KÖTTER CONSULTING ENGINEERS

PULSATION STUDIES

Optimal phase shift = 15°!

In a plant for the production of polyethylene two hyper compressors (2-stage, 8 cylinders, 5 MW synchronous motor per compressor) were operated with a discharge pressure of 2,250 bar. For procedural reasons the discharge pressure had to be increased to 2,400 bar. Therefore, it was necessary to avoid a triggering of the safety valves caused by pressure pulsation peaks and to prevent critical compressor or pipeline vibrations due to changed pulsation forces. KÖTTER Consulting Engineers was assigned with this task and realised it with a tightly focused proceeding in two phases which was agreed with the operator.

In phase I the existing pressure pulsations and vibrations of the plant were registered by measurements for the current situation of 2,250 bar discharge pressure. For the pressure measurements the firmly installed pressure transmitters of the process control system were used. So, no time-consuming preparations for measurements in the plant were necessary. Knowing the physical context, a pulsation study was carried out in phase II. For this purpose, the numerical model was verified in a first step by the measurement results of phase I. Afterwards, the adjusted model for the calculation of pulsations was used for the situation with increased discharge pressure as well as for the design of remedial measures.

A section of the 2nd stage (figure 1) as well as the calculated and measured pressure pulsations in this section are shown in the figures 1 and 2. In this situation, both compressors had a fixed phase relationship (synchronous motors) which developed by chance when starting the system. In total, significant pulsations occurred which could be clearly indicated by the calculations.

To reduce the pulsation related pressure peaks, we analysed how pulsations could be minimised by a changed phase relationship of both compressors in the situation with increased discharge pressure. It turned out that a constant phase relationship of $\phi = 15°$ was optimal (figure 3). Calculations indicated that in this phase relationship a triggering of the safety valves was not expected. Therefore, it was decided together with the customer to realise this measure. Furthermore, on the basis of measurements and accompanying fluid and structural simulations, measures for reducing structural vibrations were proposed and realised.

Already during the next start-up, our customer noted a considerably more quiet operation of the complete plant. The intended discharge pressure could be reached without triggering of the safety valves and without any vibration problems. Finally, a control measurement confirmed the good effect of the measures.

Sometimes, two compressors in harmony work better than one.

PULSATION STUDIES

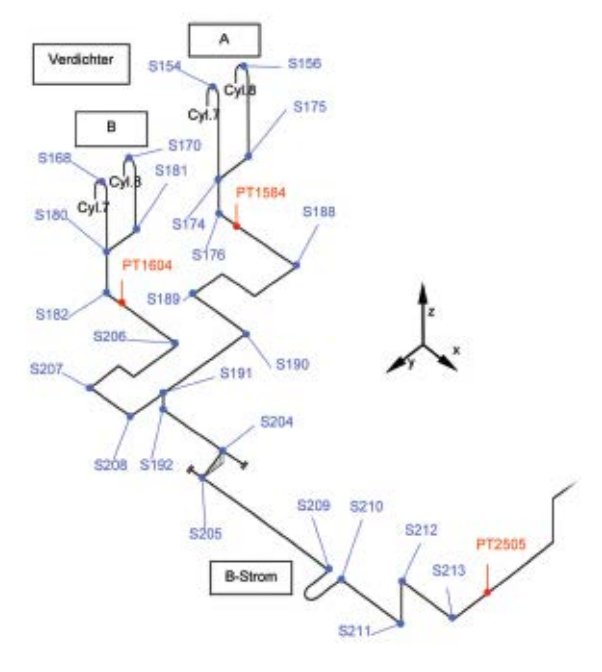

Figure 1

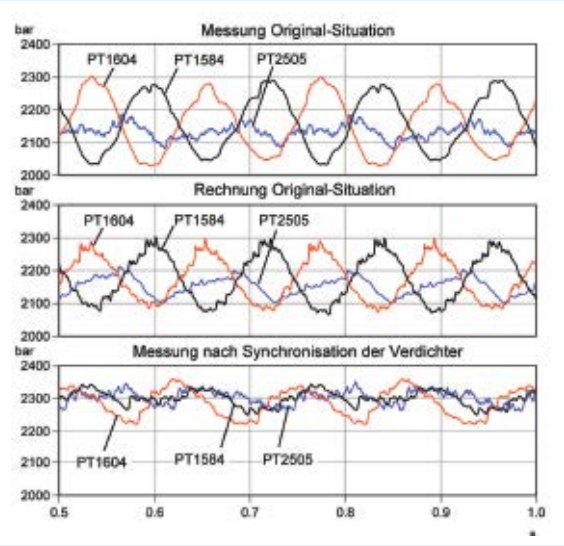

Figure 2

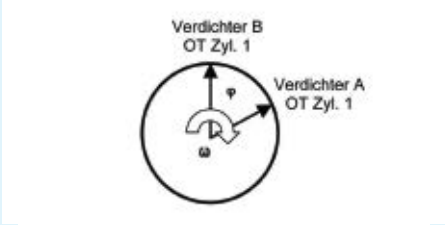

Figure 3

Prof. Dr.-Ing.
Andreas Brümmer

Contact:
Dr.-Ing. Jan Steinhausen
Telephone: +49 5971 9710-64
j.steinhausen@koetter-consulting.com