

Rise of Temperature in Adsorption

Equipment:

goblet (conical glass cup)
demonstration thermometer with clamp and ring stand or digital thermometer with sensor and large display
graduated cylinder
glass beaker

Chemicals:

granular activated carbon
acetone

Safety:

acetone (C₃H₆O):



H225-319-336, EUH066
P210-240-305 + 351 + 338-403 + 233

Liquid and vapor are highly flammable. The vapor should not be inhaled as it may irritate the bronchi and cause headache, drowsiness and dizziness. Acetone also causes severe eye irritation and prolonged or repeated topical use damages the skin, which becomes brittle and cracked.

The experiment obligatorily has to be carried out in a fume hood. It is also necessary to wear safety glasses and suitable protective gloves made from butyl rubber.

Procedure:

Preparation: The demonstration thermometer is attached to the ring stand in such a way that it leads deep into the goblet (or the sensor is placed in the goblet). Subsequently, the lower part of the thermometer (or sensor) is surrounded with activated carbon, so that the relevant range of the temperature scale is still visible. 50 mL of acetone are measured in the graduated cylinder and then filled into the beaker.

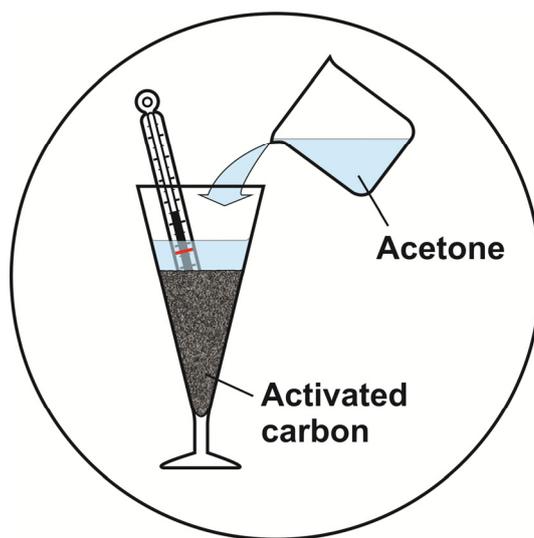
Procedure: All the acetone is poured over the activated carbon.

Observation:

A noticeable rise in temperature occurs.

Explanation:

The adsorption process is accompanied by a "heat effect." As always in chemical reactions, there are actually two effects at work. Energy is released and dissipated whereby entropy is generated: $S_g = \mathcal{A} \times \Delta\xi / T$. This exothermal contribution is complemented by the (usually) exothermal latent entropy $S_l = \Delta_{\square} S \times \Delta\xi$ (the symbol \square stands for the adsorption process), because the adsorption on a solid surface limits the mobility of the particles, resulting in the release of entropy.



Disposal:

The activated carbon can be regenerated after the end of the experiment by heating it overnight in a drying oven at about 150 °C.