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Coupling damage at a compressor of a LPG-tanker

Only some weeks after the commissioning of a new LPG-tanker (figure 1) coupling damages appeared at the three compressors which were driven by electric motors. Several measures like exchanging the coupling, reviewing the strength calculation and adjusting the motor and compressor did not lead to a significant improvement of the situation. After further theoretical investigations and the indication of possible resonance problems, KCE was asked to carry out a metrological analysis of the damages.

This vibration investigation at the compressors was carried out during a transit of the tanker from Houston, Texas via the Gulf of Mexico to Panama. Besides recording the absolute system vibrations and the rotor vibration, the investigation focused on the registration of the dynamical torque process in the drive train (figure 2). By using strain gauges on the drive unit and a signal transmission route via telemetry, the torque of the rotating drive shaft was measured during start-up and shut-down as well as during different load cycles in the operating compressor.

This measurement of the torque (figure 3) showed a significant torsional vibration in the double torque frequency of the compressor, overlaying the rated torque, which led to harmful alternating loads of the coupling. An analysis of the natural torsional frequencies during standstill of the compressor revealed that the first natural torsional frequency of the drive shaft lay very close to the frequency of the double operating speed of the compressor. The excitation did not occur directly through the motor but mediated via the compressor side. So, the mechanism of action was detected and in a second step target-oriented measures were proposed and designed.

Due to the pros and cons of the proposed measures and the costs of their implementation, finally the diameter of the intermediate shaft was enlarged so that the natural torsional frequency was shifted out of the critical band of excitation. Since realisation of this measure, no coupling damages appeared at the “Wilhelm Schulte” and two other ships with 10 identical compressors.

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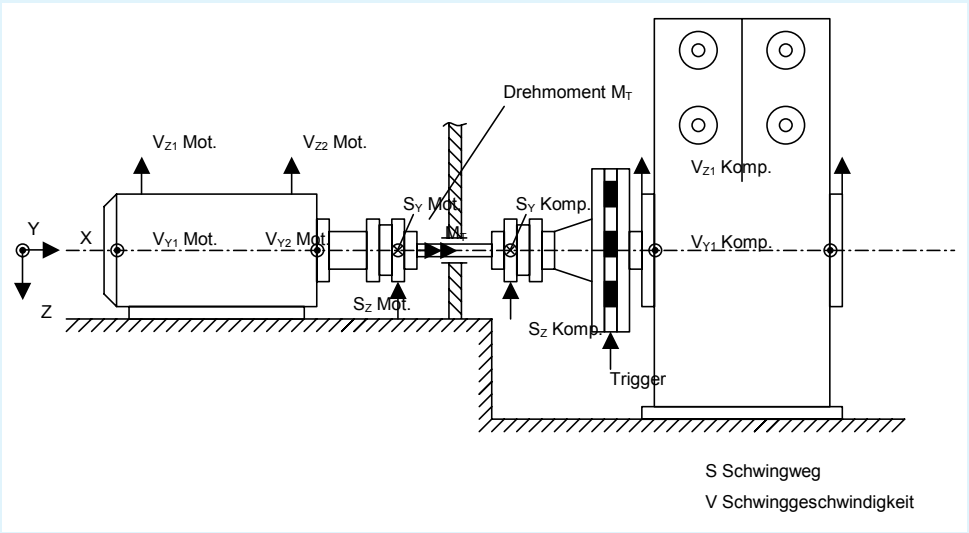
Overall view of the “Wilhelm Schulte”



Overview of the measuring points

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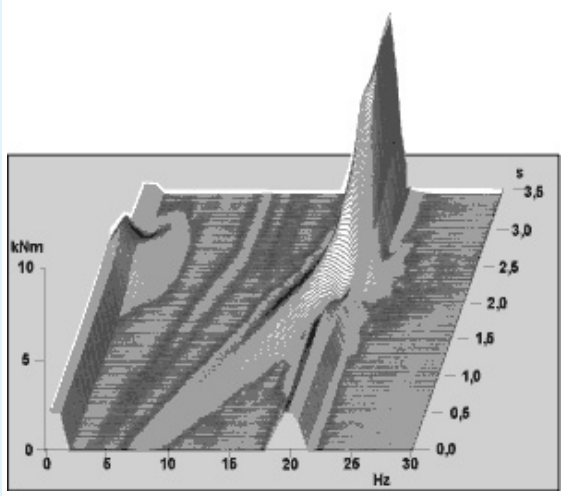

Time-amplitude spectrum of the torque process during start-up

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