ET 480
Absorption refrigeration system

Description

- **model of an absorption refrigeration system**
- **boiler operated alternatively by gas or electrically**
- **adjustable heating at the evaporator serves as cooling load**

Refrigerating plants make use of the fact that a refrigerant evaporates at low pressure. In absorption refrigeration systems, the absorption of ammonia in the water produces this low pressure. The absorption process is driven by thermal energy, which can come for example from industrial waste heat or solar collectors to operate these systems.

This basic principle of an absorption refrigeration system is demonstrated in the ET 480 experimental unit taking the example of an ammonia-water solution with the ammonia acting as refrigerant. In the evaporator the liquid ammonia evaporates and withdraws heat from the environment. To keep the evaporation pressure low, the ammonia vapour in the absorber is absorbed by the water. In the next step, ammonia is permanently removed from the high concentration ammonia solution to prevent the absorption process from being halted. For this purpose, the high concentration ammonia solution is heated in a generator until the ammonia evaporates again. In the final step, the ammonia vapour is cooled in the condenser to the base level, condenses and is returned to the evaporator. The low concentration ammonia solution flows back to the absorber. To maintain the pressure differences in the system, hydrogen is used as an auxiliary gas.

In process technology systems the resulting waste heat can be used for cooling. In small mobile systems, such as a camping refrigerator or minibar in a hotel, the required heat is generated electrically or by gas burner. Another benefit of absorption refrigeration systems is their silent operation.

ET 480 demonstrates the functional principle of an absorption refrigeration system with its main components: evaporator, absorber, boiler as generator with bubble pump, condenser. The boiler can alternatively be operated with gas or electrically. Another electric heater at the evaporator generates the cooling load.

Temperatures in the refrigeration circuit and the heating power at the boiler and at the evaporator are recorded and displayed digitally.

Learning objectives/experiments

- demonstrate the basic principle of an absorption refrigeration system
- absorption refrigeration system and its main components
- operating behaviour under load

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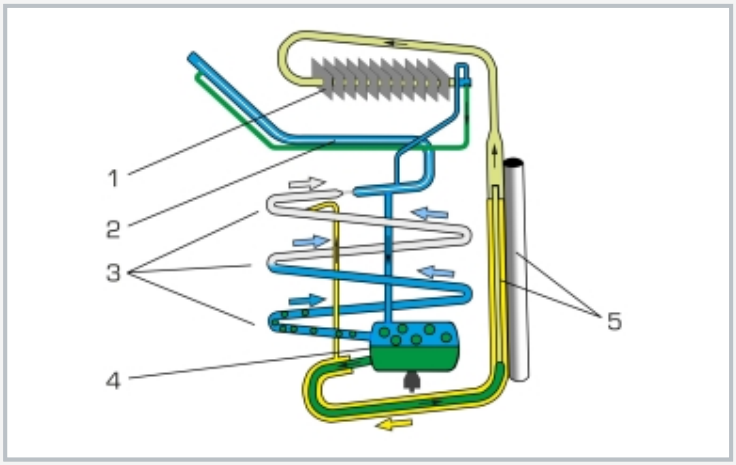
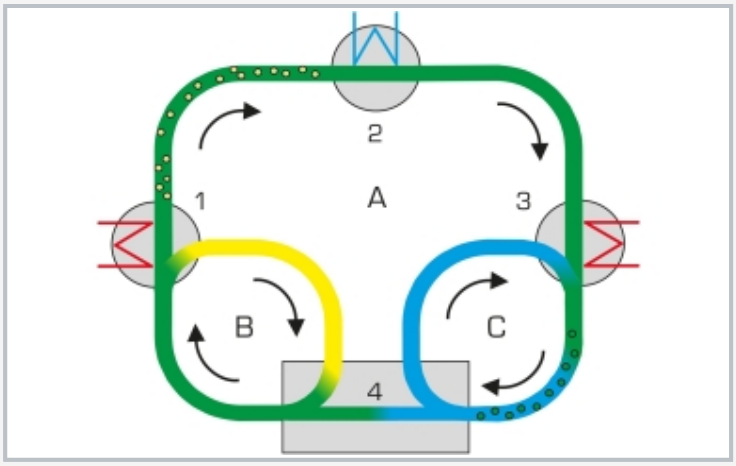
1 condenser, 2 evaporator with heater, 3 absorber, 4 tank, 5 gas burner, 6 pressure reducing valve for propane gas operation, 7 boiler with bubble pump to separate the ammonia, 8 displays and controls



1 condenser, 2 evaporator, 3 absorber, 4 tank, 5 boiler with bubble pump;
green: high concentration ammonia solution, yellow: low concentration ammonia solution, blue: gas mixture ammonia-hydrogen



1 boiler with bubble pump, 2 condenser, 3 evaporator, 4 absorber;
A: ammonia circuit, B: water circuit, C: hydrogen circuit

Specification

[1] operation of an absorption refrigeration system
[2] main system components: evaporator, absorber, boiler with bubble pump, condenser
[3] ammonia-water solution as working medium, hydrogen as auxiliary gas
[4] boiler to separate ammonia
[5] bubble pump for transportation in the circuit
[6] adjustable electrical heater at the evaporator serves as cooling load
[7] boiler is alternatively heated by electrical heater or gas burner
[8] piezoelectric igniter for gas operation
[9] digital displays for temperature and power

Technical data

Working medium: ammonia-water solution
Auxiliary gas: hydrogen
Electric heater: 125W
Gas burner, adjustable: propane gas
Evaporator heater, adjustable: 50W

Notice: ambient temperatures near to 30°C or more do minimise the cooling effect

Measuring ranges
- temperature: 4x -50...200°C
- power: 0...150W

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 750x450x750mm
Weight: approx. 47kg

Required for operation

propane gas: 30...50mbar

Scope of delivery

1 experimental unit
1 hose
1 pressure reducer
1 set of instructional material

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Optional accessories

WP 300.09	Laboratory trolley