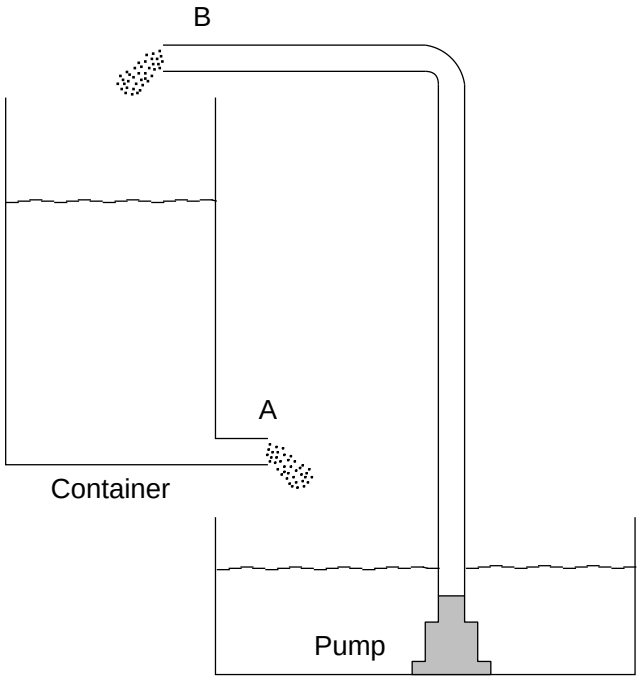
Level Control

General Description

The process consists of a container with the maximum capacity of 3 liters. A pipe situated in the bottom of this container lets the water flowing out (A), while a pump can be actuated to put water into the tank (B). A pressure transductor lets to know the height of the water column stored in the tank.



Process Parameters

Max. container capacity	$3\,l$
Container section	$0.01\,m^2$
Pipe's internal radius (A)	$2.25\,mm$
Pump max. voltage	$6\,V$
Pump max. flow	$41\,ml/s$
Max. pump voltage for no flow	$3.7\,V$

Mathematical Model

The free-dynamics of the process can be modelled as follow:

$$\dot{h} = -k\sqrt{h}$$

with:

$$k = \frac{A_2}{A_1}\sqrt{2\,g}$$

h	height of the water in the tank (m)
A_1	container section (m^2)
A_2	pipe section (m^2)
g	gravity acceleration (m/s^2)

Due to a threshold and a non-linearity present in the pump, full dynamics can be approximated as:

$$\dot{h} = -k\sqrt{h} + \frac{q}{A_1} = -0.007\sqrt{h} + 100\,q$$

with:

$$q = \begin{cases} 0 & \text{if } V \leq 3.7 \\ 1.78 \times 10^{-5}\,(V - 3.7) & \text{if } V > 3.7 \end{cases}$$

where q is the water flow and V is the voltage applied to the pump.

Since the output is the volume (in liters) of the water in the tank, it results:

$$\begin{cases} \dot{h}(t) = -0.007\sqrt{h(t)} + 100\,q(t) \\ y(t) = 10\,h(t) \end{cases}$$