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Acoustical driven vibrations — Don't let it fail you

Acoustical driven vibrations can lead to failure and performance problems. I am sure that the first thought in your mind is, "What is acoustical driven vibration?" Fair question. Every contained volume has an acoustical response. Many times acoustical response or noise is welcome, like at a concert or event.

If the acoustical natural frequencies match the mechanical natural frequencies the structure can vibrate.

Acoustics physics and its harmful interactions can be explained as follows:

• First there has to be a noise or acoustical source that corresponds to the acoustical nature of a contained volume. Now I know this may still not make sense, so let's go into more detail. Every contained volume has a set of natural frequencies. You know how when you are in some rooms with many people you cannot hear anything, while in others you can hear just fine, even with the rooms being approximately the same size and containing the same number of people? Well, the difference is the acoustical response. One may have acoustical lagging to change the response and dampen out the noise. Examples in industry of the contained volume may be a building, rotating equipment case, piping, pressure vessels, heat exchangers or tanks.

• The acoustical source must drive the contained volume at one or more of its natural frequencies. This means that the source must excite the contained volume acoustic natural frequencies. These excitations cause noise leading to pressure pulsations in the system. Usually in industry the exciters are equipment or devices that cause radical changes in the momentum and pressure of the fluid within the contained volume. Usually these conditions lead to some type of fluid pulsations as a primary driver. Unique or complex process dynamics can also drive the acoustics. Examples of exciters might be reciprocating compressors and pumps; axial, screw, liquid ring or centrifugal compressors; let down or recycle valves; or two-phase flow conditions.

• The acoustical natural frequencies must correspond to the mechanical natural frequencies. Every structure has natural frequencies. If the acoustical natural frequencies match the mechanical natural frequencies the structure can vibrate.

Now that you know all of this, how do you identify the problem and solve it? Let's first go over a few points regarding these types of problems.

1. These problems are frequently complex and have to be diagnosed and calculated precisely.

2. The quick fix rarely works and can make matters worse.

3. The details of the actual physical geometry and the fluid physical problems are important.

4. The frequencies causing problems are typically the higher modes with lower amplitudes.

5. Sometimes during the course of operation, the vibration will "tune in and out."

6. No shortcuts can be implemented on the typical solutions methodology and be successful.

7. The analysis must match the physical situation.

The solution methodology is as follows:

• A field study with a data acquisition system to look at vibration and pressure pulsation.

• A tuned acoustical model to match the physical situation.

• Rework analytically.

• Design implementation.

Computation Fluid Dynamics and finite element codes are more advanced than ever to aid in addressing complex acoustical problems. KnightHawk has been involved in advanced studies of cavity acoustics (the study of acoustic responses in the rotating equipment enclosures). The results of this work have been able to answer "phenomena" failures that have occurred in open face impeller compressors.

Any of these problems are complex and should be under the direction of a professional engineer competent in acoustical vibrations.

For more information, visit www.knighthawk.com or call (281) 282-9200. ●

NEWS **UPDATE**

Study: Oil sands will be major U.S. job creator

WASHINGTON — The economic impact of oil sands development in neighboring Canada is a boon for the U.S. economy and is expected to lead to the creation of more than 342,000 new U.S. jobs between 2011 and 2015, a new study by the Canadian Energy Research Institute (CERI) finds.

The study, titled "Canada's Oil Sands and Economic Impact on the USA," said greater production of Canadian oil sands would stimulate economic activity in both countries. As oil sands production and investment in Canada rises, demand for U.S. goods and services increases significantly, adding an estimated $34 billion to U.S. gross domestic product in 2015 and $42.2 billion in 2025. Canada is the largest trading partner of the United States.

"Oil sands reserves play an increasingly important role in the economic development of Alberta, Canada, and the United States," CERI said in its study. "What is often not clearly understood is that the large investment in the oil sands industry contributes to increased economic activity in the rest of North America by stimulating demand for goods and services across a wide range of industries."

"Clearly Canadian oil sands development is a win-win for both Canada and the United States," said API President Jack Gerard. "Not only is greater oil sands production crucial for U.S. energy security, it also supports thousands of American jobs and is a major contributor to our nation's economic growth."

In the study commissioned by API, CERI based its assumptions on oil sands output rising from about 1.4 million barrels a day to around 4 million barrels a day in 2025. It estimated annual capital investment and operating costs needed to achieve this output — about $25 billion in new investment and $7 billion in operating costs in the peak year of 2015 — and then estimated the economic impact to Canadian and U.S. economies.

For more information, visit www.api.org or call (202) 682-8000. ●