THOUGHTS FROM THREE CONFERENCES

PUSHING THE DESIGN ENVELOPE; GETTING BACK TO COAL

September is conference month as companies position themselves for a strong year-end finish. I attended three such conferences: Texas A&M Turbo Symposium, the Pittsburgh Coal Conference, and another forum on Carbon Capture.

High-speed motor drives

High-speed, direct-drive compressor designs continued to attract attention at the Turbo Symposium. Most, if not all, major compressor OEMs now offer a high-speed motor driving a multi-stage barrel compressor.

Matching the power and speed to the gas and pressure ratio required by the application will always be a challenge for these dedicated motor designs. The most effective way to do this is to use an inline design with a constant-stage diameter. The head required is achieved by changing the number of stages, and in this way, the compressor-motor speed remains constant. The design capacity, and therefore power required, is achieved by changing the stage specific speed.

The attached plot from TMEIC Motors provides a sense of the speeds and powers that are possible today (Figure 1). In reality, this is not the smooth plot as indicated. These motors are more likely designed with some form of rotor length adjustment to cover a range of various power levels within a frame (think diameter), so the curve is more likely to be a "saw tooth" as applied to each manufacturer. In aggregate, the line seems appropriate for the industry.

The designs shown were all "canned" with magnetic bearing and use the product gas for motor cooling. Pressure ratios are up to 4.5 on methane with 2 x 4 stages in a back-to-back configuration. For gas storage applications, methane is compressed from 40 bar to 200 bar (580 psia to 2,900 psia). The GE Integrated Compressor Line from its Thermodyn operations offering tops out at 3,300 psia and is rated at 15 MW.

At the other end of the spectrum, Siemens Power Generation (DeMag) introduced a new large-frame "Isotherm" unit rated at 600,000 m³/hr and 50 MW (Figure 2). Siemens is not yet disclosing any details, but at a nominal 125 psig rating and constraining the operating speed to 3,000 rpm, I have estimated that the overhung first stage diameter is a whopping 2,200 mm (86 inches). My guess is that the balance of the inline casing fits into an 1,800 mm barrel with the last stage designed at a NASA specific speed of approximately 0.50.

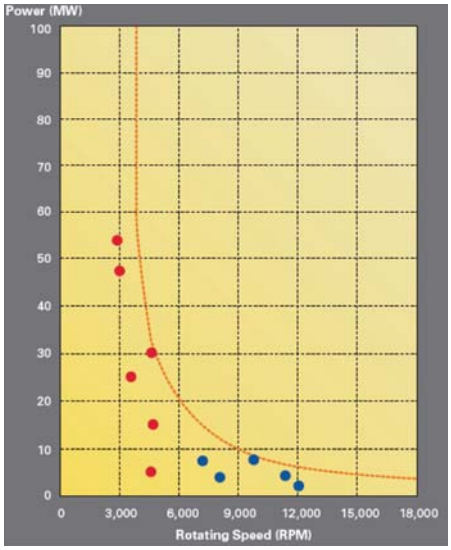

Figure 1: The power required is achieved by changing the stage specific speed of the motor

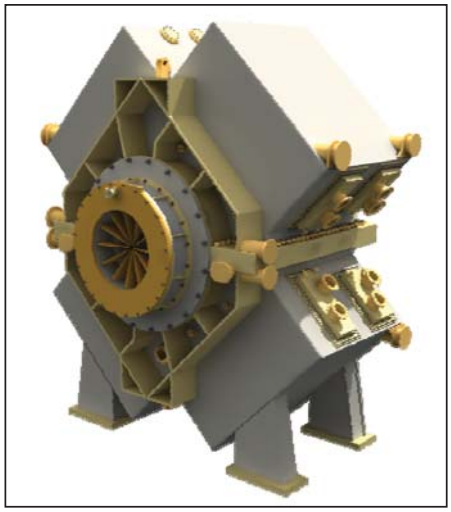

Figure 2: Siemens' 50 MW 'Isotherm' compressor could feature a first stage overhung diameter of 86 inches

The unit features interstage coolers nested between the inline stages in an array that looks like a cross between a Gatling gun and a Patriot Missile Battery. This is an interesting concept, driven by the need for large air separation plants and perhaps some future Compressed Air Energy Storage plants that push air machine capacities beyond the practical range of integrally geared designs. Geared designs are limited by space available to mount the large scrolls needed to maximize efficiency, and the resulting effect on increased gear center distances. At some point these gear center distances exceed gearing pitch line velocity limits.

This is not a new issue. Years ago, Ingersoll-Rand developed a frame 7 design that used a set of idler gears to resolve this conflict, but the product proved unattractive for a variety of reasons, and was discontinued.

Almost everyone has expressed concern over material and component lead times, extending lead times and adding emphasis to the need to include escalation clauses in any offering. There is continuing concern over underlying EPC capacity.

Of course, the conference was in early September and it is now early November. As the economy winds down, this whole issue is likely to have resolved itself, at least for now.

Meanwhile, there was tremendous interest in Underground Coal Gasification (UCG) at the recent Pittsburgh Coal Conference. The key to UCG's appeal is that the technique uses the large supplies of indigenous, but uneconomic and unmineable, coal by gasifying them in situ. If done correctly, this approach eliminates the intrusive mining techniques that many find so objectionable. These seams, once completed, can provide an interim end-of-life source of geothermal energy, followed by use as CO_2 storage capacity in Carbon Capture and Sequestration Systems.

Speaker tidbits

A few 2010-2030 figures:

- 9 billion kWh to 31 billion kWh worldwide
- Population 6.8 billion to 8.2 billion
- 812 million to 2.1 billion vehicles

There are 64,000MW of wind power in the Midwest waiting to get on the ISO grid. At the same time, there is an 8-year backlog for transmission right-of-way approvals.

Lastly, the U.S. spent $1.5 billion on energy efficiency and $5.0 billion on Halloween.

Happy Halloween! TI

Author

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