Premium Laboratory Equipment

Reflux Condenser Buyer's Guide

heidolph
research made easy

Understanding the air cooled reflux system

Increased requirements on safety and sustainability in the chemical laboratory have been the trigger for the development of new reflux condensers without water cooling. With the Findenser™, Heidolph offers an efficient, air cooled reflux system, too.

What are the advantages and disadvantages of reflux condensers? What are the general aspects to consider when buying one?

The Heidolph 'Reflux Condenser Buyer's Guide' answers the most important questions you may have. For all other matters, the Heidolph Customer Support will be glad to provide advice.

List of contents

1 Why refluxing?

Refluxing is one of the most common working methods for organic synthesis. Many chemical reactions only take place under heat or are accelerated by an increased reaction temperature. Reflux condensers are used to prevent the solvent of a reaction mixture from evaporating even when it is heated for extended periods of time.

2 Air cooled or water cooled. What is the difference?

The refluxing principle is as simple as it is ingenious: The boiling vapor from the solution in the flask rises vertically upwards in the glass column, condenses on the cooling surfaces and drops back into the flask as liquid condensate. Cooling inside a reflux condenser takes place according to the heat exchanger principle. The following applies for the cooling surfaces: the larger the surface, the better the cooling behavior.

Water cooled: In a predominant number of cases, tap water is used as coolant. Like a water sheath, it flows around the reflux column on the inside of which the boiling vapor rises. Convexities on the inner side walls of the column or cooling coils enlarge the cooling surface. (Fig. 1 Functional principle of a water cooled reflux condenser)

Air cooled: Reflux condensers with air cooling are available in different versions. In low-priced systems, heat exchange with the ambient air takes place only on the outer surfaces of the glass column. Thus, the column must be accordingly high to be able to dissipate heat to the environment. The much more elaborately designed reflux condenser system Findenser™ is equipped with a finned aluminum jacket, which multiplies the heat exchanger surface in a compact way.

3 Safety in the laboratory has many facets.

If you have ever witnessed how fast a hose can come off a water cooled reflux condenser and the immense damage caused by such a flooding in a laboratory building you will appreciate an air cooled laboratory condenser as a true alternative. In the worst case, laboratory equipment worth thousands of dollars can be destroyed overnight. After all, roughly 2.5 liters per minute are flowing through a water cooled reflux system. In addition, the lack of any tubing – as in air cooled reflux condensers – means that there is no risk of the tubing coming into contact with hotplates (leakages) and furthermore entails a simple set-up and less space that is required in the fume hood.

4 Water consumption and cooling costs.

Extrapolated, an average of 150 liters of water flow through a water cooled reflux condenser per hour (Fig. 2 Diagram Water consumption in comparison). Fortunately, many laboratories have installed recirculating chillers or central water recirculating systems to reduce the enormous water consumption during refluxing. However, even cooling the coolant has a negative impact on the energy balance.

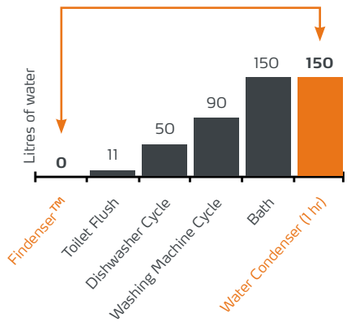


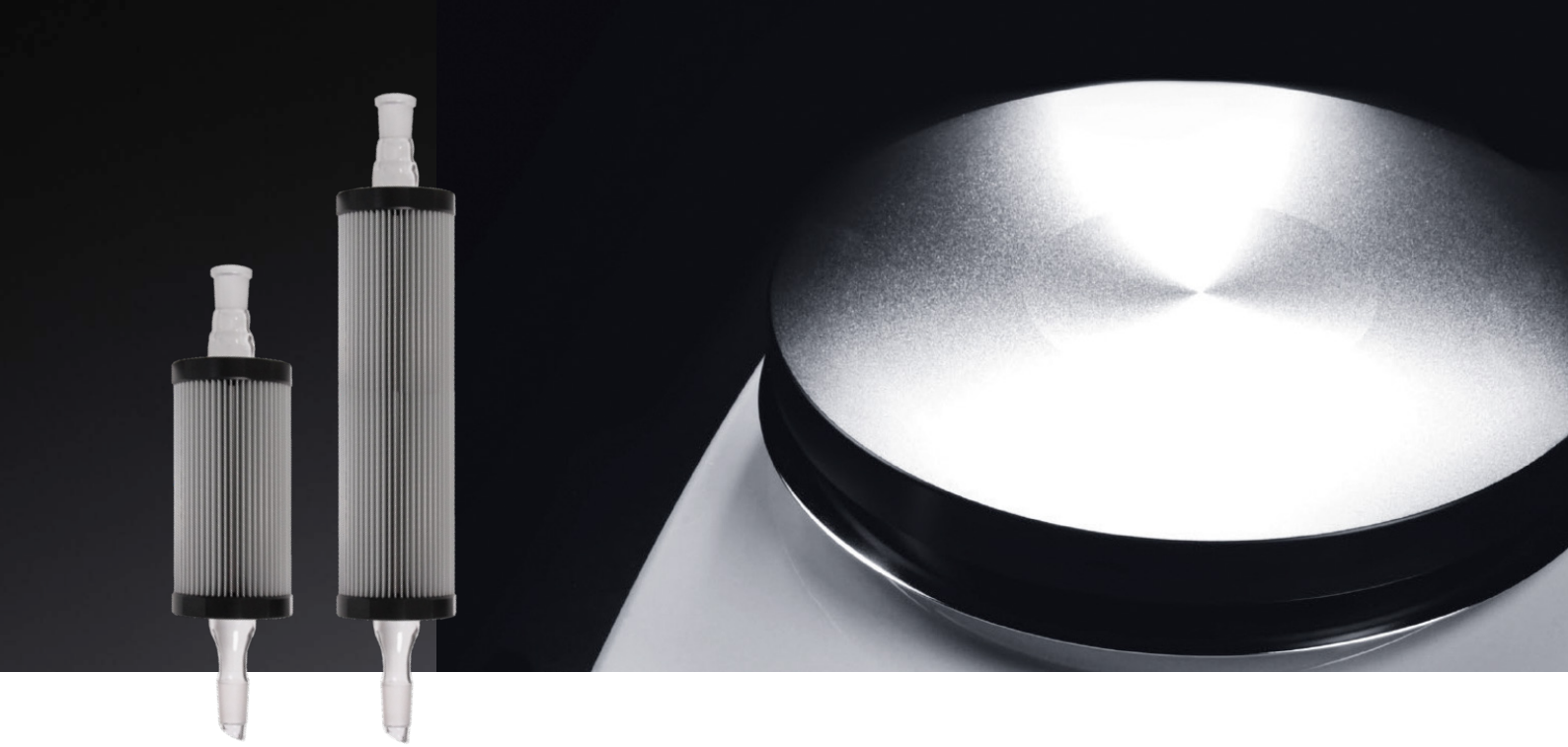
Fig. 2 Diagram: Average water consumption of common household appliances compared to the Findenser™ and the water cooled reflux condenser

Fig. 1 Water cooled reflux system

5 An as wide as possible range of applications.

Traditional, air cooled reflux condensers have a significantly narrower range of applications as water cooled devices. This lies in the nature of physics, because their low cooling capacity makes them unsuitable for highly volatile, low-boiling solvents - and this applies to the vast majority of common solvents used for syntheses. You should therefore pay attention to the application range when selecting your reflux condenser.
Although the Findenser™ is also air cooled, it offers an excellent cooling capacity thanks to its highly thermally conductive aluminum cooling fins and is therefore suitable for around 95 % of all chemical syntheses.

These common solvents are already successfully used with the Findenser™ for chemical synthesis without any appreciable volume loss:
Hydrocarbons: e.g. pentane, hexane, cyclohexane, heptane
Chlorinated solvents: e.g. dichloromethane (DCM), chloroform
Alcohols: e.g. methanol, ethanol, isopropanol
Aromatic hydrocarbons: e.g. toluene, xylene, benzene
Miscellaneous: Methyl tert-butyl ether (MTBE), acetone, tetrahydrofuran (THF), ethyl acetate, acetonitrile, dimethyl furan (DMF) and others
The top limit for the boiling temperature is 155 °C / 311 °F. In case of doubt, please ask the Heidolph Customer Support.



⑥ The best is to test: solvent volume.

The volume too is a determining factor for solvent loss during refluxing. Traditional, air cooled reflux condensers are in many cases not efficient enough for larger volumes. At high volatility, too much, if not all, of the solvent is lost relatively quickly. Even the air cooled Findenser™ – despite its significantly higher cooling capacity - sometimes reaches its limits. To be on the safe side, carry out a test under real conditions with highly volatile solvents like ether before the actual test; always work in the fume hood while doing so.

⑦ Essential: accurate temperature control.

Many tests have shown that the Findenser™ works with particular efficiency if the temperature is accurately controlled. The control temperature set at the hotplate should be 10 – 15 °C / 50 – 59 °F above the boiling point of the solvent used. If it is too high or if it strongly fluctuates, the solvent can boil over and the sample can be damaged. This is why, for your next reflux reaction, you should not only pay attention to a suitable reflux condenser but also to the heat source you are using. Do you prefer magnetic stirrers with a digital display or with interface for a digital contact thermometer. For further information, please contact the Heidolph Customer Support.

⑧ Suitable for almost all ambient conditions.

The higher the ambient temperature, the worse the performance. Compared to water cooled models, the ambient temperature plays an important role in air cooled reflux condensers. For this reason and of course also for safety reasons, we generally recommend to perform refluxing in the fume hood. This ensures reproducibility and the room temperature is no longer an issue.

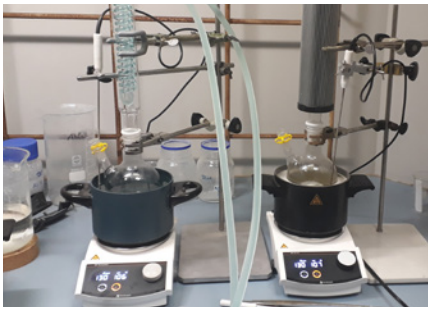
⑨ Good price/performance ratio.

Simple reflux condensers can already be bought at little money. However, you should always put the running expenses for water and cooling energy into relation to the costs of acquisition. Especially the safety aspect should not be underestimated. In the event of flooding, the damage caused is a thousand times higher.

Any questions?
Contact us:
Heidolph Instruments GmbH & Co. KG

+49 9122 9920-0
sales@heidolph.de

Further links:
Heidolph Magnetic Stirrers
Heidolph Findenser™



Safety in the lab: Findenser™ (on the right side) takes less space in the fume hood

A precise temperature control of the reaction is only possible by means of use of an external temperature sensor

heidolph
research made easy