

Formerly, the glass walls of evaporating flasks were generally thicker. Thanks to years of research, modern technology and automated manufacturing processes, the design of the evaporating flask is now optimized to maximize efficiency. The demands and requirements are high as the glass has to be resistant to breakages and withstand conditions such as high temperatures as well as rapid temperature changes at very low pressure. It is therefore of great importance to be aware of the optimum glass thickness and of the safety issues when choosing an evaporating flask.

The evaporation efficiency depends primarily on the amount of heat energy which reaches the solvent inside the evaporating flask. It is obvious that a thicker (glass) barrier hinders heat transfer.

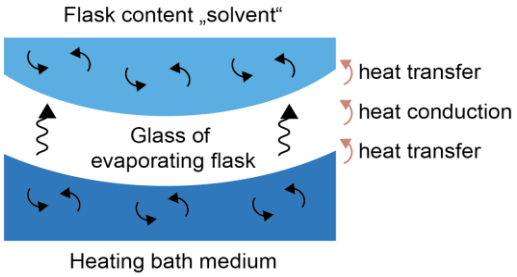



***Figure 1:*** *Schematic representation of heat transfer from the heating bath to the solvent.*

### Experiment

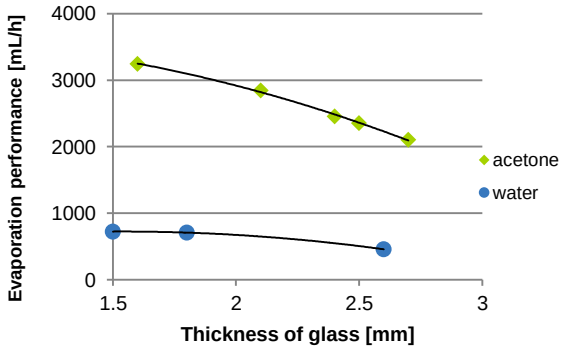
The aim of the following experiment was to analyze the influence of the evaporating flask glass thickness on the evaporation rate of a solvent single-stage distillation. The experiment was executed with a BUCHI Rotavapor®.

For the realization of the experiment, the evaporation process was first performed with acetone, using five 1 L evaporating flasks differing in the glass wall thickness (from 1.6 to 2.7 mm) and then with water, using three different flasks (from 1.5 to 2.6 mm thickness respectively).

### Parameter

| | |
|---|---|
| Solvent | acetone<br>water |
| Heating bath temperature | 60 °C |
| Cooling temperature | 10 °C |
| Pressure | 556 mbar (acetone)<br>72 mbar (water) |
| Flask size | 1 L |
| Content | 500 mL |
| Immersion depth | fill level |
| Rotation speed | 280 rpm |

### Results




***Graphic 1:*** *Illustration of the influence of the glass wall thickness of flask on the evaporation output.*

As illustrated in the above graphic, the thinner the evaporating flask' glass walls, the higher the evaporation output. The disparity was especially obvious in the experiment using acetone. For example, the evaporating flask, with a thickness of 1.6 mm, achieved 54 % higher evaporation output compared to the flask with 2.7 mm glass wall thickness.

### Interpretation

This experiment shows that glass wall thickness has a significant impact on the evaporation output. With thinner glass walls, the heat transfer from the heating bath medium to the solvent inside the evaporating flask is improved, speeding up the evaporation. On the other hand, the thicker the glass, the more prolonged the heat transfer becomes, thus reducing the evaporation output significantely.

### Recommendation

There is a fine line between glass that is too thin and glass that is too thick. For instance, using thinner glass might put the glass at higher risk of breaking. On the other hand, thicker glass slows down the evaporating output. Generally speaking, the evaporating flask should be as thin as possible, but still withstand very low pressure and other exposures as high temperature and rapid temperature changes.

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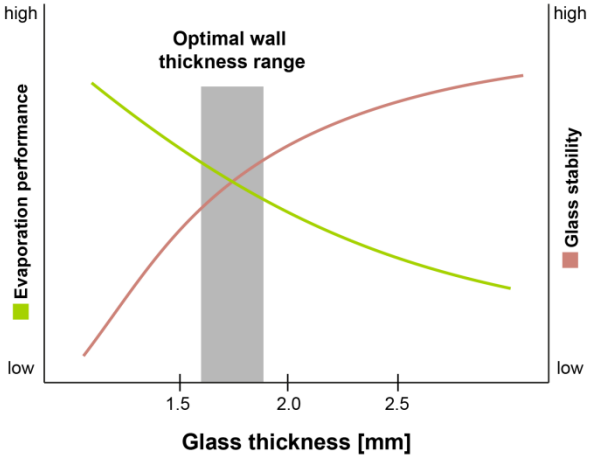
The BUCHI evaporating flasks are designed for high evaporation output and to fulfill highest safety requirements. The standardized 1 L evaporating flask has a glass wall thickness around 1.8 mm. According to customer feedback and internal tests, this condition provides the optimum ratio of high heat transfer efficiency along with high safety.




***Graphic 2:*** *Representation of optimal glass thickness (1 L flask) by the intersection of the two curves.*

The high-quality glass consists of inert industrial glass, borosilicate glass 3.3, resistant to chemicals high temperatures and rapid temperature changes. The quality and precision of BUCHI glassware also guards from breakages. In addition, if there are special requirements from customers, BUCHI modifies glass components in any ways or develops complex new designs for individual needs.