Building a Foundation for Controls: The Importance of Accurate Measurements and good Regulatory Loop Performance

Fall 2019 PAPTAC Bleach Committee Meeting

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Agenda

- MPC Controls (Matrix)
- Dosage Control
- Brightness/Kappa
- pH
- Loop Tuning
- Examples

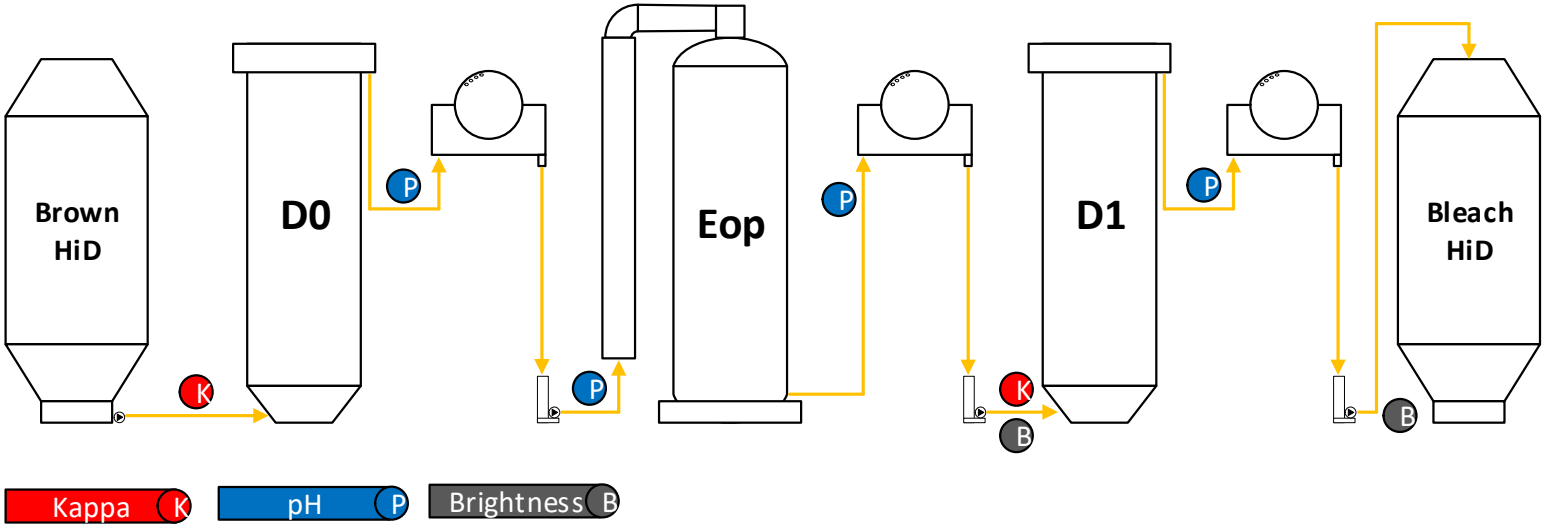
MPC Controls

MPC controls rely on feed forward and feedback control.

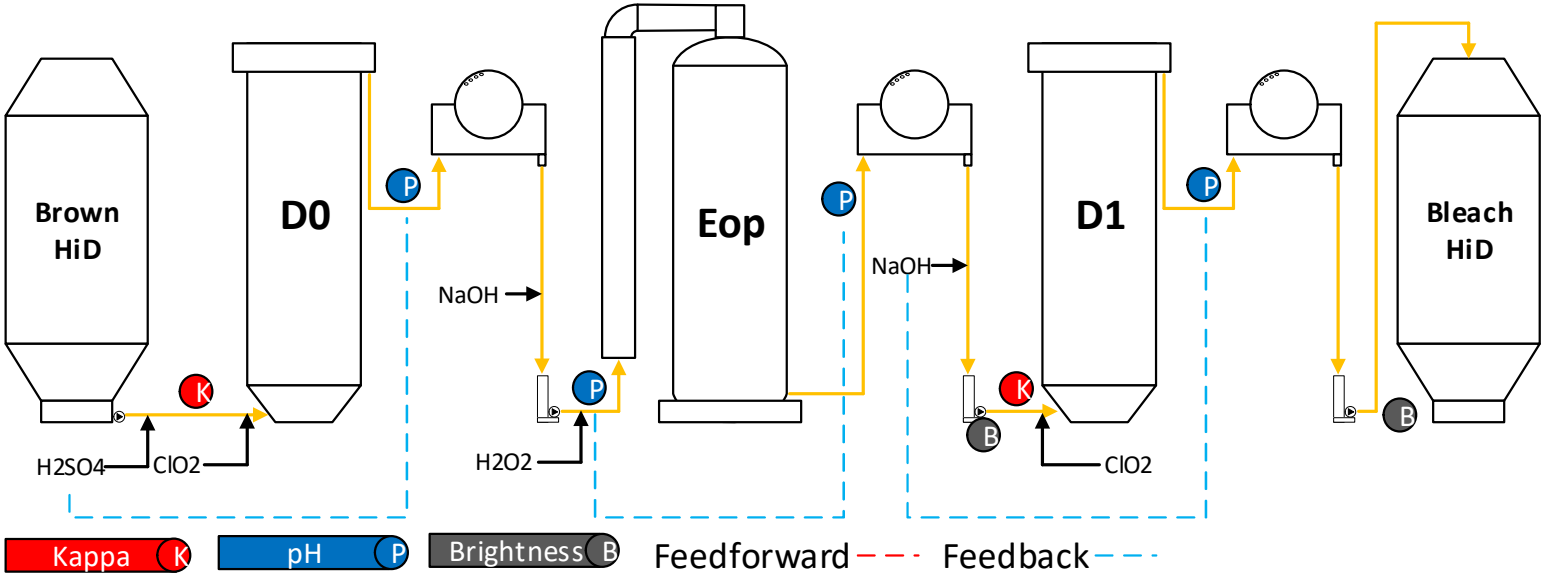
Important foundation

- Measurements should be calibrated correctly within the range of use
- When you have a particular situation (Kappa/pH), you should be able to dose the same amount of chemical to control your process every time.

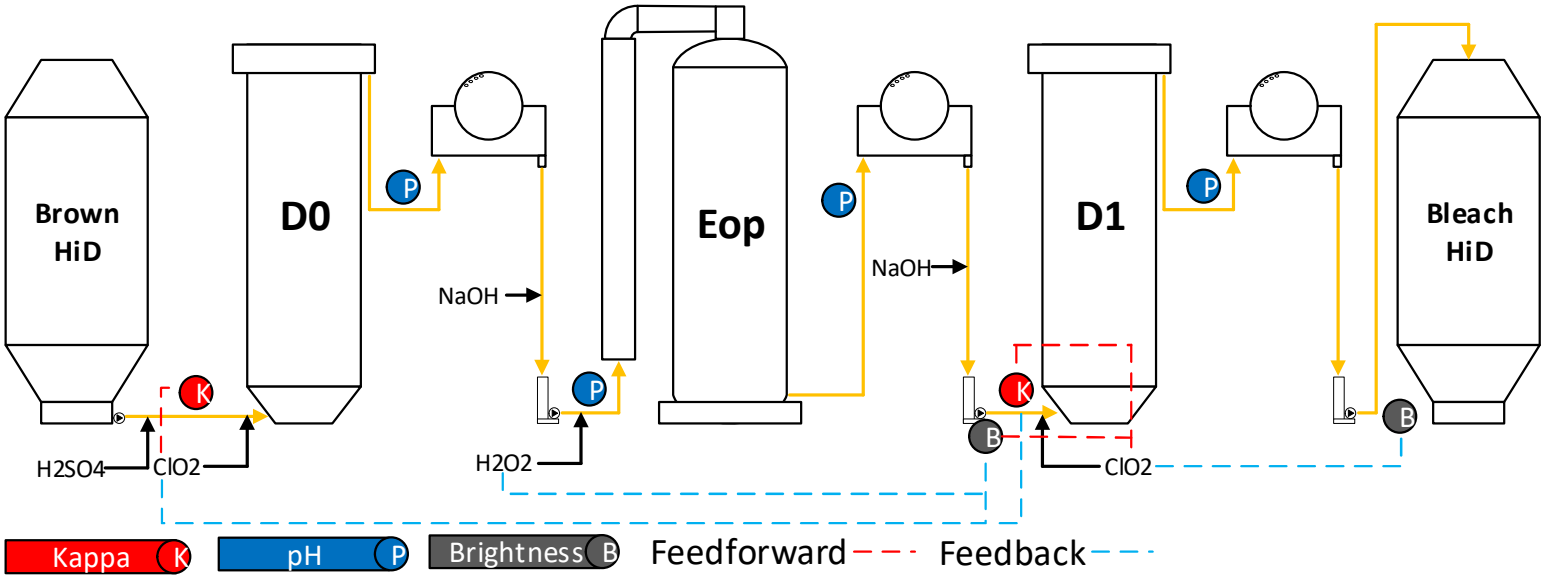
MPC Controls - Overview



MPC Controls - pH



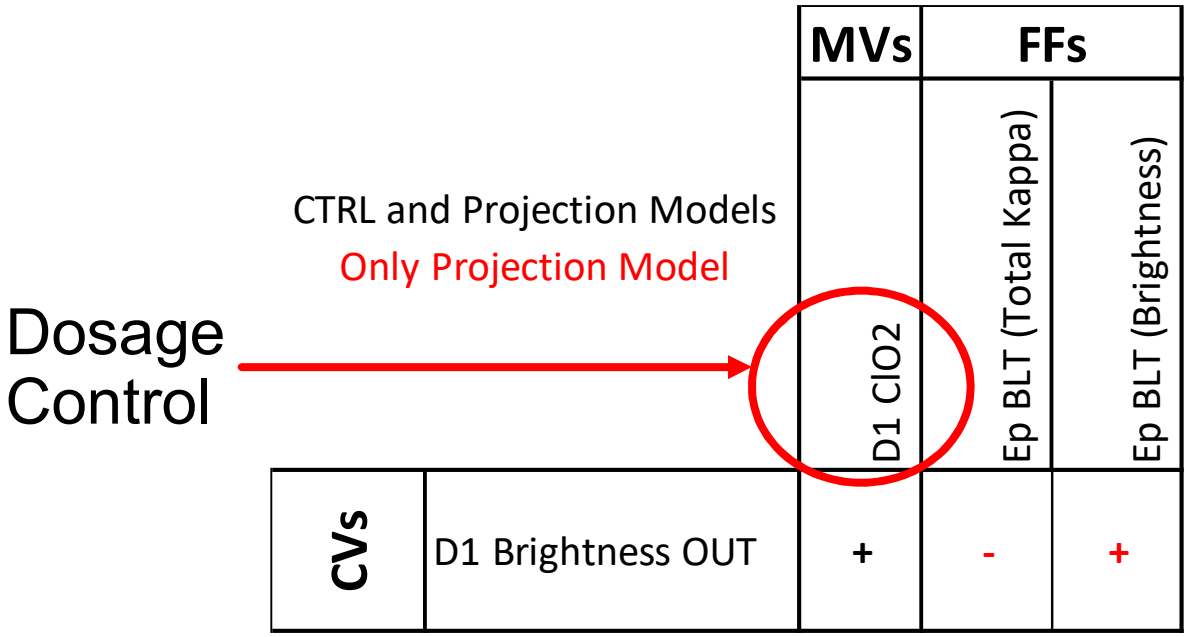
MPC Controls – Kappa/Brightness



MPC Controls – D1 Control Matrix

CTRL and Projection Models Only Projection Model		MVs	FFs	
		D1 ClO2	Ep BLT (Total Kappa)	Ep BLT (Brightness)
CVs	D1 Brightness OUT	+	-	+

MPC Controls – D1 Control Matrix



Dosage Control

$$\frac{Kg}{Ton} \longrightarrow \frac{Chemical\ Flow}{Concentration}$$

$$Ton \longrightarrow Stock\ Flow\ x\ Consistency$$

Brightness/Kappa Measurement

There are inline and external measurements for either

Inline measurement examples:
Measures fibre kappa, filtrate kappa, and brightness: BLT
Measures brightness: BT, Cormec

External measurement example:
Measures fibre kappa: SPK, Kappa Analyzer

Calibration Example

D - D0 BLT		
Brightness		# Tests
8	9	0
9	9.5	1
9.5	10	3
10	10.5	10
10.5	11	10
11	11.5	10
11.5	12	3
12	13	5

Instructions

GREEN	No more tests are needed in that range. >4
YELLOW	More tests are needed. >0 and <4
RED	No test in that range. =0

Since it is not always possible to get all ranges for calibration
Then, we should have at least 5 ranges for each Lab test.

pH Measurement

It is very important to keep your pH probes in good working order.

It costs a lot in chemicals or off spec product when one of these probes fails, scales, or drifts from calibration

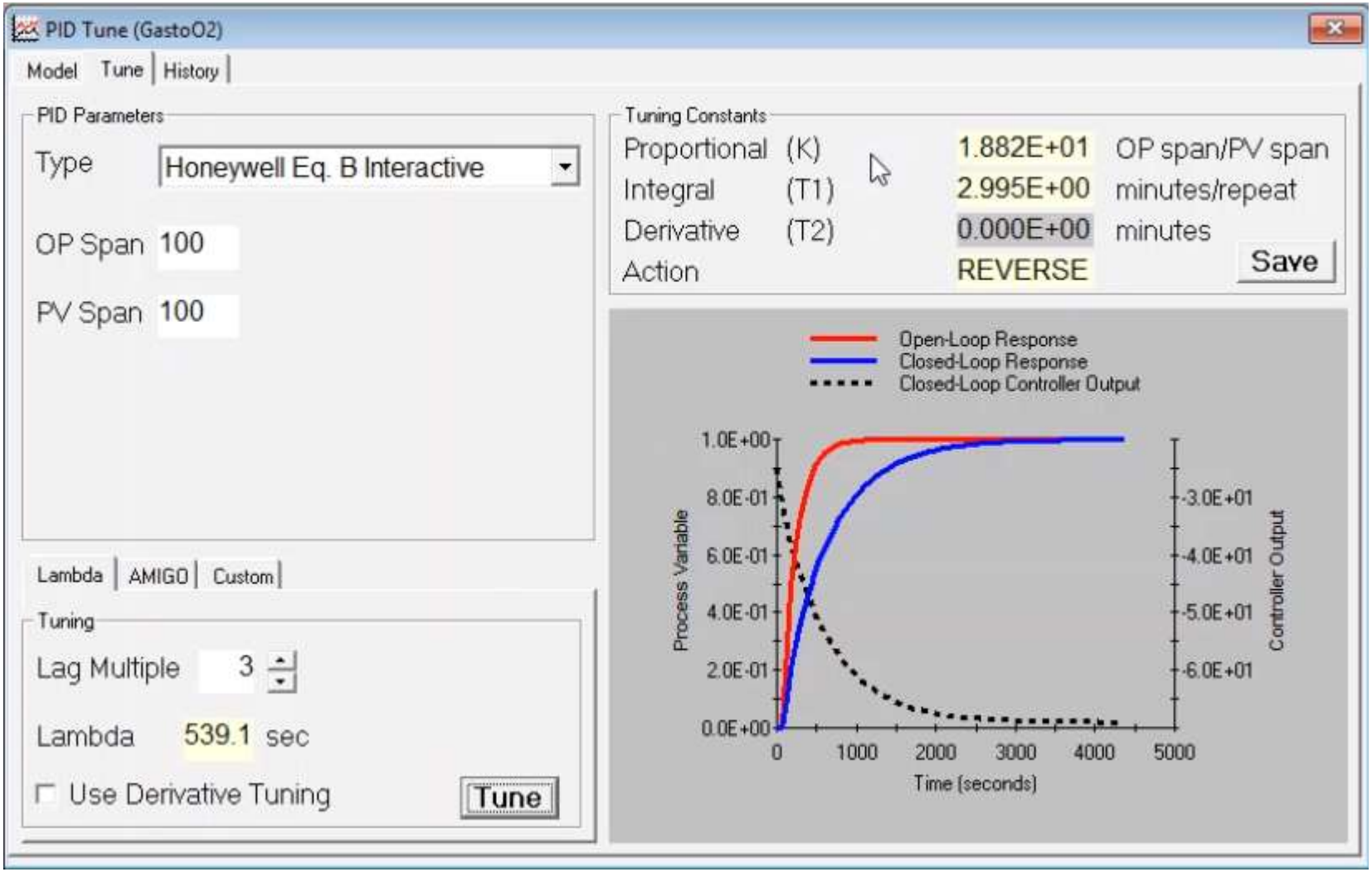
Specifically the high pH, high temperature probes tend to be more troublesome.

Loop Tuning

When using MPC controls, it is important that when you ask for a manipulated variable to move, that it moves where you want it and stays there.

Often these values are used for prediction within the controllers, and it can add a lot of unmeasured error if the regulatory loops are not tuned properly.

Loop Tuning

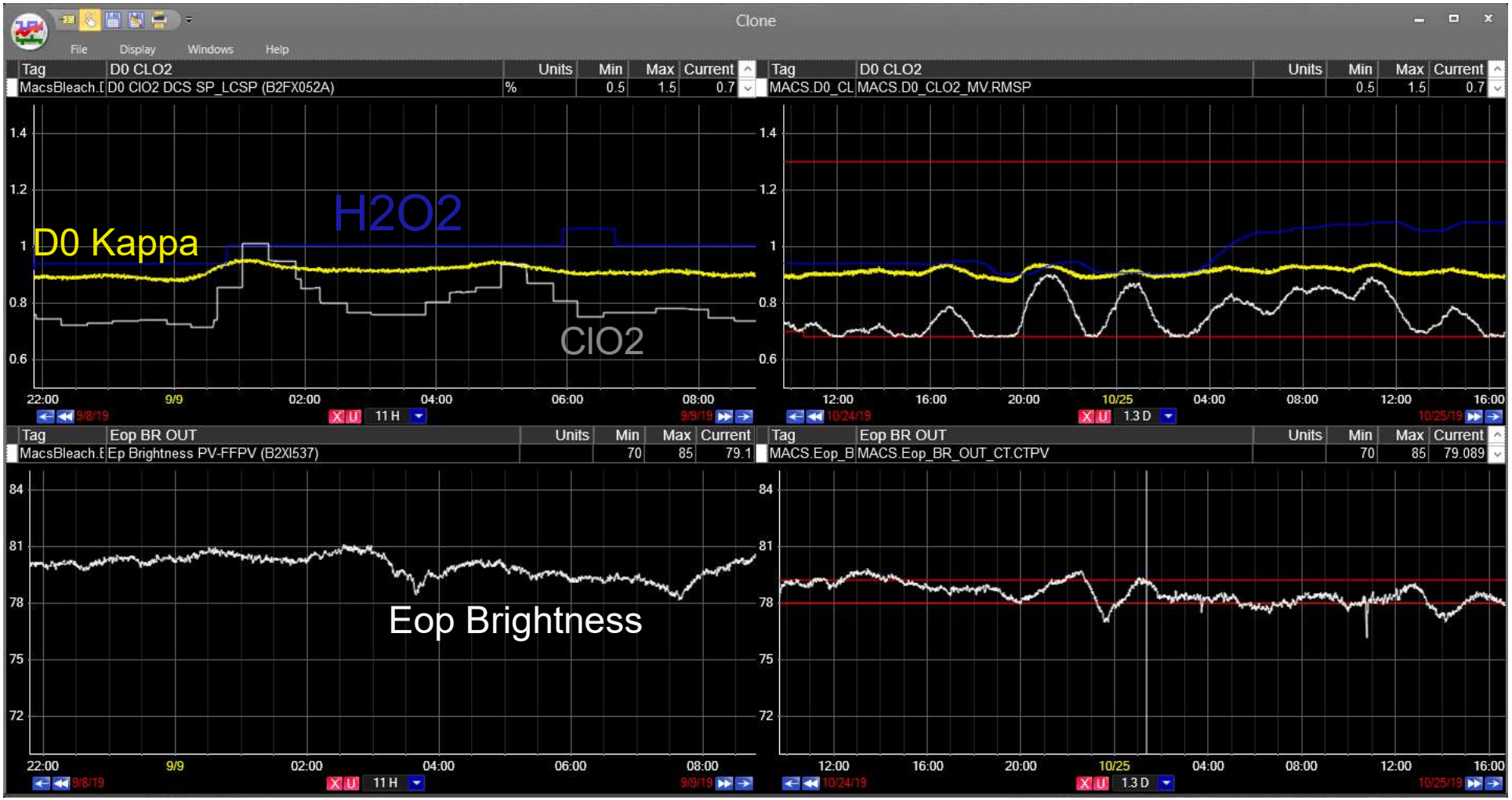

PID Tune (GastoO2)
Model
Tune
History
PID Parameters
Type
Honeywell Eq. B Interactive
OP Span 100
PV Span 100
Lambda
AMIGO
Custom
Tuning
Lag Multiple 3
Lambda 539.1 sec
Use Derivative Tuning
Tune
Tuning Constants
Proportional (K) 1.882E+01 OP span/PV span
Integral (T1) 2.995E+00 minutes/repeat
Derivative (T2) 0.000E+00 minutes
Action REVERSE
Save
Open-Loop Response
Closed-Loop Response
Closed-Loop Controller Output
Process Variable
Controller Output
1.0E+00
8.0E-01
6.0E-01
4.0E-01
2.0E-01
0.0E+00
-3.0E+01
-4.0E+01
-5.0E+01
-6.0E+01
0
1000
2000
3000
4000
5000
Time (seconds)

Loop Monitoring

Examples – D0 ClO2 tuning

Tuning this D0 ClO2 control cut the lag time in half

Examples – Continuous Measurement



We can get a better variation in Eop brightness by using continuous measurements and well calibrated loops