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**Home Brewing Fermentation Temperature Control, using Auber Instruments PID Controllers.**

Hi,

I am a home brewer from The Netherlands. I have created a temperature control system for my beer fermentations. I'll show you the setup:

I have a water cooler, as they are used in bars for draught beer. I have bought it on one of those 'second hand' websites. This cooler is just like a refrigerator, but it makes cold water. It holds 40 liters ( US gallons).

**Figure 1, The water cooler**

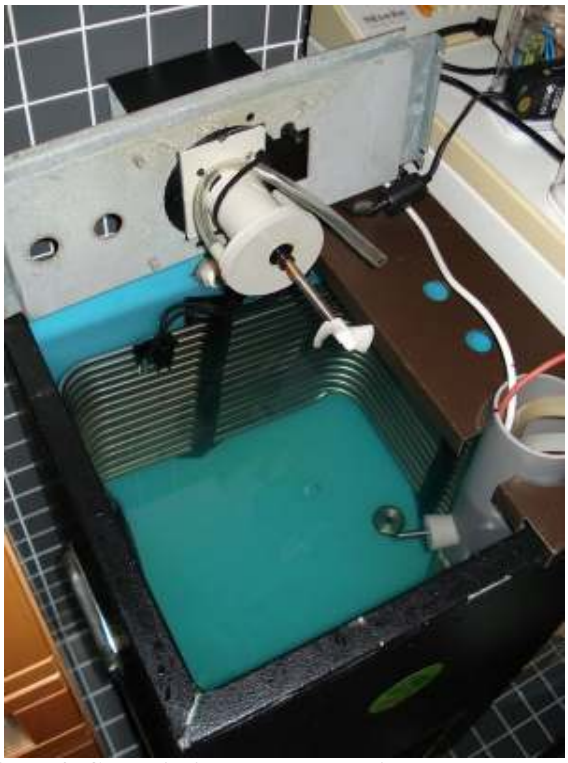

**Figure 2, Cooler inside water reservoir**

The cooler has it's own temperature control, but I do not use that. I use an Auber Instruments SYL2342P PID controller. I have built the controller into a plastic box and added a 220V socket. The cooler is plugged into the socket, which is controlled by the Auber Instruments controller. A PT100 sensor is placed in the cold water reservoir. This way I can control the water temperature. The controller functions in on/off mode, to spare the compressor.

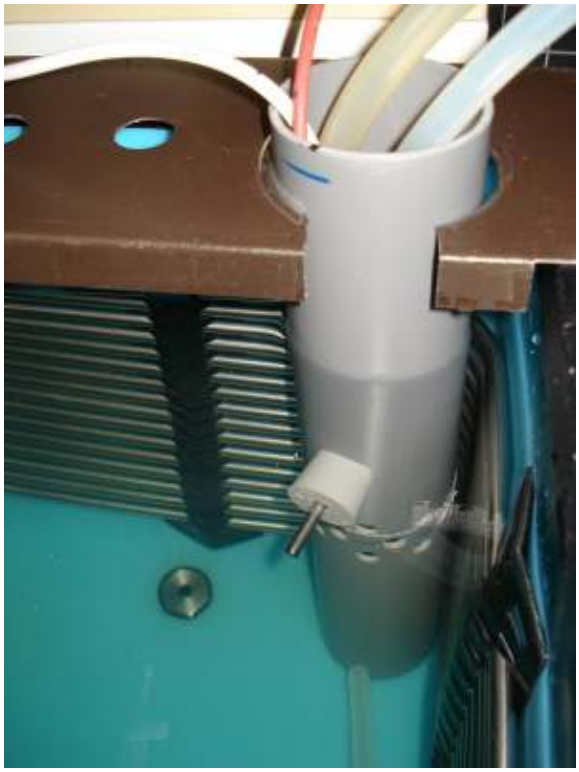


**Figure 3, 'The Tube' with PT100 sensor in rubber stopper**

In order to control fermentation temperature, I circulate the cold water through a stainless steel spiraled pipe which is in the beer fermentation vessel. The cold water is pumped by a small 12VDC immersion pump. To keep the pump at a fixed location in the cooler water reservoir, I have created 'the tube'. You can see the tube on the pictures. It contains the PT100 to measure the water temperature sensor (reddish wire and steel stub sticking out of the grey rubber stopper) and the immersion pump and it's in- and out-hoses and 12V power cable (white). You can see how the out-hose comes out the bottom, to ensure mixing water temperature. I created a mesh in the tube as a platform to stand the pump on. The holes in the tube provide for the entry of water.

The fermentation vessel contains a stainless spiral which gets cold from the water. It is immersed in the beer. You can see another PT100 element which measures beer temperature. The picture shows the setup in water.

I did not want to drill holes in my fermentation vessel, so I created a special silicon stopper. This stopper transports the cooling water hoses and PT100 (reddish cable) and has an airlock hole.

An Auber Instruments SYL2342P controller controls the beer temperature with the immersed PT100, by switching the immersion pump and thus controlling the flow of cooling water

The controllers are of the ramp/soak type, which enables programming the temperature intervals needed during fermentation. Cooling water temperature is set 2°C lower than the beer temperature. This small temperature difference prevents temperature shock to the yeast cells.


The complete setup. Apologies that it is in my bathroom…

I place the fermentation vessel on an aluminum ‘drip tray’. During cold conditioning (4°C) condensation is a nuisance. The drip tray disposes of the water in my bath tub.

I use the following framework programs. Actual temperatures and durations may vary on type of beer brewed:

| Step | Programmakeuze | | C | t |
|---|---|---|---|---|
| 1 | **Option:** | **Jump to:** | 0 | **Select:** |
| | 1. Constant temperature | Step 2 | | -2 |
| | 2. Top Fermentation | Step 5 | | -5 |
| | 3. Bottom Fermentation | Step 11 | | -11 |

| Step | Constant Temperature | C | t |
|---|---|---|---|
| 2 | Maintain at 18°C | 18 | 9999 |
| 3 | Loop back to previous step | 18 | -2 |

| | | Cooling Water | | Beer | |
|---|---|---|---|---|---|
| Step | Top Fermentation | C | t | C | t |
| 5 | Primary Fermentation: Maintain constant at 18°C 5 days | 16 | 7200 | 18 | 7200 |
| 6 | Primary Fermentation: Maintain constant at 18°C until racking | 16 | 0 (hold) | 18 | 0 (hold) |
| 7 | Conditioning: Cool to 8°C in 7 days | 16 | 9999 | 18 | 9999 |
| 8 | Conditioning: Maintain constant at 8°C 1 week | 6 | 9999 | 8 | 9999 |
| 9 | End: | 6 | -121 (stop) | 8 | -121 (stop) |

| | | Cooling Water | | Beer | |
|---|---|---|---|---|---|
| Step | Bottom Fermentation | C | t | C | t |
| 11 | Yeast Growth: Maintain constant at 18°C 4 hrs | 16 | 480 | 18 | 480 |
| 12 | Primary Fermentation: Cool to 10°C in 12 hrs | 16 | 720 | 18 | 720 |
| 13 | Primary Fermentation: Maintain constant at 10°C 6 days | 8 | 8640 | 10 | 8640 |
| 14 | Primary Fermentation: Maintain constant at 10°C until racking | 8 | 0 (hold) | 10 | 0 (hold) |
| 15 | Diacetyl Rest: Heat to 18°C and maintain constant 2 days | 16 | 2880 | 18 | 2880 |
| 16 | Lagering: Cool to 4°C in 7 days | 16 | 9999 | 18 | 9999 |
| 17 | Lagering: Maintain constant at 4°C 1 week | 2 | 9999 | 4 | 9999 |
| 18 | Lagering: Maintain constant at 4°C until finished | 2 | 0 (hold) | 4 | 0 (hold) |
| 19 | End: | 2 | -121 (stop) | 4 | -121 (stop) |

These are the parameter settings used:

**Cooling Water** SYL2342P (ramp/soak)

| Parameter | Description | Value |
|---|---|---|
| ALM-1 | Process high alarm | 18 |
| ALM-2 | Process low alarm | 1 |
| Hy-1 | Deviation high alarm | 2 |
| Hy-2 | Deviation low alarm | 2 |
| Hy | Dead band | 0.5 |
| At | Auto tuning | 0 |
| I | Integral time | n/a |
| P | Proportional constant | n/a |
| d | Derivative time | n/a |
| t | Cycle time | 30 |
| Sn | Input type | 21 |
| dP | Decimal point position | 1 |
| P-SL | Display low limit | 1 |
| P-SH | Display high limit | 22 |
| Pb | Input offset | -0.8 |
| OP-A | Output mode | 0 |
| OUTL | Output low limit | 0 |
| OUTH | Output high limit | 100 |
| AL-P | Alarm output definition | 5 |
| COOL | System function selection | 1 |
| Addr | Communication address | 1 |
| bAud | Communication baud rate | 4800 |
| Filt | PV input filter | 5 |
| A-M | Control mode | 2 |
| Lock | Configuration privilege | 808 |
| EP1 | Field parameter | nonE |
| EP2 | Field parameter | nonE |
| EP3 | Field parameter | nonE |
| EP4 | Field parameter | nonE |
| EP5 | Field parameter | nonE |
| EP6 | Field parameter | nonE |
| EP7 | Field parameter | nonE |
| EP8 | Field parameter | nonE |

**Beer** SYL2342P (ramp/soak)

| Parameter | Description | Value |
|---|---|---|
| ALM-1 | Process high alarm | 25 |
| ALM-2 | Process low alarm | -1 |
| Hy-1 | Deviation high alarm | 1 |
| Hy-2 | Deviation low alarm | 1 |
| Hy | Dead band | 0.0 |
| At | Auto tuning | 3 |
| I | Integral time | 17 |
| P | Proportional constant | 9998 |
| d | Derivative time | 180 |
| t | Cycle time | 120 |
| Sn | Input type | 21 |
| dP | Decimal point position | 1 |
| P-SL | Display low limit | 2 |
| P-SH | Display high limit | 24 |
| Pb | Input offset | -1.1 |
| OP-A | Output mode | 0 |
| OUTL | Output low limit | 0 |
| OUTH | Output high limit | 100 |
| AL-P | Alarm output definition | 5 |
| COOL | System function selection | 1 |
| Addr | Communication address | 1 |
| bAud | Communication baud rate | 4800 |
| Filt | PV input filter | 5 |
| A-M | Control mode | 2 |
| Lock | Configuration privilege | 808 |
| EP1 | Field parameter | nonE |
| EP2 | Field parameter | nonE |
| EP3 | Field parameter | nonE |
| EP4 | Field parameter | nonE |
| EP5 | Field parameter | nonE |
| EP6 | Field parameter | nonE |
| EP7 | Field parameter | nonE |
| EP8 | Field parameter | nonE |

And the instruction labels on the PIDs:

| Cooling Water | | |
|---|---|---|
| **Key** | **Touch** | **Hold** |
| SET | Step Status<br>Next Step | Setup |
| A/M | Program<br>Select Digit | |
| ▼ | Down | Run<br>Hold<br>Resume |
| ▲ | Up | Stop |

| Beer | | |
|---|---|---|
| **Key** | **Touch** | **Hold** |
| SET | Step Status<br>Next Step | Setup |
| A/M | Program<br>Select Digit | |
| ▼ | Down | Run<br>Hold<br>Resume |
| ▲ | Up | Stop |

**Update**.
I have added a gadget to my setup. I can now also control the temperature of my yeast starters. When you brew, you heave to cultivate yeast first. This yeast is optimally

temperature controlled too. So I have made this accessory copper tubing thing to control the yeast culture temperature. See the pictures:
The yeast is grown in a 3 gallon glass carboy. The carboy sits on a magnetic stirrer, to keep the yeast in suspension. An aquarium air pump aerates the starter continuously with a stainless diffusion stone. The carboy is placed in a red plastic square low bucket. The bucket is filled with water. A piece of copper tubing sits in the water and cold water is pumped through it. The cold water is made with the same setup as is used for the fermentation.
The water in the bucket is controlled by an Auber controller and a pt-100 which switches on/off the cold water pump. Inside the bucket is another small immersion pump to keep the water in motion. It is switched on/off simultaneously with the cold water pump by the Auber controller.