

Beating mercury heart:

Hi. I am Balázs from Kőszeg.

About 70 times a minute, 100,000 times a day, 3 billion times within 75 years, your heart keeps the beat...the beat of life. But, how does the heart beat? Well, the heartbeat's pump function is due to the heart muscle. The atria and ventricles work together by alternately contracting and relaxing to pump blood through your heart.

Heart can be associated with many things: love, Valentine Day, Mothers' day etc. It's often used in topiaries, folk art, food like ginger bread heart, heart-shaped candies etc.

Heart reminded me of a spectacular experiment called **the beating mercury heart**. We put a larger drop of mercury on the watch-glass and pour 6 mol/dm^3 concentration of sulphuric acid solution. Then we need to add approximately 0.1 mol/dm^3 of potassium-dichromate solution until the solution changes its colour into pale yellow. For the sake of the cause hold the needle firmly in your hands in order to just barely touch the drop of mercury. As you can see it starts beating in a regular rhythm and meanwhile it's taking triangular and spherical shapes alternately. It's not me: it's working by itself, as you can see.

The shape of the drop of mercury is determined by the extent of surface charge in connection with the surface tension. The drop of mercury contracts with the increase of surface tension in order to achieve the least possible surface. However, if there is charge on the surface, as a consequence of repelling strength the intention is to achieve the greater surface as possible and that's why the drop of mercury goes flat. In the acidic, oxidizing medium the mercury atoms on the surface are oxidized. Moreover, the mercury and sulphate ions in sulphuric medium form a precipitation layer on the surface of the metal which prevents it from the further oxidation. The surface charge becomes positive and the drop flattens.

The needle or nail may be oxidized in several ways. During the hydrogen generation the sulphuric acid oxidizes the needle and we can observe the arising gas bubbles. Besides this, both the iron and iron (II) ions are oxidized and the colour of the solution changes from orange into green. These oxidation reactions are extremely fast, thus electrons are collected on the surface of the iron and the needle becomes negatively charged. When the drop of mercury goes flat, it comes into direct contact with the needle and therefore a considerable part of electrons accumulated on the iron goes over the mercury. The electrons reduce the mercury ions into metallic mercury. Consequently, the positive charge of the drop decreases, the surface tension increases and the drop contracts.

However, the mercury and the iron are oxidized again and the process starts from the beginning. As a summary, the pulsation of the mercury heart is due to the periodic increase and decrease of the drop of mercury.

During the vibration of the mercury drop the energy lost is continuously regained by the electrochemical reactions. The energy is given to the system periodically, exactly with the frequency of the natural frequency of the mercury drop. This is a self-regulated **forced vibration**.

The shape of the stationary wave depends on the size of the mercury drop. The larger the drop is, the more wave-forms can be produced. There is much more to talk about it, but it has been so nice here, that I decided to talk about them only next year. Thanks for your attention.