

Findensers

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The use of Findensers in the undergraduate laboratories including practical application and learning resources.

- Excessive amounts of water are needed to carry out reflux with water-cooled condensers.
- Findensers eliminate the need for flowing water through a combination of features including large internal and external surface areas.
- Findensers offer environmental and economical benefits for both industrial and educational application.



Design features:

1. Ground glass socket.

Allows the attachment of apparatus such as calcium guard tubes.

2. Aluminium jacket.

"Fins" provide a large surface area for heat emission.

3. Anti-roll design.

Contoured edges above and below the Findenser.

4. Internal design.

Large internal surface area.

5. Water jacket.

Allows fast transfer of heat energy from the vapours in the column.

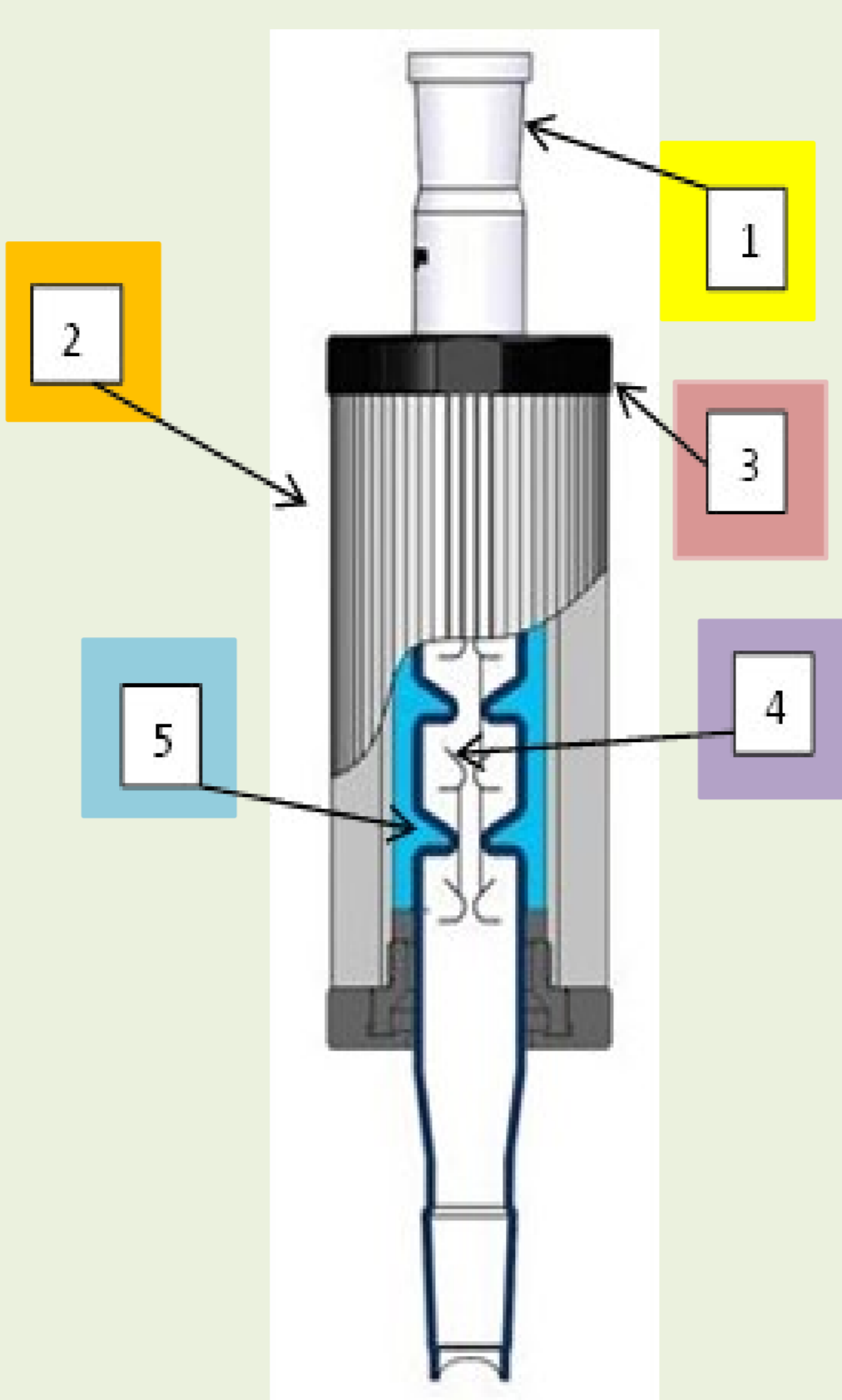
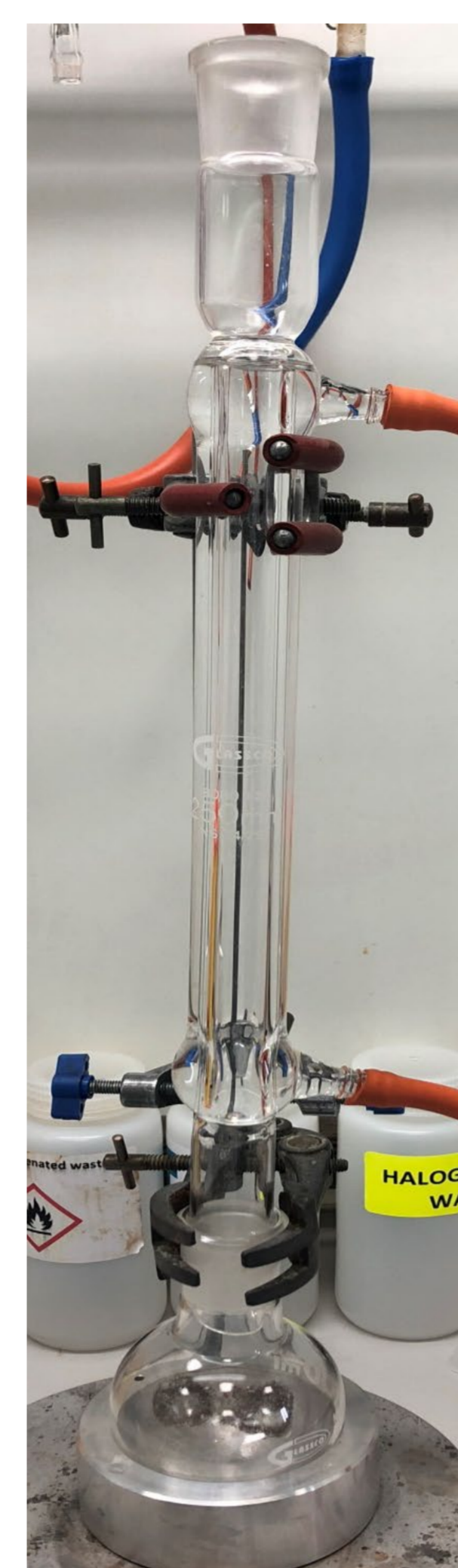


Figure 1. Diagram of a Findenser¹



Condenser	Structural Feature	Findenser
Straight circular column	Internal surface area	Large internal folding maximizes heat absorption.
A constantly replaced water jacket keeps the column cool.	Jacket	Sealed water jacket maximizes heat transfer by conduction and convection.
Smooth and round glass casing	External surface area	External fins increase surface area and maximise heat emission

Table 1. Comparing structural features of condenser and Findenser.



Water usage:

Unlike traditional condensers, Findensers do not require running water.

Findensers can save **19 litres of water** per 15 minutes of reflux.

Using Findensers in undergraduate laboratories could save **61,000 litres of water** a year.

Practical considerations and safety:

- Findensers are heavier than condensers – they must be securely supported when in use.
- The Findenser does not have a straight column – reactants and stirrer bars cannot be dropped down the column.
- The finned aluminium jacket can become hot – care should be taken when moving apparatus.
- The Findenser should only be cleaned with water and acetone, not detergent.

Solvent loss:

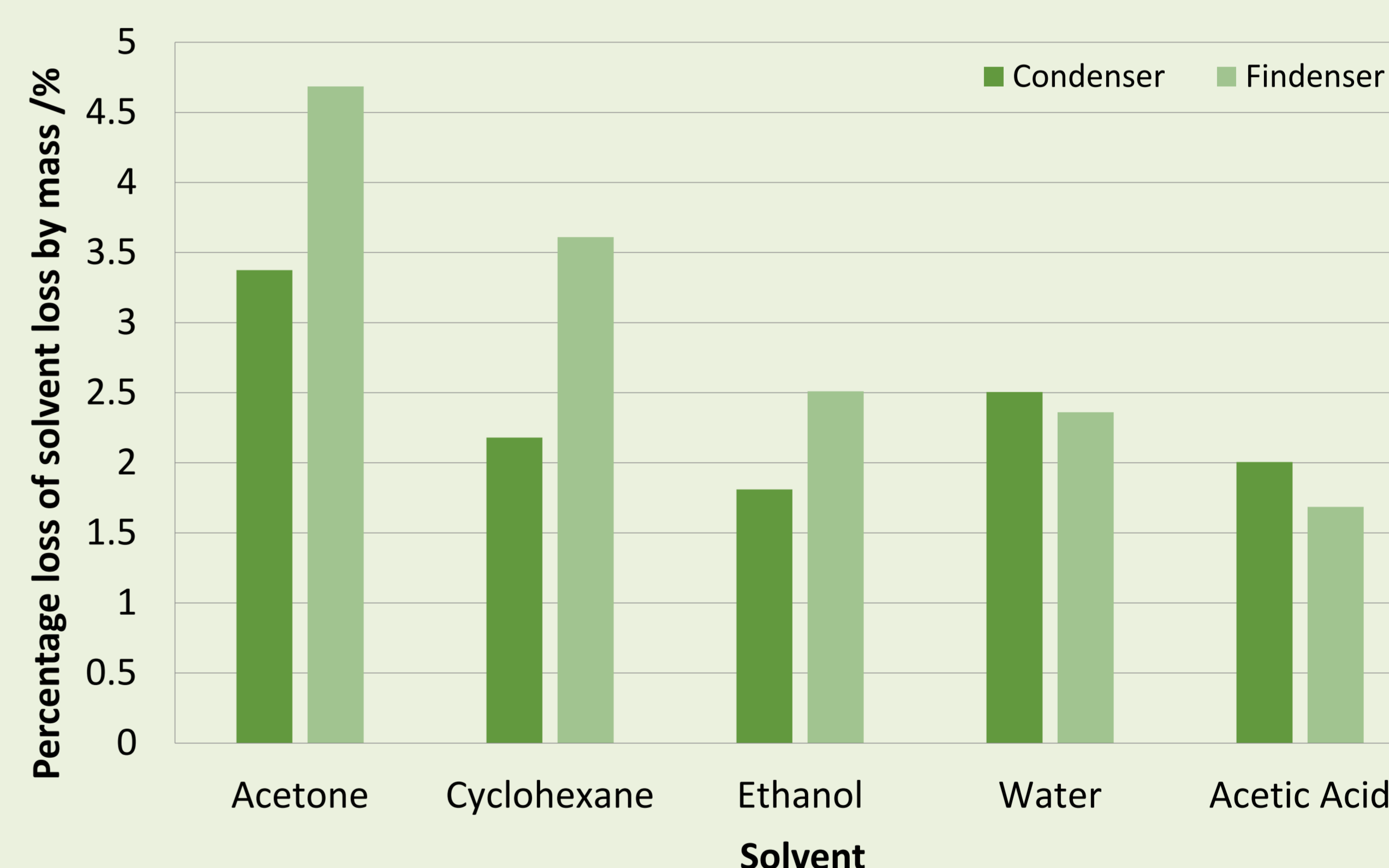


Figure 2. Comparing the percentage loss of solvent using a condenser or Findenser.

Findensers have a lower solvent retention capacity for lower boiling point solvents than condensers. However, this trend is not as clear for higher boiling point solvents such as water and acetic acid.

Learning resources – understanding impact:

Water usage & individual impact:

In years 1 and 2, students will use both condensers and Findensers.

Pre-lab questions require the amount of water saved to be considered:

"A typical person in the United Kingdom is thought to use around 150 Litres of water per day. A condenser is thought to use around 76 Litres of water for every hour of reflux. A school laboratory has 38 students carrying out around 35 minutes of reflux per day. Calculate how many peoples supply of water is used by the school in five days."

In year 3, students will have a choice of which apparatus to use.

Understanding the volume of water used in the lab should encourage users to be mindful of the impact of their practical work.

Safety:

Pre-lab questions highlight the hazards associated with the use of Findensers

"Select what is wrong with the picture below"



Contextualising themes:

Pre-lab questions contextualise themes from lectures, for example using the rate of heat emission (from year 2 thermodynamics lecture course)

"A Findenser can be assumed to behave like a black body, a physical model used to predict energy emissions from objects. The amount of energy emitted per unit area per unit time can be given by: Energy per unit area: Stefan- Boltzmann Constant x (Temperature)⁴. An operating Findenser has an exposed surface area of 904 cm² and a temperature of 60°C. Water vapours inside the Findenser are assumed to be at 100°C. Calculate the rate of water condensation in terms of mass for the given temperature."

References

¹Radleys, <https://www.radleys.com/>, last accessed 18th September 2018

Acknowledgements

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