Condensation of gases through a pressure increase and cooling (Artikelnr.: P3011400)

Curriculare Themenzuordnung

Fachgebiet:	Bildungsstufe:	Lehrplanthema:	Unterthema:	Experiment:
Chemie	Hochschule	Physikalische Chemie	Phasengleichgewicht	

Schwierigkeitsgrad	Vorbereitungszeit	Durchführungszeit	empfohlene Gruppengröße
Mittel	10 Minuten	10 Minuten	2 Schüler/Studenten

Zusätzlich wird benötigt:

Versuchsvarianten:

Schlagwörter:

Kondensation, Gasgesetze, Stoichiometrie, Kondensation von Gasen

Overview

Short description

Principle

Gases are condensing when they are cooled and at high pressure. In this experiment butane is condensed by cooling it to ca. -15 °C. In the second part of the experiment butane is condensed by compressing it.

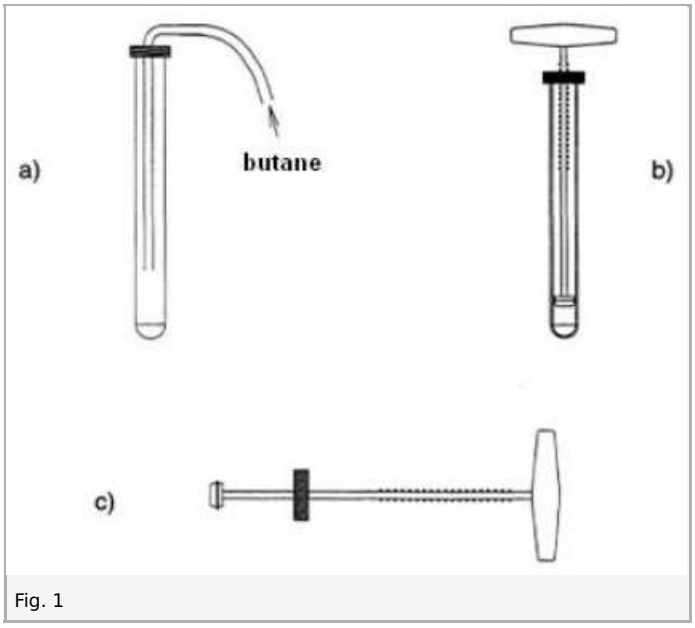

Fig. 1

Schüler-/Studentenblatt

Gedruckt: 13.04.2017 19:01:10 | P3011400

Safety instructions

Safety information
Be careful when working with liquefied gas! When combined with air, explosive mixtures result.
When burning it off, ensure that the apparatus has been flushed in an air-free manner. Otherwise, there is a risk of blowback and explosion.
Avoid any pressure build-up in closed apparatuses!

Propane/butane mixture
H220: Extremely flammable gas
P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P283: Wear fire/flame resistant/retardant clothing.

Equipment

Position	Material	Bestellnr.	Menge
1	Support base DEMO	02007-55	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
3	Right angle clamp	37697-00	4
4	Universal clamp	37715-00	4
5	Lab jack, 160 x 130 mm	02074-00	1
6	Gas liquefier	08173-00	1
7	Gasometer 1000 ml	40461-00	1
8	Dewar vessel,500 ml	33006-00	1
9	Thermometer,-100....+30 C	38151-00	1
10	Test tube GL25/8, w.hose connec.	36330-15	2
11	Glass tubes,right-angled, 10	36701-59	1
12	Glass tube,right-angled w.tip,10	36701-53	1
13	Stopcock,3-way,t-shaped, glass	36731-00	1
14	Rubber stopper, d=22/17 mm, without hole	39255-00	1
15	Rubber tubing, i.d. 6 mm	39282-00	2
16	Commercial weight, 1000 g	44096-70	1
17	Pinchcock, width 15 mm	43631-15	1
18	Butane cartridge C206, without valve	47535-00	1
19	Butane burner, Labogaz 206 type	32178-00	1
20	Quartz glass wool 10 g	31773-03	1
21	Sodium chloride, 500 g	30155-50	1
Additional material			
	Ice		

Schüler-/Studentenblatt

Gedruckt: 13.04.2017 19:01:10 | P3011400

Tasks

1. Condense butane by cooling it under its boiling point of 0.4 °C.
2. Condense butane at high pressure.

Robert-Bosch-Breite 10
37079 Göttingen
Tel: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Set-up and Procedure

Safety information

Be careful when working with liquefied gas! When combined with air, explosive mixtures result.
When burning it off, ensure that the apparatus has been flushed in an air-free manner. Otherwise, there is a risk of blowback and explosion.
Avoid any pressure build-up in closed apparatuses!

1. LIQUEFYING GAS THROUGH A PRESSURE INCREASE

Procedure

Guide some butane gas from a butane source (butane burner, butane soldering torch, pressurised dispenser) as shown in Fig. 1a) via a hose and a glass tube into the cylinder of the gas liquefier until it is completely full (butane is heavier than air). Then, insert the piston (Fig. 1c) into the cylinder, attach and tighten the union nut, push the piston deep into the cylinder and lock it in place by rotating it slightly (Fig. 1b).

2. LIQUEFYING GAS THROUGH COOLING

Procedure

Set the experiment up as shown in Figure 2. The Dewar vessel holds a calorimeter insert. Via connector 2 (see the additional illustration), this calorimeter insert is connected to a three-way stopcock to which a butane gas source and a gasometer are connected. Connector 1 holds a bubble counter with a right-angled glass tube. Fill some quartz glass wool into the glass tube as blowback protection. Opening 3 of the calorimeter insert is sealed tightly with a rubber stopper. The hose connection between the calorimeter insert and the bubble counter is equipped with a pinchcock. Keep some crushed ice and common table salt ready. In order to liquefy the gas, let some butane gas flow into the calorimeter insert and bubble counter via the three-way stopcock (position a) until the air has been completely pushed out of these equipment parts. Then, set the three-way stopcock to position b and close the pinchcock upstream of the bubble counter. Let 500 or 1,000 ml of butane flow into the gasometer. Then, stop the gas flow, set the stopcock to position c, and fill a mixture of ice and salt into the Dewar vessel.

Schüler-/Studentenblatt

Gedruckt: 13.04.2017 19:01:10 | P3011400

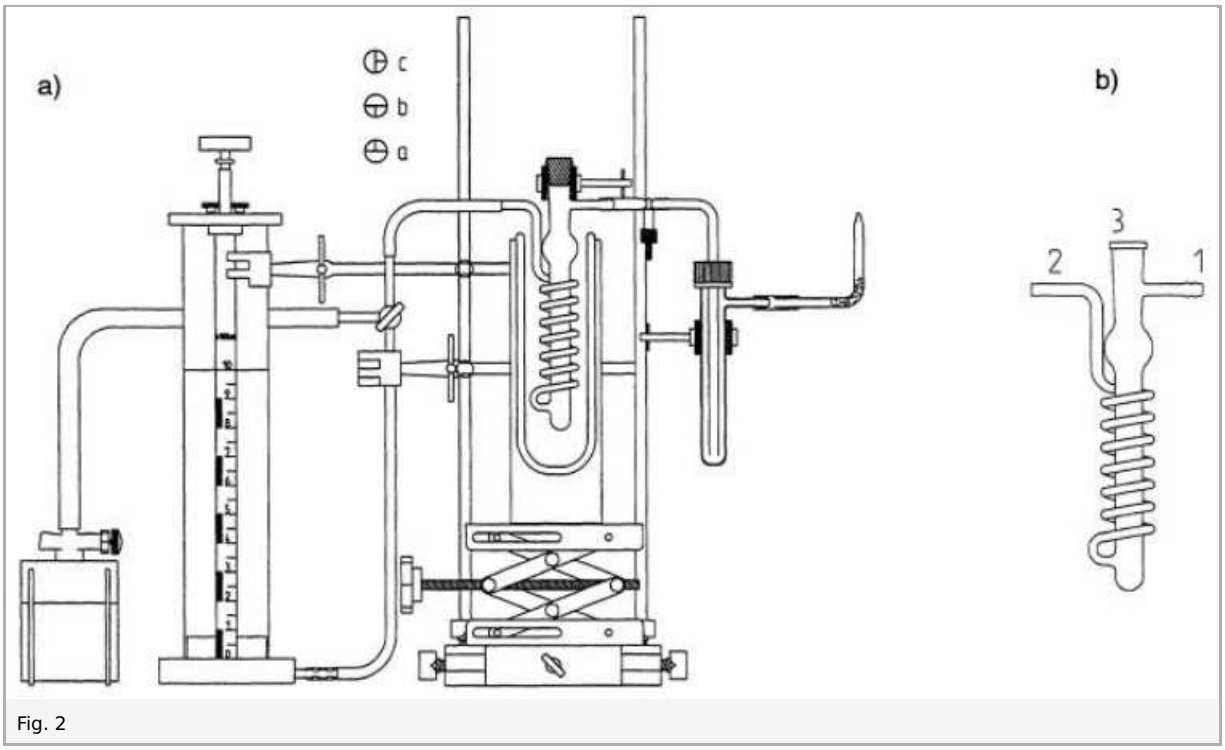

Fig. 2

Theory and Evaluation

1. LIQUEFYING GAS THROUGH A PRESSURE INCREASE

Observation

The butane gas liquefies due to the pressure that is applied by the piston. When the piston is unlocked, the butane evaporates slowly, thereby pushing the piston back into its initial position.

Result

Gas can be liquefied through pressure.

2. LIQUEFYING GAS THROUGH COOLING

Observation

The temperature in the Dewar vessel falls to a value below -10 °C (measured with a low-temperature thermometer). The piston in the gasometer moves relatively quickly downwards until it reaches the bottom. When the insert is then lifted out of the Dewar vessel, a crystal-clear liquid can be seen (a few millimetres high). When the insert heats up in the air (or in a beaker with lukewarm water), the liquid evaporates once again. The resulting gas fills the gasometer once again until the initial position is reached.

Result

Butane can be easily liquefied through cooling.

Note

If the butane in the gasometer is not required for any subsequent experiments, place a weight of 500 g on top of the gasometer and let the gas burn slowly at the outlet nozzle downstream of the bubble counter.

The boiling point of butane is at -0.4 °C.

Notes

The experiments described herein are intended to consolidate the concept of the composition of sub-stances based on particles. The three states of aggregation of a substance in the context of thermal mo-tion can be explained only by way of the particle theory. During these experiments, the students learn about pressure increase and cooling as methods for transforming a gas into a liquid.

Robert-Bosch-Breite 10
37079 Göttingen
Tel: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de