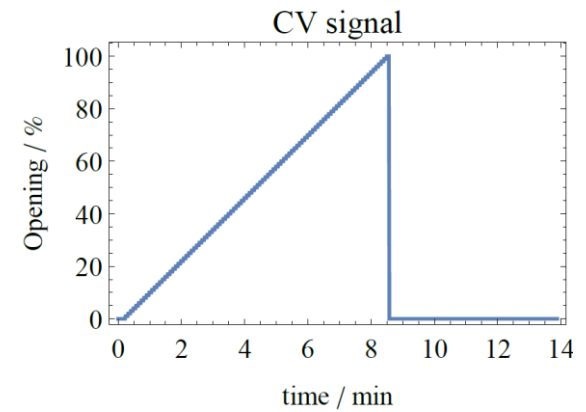
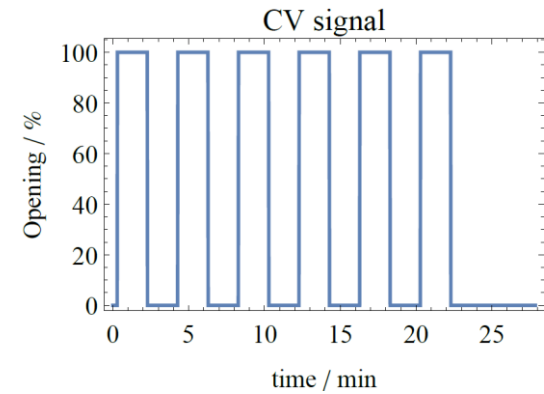


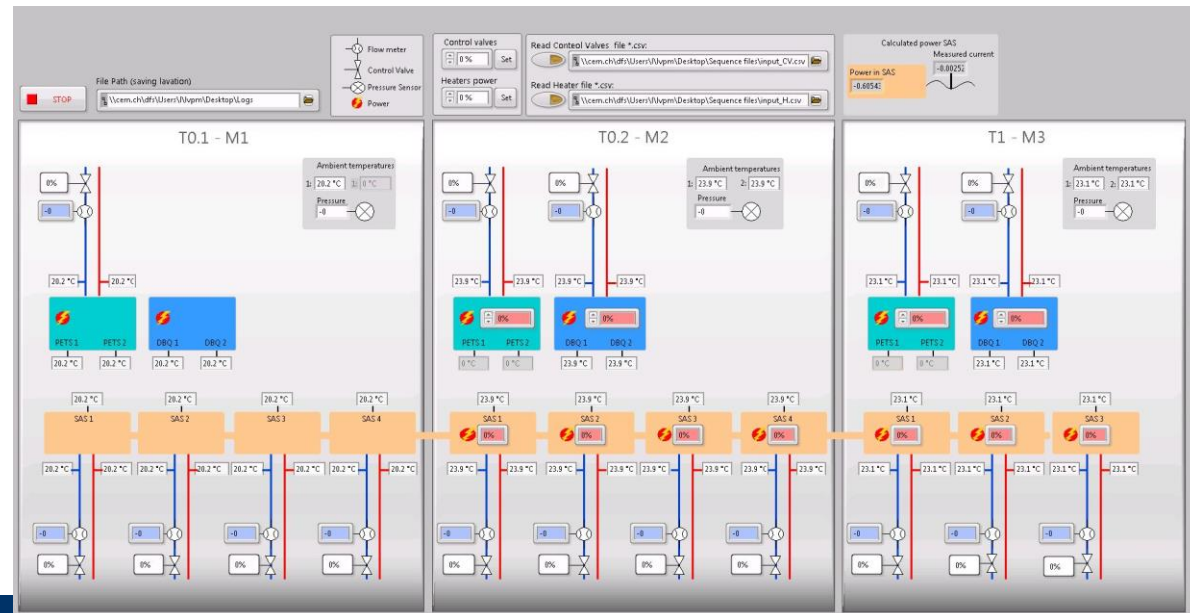
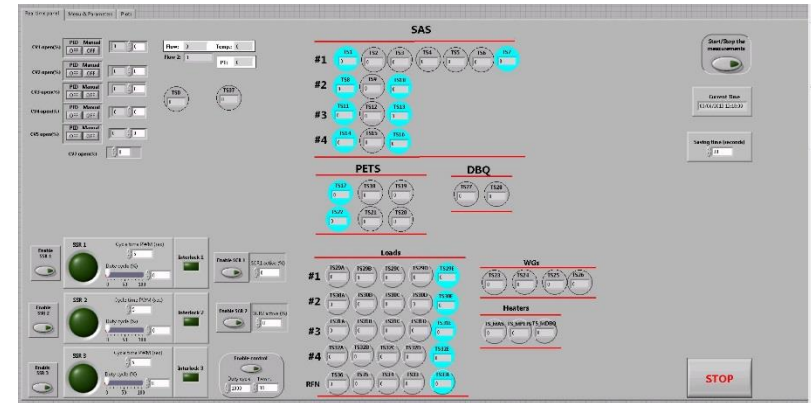
# Control Valves & Flow meter characteristics



- New LabVIEW + technical specifications
- TEST1: Reaction time Control Valves (CV)
- TEST2: Sensitivity test CV
- Conclusion



- 112 channels
- Controlling heaters and CV with .csv files or manually
- Automatically saved as .tdms file
- Sampling time 1 second
- Added sensor to measure current, in order to calculate power produced by heaters.





## Flow Meters (FM)

- 18 monitors, 6 per module
- SAS1-4, PETS and DB
- Type SM6050, imf electronic

## SM6050



Magnetic-inductive flow meter

SMR12GGX10KG/US-100

Response times		
Power-on delay time	[s]	5
Flow monitoring		
Response time	[s]	0.15



## Control Valves (CV)

- 18 valves, 6 per module
- SAS1-4, PETS and DBQ
- Type 6027 compact, bükeret

Orifice [mm]	Response times AC		Response times DC	
	Opening [ms]	Closing [ms]	Opening [ms]	Closing [ms]
1.0 -12.0	10-30	20-30	20-80	20-30

### Response times [ms]:

Measured at valve outlet at 6 bar and +20 °C

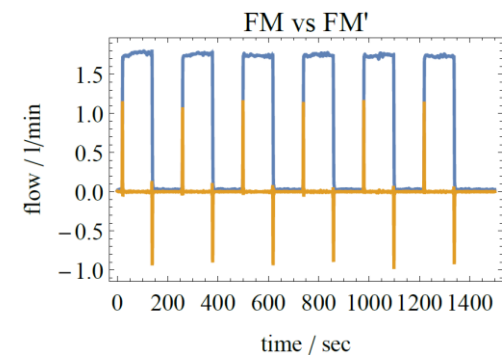
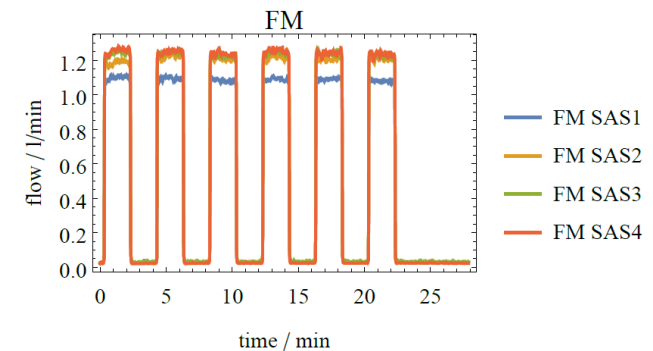
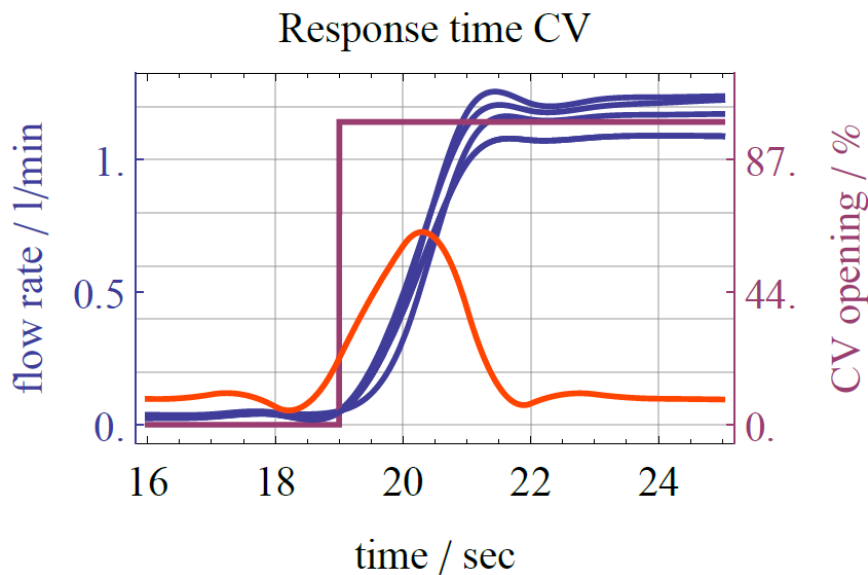
*Opening*: pressure build-up 0 to 90%, *closing*: pressure relief 100 to 10%

	response time FM (s)	response time CV (s)	total reaction time (s)
open	0.8	0.15	0.95
close	0.3	0.15	0.45

\* Sampling time in LABVIEW is not taken into account (yet)

- Time to reach desired flow
- Important to not over regulating flow
- It takes ca 3sec to:
  - 1) send signal to open valves from LabVIEW
  - 2) CV to react
  - 3) accelerate water from v1 to v2
  - 4) FM to react
  - 5) Values to again be read into LabVIEW

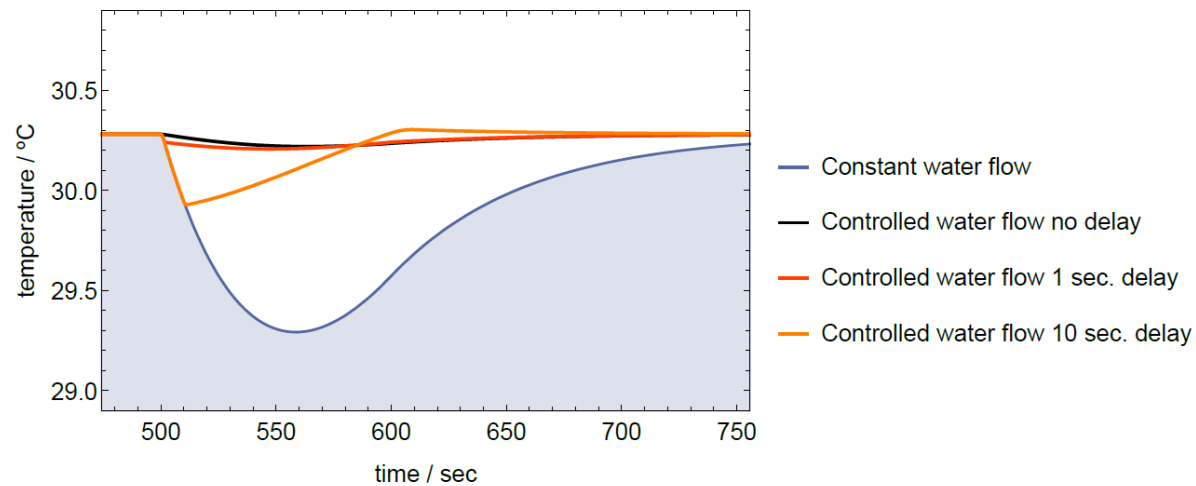
Valve name	$\Delta t$ open (s)	$\Delta t$ close (s)
SAS1	3	4
SAS2	3	4
SAS3	3	4
SAS4	3	4
PETS	3	4



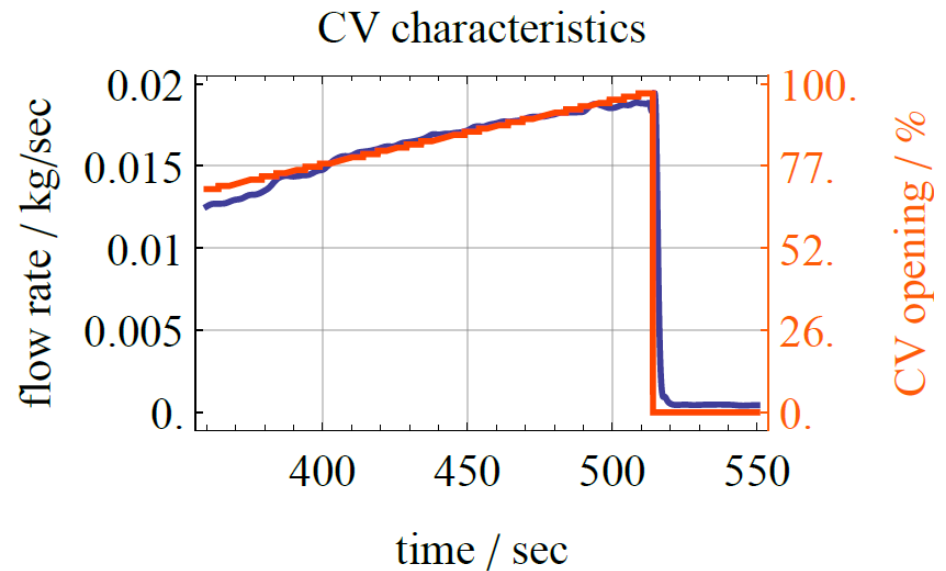
- Effect of delay on temperature control
- With 10 sec delay, the control is still effecient

Valve name	$\Delta t$ open (s)	$\Delta t$ close (s)
SAS1	3	4
SAS2	3	4
SAS3	3	4
SAS4	3	4
PETS	3	4

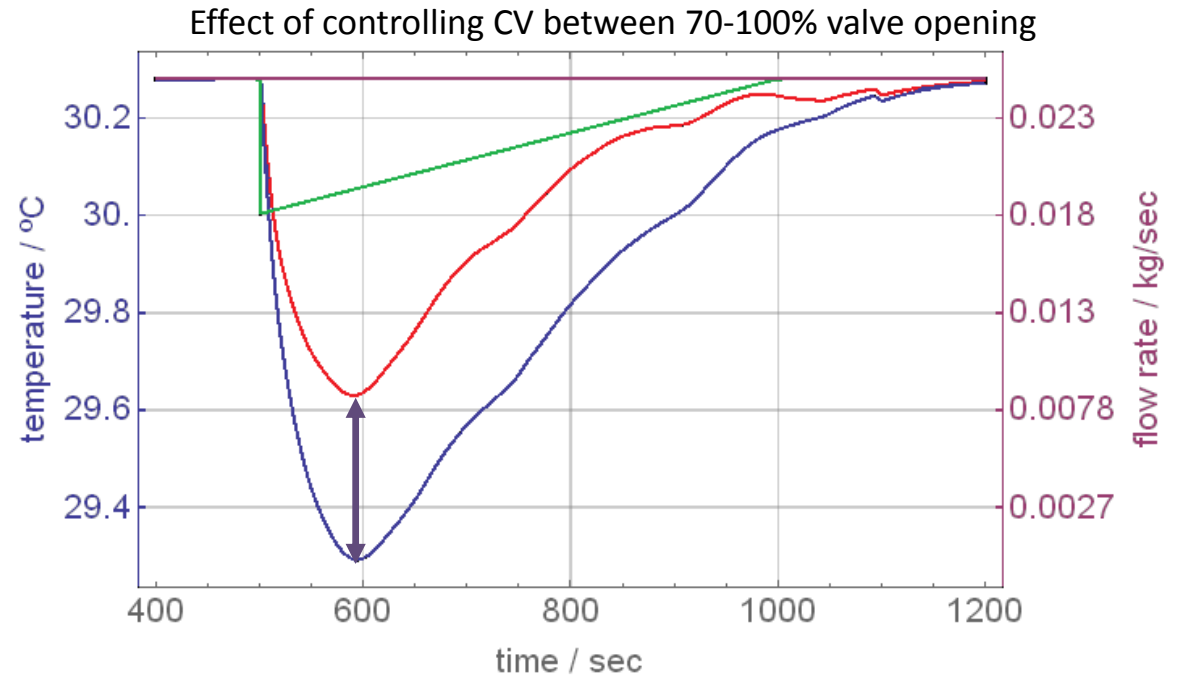
Effect of dalay on temperature control



- No reaction in flow rate until the CV is 50% opened
- Proportional response from 60-100% opening of valves
- With present pressure settings, flow can be controlled accurately between 0.015-0.02 kg/sec



- Effect of controlling CV in 70-100% range







# Conclusion



## Conclusion:

- When sampling time is 1 sec, it takes 3-4 seconds from CV settings are changed to it is again registered and read into LabVIEW.
- Need higher data resolution
- Flow react proportionally to CV opening in the range from 70 - 100 %, (which is mainly the range we need).
- If temperature is controlled with water flow, the reaction time is important to avoid over regulation

## Next steps:

- Repeat tests with higher resolution
- Effect of gradually open/close valves
- Vibrations



Thank you!



## Vibrations

- How much water flows in pipes? (find pipe facts)
- Relationship  $m_{SAS} : m_{water}$
- What happens with the water in sharp bends – acceleration
- Investigate effect of water flow gradually on/off. Measure vibrations?