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DRUCKLUFTTECHNIK

G 19099

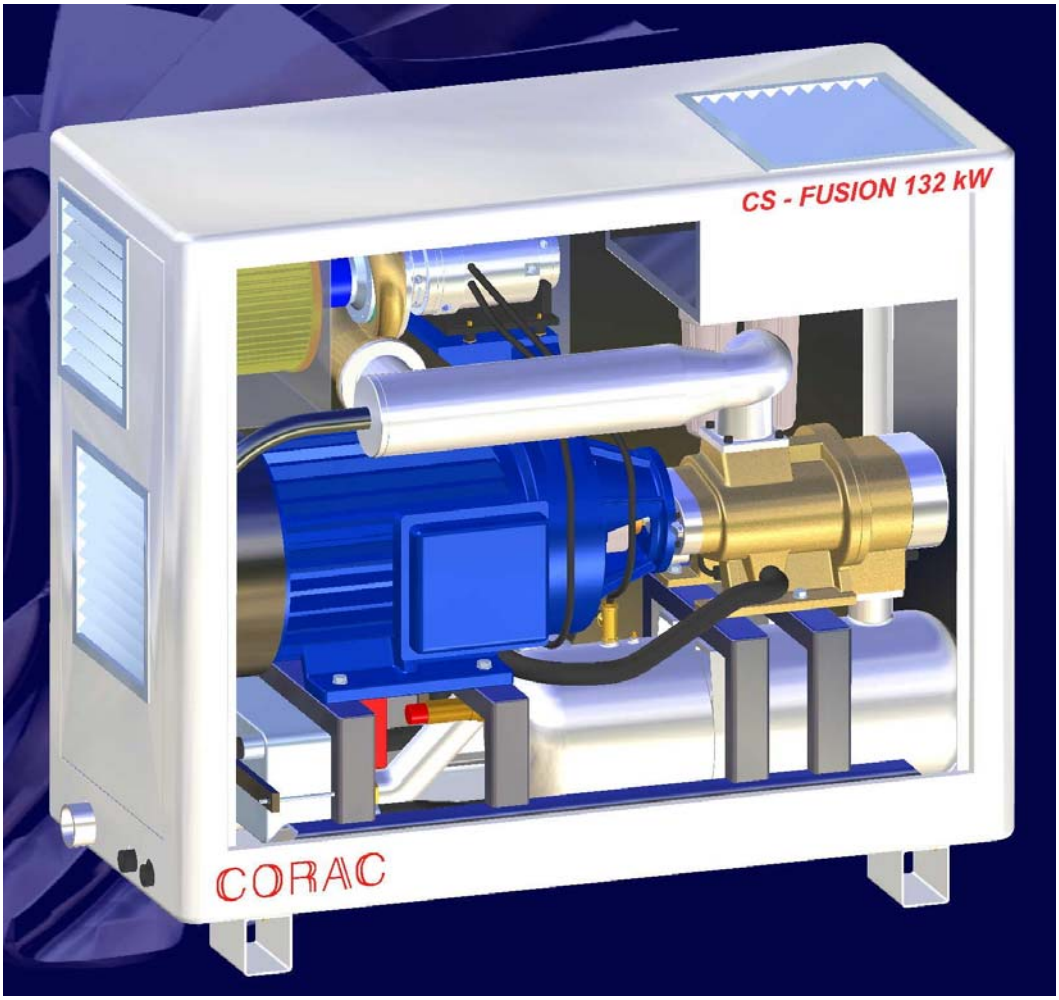
5-6

MAI/JUNI
2005

Zeitschrift für die Anwendung von Druckluft in der Industrie

(The German magazine for the application of industrial air)

The future lies with improved technology



The economical production of oil-less compressed air with the CS-Fusion.

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The future lies with improved technology

The economical production of oil-less compressed air with the CS-Fusion.

Specialists predict that water lubricated screw compressors will, in the future, replace oil-free, two stage tooth and screw compressors as generators of oil-less compressed air, due to their numerous advantages in the range from 15 to 90 kW. This tendency will be continued in the range above 90 kW by the trend-setting developments of the CORAC Group PLC. (UK).

CORAC presented at the Hanover fair 2005 the CS-Fusion-concept from 110 to 300 kW. The two stage, oil-less CS-Fusion consists of a VSD-Turbo-Booster with intercooling, integrated into a water lubricated screw compressor package. This combination is ideal, because the VSD-HS-Turbo is most suitable for large volume air delivery and low pressures and with the Water-Screw the converse is true, namely high pressure with restricted volume. With these components, we have: “The best of both worlds“. The professional world received this completely new concept of the CS-Fusion from CORAC with both curiosity and enthusiasm.

Author: N. Barlmeyer operates a press office for compressed air engineering in 33611 Bielefeld

Dipl.-Ing. Gerd W. Cromm, Director Industrial Air and member of the executive board of the English CORAC Group plc.

Norbert Barlmeyer spoke about this new concept with Dipl.-Ing. Gerd W. Cromm, Dipl.-Ing. Gerd W. Cromm, Director Industrial Air and member of the board of the CORAC Group plc. as well as Managing Director of GCI Consulting GmbH in Dortmund founded in the beginning of 2004.

The CS-Fusion was an extremely interesting new development at the Hanover fair 2005. How did this development arise?

As you know, I have been active for over 30 years in the compressed air industry, for over 20 years in leading positions of considerable enterprises. In the last ten years my special interest was in the development of water-lubricated-screw compressors and turbo-technology. The idea to use a turbo compressor as turbocharger for oil-free screw compressors is not new; it was already applied in the 80's by MAN GHH in Oberhausen. But then it concerned however, a compressor consisting of a conventional transmission turbo, with fixed speed as first stage, intercooling and a two stage oil-free screw compressor as second and third stage. This configuration did not become generally accepted, because among other things, the energy savings were not very good compared with the high manufacturing costs of this three stage machine. Through my activities at CORAC, the idea came to me to integrate the compact VSD High-Speed Turbo modules developed there, as the first stage with intercooling, into a standard water lubricated screw compressor cabinet, effectively as a turbocharger. The CORAC design team has extensive knowledge of aero-dynamic and bearing technology as well as high-speed motor drives which enabled one to achieve this market changing technology. This resulted in an oil-less compressor with substantially lower specific power demand and noise level, at the same time with less construction volume compared with a oil-free, two stage Tooth- or Screw Compressor.

Mr. Cromm, how did you come to the designation CS-Fusion?

C stands for “Centrifugal“, i.e. Turbo, S stands for “Screw“, ie water screw and Fusion for the merged or hybrid technology.

What advantages does the CS-Fusion have compared with a "normal" oil-free screw compressor?

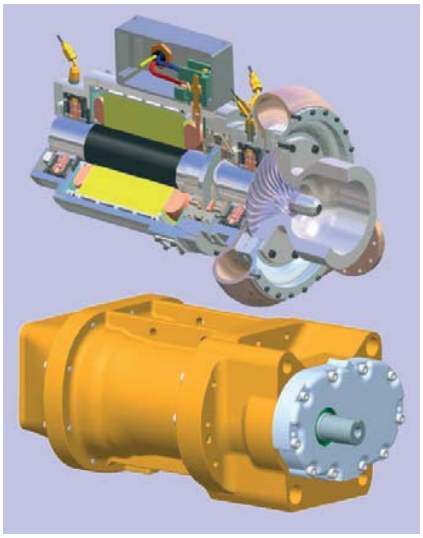
As already mentioned, the one stage turbo compressor is optimal for high volume suction capacity and pressures between 2 and 3 bar. The water screw however is most suited for low suction capacities and high delivery pressures -

INFO The CORAC Group plc.

The CORAC Group plc. is a intellectual property (IP) company with expertise in a number of key enabling technologies, including high-speed drives (HS-motors and HS-frequency converters), air and gas-lubricated high-speed bearings, aero and thermodynamics. CORAC is holder of over 45 valuable Patents. These have been the basis for 3 product lines:

- High-pressure non-contacting Dry Gas Seals up to 300 bar; 2004 saw an exclusive license agreement with Aesseal signed, the fourth largest manufacturer in the world on this sector. The Products will be marketed at the end of 2005.
- Turbo Compressors for the Oil- and Gas Industry (Downhole-Gas-Compression for Natural- Gas extraction. Significant International Oil and Gas companies are involved in a joint project with Corac and are sharing development costs.
- High-Speed-Turbo Compressors for the Compressed Air- and Refrigeration Industry as well as Water Chillers. These have been developed as integrated drive/air end units from 50 to 250 kW, from 1 to 15 bar, one to four stages and now are used as VSD Turbo-Boosters for the CS-Fusion.

Further information under www.corac.co.uk and www.gci-consulting.de



HS-Turbo (above) and Water lubricated Screw

In other words “The best of both worlds“. The variable speed turbo compressor can reduce the flow rate down to 45 % leaving the water screw to deliver its optimum pressure flow. Therefore this turn-down can be achieved with the power electronics of the turbo which only have to be rated at 50 % of the total machine power. Thus producing considerable savings in cost. The energy saving is also an important contribution to the environmental cause.

The professional world in Hanover was surprised at the previously inconceivably small construction size; how did you achieve this goal?

A CS-Fusion with a drive power of 132 kW has almost identical dimensions to a normal water screw with 75 kW rating. The reason for this is, that the speed controlled CORAC-Turbocharger with 50 kW is not much larger than a normal intake filter with Centrifugal-Pre-Separation. It therefore fits ideally into a cabinet of a water screw with 75 kW power demand. That results in a CS-Fusion with 120 kW and you will get, at the same pressure, more delivery volume than a two-stage oil-free speed controlled screw compressor with 132 kW. For example, a CS-Fusion with 132 kW has a 15 to 17 % higher volume flow rate than an oil-free screw compressor with 132 kW. In addition the CS-Fusion is with the same noise insulation measures. The CS-Fusion therefore can be installed directly at the workspace and the operator does not need a separate compressor room and additional piping.

With the CS-Fusion it concerns a compressor with oil-less Design. Does that apply as well for the bearings?

Yes, that applies also to the bearings. These compressors work without a drop of oil to any part of the system. The CORAC turbo-compressor works on air bearings and the water screw will use water-lubricated bearings. This guarantees absolute safety. Therefore the CS-Fusion is particularly welcome by users in the food Industry, medical technology, chemistry and everywhere where oil can affect the production process negatively. Hospitals, which are built according to American regulations which specifically specify oil less compressors. This applies as well for Switzerland.

Why does one achieve better specific performance data with this two-stage combination compared with a two-stage screw compressor?

The oil-less HS-Turbo, as a volume-flow machine, has a smaller construction volume compared with the first stage of an oil-free screw compressor, and at an intermediate pressure of approximately 2.7 bar (absolute), has better specific values. The CORAC turbo compressor has a speed of 72,000 rpm so it achieves maximum efficiency from its air ends. The water screw as a second stage has also better specific values, since it compresses at final temperatures within the range of 40 to 50 °C, thus almost isothermally. In comparison, the final compression temperatures of the first and second stages of an oil-free screw compressor, depend upon the pressure ratio, are between 160 and 200 °C. For this reason the two-stage oil-free screw is limited to 10 bar pressure and is also sensitive to higher ambient temperatures. On the other hand you can achieve 15 bar with our CS-Fusion at any ambient conditions.

Mr. Cromm, that sounds itself pretty good, but has your theory been confirmed in practice?

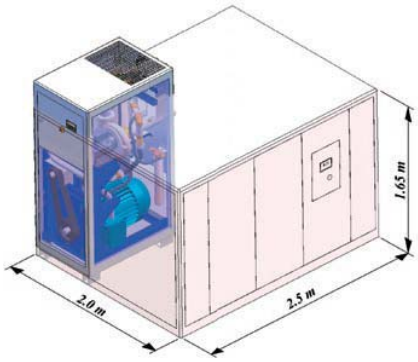
We at CORAC have validated this theory with a CS-Fusion test package. With this compressor package we could obtain, at the first attempt, energy conservation of 8 % compared with an oil-free two-stage screw compressor with speed regulation, although the assigned water screw did not work with an optimal efficiency. The efficiency calculation with an SRM water screw of

CS-Fusion compressor

the newest generation resulted in an improvement of the specific output from 8 to 14.6 % in the case of 100 % delivery volume and 7.5 bar. We can demonstrate these results to prospective customers at any time at CORAC in London.

You are talking about an improvement of 14.6 % better specific power consumption. That adds up, over a yearly operating time of 8,000 operating hours, to a substantial amount. How does this look in concrete numbers?

This is indeed the case. Energy conservation is also equivalent to environmental improvement. If one can save, for example, with a 300-kW-Package per hour 14.6 % or 43.8 kW of electricity, this will add up the annual saving potential at 8,000 operating hours to a considerable 350-400 kW/H. That results, in the case of an electricity tariff of 0.10 Euro per kW/H to an annual saving of approximately 35,000 Euro. Therefore the operator saves during one life span of ten years with a CORAC CS-Fusion altogether 350,000 Euro’s worth of electricity at today’s prices. The amortization period is accordingly short. And if one considers then that the energy costs of a compressor, at a long-



Size comparison oil-less CS-Fusion / oil-free Screw

term view, constitutes more than 70 % of the total costs, then the energy-saving concept of the CS-Fusion becomes particularly clear.

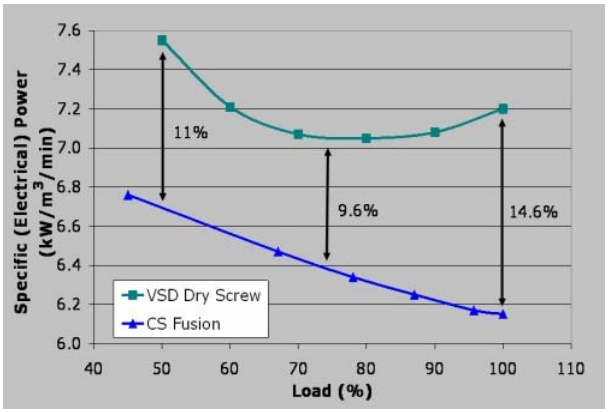
What do you mean with the "newest generation" of water screw by SRM?

SRM in Stockholm is well known as the company, who developed and patented the asymmetrical screw profile in the 70's. SRM assigned world-wide licenses to approximately 23 of the largest compressor manufacturers and thus contributed to the success of the oil-injected screw compressors considerably. SRM began more than ten years ago with the development of water-lubricated screw compressor stages. Now, after going through different development stages, SRM presented the newest water-lubricated bearings, thus oil-less stages, on the combined stand of CORAC/SRM at Hanover. There are a number of companies developing water screws or have trial units. The CORAC turbo compressor is capable of being interfaced to other examples thus enabling the company to address the market either as an integrator of hybrid machines or as a supplier of turbo compressors to be matched with other water screw arrangements.

Bacteria, from solids in the ingested air, lime deposits in the circulating water and corrosion play a substantial role with water-lubricated screw compressors. How did you solve these tasks?

During compressor operation most bacteria die, because of the pressure change in the system. During downtimes the living bacteria nourish themselves off these dead bacteria and settled substances, which are brought into the water circulating system by the intake air from the environment. This has been a concern for the industry for some time but I hold patents which are an elegant way of overcoming these problems and its simplicity will ensure adoption by the industry as a whole. What is more, it has impact in reducing corrosion and thus give water screw compressors an extended life. This is achieved with a simple 5-micron filter and a reverse osmosis filter integrated in the compressor. A CS fusion can operate irrespective of the water conditions worldwide.

Performance chart

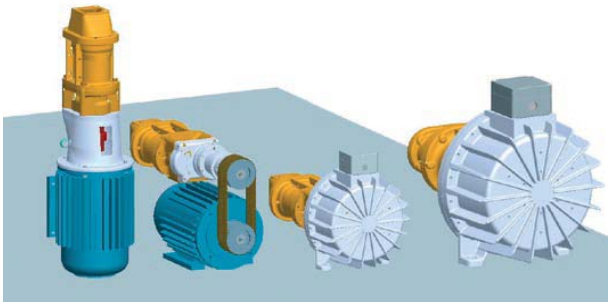


Direct drive

Belt drive

VSD drive

Water lubricated screw compressor drive concepts



How do you see the future of the CS-Fusion?

Our concept has, due to two reasons very substantial market opportunities. It uses, on the one hand, the large technical advantages of the water-lubricated screw compressor in relation to the two-stage “dry” compression. On the other hand these advantages are combined in our CS-Fusion with a VSD HS-Turbocharger. This results in a particularly economical energy saving, environmental protecting and reliably small working compressor package.

For which capacity range is the CS-Fusion suitable?

At present the CS-Fusion can be realized in the capacity range from 110 to 300 kW, and it will prevail in the present domain of the two-stage oil-free screw, because of the stated substantial advantages including improved economy, the achievement of lower “lifecycle costs”, its compact design and its environmental friendliness.

Why isn't the CS-Fusion concept used below 90 kW?

Quite simply, because the absolute energy savings with these relatively small drive powers do not justify the extra costs of a two-stage CS-Fusion because they will not amortize fast enough in relation to the low specific power ratings of a single-stage water screw. I think that in this capacity range the single-stage oil-less water-lubricated screw compressor will substitute the two-stage oil-free tooth- and screw compressor and the question for me is not "whether", but "when". It was so similar in the 70's with the oil-inject-cooled screw, which displaced to a large extent the oil-lubricated piston and rotary compressors from today's market. Nevertheless, it can be well expressed by the phrase -

“The future lies with improved technology”