

Virtual pipe supports for high pressure piping

Measurement, assessment and mitigation of pipe vibrations with state of the art technologies

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Dr.-Ing. Christian Jansen, KÖTTER Consulting Engineers

c.jansen@koetter-consulting.com

Due to the unsteady flow of reciprocating compressors utilized in LDPE/EVA plants, huge efforts are necessary to control the dynamic forces. For every modern plant a study of pulsation and a study of vibration has been performed in the engineering phase. The main benefits of these studies are an optimized acoustic interaction of the compressors with the pipe acoustics and a pipe support setup which is able to take the resulting dynamic forces in an effective manner. The main objective is thereby always the avoidance of acoustic and mechanical resonances.

Once the plant is in operation, the deviation of the numerical models of the studies and the reality will become obvious. For almost every LDPE/EVA plant, adjustments of the acoustics and/or the support concept are necessary to maintain a vibration level within the applicable guidance values.

From a mechanical perspective, these adjustments are modifications of existing pipe supports or the implementation of new ones. Changing the support concept is normally implemented within an iterative process of static stress calculation (e.g. due to thermal expansion) and dynamic stress calculation (due to dynamic forces and mechanical resonances). This makes a short-term modification difficult.

By means of virtual pipe supports, the dynamic behavior of a pipe vibrating in resonance is modified without any significant influence on the static pipe load. The basic working principle of a virtual pipe support is a damped tuned mass absorber. This passive oscillator is clamped to the problematic pipe section and tuned to resonance frequency. This allows the reduction of the pipeline vibrations due to two effects: The first one is the storage of kinetic energy and phase-shifted release to counteract the pipe vibrations. The second effect is the dissipation of kinetic energy by viscous damping.

Virtual pipe supports have proven their effectivity in all stages of LDPE/EVA plants starting with compressors in ethylene storage facilities, through booster/primary compressors and ending with the hyper compressor.

This presentation will present background on the measurement and assessment of pipe vibrations. Furthermore, the basic theory of tuned mass absorbers is explained. Finally, by means of case studies the application and the potential of this approach is highlighted.