# PRESSURE CONTROL

## FINDING A MODEL

Immagine che contiene testo

Descrizione generata automaticamenteto perform control on the pressure difference, the control variable used is the speed of the pump n, therefore the control loop could be sketched as:

The pump characteristic is , from the model data we know that   
 , leading to

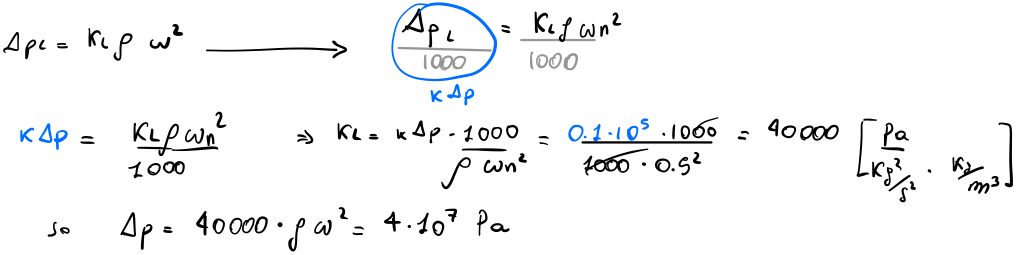
The dependency of H0, H1 from n is assumed to be , (non sono sicuro, però in questo modo, al variare di n, la caratteristica della pompa shifta verso il basso, come ci si aspetta.)

The network model is obtained under some assumptions:

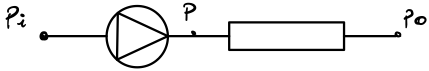
1. We assume the network to be one long pipe, so we are assuming the flow rate in the pipes is the same. In this way, the single tube elements can be simply added.
2. The load on the heater tube is neglected (if we run the simulation, we see that the drop is minimum)

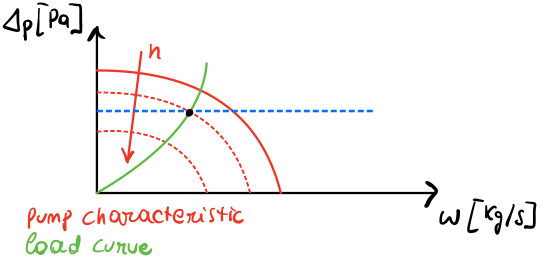
The pipe equation is . Again, from the model data, we know that:

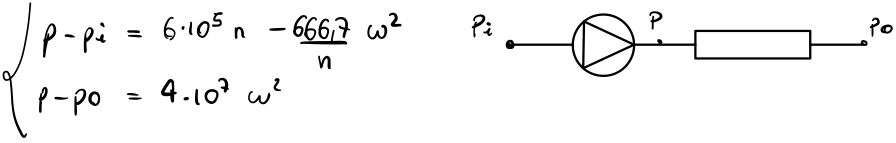
1. The nominal Δp per km at nominal flow rate is kΔp = 0.1\*Pa
2. Nominal flow rate wn = 0.5 kg/s



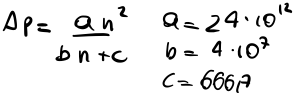
So the total network approximated model is .

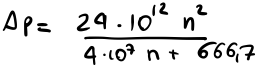
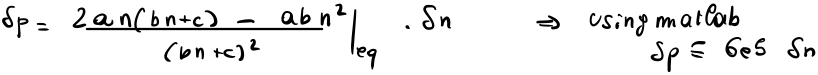
 Because of assumption 2, pi = po;

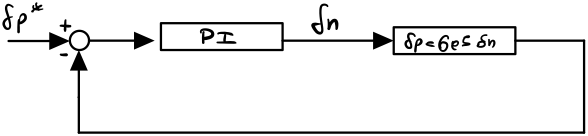
As the valves for the zones are opened, the load curve of the model changes. The idea is to change the speed of the pump accordingly, to maintain the operating point as close as possible to Δp\*



Now I compute the equilibrium point for n, by imposing p-po = Δp\* = 🡪

Since pi = po, the 2 pressure differences are equal, so by computing w^2 in the 2° eq and substituting in the 1°, we have:

The next step is to perform linearization around



## TUNING CONTROLLER

The model we have found is an “algebraic?” model, so not dynamic. However, in reality, this is an approximation. A real system has to have some sort of dynamics, in this case, it’s a very fast one that could be neglected concerning the temperature time constants:

So in reality, the system will be: with τ very small. The controller structure adopted for maintaining the pressure is a PI , leading to an . Experimentally, we could see that the closed loop will have a dominant pole whose value is **almost 1/Ti** (which is the dynamics introduced by the PI)**.**

The use of the Pi here is to track the reference and guarantee good rejection of disturbances (corresponding to the opening of the valves for the zones)

So, experimentally, a good tradeoff for the settling time could be Ta 2500s so a possible choice is Ti = 500; For the gain, the idea can be to keep it low, to reduce the oscillation around the steady state, which could be around 0.001 (era quello che abbiamo messo a caso)