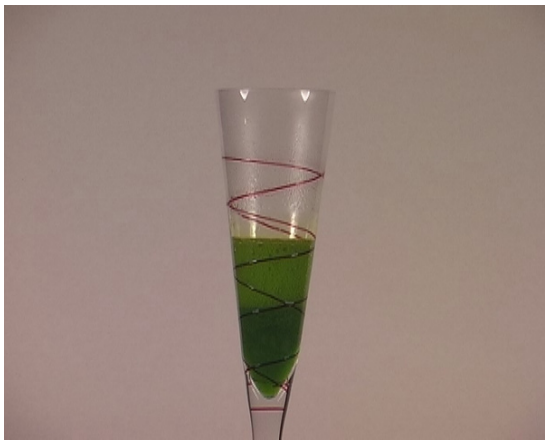
Dancing Absinthe



Equipment:

champagne flute or glass
beaker (100 mL)
graduated cylinder (50 mL)
3 graduated cylinders (10 mL)
spatula

Chemicals:

hydrogen peroxide solution (30 % w/w)
copper(II) chloride dihydrate
concentrated hydrochloric acid (37 % w/w)
concentrated sodium hydroxide solution (32 % w/w) or acetone

Safety:

hydrogen peroxide solution (H_2O_2):

H302, H315, H318, H335
P280, P302 + P352, P305 + P351 + P338, P310

copper(II) chloride dihydrate ($CuCl_2 \cdot 2\ H_2O$):

H290, H302 + H312,H315, H318, H410
P273, P280, P301 + P330 + P331, P302 + P352, P305 + P351 + P338, P312

concentrated hydrochloric acid (HCl):

H290, H314, H335
P280, P303 + P361 + P353, P304 + P340, P305 + P351 + P338, P310

concentrated sodium hydroxide solution (NaOH):

H290, H314
P280, P303 + P361 + P 353, P305 + P351 + P338, P310

The chemicals cause very severe skin burns and eye damage and the vapours may also cause respiratory irritation. Therefore, it is absolutely necessary to wear a lab coat, safety goggles and protective gloves and to work in a fume hood.

Procedure:

Preparation: The champagne flute is filled with concentrated sodium hydroxide solution and allowed to stand for approx. 12 hours. Subsequently, the flute is carefully rinsed with deionized water. Alernatively, the flute can be rinsed with some acetone. Afterwards, the remaining acetone is allowed to evaporate.
Procedure: 10 g of copper(II) chloride dihydrate are dissolved in a mixture of 50 mL of concentrated hydrochloric acid and 10 mL of deionized water in the beaker. 10 mL of the strongly acidified copper(II) chloride solution are poured in the champagne flute and 10 mL

of hydrogen peroxide solution are added. Afterwards, the flute should not be touched anymore.

Observation:

After a few minutes, an evolution of gas starts which becomes more and more intense whereby a foam head is formed. In the following, the strength of gas evolution and foam formation changes in rhythmical intervals for several minutes. During the course of the reaction, the frequency of the oscillations increases until only a strong evolution of gas can be observed. Thereby, hydrochloric acid vapors escape and finally the reaction comes to a standstill after the consumption of the hydrogen peroxide.

Explication:

The present oscillating reaction is based on the decomposition of hydrogen peroxide. This decomposition is homogeneously catalyzed by many heavy metal ions such as Fe^{3+} but also by a hydrochloric copper(II) chloride solution. There are indications that not only the copper(II) ions and the copper chloro complexes are catalytically active but also the chloride ions. In the case of the copper(II) ions one assumes a reaction chain analogous to the HABER-WEISS mechanism.
First, the produced oxygen remains physically dissolved in the solution. Only when the solution is supersaturated with O_2, larger amounts of gas can be released and the solution foams up. Thereby, more O_2 is released as can be reproduced by the catalytic reaction. As a consequence, the concentration of oxygen in the solution falls below the saturation limit and the gas evolution decreases remarkably. Only if the solution is again supersaturated, the next strong gas evolution can take place.

Disposal:

After the experiment, the solution is neutralized and poured into the container for heavy metal waste.

Reference:
H. Kunz, F. Johannsmeyer, M. Oetken: „Das pulsierende Sektglas“, *ChemKon*, Vol. 7 (2000), p. 30–31 (in German)