CHUPS status report

All notations in the text refer to the updated CHUPS gas scheme.

1. Additional mass-flow controller and new reserve volume

New reserve volume (RV2) is installed in the TPC outlet manifold together with additional MFC5 mass-flow controller and pressure transmitter PT4. This greatly improved the pressure stability in the TPC. MFC5 controller restricts the TPC outlet flow and together with RV2 reduces the influence of the pressure drop caused by compressor columns.

Pressure behaviour is shown in Fig.1 together with compressor temperature cycles. The pressure stabilization algorithm was the following. TPC outlet mass-flow controller (MFC5) was set to a constant flow manually while inlet controller (MFC4) was regulated by a control system to stabilize the TPC pressure. Regulation algorithm for the MFC4 setpoint was also changed. Now it is PID-regulation in a special form which uses proportional, derivative and second derivative terms. MFC5 setpoint should be chosen in such a way that PT4 pressure will not exceed PT1 pressure. Otherwise MFC5 controller will be totally open and will not protect TPC from pressure drops.

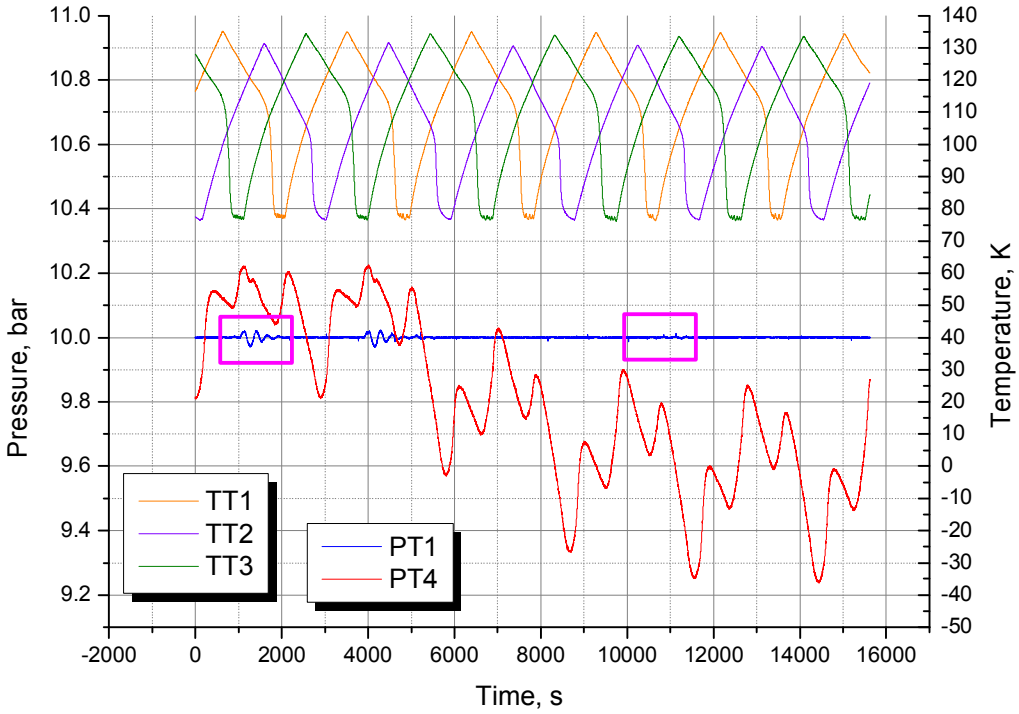

Fig. 1. Pressure and compressor temperatures behaviour.

Two magenta boxes in the chart show the PT1 pressure behaviour in case of too high MFC5 setpoint (left box) and normal MFC5 setpoint (right box). These boxes are zoomed in Fig.2.

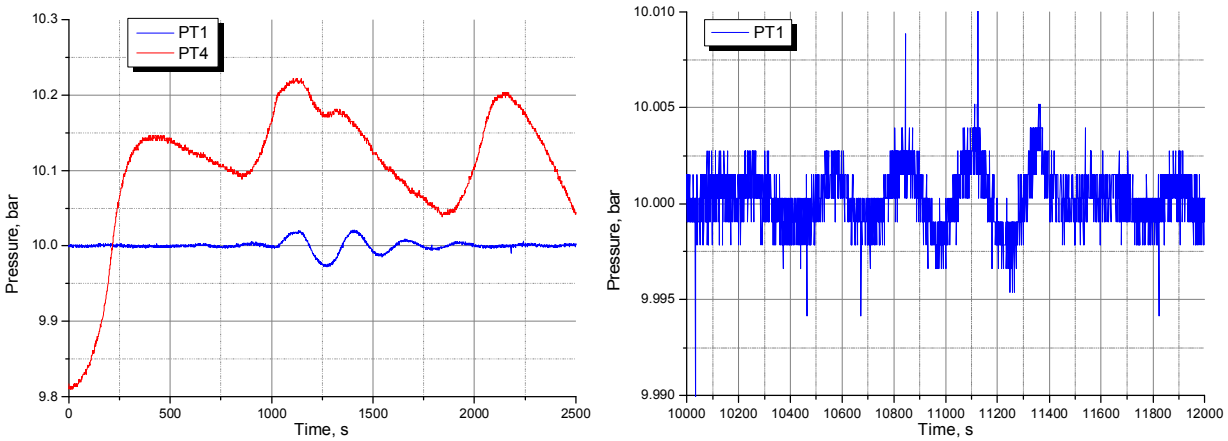

Fig. 2. PT-1 pressure oscillations for high MFC5 setpoint (left chart, MFC5 = 2L/min) and normal MFC5 setpoint (right chart, MFC5 = 1.8L/min).

Pressure histogram is also improved (Fig.3). Due to additional mass-flow controller and new PID regulation algorithm, width of the Gaussian fit of the pressure histogram reduces from 12 mbar to 1.7 mbar which is nearly equal to ADC resolution (ADC discretization is clearly shown in the right chart of Fig.2). Both histograms shown in Fig. 3 are measured with the dummy TPC. With real TPC histogram width slightly increases.

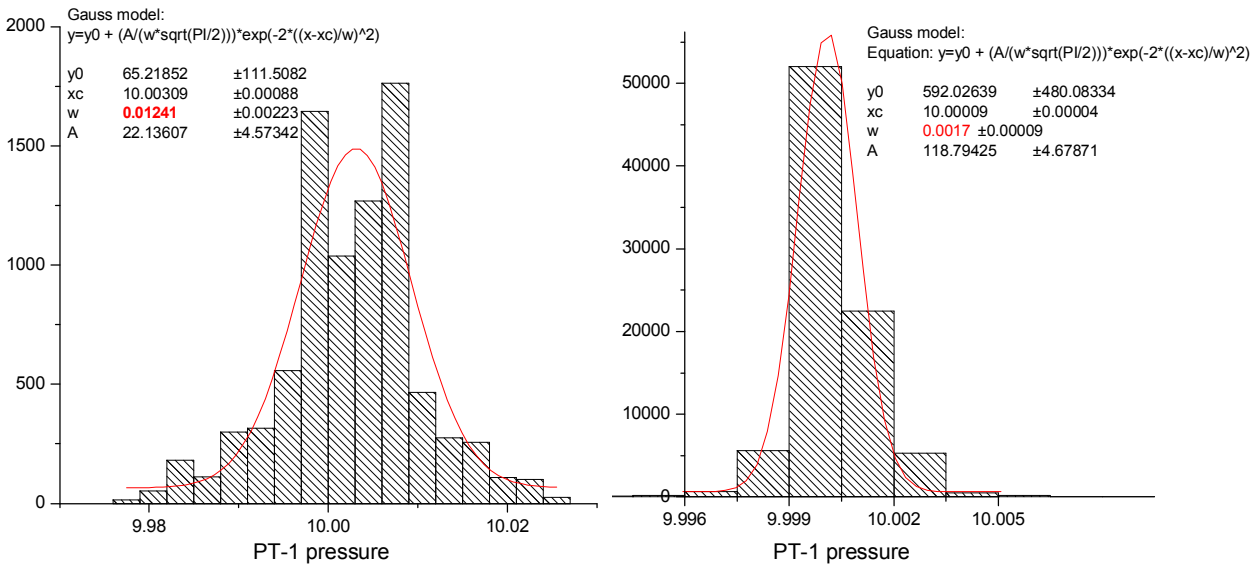

Fig. 3. Pressure histograms for old (left) and new (right) CHUPS.

TPC inlet hydrogen flow became more stable in comparison with old CHUPS setup. Flow oscillations required for TPC pressure stabilization decreased from 3.5 L/min to 0.15 L/min (Fig. 4 and 5). This obviously provides more stable conditions for TPC.

Difference in MFC4 and MFC5 readings in Fig. 4 is not clear – we have to calibrate these controllers as well as all pressure sensors.

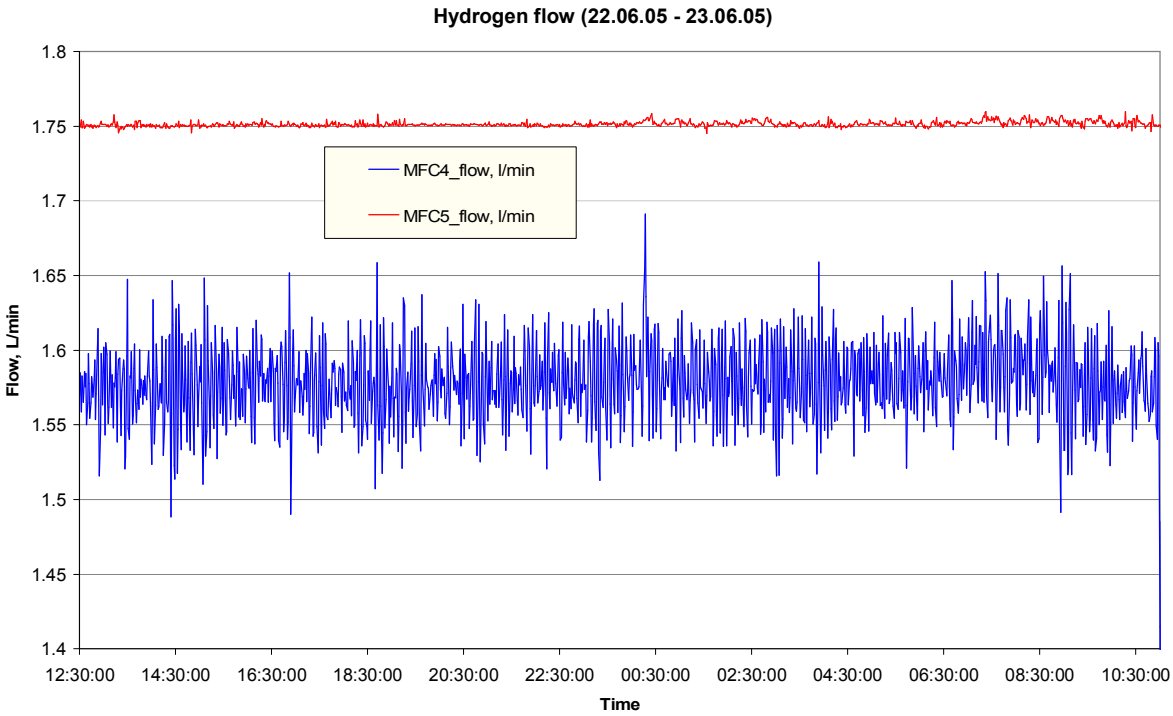

Fig. 4. TPC inlet (MFC4) and outlet (MFC5) flows.

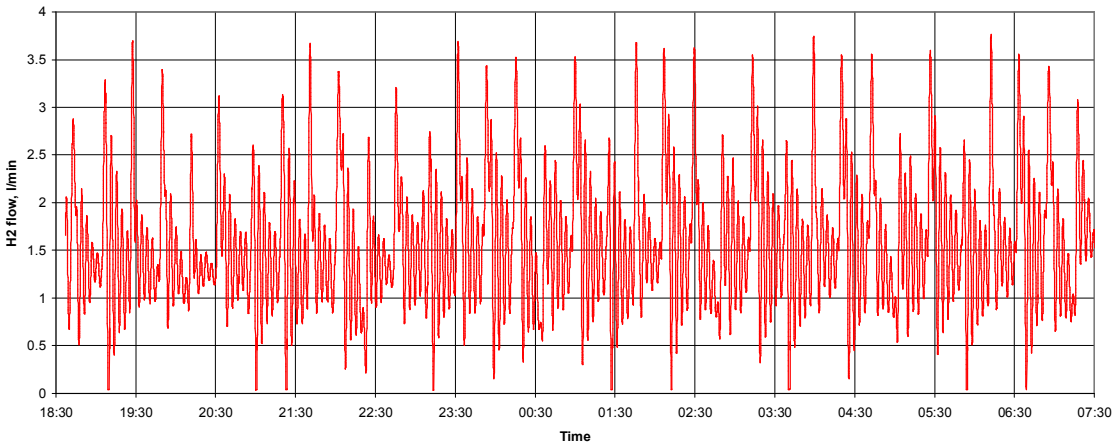

Fig. 5. TPC inlet flow for old CHUPS setup.

2. Membrane pump for nitrogen

We have installed the membrane pump at the nitrogen outlet manifold of compressor (outputs of the MFC1, MFC2 and MFC3 controllers). This allows us to keep liquid nitrogen tank of compressor at the atmospheric pressure. The advantages are:

1. Compressor columns could reach lower temperature during the cycles (see Fig. 1, 78K instead of 90K).
2. Atmospheric pressure in the liquid nitrogen tank simplifies the filling procedure. This also makes possible to join all three liquid nitrogen vessels by a single filling system and the automatic filling procedure in the future.

3. Humidity sensor

Pura gas dew-point transmitter (HS) was installed in the TPC outlet line together with electrostatic dust filter (EF). Vacuum and purity tests has been done. Moisture measurements are in progress.

4. Gas hardware

Most of the pipes were reassembled. All hanging components from the front panel were mounted in the new vertical panel (see Fig.6). Some manual valves were added to enable flexible operation of CHUPS with electrostatic filter, moisture sensor and vacuum system. Due to new design of the hydrogen lines in the Zeolite filters block liquid nitrogen consumption was reduced significantly. New 10 micron filters were installed in the outlet lines of Zeolite filters to protect manual valves.

5. New control system

The new control electronic board was produced and installed. Now it supports up to 16 temperature (Pt-100) sensors. ADC and DAC channels were added to control and measure additional mass-flow controllers, pressure transmitters and moisture sensor.

New linear power supply was produced in exchange for switched computer power supply that was used in the control block last autumn. Hopefully this eliminates sensors readout problems happened in November 2004. Now there are two linear power supplies in the control block:

1. 12VDC 4A power supply for nitrogen mass-flow controllers,
2. Quad voltage (+5VDC, +15VDC, -15VDC and +24VDC) power supply for the rest of the system.

Everything except resistive thermalizers at the nitrogen filling ports is supplied from the control block power supplies.

New patch panel and all cables were produced and installed.

Fig. 6. CHUPS.