Deliver Gas efficiently and with less environmental impact.

TurboCool
Effective Optimization of Compressor Station Operation

Compressor stations at the start of the gas delivery chain, e.g. wellhead, gathering and booster stations, employ internal combustion engines as the power source. The fan in the cooling system is usually coupled directly to the engine and the engine speed determines the cooling capacity. With the Voith TurboCool, it is possible to control the fan’s speed. This makes it easy to adjust the cooling to the actual requirement.

Overall system flexibility is important in order to operate the equipment at optimal efficiency. Previously, equipment cooling was designed on the basis of maximum cooling capacity. This made it difficult to respond to changes in input parameters. Frequent problems such as overcooling and the associated system downtime were the result.

The Voith TurboCool coupling makes it possible to control cooling as a function of the input parameters.

The major benefits of TurboCool:

- High availability
- Prevention of overcooling/overheating
- No manual adjustment of fan pitch necessary
- Greater productivity
- Increased gas production, up to 400,000 SCFD
- Lower service/maintenance expenses as a result of protecting the driveline
- Environmental benefits
  - CO₂ emissions lowered by as much as 500 kg per day
  - Reduced fan noise

Position of TurboCool in a compressor station

The coupling is installed on the auxiliary output shaft (power take-off) between the fan and engine.
TurboCool tested successfully

WBIP in Baker, Montana (USA) has been using the TurboCool successfully since February 2011.

Facts about the system
• Location: Williston Basin, Baker, Montana (USA)
• Temperature fluctuation from -25 °C to +35 °C (-13 °F to +95 °F)
• Remote, not readily accessible, especially in winter
• Self-contained alone unit without a 3 phase power source
• Until now, cooling capacity was adjusted manually by pitch control and additionally by louver control
• Previously, frequent downtime due to overheating or freezing of the cooling circuit
• Compressor: Ariel JGK 4 / 3 3-stage; adjustable cylinder head pockets
• Engine: Waukesha 7044 GSI 1680 HP
• Fan: Air-X-Changers 132 F2

Results after the first two months
• A temperature of 80 °C (176 °F) for the cooling water (engine jacket water set point) was taken as the controlled variable and maintained during operation.
• In the first month, the average fan speed was reduced by 52 %; in the second month, by 36.5 % of maximum output.
• The result: a reduction in CO₂ emissions of almost 40,000 tons.
• During these two months, an increased output of 265,000 SCFD would have been possible.
• This corresponds to increased revenue of $63,600 in only two months (calculated on the basis of 30 pumping days / month and a price of $4 per thousand SCF).

"Thanks to the TurboCool we reduced the downtime of our compressor station significantly. The system enables us to automatically adjust the fan speed and therefore cooling power to our frequently changing ambient conditions."
Dave Linn, Manager Compressor Engineering, WBIP
Higher Availability and Productivity

High degree of system availability
Controlling the fan’s speed protects the system against freezing and overheating as well as the associated damage that results. This increases system availability. Manual adjustment of the fan blades as the seasons change is no longer necessary. Cooling adjusts easily to brief and unforeseen temperature fluctuations.

Protects the driveline
As in every hydrodynamic coupling, there is no mechanical connection between the input and the output in the TurboCool. Power is transmitted by a fluid that also dampens torque oscillations. Torque peaks that occur during an emergency shutdown or when starting the equipment are significantly reduced, protecting the entire driveline. Belt slipping is prevented, thereby avoiding unforeseen equipment downtime due to belt wear or belt failure.

Uninterrupted production
By operating at a controlled, lower speed (below the maximum design point), the fan is quieter. Noise emissions are reduced. It is thus possible to operate compressor stations close to residential and other noise sensitive areas – even at night.

Energy savings

<table>
<thead>
<tr>
<th>Location</th>
<th>Dallas Texas</th>
<th>Calgary Alberta</th>
<th>Pittsburgh Pennsylvania</th>
<th>Gillette Wyoming</th>
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<tbody>
<tr>
<td>Maximal cooler design temperature</td>
<td>104 °F</td>
<td>104 °F</td>
<td>104 °F</td>
<td>104 °F</td>
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<tr>
<td>Average annual air temperature</td>
<td>66 °F</td>
<td>39 °F</td>
<td>48 °F</td>
<td>44 °F</td>
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<tr>
<td>Required average fan speed</td>
<td>58 %</td>
<td>41 %</td>
<td>46 %</td>
<td>44 %</td>
</tr>
<tr>
<td>Required fan power</td>
<td>20 %</td>
<td>7 %</td>
<td>10 %</td>
<td>9 %</td>
</tr>
<tr>
<td>Yearly fan power savings</td>
<td>80 %</td>
<td>93 %</td>
<td>90 %</td>
<td>91 %</td>
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</tbody>
</table>
Lower Emissions and Operating Costs

Reduce cooling by up to 93 %
At present fan output is established on the basis of the maximum ambient temperature during the year. This maximum output is needed on only a few days, however. Depending on the prevailing conditions, TurboCool can reduce by up to 93 % the cooling that needs to be provided by the fan. This corresponds to as much as 3.5 % of overall engine output. This "freed" energy can then be used to increase the amount of gas pumped, with a corresponding increase in revenue.

CO₂ reduction
The lower fan speed means a lower load on the engine; it consumes less fuel and produces less CO₂. Most compressor stations reduce fuel consumption by up to 3.5 % annually, which translates into 182,500 fewer kg of CO₂ per year.

Reduction in noise emissions

Performance improvement

Reduced maintenance
Thanks to wear-free transmission of power by the working fluid, the TurboCool requires minimal maintenance. It is not necessary to change the working fluid during the unit’s operating life. The coupling has been designed to operate a minimum of 40,000 hours without the need for maintenance, while protecting the components of the fan drive during operation. By preventing freezing and overheating, associated damage is avoided and continuous production is assured.
Operation and Incorporation

In the Voith TurboCool, the output speed varies with the fill level in the coupling. The fill level is changed by means of pressure. A proportional valve is used to set the pressure, and thus the output speed. The PLC adjusts the pressure on the basis of the engine jacket water and process gas temperatures, and in this way the output speed. A pressure range of 0 to 1 bar (0 - 15 PSI) suffices for control.

The control algorithm can easily be incorporated into the existing controls and does not require any additional power. This is especially beneficial for remote installations without an external power source.

Cooling of the coupling is provided by a plate-and-frame heat exchanger that is connected to the cooling water circuit for the entire system.

The coupling is installed between the fan and engine on the auxiliary output shaft (power take-off). The fan’s shaft is driven by a jackshaft or directly by a pulley.

This makes it easy to add the TurboCool coupling to new as well as existing compressors.

Fans for compressor motors with a Voith TurboCool coupling

Input parameters:
- Ambient temperature
- Engine jacket water
- Process gas temperature

Control medium
- Compressed gas/air

Digital signal

Control medium compressed gas/air

Proportional valve 3/2

Vent pipe

Louver (optional)
Basic Principles and Specifications

Hydrodynamic power transmission
In a hydrodynamic coupling, the mechanical energy introduced is transmitted by a fluid. This involves two vaned wheels positioned opposite one another. The primary wheel is connected with the engine or motor and acts as a pump, the secondary wheel is connected with the fan and acts as a turbine.

- Wear-free power transmission
- No mechanical linkage
- Simple adjustment of the transmission ratio
- Continuously variable speed
- Damps vibrations and torque surges
- Millions of units in operation with proven reliability

Dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>Unit</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
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</thead>
<tbody>
<tr>
<td>435</td>
<td>mm</td>
<td>834</td>
<td>780</td>
<td>680</td>
<td>646.5</td>
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<tr>
<td></td>
<td>inch</td>
<td>32.83</td>
<td>30.70</td>
<td>26.77</td>
<td>25.45</td>
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TurboCool design

TurboCool performance range