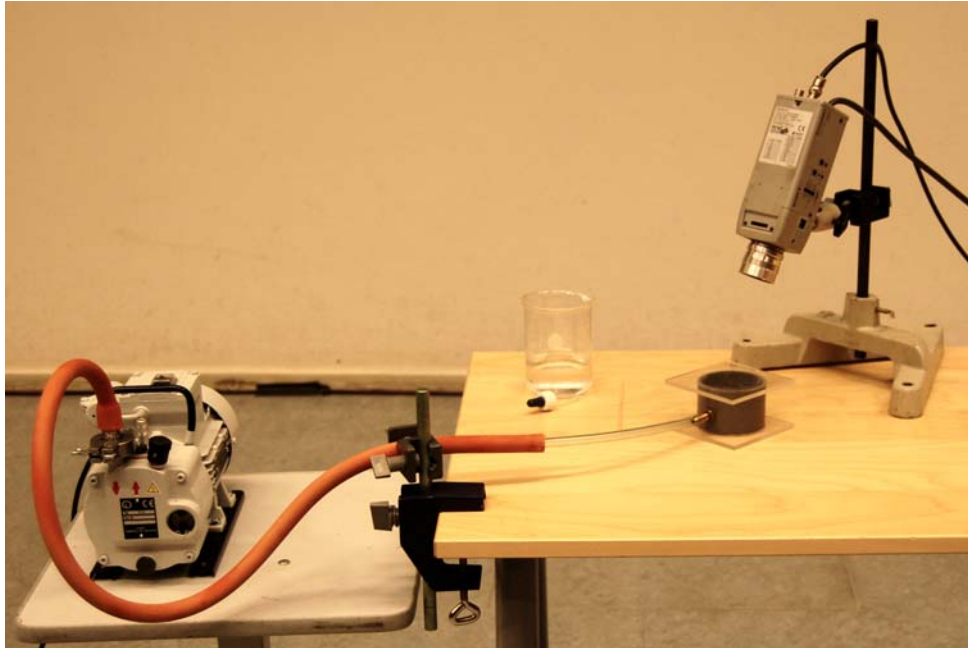


Boiling to freeze

Aim: To show that boiling evaporation needs a lot of heat.

Subjects: 4C30 (Phase Changes: Liquid-Gas)

Diagram:



Equipment:

- Vacuum pump
- PVC-cylinder with transparent end caps and a small table inside.
- Dropper.
- Camera and beamer focussed on the drop of water.

Safety:

- In using the vacuum pump never expose parts of the body to vacuum. There is danger of injury. Never operate the pump with an open and thus accessible inlet. Do not open the vacuum system during operation of the pump.

Boiling to freeze

Presentation: Preparation:

The vacuum pump is connected to the cylinder. One rim of the cylinder is greased with vacuum grease and then one of the square transparent end caps is pressed to the cylinder. This makes the bottom of the assembly. Also the upper rim of the cylinder is greased. Next the small table is placed inside the cylinder.

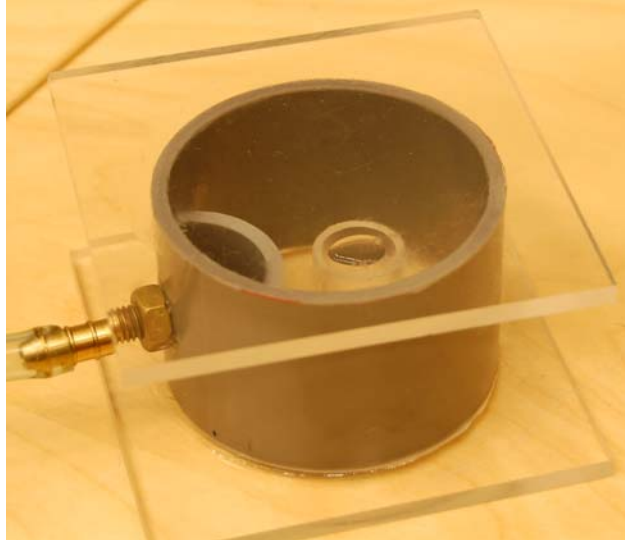


Figure 1

Presentation:

By means of a dripper a large drop of water is put down on the table top. The second transparent end cap is put on top of the cylinder and pressed down. The assembly is ready now (see Figure 1) and the camera is focussed on the drop of water. The pump is switched on. Almost immediately a vigorous boiling is observed. This stops and a quiet drop of water is observed. Then after some time suddenly the drop of water turns opaque (see Figure 2)

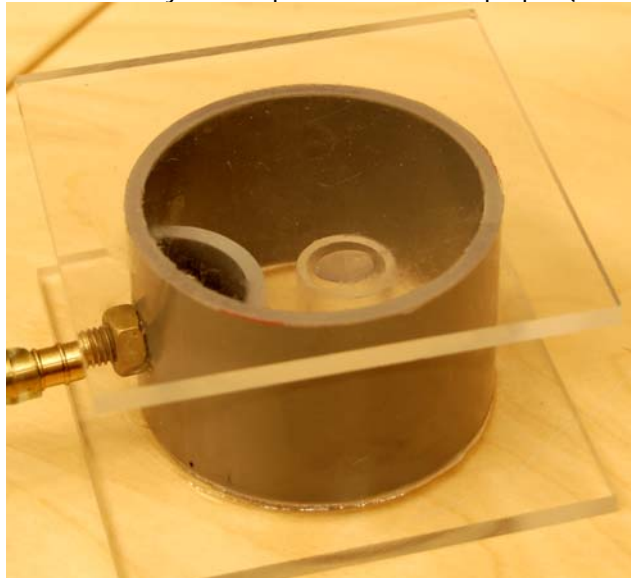


Figure 2

We stop the pump, remove the upper transparent cap and with a small stick we shift the frozen drop across the table, to show the audience that the drop is solid.

Boiling to freeze

Explanation: When the pump is switched on the water starts boiling because of the low pressure. This boiling is vigorously because of the fast drop in pressure. Then after some time this boiling stops because now the decrease in pressure is continuing at a slower rate. (The evaporation of water continues in this part of the demonstration but is not visible to us now.) During the process of boiling and evaporation the drop of water loses heat and its temperature decreases. Because the small table top is very clean, the drop of water even becomes supercooled; it reaches a temperature below the freezing point of 0°C. At that low temperature it suddenly freezes.

Remarks: •

Sources: •