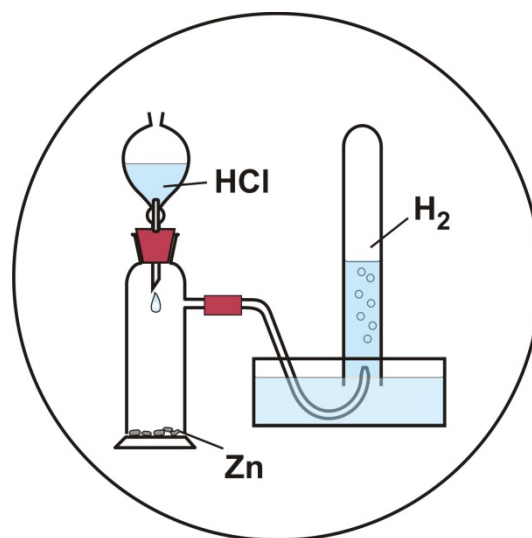


Volumetric Determination of Conversion

Equipment:

gas washing bottle with dropping funnel
curved glass tube
pneumatic trough (glass trough with round bottom and cylindrical rising walls)
eudiometer tube (glass tube with graduation markings and closed at one end)
short rubber hose
ring stand, clamp holder
optionally stopwatch



Chemicals:

zinc granules
dilute hydrochloric acid (2 kmol m^{-3})
orange G (or another water soluble dye)
tap water

Safety:

hydrochloric acid (HCl) (2 kmol m^{-3}):



H290
P390, P406

It is strongly recommended to wear safety goggles. In addition, the experiment should be carried out in a fume hood.

Procedure:

Preparation: First, the pneumatic trough is filled with water that has been colored with orange G; the eudiometer is filled with water in the trough (as possible without bubbles), inverted so that its open end is facing the ground (while holding the open end so that no water escapes), and then attached to the ring stand with the clamp holder.

Subsequently, five to six zinc granules are placed on the bottom of the washing bottle. The stopcock of the dropping funnel is closed and it is filled with hydrochloric acid. Finally, the curved glass tube is connected to the outlet tube of the washing bottle.

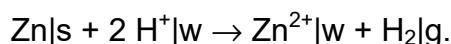
Procedure: To start the reaction, the stopcock of the dropping funnel is opened. The dropping speed of the hydrochloric acid should be regulated in such a way that a continuous, not too violent formation of gas is achieved. The gas should be allowed to escape for a short while to purge all the air from the system; then, the end of curved tube is placed directly under the eudiometer tube. If necessary, the reaction can be accelerated with a little bit of copper sulfate. (The copper sulfate reacts with the zinc, forming a deposit of copper metal on the zinc. This acts as catalyst, speeding up the production of hydrogen.)

Observation:

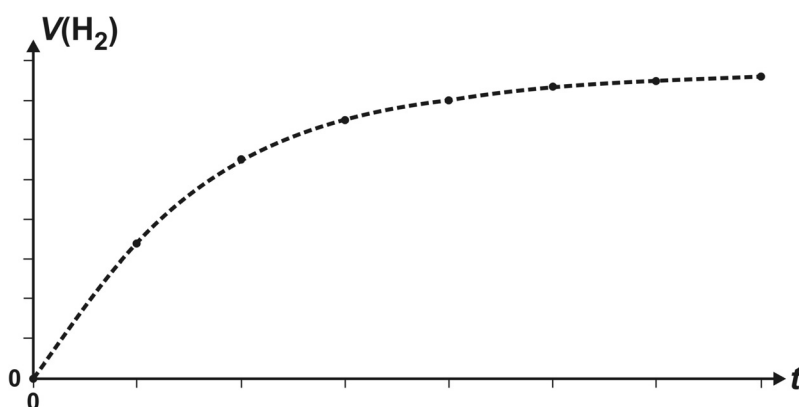
After the addition of hydrochloric acid, the evolution of hydrogen gas starts readily. Over time, the number of bubbles rising in the eudiometer tube decreases until the gas evolution finally ceases. By measuring the gas volume at equal time intervals with the aid of the scale on the eudiometer tube, a (semi) quantitative recording of the reaction process is possible.

Explanation:

The metal zinc reacts with hydrochloric acid, forming zinc (II) and releasing hydrogen gas:



The following schematic curve is obtained by plotting the gas volume $V(\text{H}_2)$ as a function of the time t :



The fitted curve indicates the exponential nature of the volume change.

Disposal:

After the end of the experiment, the zinc granules are completely dissolved by adding more hydrochloric acid and the zinc-containing solution is disposed of in the container for inorganic solutions containing heavy metals.