

Integrally Geared Compressors for Urea Plants



MAN TURBO AG



Introduction

In urea plants CO₂ (washed out in the ammonia process) is converted with ammonia to produce fertiliser.

In earlier times, single-shaft centrifugal compressors were used for the compression of the CO₂ gas mixture.

Now, MAN TURBO has developed a concept which uses an integrally geared compressor and has significant advantages when compared with a single-shaft centrifugal compressor.

MAN TURBO has supplied integrally geared compressors for CO₂ plants in Russia and the USA which are already in successful operation.

These machines have been developed as an extension to the wide range of integrally geared compressors used in different applications. To meet process and environmental requirements various sealing systems are used.

Cooperation with Stamicarbon

With this concept MAN TURBO has found in Stamicarbon, the licensing subsidiary of DSM in the Netherlands, an important process licensor as partner for cooperation.

Here, the decisive factor was a reduction in power requirement of approx. 20%, compared with the conventional single-shaft machine; at the same time there was a saving in capital costs.

The concept

An integrally geared compressor and driver (motor or steam turbine) are packaged on a single base frame fitted with columns forming a steel foundation. Intercoolers and oil system are also integrated in the frame.

The compressor

The compressor is an integrally geared compressor with 8 overhung mounted impellers. This arrangement results in advantages in cost and, above all, efficiency.

A better efficiency is achieved by:

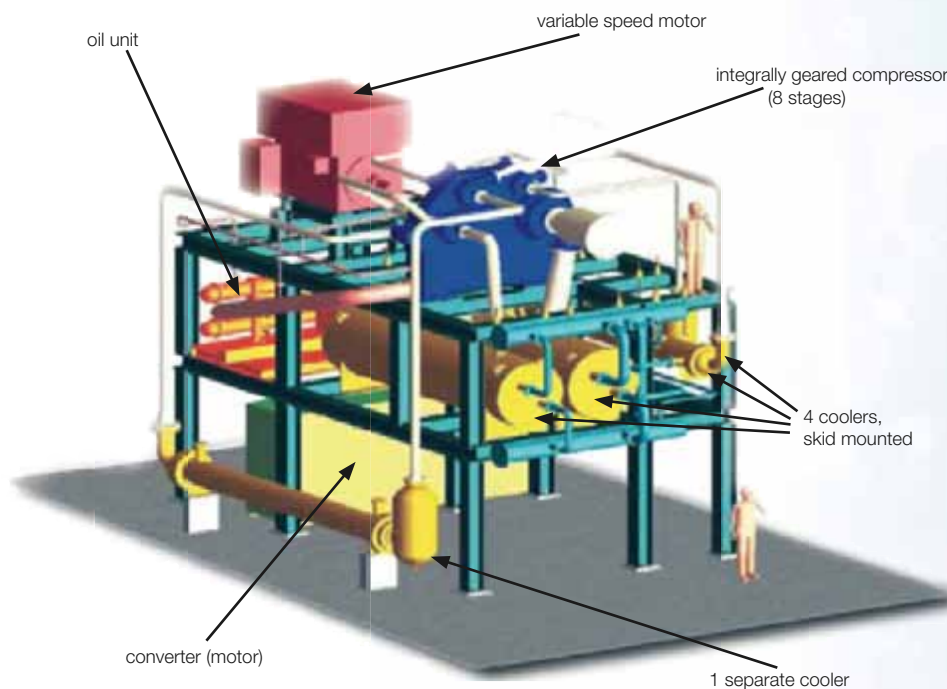
- Axial inlet at each impeller
- Four compressor pinion speeds. Impeller diameter and speed can be adjusted stage by stage to achieve flow coefficients near to optimum
- Five instead of three intercoolers
- Leakage reduction by special carbon ring shaft seals

All these design elements contribute to an efficiency which is 20% better than the efficiency of a single-shaft machine.

The driver

Depending on the process/plant conditions the driver can be a steam turbine or an electric motor.

The electric motor is coupled directly to the bullgear shaft. In the case of a steam turbine driver, the compressor is driven via a separate pinion, allowing the steam turbine speed to be freely selected.



1 Package arrangement

The frame

The compressor and driver are mounted on the structural steel base frame. The other elements, such as coolers with interconnecting piping and oil system are integrated in the frame.

This forms a very compact unit with considerable advantages in erection and commissioning times and also in cost. The fact that the machines are shop assembled (and tested) reduces the possibility of delay during commissioning on site.

If due to transport limitations it is not possible to deliver the unit as a whole, then the compressor and driver may be removed, but the major part of the package remains intact and in this case also time and cost will be saved during erection.



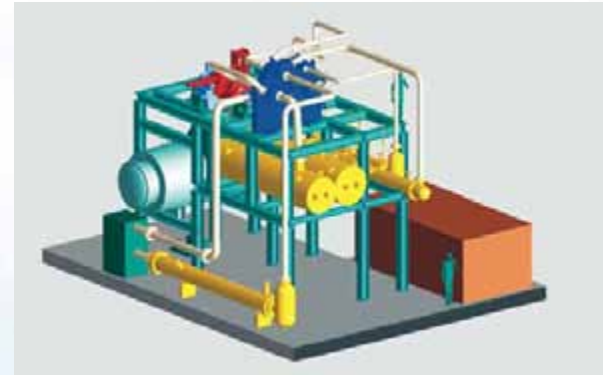
Testing

The completely assembled module allows relatively simple full-load testing with CO₂ gas and the original coolers and pipes. This ensures that a mechanically and thermodynamically tested unit leaves the factory.

First order

A concept was developed for three standard machine sizes and meanwhile MAN TURBO has received a first order for a plant in Slovakia. Stamicarbon is the process licensor for this plant. The design capacity is 750 t/d, with the possibility of a later upgrade to 900 t/d; this size corresponds to the smallest standard module.

The 8-stage machine compresses the CO₂ gas mixture from 1 bar abs. to 147 bar abs., the required power of approx. 3,900 kW (actual status of extension) is provided by a variable speed asynchronous motor.



2 Steam turbine as driver (standard design)

Outlook

With this machinery and plant concept MAN TURBO has created a possibility to implement efficiency improvements and at the same time cost reductions.

These modules can be used both for new plants and for revamp projects.

3 Compressor unit during test run

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