

Brunner Mond Group plc, Northwich (Great Britain)

Electrical drive system with Simover MV replaces steam turbines at Brunner Mond Chemie

Simover MV in compressor drives

As part of a modernization project, the chemical company Brunner Mond, based in north-west England, is now using variable-speed drives, instead of steam turbines to drive its centrifugal gas compressors. The 50-year-old compressors, now fitted with state-of-the-art drive technology, will remain to become an energy-saving, low-maintenance system with a high availability. This has all been made possible by combining special high-speed motors, gearless couplings and medium-voltage drive converters with intelligent HV IGBT (Insulated Gate Bipolar Transistor) power semiconductors. In addition to supplying the drive system, Siemens carried-out the computer-based vibration analysis, system integration, training of the operating personnel, commissioning and after sales service.



Brunner Mond Group plc. is one of the leading European producers of alkaline chemicals. The Company has a total of four plants in Europe and Africa with its head office located in Northwich, in north-west England. The company produces mainly soda ash, a basic material for use in the glass industry and the production of washing powders, as well as industrial minerals. Until September 2000 Brunner Mond owned and operated coal, oil and gas-fired boilers in the production facilities at Winnington and Lostock, close to Northwich. The boilers kept the plants supplied with process steam as well as high-pressure steam for the steam turbines driving the compressors. Brunner Mond now have all of their steam raising carried out by Powergen Combined Heat and Power, via a combination of five new gas boilers. These central, gas-fired boilers supply low-pressure steam to the two facilities at Winnington and Lostock. This can be used as process steam, but is not suitable for driving the compressors. Brunner Mond therefore decided to keep the fifty-year-old compressors, which were still fully operational, and replace the steam turbines with variable-speed electric drives. At Lostock, this involved four units. Low maintenance, high process accuracy and energy saving. Compared with steam turbines, electric drives are distinguished by their high reliability and low service requirements. As deposits continually reduce their efficiency, steam turbines have to be stripped down completely twice a year, cleaned and the seals replaced. Modern electric drives, however, operate almost maintenance-free, with the added advantages of significantly lower noise levels and cooler operation. The speed of the motor is continually adapted to actual operational requirements, which guarantees accurate process control. Energy is also saved because the system takes only the amount of power which it actually requires. Optimally harmonized. In order to gain the advantages of variable-speed drive technology for the existing Brunner Mond compressors, Siemens selected a system comprising special high-speed motors, gearless couplings and water-cooled medium-voltage Simostart MV drive converters. The drive converters are equipped with intelligent HV IGBT (Insulated Gate Bipolar Transistor) modules which are optimally harmonized with each other. These drives guarantee optimum reliable compressor operation over the complete speed range. The motors, which have an operating range from 3800 to 6400 RPM, are an individually customized design from the Siemens special drives center in Berlin. Induction motors with laminated squirrel-cage

rotors are used for the four drives; two machines require 1.5 MW of absorbed power at the coupling, and two smaller machines of 1.3 MW, so that the motor dimensions allow the two existing compressors to be used without modification. The motors have air-to-water heat exchangers, the internal cooling circuit using separately-driven fans with counter current cooling at both ends. The rotor has a ribbed surface for good cooling. In order to eliminate vibration problems from the very beginning, the usual bending and torsion analysis of the rotor was supplemented by investigations into the strength and stiffness of the motor frame, which was optimized by computing the natural frequency. In order to optimize the dynamic performance of the rotors, Siemens used special tilting-pad bearings. Four additional balancing, planes permit modal balancing and therefore a specific reduction in the bending vibrations in all of the natural forms. In spite of the wide range of speeds, the application of each of these measures made it possible to locate all of the natural frequencies outside the speed control range. Full-load system tests were carried out in the Berlin Dynamowerk factory prior to installation, to ensure that all of the specifications were fulfilled. For the Brunner Mond application, the motors are coupled to the compressors without using gearboxes. This configuration has the advantages of a higher overall efficiency, low wear, and increased availability, due to the elimination of all problems associated with gearboxes. Computer supported vibration analysis. In order to guarantee the smooth running properties of the new motors, they were perfectly harmonized with the 50-year-old compressors. Siemens carried-out a torsion and vibration analysis for the complete mechanical transmission, using a specially-generated three-dimensional finite element model of the old compressor and the new motor. The moment of inertia for the compressor was determined from documents which were about 40 years old, and using the FEM model, all possible operating situations and mutual interactions were simulated by computer. From the information gained, optimum smooth running characteristics were obtained for the mechanical transmission up to a maximum speed of 6400/min. High availability medium-voltage drive converter. A Simovert MV medium-voltage converter is used to control the speed. This unit has an output of 2300 kVA at a motor voltage of 3.3 kV, and an output frequency of 107 Hertz. As a result of its unique design, Simovert MV requires little maintenance and has a high availability. This is especially due to the fact that it is the first medium-voltage

drive converter which uses HV-IGBT power semiconductors (Insulated Gate Bipolar Transistor). When used with the three-level voltage DC link technology, HV-IGBT modules permit a simple configuration: Modular, space-saving, less prone to faults - but, in spite of all this, extremely service-friendly. This isn't possible in this form when other power semiconductors are used, as the HV-IGBT is the only component in its class which can be operated without any snubber circuitry at all. In conjunction with the gating circuit, the HV-IGBT modules form an intelligent switching unit which guarantees optimum drive converter protection. This is achieved, for example, by limiting or switching-off short circuit currents. The use of HV-IGBT in conjunction with 3-level technology and the high-performance Transvector control guarantees sinusoidal motor currents, thus reducing the motor losses, and minimizing torque fluctuations. This also reduces the stressing on the complete drive line-up. Although Simovert MV units can be either water-cooled or air-cooled, it was only possible to use the water-cooled version for the Brunner Mond drives. The ambient air was far too aggressive for air-cooled converter technology, which is frequently the case in the chemical industry. The water-cooled Simovert MV is part of a turnkey container solution. It fulfilled the customer's demand to have a project which did not involve any civil engineering modifications in the production hall, but had minimum downtimes. To meet these clear customer requirements, Siemens supplied climate-controlled containers which accommodate the drive converter, transformer, cooling system and control system for each drive train. These were shipped to the site ready-wired and tested. Special cranes were used to lift the containers onto their bases and it was only necessary to connect power cables to the mains supply and couple-up the raw cooling water pipe work. The final task was to connect the drive system to the supervisory control via Profibus-DP, and the system was ready to be commissioned. As Karl Cleary, Brunner Mond's Northwich East Plant Manager commented recently, "The conversion of our compressors to high efficiency electric drives was a major operation. Our main concerns were the potential impacts on both production and future drive train reliability. Detailed planning, including containerization of key components, ensured that installation was completed with minimal loss to production capacity. Similarly, the careful harmonization of individual drives and compressors has resulted in extremely smooth operation. We are very pleased indeed with the

quality that Siemens delivered at every stage of this project. "In addition to installation, system integration and commissioning, Siemens provided training support for operating personnel and also became responsible for after-sales service. Replacing out-of-date drive technology with state-of-the-art converter systems, no matter whether it is for steam turbines or fixed-speed drives, provides many advantages, especially in the chemical industry. In addition to compressors, this is particularly true for pump drives in the widest range of processes. The reason is, as in the Brunner Mond case, that energy consumption increases as a function of the cube of the speed of the drive. The Central Committee of the Electrical Industry in Germany [Zentralverbandes Elektrotechnik und Elektroindustrie e.V.(ZVEI)] has estimated that in Germany alone, the potential savings from using variable-speed drives is of the order of billions of marks.

Drive, Switch & Control 4 / 2001