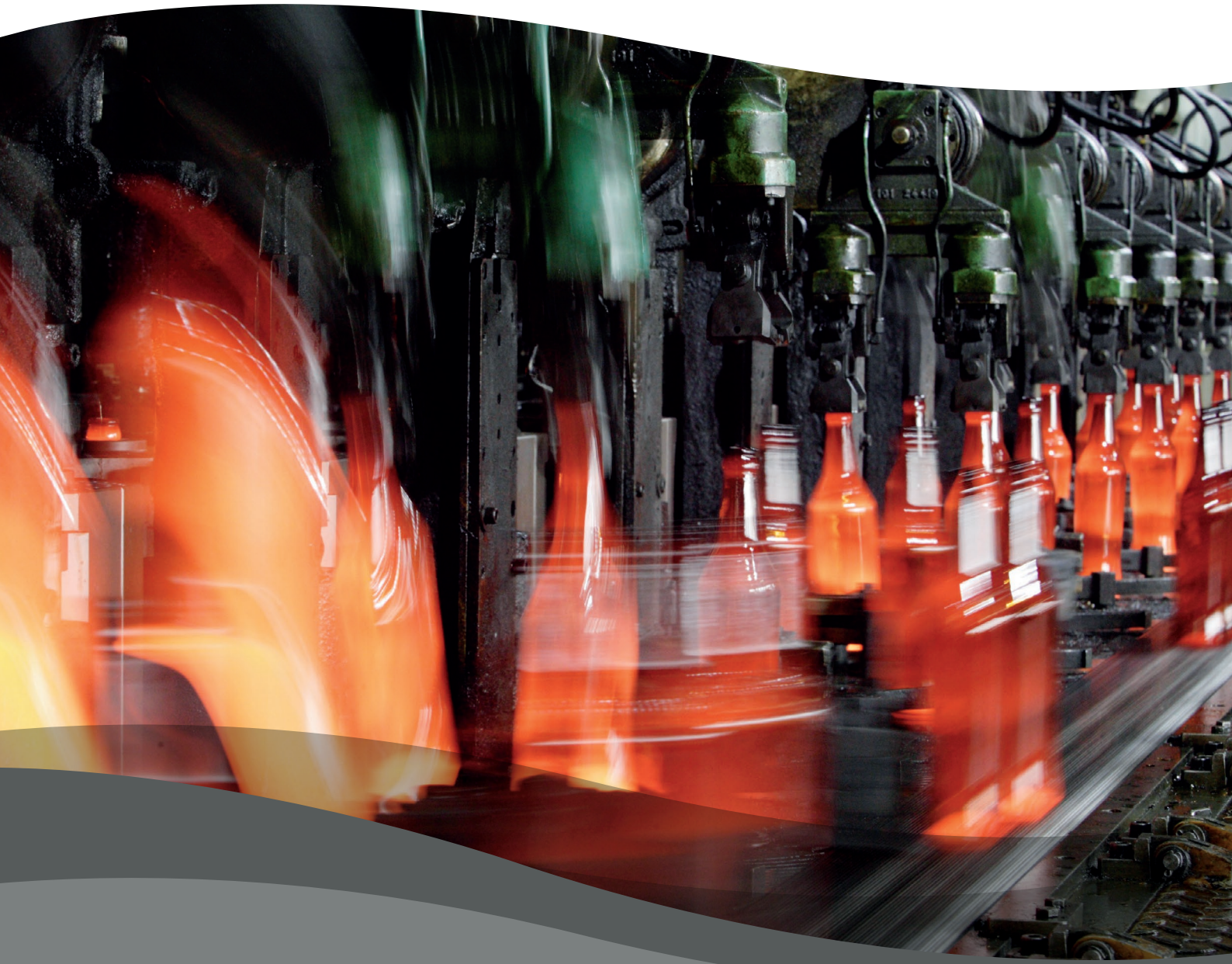
Gardner Denver

WITTIG INDUSTRIAL SYSTEMS

IE3 and IE4: comparative test of the drives on rotary vane compressors

Rotary vane compressor with synchronous reluctance motor in glass production at Verallia



The compressed air experts at Verallia in Bad Wurzach were the first to test a new drive technology for Gardner Denver rotary vane compressors from the Wittig Industrial Systems brand. When compared directly with the previous asynchronous machines, the synchronous reluctance motors from ABB impressed with their increased efficiency and correspondingly lower energy consumption. Verallia is a brand of the listed company Saint-Gobain Oberland AG. The company is one of the leading manufacturers of glass packaging for food and drink in Germany and with four sites in Bad Wurzach, Neuburg an der Donau, Essen and Wirges in Westerwald it is well placed to serve what is still a predominantly regional glass packaging market.

Special rules apply to the industrial production of packaging glass because the quantities required are very high and the production sites must be able to keep up with this demand. The process does not allow for any downtime: the systems are in operation 24/7, all year long.

50 years of glass production with Wittig compressors

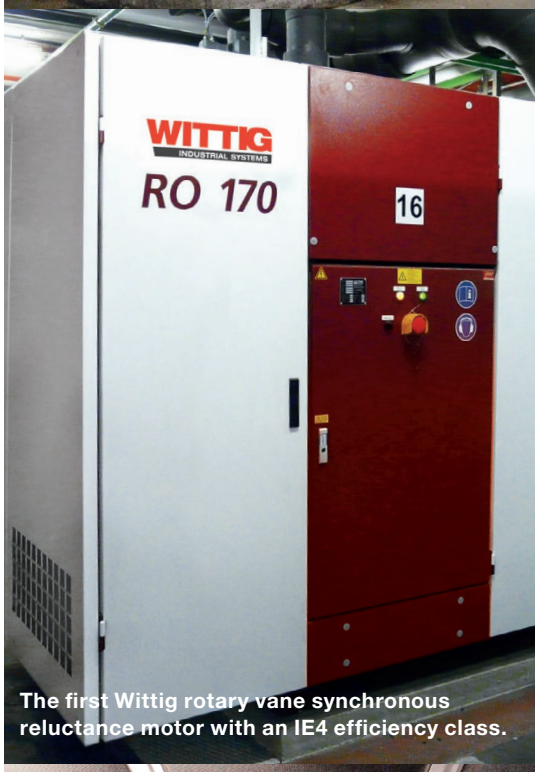
The compressed air and vacuum supply are also subject to extremely high requirements. Numerous compressors and vacuum pumps are installed in the Verallia plant at Bad Wurzach. As is typical for hollow glass production, they work in three networks: 4 bar, 6 bar and a vacuum network. The compressors and pumps generate compressed air and vacuum for the production of around 2.5 million bottles per day. The start of the process involves several sumps which each store around 300 tonnes of molten glass at a temperature of approximately 1,600 oC – and they do so 24/7. During production itself, precisely proportioned redhot glass droplets are “shot” through glass channels to create hollow glass every second. In doing so, the compressed air presses the hot mass into the mould and the vacuum pulls the molten glass onto the mould walls.

The compressors in the extensive compressed air station look very different due to their year of manufacture, rather than their brand: in Bad Wurzach, Wittig rotary vane compressors were installed more than fifty years ago. The oldest system, which is still in operation, dates back to 1965, which means it has been in operation for exactly 50 years and is still used as a redundancy machine.

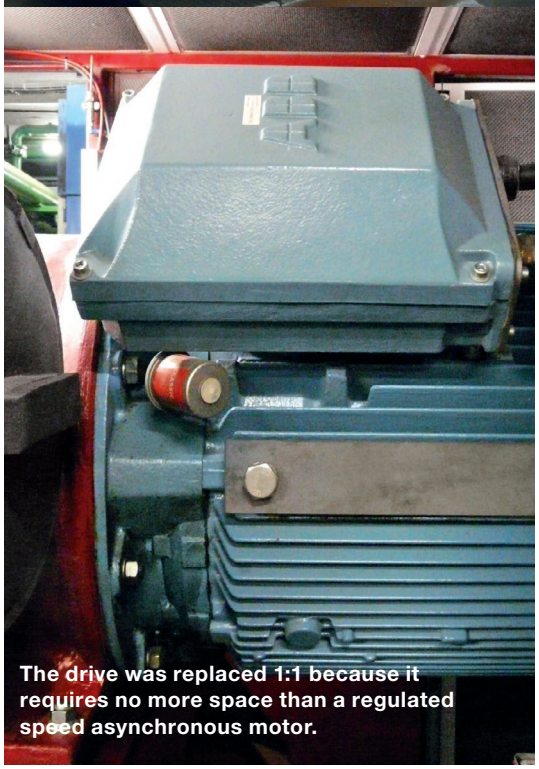
Ideal principle: the rotary vane compressor

This explains the commitment to the principle of the rotary vane compressor, which was patented in 1908 by Karl Wittig. Wittig was the first company to apply the multicell principle. A rotor is mounted eccentrically in a cylindrical housing. The slotted rotor contains movable vanes which divide a crescent-shaped working chamber into cells with changing volumes. Gas and centrifugal forces press the rotor vanes against the wall of the housing and thereby enable air or gas to be taken in, compressed and discharged. The low speed of 1,500 rpm, the low rotor weight and the low amount of moving parts all help to ensure a long service life with minimal maintenance requirements. As a result, rotary vane compressors are extremely durable, even when used 24/7, as evidenced by the fifty year old machine at the Verallia plant.

It keeps on running and running: several rotary vane compressors dating back to between 1965 and 1975 are in use at Verallia Deutschland



The first Wittig rotary vane synchronous reluctance motor with an IE4 efficiency class.



The drive was replaced 1:1 because it requires no more space than a regulated speed asynchronous motor.

The rotary vane compressors, with performance ranges of 250 to 6,000 m³/h or 30 to 710 kW, are developed and produced at Gardner Denver, Schopfheim.

Regulated speed compressor, central PLC controller

Energy efficiency is extremely important at all of Verallia's production sites. In particular, this also applies to compressed air and vacuum generation, which make up a considerable proportion of the energy consumption of the entire plant. Siegfried Heinrich, Head of the mechanical maintenance department, who is responsible for compressed air supply at Bad Wurzach commented: "The compressed air network requires around 55,000–60,000 kWh of electrical energy per day, while vacuum generation requires less than 15,000 kWh."

To generate the required amounts of air economically, all newer compressors are equipped with regulated speed drives. The compressors and vacuum pumps in the three networks are regulated according to demand via the self-programmed PLC.

An energy-conscious and exacting user

Not only are Siegfried Heinrich and his colleagues valued clients for Wittig, they also make excellent partners when it comes to the further development of the machines. Bernd Haas, Manager Sales Systems at Gardner Denver Schopfheim GmbH: "Verallia has consistently provided us with suggestions for improvement, which we are pleased to implement." This is also relatively easy as the Gardner Denver Wittig rotary vane compressors are still custom-built and produced in Schopfheim with a high degree of vertical integration. The production paths are therefore kept short. For example, the sound hood was optimised at the request of Verallia, so that all components of the compressor can be accessed as quickly as possible in the event of maintenance or repair.

From IE3 to IE4: new drive technology for regulated speed rotary vane compressors

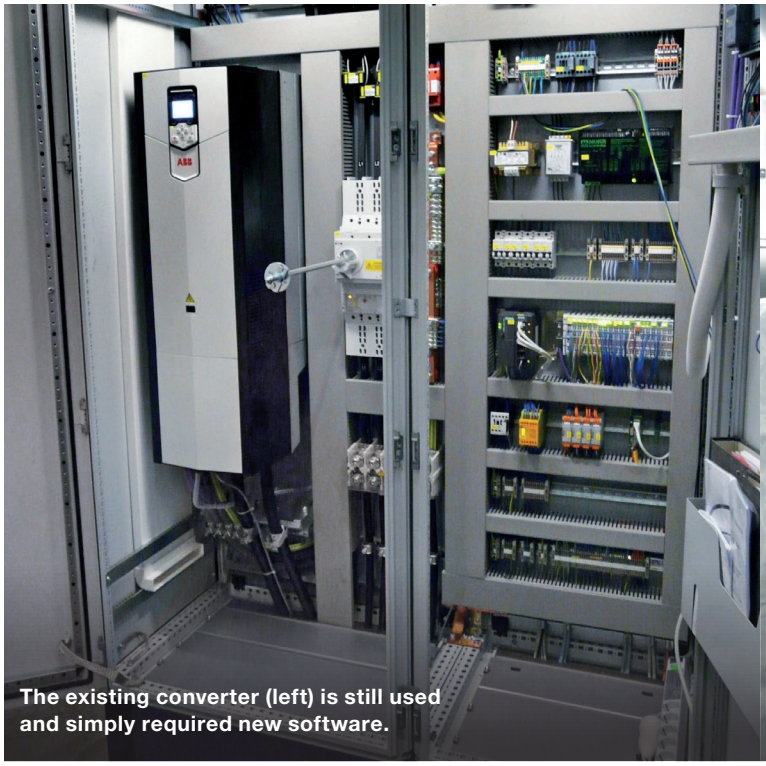
The newest compressor in the compressor station is a regulated speed RO 170 with 132 kW drive, which supplies up to 1,408 m³/h of compressed air into the 4 bar network. Bernd Haas: "Our ROW compressors are standard compressors in many operations which require continuous compressed air." They are equipped with three-phase asynchronous motors and frequency converters from ABB.

After Verallia ordered the ROW 170, ABB approached Gardner Denver with a new drive concept. At that point, the company had developed synchronous reluctance motors that worked with a higher degree of efficiency than conventional three-phase motors and was ready to start production. They are ranked in efficiency class IE4 and can be used together with conventional ABB converters.

Nobody wants to be the first

When launching such innovations, all system manufacturers are faced with the same dilemma: many users want to use energy-saving technology, but nobody wants to be the "guinea pig", especially when there are no practical comparative values available and the benefit is not yet clear.

So, a collective idea arose: a new energy-saving drive concept for rotary vane compressors was available. As was a manufacturer of compressors that wanted to use the concept. Along with a highly active and critical user. Why not come together to carry out a practical test which would benefit all involved?



The existing converter (left) is still used and simply required new software.

The stars of the comparative test from left to right: Bernd Haas, Manager Sales Systems of Gardner Denver Schopfheim GmbH, Siegfried Heinrich, Head of the mechanical maintenance department at Verallia Deutschland and Henrik Bräutigam, ABB Automation Products.

Drive concept comparative test

This idea became a reality. The operating parameters of the new compressor at Verallia (with the "old" drive) were precisely recorded over several months. They then switched to the synchronous reluctance motor and continued the measurements.

The result is a comparison of both drive systems under identical conditions. And it is better than they had hoped "on paper". Henrik Bräutigam, ABB Automation Products: "The calculations indicated a 0.8 % advantage in terms of the degree of efficiency of an IE4 reluctance motor in comparison with a regulated speed IE3 motor. This is the value specified in our documents. However, the measurements showed that the efficiency was improved by 1.5 %."

Numerous advantages to using a synchronous reluctance motor

The reduced energy consumption is not the only advantage of the new drive. Henrik Bräutigam: "There is no slip during operation in the synchronous machine. This means that the motor, and thereby the entire machine, runs more quietly. The rotor does not produce any losses and less waste heat is generated. When it comes to compressors, this is an important factor, because heat promotes bearing wear. As a result, we also expect that the maintenance intervals of the compressor bearings will be increased." Furthermore, the motor only runs under partial load with 80 to 85 % of the full load. This is where the degree of efficiency of the reluctance motor is at its best – and therefore the wear is low since the motor is never run at its performance limits.

And to retrofitting

Another major advantage of the synchronous reluctance motors is their compact design: The fitters at Verallia in Bad Wurzach were able to replace the drives 1:1; the new drive fitted in the existing sound hood. This means that users of Gardner Denver Wittig rotary vane compressors can also upgrade their old regulated speed machines, which are still equipped with IE1 and IE2 motors, to benefit from increased efficiency and retrofit a reluctance motor. Even the control technology poses no problems: a new program simply needs to be installed onto the existing ABB converter.

Convinced pilot users

The comparative test was conclusive for ABB and Gardner Denver: with a payback period of significantly less than two years, the synchronous reluctance drive is clearly a competitive alternative to the well-known asynchronous motor. The test also impressed those responsible at Verallia. They have already ordered the next rotary vane compressor for the Bad Wurzach plant and it is currently being produced in Schopfheim. Needless to say, it is equipped with an IE4 synchronous reluctance motor from ABB.

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www.gardnerdenver.com/industrials

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