Dale's Closed Loop PI Tuning Technique

The concept with Dale's tuning is to take advantage of the form of the PID equation.

$$Output = k_c\left[\varepsilon(t)+\frac{1}{\tau_I}\int_0^t \varepsilon(t)dt+\tau_D\frac{d\varepsilon}{dt}\right]+C$$

Note that the integral and the derivative actions in the controller are dependent on the value of k_c but the proportional action is not dependent on the integral (τ_I) or derivative (τ_D) tuning. If we can first get a value of k_c that we know is stable but aggressive we can then easily determine a value for τ_I that works well. Derivative can be added if the dynamics of the process are slow and the process value is not noisy.

1. Understand your process. You should have a reasonable knowledge of the process characteristics (self regulating, integrating). In addition, you should have a reasonable knowledge about how much deadtime, lag, inverse response etc.
2. Decide what type of controller response you would like. Overdamped, underdamped, critically damped, etc. based on control objectives.
3. Unless the process has significant delays or lags don't use derivative action.
4. Set the integral and derivative tuning constants to zero. This should disable integral and derivative action of the controller.
5. Set the controller mode to Auto.
6. Make a small step change in the setpoint of the controller.
7. Watch the response.
   - If the process value oscillates (underdamped) decrease the controller gain and repeat step 5.
   - If the process value does not oscillate increase the controller gain and repeat step 5.
   - The goal is to find the controller gain where the process is critically damped (K_{cd}). This is where the process response goes from an overdamped to an underdamped response.

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