Looking at the big picture.

KÖTTER CONSULTING ENGINEERS

FLUID MECHANICS

Defective pressure valve – theory and practice

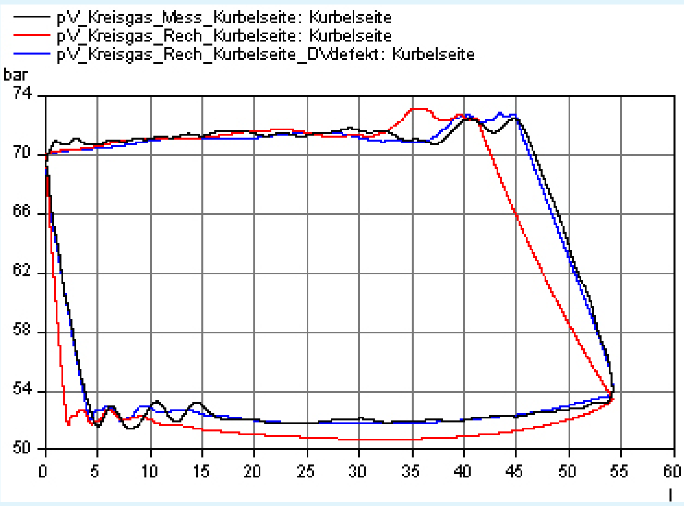
According to a rumour – or to experience – it comes to a deviation between calculation and reality “from time to time”. We agree with that! However, “from time to time” it comes to a useful compliance as described in the following case.

At a reciprocating compressor a significant loss in output was observed. The cause was not known although a damage of the valves was assumed. Unfortunately, this theory could not be proved by the measured valve temperatures.

For a detailed analysis the internal pressure of the cylinder chamber (indication pressure) was measured and converted into a p-V diagram (see figure 1).

Moreover, a theoretical p-V diagram for the cylinder was calculated by a method of characteristics under consideration of the cylinder chamber – geometry changing over time as well as of the valves, gas passages etc. In a first step, the assumption that the valves were intact was considered. The calculation showed significant deviations compared to the measurement, which pointed to a defective pressure valve as cause of the loss in output. To verify this theory, a new calculation was carried out simulating a defective pressure valve in a numerical model. In this way, a good compliance of the theory with the measured p-V diagram was achieved. By the gas flowing back in the cylinders on the discharge side, the compression line becomes sharper and the expansion line more flat. Simultaneously, the suction line gets more flat.

The in this way theoretically analysed cause for the course of the flow rate was confirmed by the practice. The installed valves showed a considerable output. After all, a good theory is “from time to time” a helpful adviser.



P-V diagram

Prof. Dr.-Ing.
Andreas Brümmer

Contact:
Dr.-Ing. Christian Jansen
Telephone: +49 5971 9710-30
c.jansen@koetter-consulting.com