

IV. STUDY OF PULSATION ACCORDING TO API 618 ANALYTICAL METHOD

According Design Approach 2 of API Standard 618 5th edition 2007, an acoustic simulation is required to evaluate and control pulsation in piping systems of reciprocating compressors. The pulsation report contains a summary of the pressure pulsations in the piping system as well as modifications proposals to reduce pulsation to the agreed level. The original system layout will be checked with respect to pulsation. All operating cases that are characterized by steady-state operating conditions will be checked, thus transient cases (e.g. start-up-cases) are excluded. Different gas properties and operation cases are considered. Valve unloading cases are considered as operation cases. Measures are proposed to reduce pressure pulsations, e.g. installation of orifices, changes in piping length or diameter. Shaking forces are used in the subsequent vibration study.

Used Documents for Pulsation Study

The exact gas data means gas composition and gas properties like velocity of sound, density, pressure, temperature flow for which compressor is going to use is considered for the pulsation simulation. Also the isometric drawings of piping and compressors are used for the pulsation simulation.

Table : 4.1 — Gas Properties / Input Data for Pulsation Simulation

Case	Phase	Pressure bar	Temp. °C	Vel. of sound m/s	Density kg/m ³	Pressure ratio	Flow rate m ³ /min	Flow rate m ³ /min
1	Normal operation	1.0	20	343	1.2	1.0	1.0	1.0
		1.1	20	343	1.2	1.1	1.1	1.1
		1.2	20	343	1.2	1.2	1.2	1.2
		1.3	20	343	1.2	1.3	1.3	1.3
		1.4	20	343	1.2	1.4	1.4	1.4
2	100% Valve unloading	1.0	20	343	1.2	1.0	1.0	1.0
		1.1	20	343	1.2	1.1	1.1	1.1
		1.2	20	343	1.2	1.2	1.2	1.2
		1.3	20	343	1.2	1.3	1.3	1.3
		1.4	20	343	1.2	1.4	1.4	1.4
3	Normal P-1	1.0	20	343	1.2	1.0	1.0	1.0
		1.1	20	343	1.2	1.1	1.1	1.1
		1.2	20	343	1.2	1.2	1.2	1.2
		1.3	20	343	1.2	1.3	1.3	1.3
		1.4	20	343	1.2	1.4	1.4	1.4
4	Normal P-2	1.0	20	343	1.2	1.0	1.0	1.0
		1.1	20	343	1.2	1.1	1.1	1.1
		1.2	20	343	1.2	1.2	1.2	1.2
		1.3	20	343	1.2	1.3	1.3	1.3
		1.4	20	343	1.2	1.4	1.4	1.4
5	Normal P-3	1.0	20	343	1.2	1.0	1.0	1.0
		1.1	20	343	1.2	1.1	1.1	1.1
		1.2	20	343	1.2	1.2	1.2	1.2
		1.3	20	343	1.2	1.3	1.3	1.3
		1.4	20	343	1.2	1.4	1.4	1.4

Calculation and Interpretation of Analytical Results

The study of the gas pulsation is carried out with the digital simulation program PULSIM which has been developed by the TPI/TPIE Institute in Gailf (G.L.). A system of pipes is built of several complicated parts and elements which must be simplified for calculations. For example volumes of a cylinder casing between valves and connecting flange, heat exchangers, separators, dampers, etc. The data of the gas might also change during operation. In order to take these uncertainties into account, we make several calculations at different velocities of sound. The range of variation is $\pm 1.2\%$ and it is varied in steps of 2%. The results are presented in tables.

Admissibility limits

The main requirements of API 618 are as follows:

[API 618, section 7.6.4.2.5.2.2.2] "For systems operating at absolute line pressures between 3.5 bar and 350 bar (0.50-5.07 MPa), the peak-to-peak pulsation level of each individual pulsation component shall be limited to that calculated by eq. 54 using:"

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