



## Two-in-one solution for BASF

Reactor condenser and sub-cooler in one compact unit

Case story

The largest BASF production facility in Latin America is the Guaratinguetá Chemical Complex, strategically located between the cities of Rio de Janeiro and São Paulo. The Guaratinguetá site consists of a total of thirteen plants that extend over an area of more than 1.6 million square metres. These provide hundreds of products, including expandable polystyrene, plastic dispersions, pigments, dyes, vitamin mixtures and products for use in agriculture.

In the pigment factory, however, BASF had a capacity problem. Two batch reactors shared the same shell-and-tube unit for condensing organic solvent, resulting in a bottleneck in production.

To solve this, BASF decided to link the existing shell-and-tube condenser to one reactor and purchase a new condenser for the other. The choice lay between an identical unit, a vertical shell-and-tube condenser with a carbon steel shell and graphite tubes, or a new Compabloc condenser in Hastelloy C-22 from Alfa Laval.

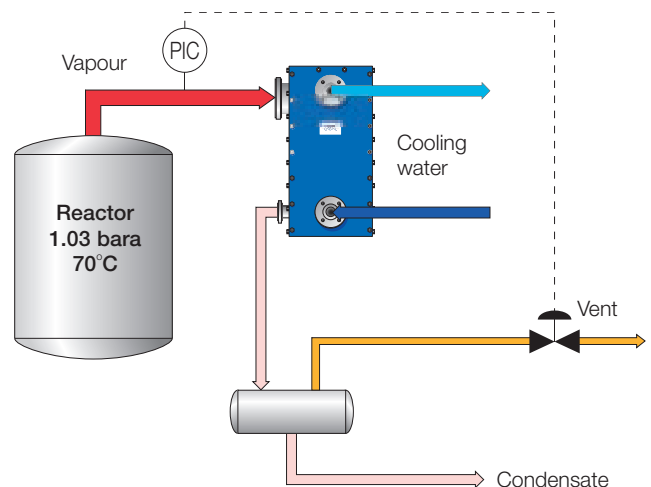
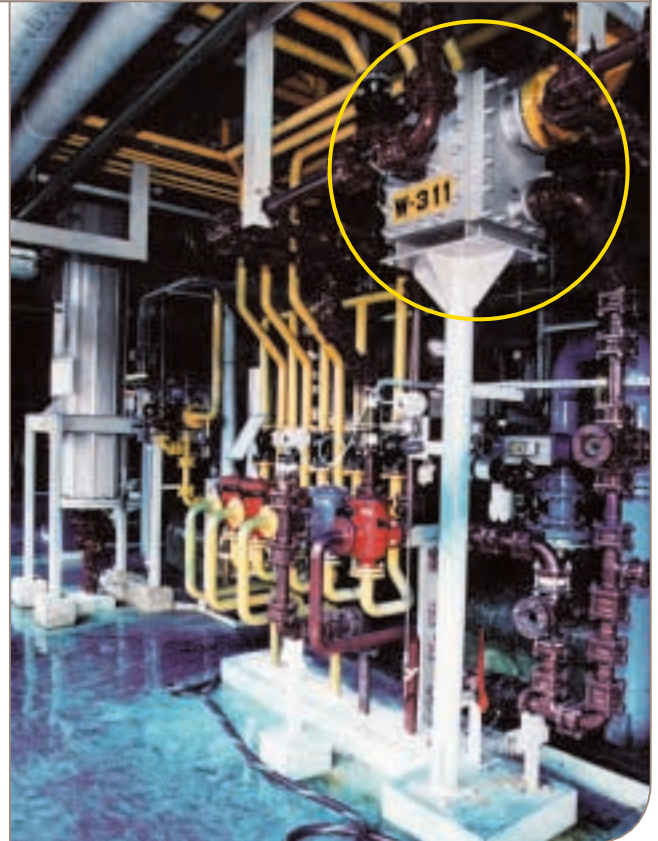
BASF decided in favour of the Compabloc unit. It was cheaper, and the compactness of the Compabloc meant that it took up only a quarter of the physical space, giving lower installation costs.

The BASF staff were quite curious when they started up the Compabloc condenser in October 2001. As production manager Walter Misfeld said, "I was really surprised when this little Compabloc unit, which is only a quarter of the size of the existing shell-and-tube condenser, proved to have almost double the capacity. To me, it seems almost like a miracle."

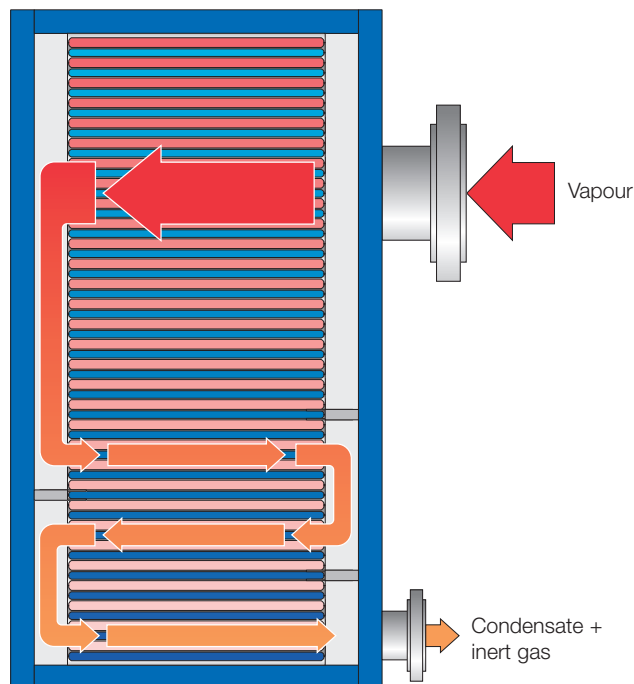
### Minimum service requirements

Another major consideration was the issue of cleaning, and the downtime this causes. Every eight months, the shell-and-tube condenser had to undergo thorough chemical cleaning because the carbon steel on the shell side became fouled and corroded.

The much greater turbulence in the new Compabloc condenser keeps fouling to a minimum. The corrosion problem on the cooling water side have disappeared since there is Hastelloy C-22 on both sides in the Compabloc. In the first ten months of problem-free operation, absolutely no cleaning



Installation sketch for the Compabloc with condenser and sub-cooler in the same heat exchanger



Compabloc assymmetric multipass condenser makes condensation and subcooling possible in the same unit

was needed. If and when inspection or cleaning procedures prove necessary, these are simple tasks that require little space and only involve a minimum of downtime compared with a shell-and-tube installation.

#### The secret inside

However, the real breakthrough at Guaratinguetá lay within the new Compabloc condenser.

Alfa Laval had designed a revolutionary new multipass unit for BASF that had double the capacity with less than one third of the heat transfer area of the alternative shell-and-tube solution. The actual figure is 9 m<sup>2</sup> compared with 30 m<sup>2</sup>, providing a heat transfer coefficient six times higher than the shell-and-tube.

The inherent problem with shell-and-tube condensers is that these relatively tall units have the same tube cross-section at both top and bottom. This means that there is very low velocity and low turbulence at the bottom, resulting in laminar flow and extremely low heat transfer efficiency.

With the new type of Compabloc condenser for BASF, however, Alfa Laval engineers have devised a way of overcoming this problem by employing an asymmetric multipass concept in the condenser to ensure maximum turbulence and heat transfer efficiency throughout the unit.

The installation also combines condensing and sub-cooling in a unique two-in-one unit. This is made possible by a special baffle system that effectively divides the flow into separate sections with widely differing characteristics (illustrated above). The first pass, with 60% of the total surface area, involves condensing in 25 channels, keeping pressure drop to a minimum. When condensation of the organic solvent is completed at about 70°C, sub-cooling to a temperature of less than 35°C then takes place in smaller passes with only 5 channels in each. This increases the velocity by a factor of five, ensuring much better turbulence and keeping the heat transfer coefficient up to the maximum right through the condenser.

#### Customised condensing

The flexible design of the Compabloc gives Alfa Laval customers the opportunity to specify Compabloc condensers with an internal flow profile customised to meet the exact configuration of the application.

The Compabloc multipass condenser makes it possible to achieve both condensing and sub-cooling of both condensate and inert gases in the same compact unit, for maximum efficiency at minimum cost.

#### How to contact Alfa Laval

Contact details for all countries are continually updated on our website. Please visit [www.alfalaval.com](http://www.alfalaval.com) to access the information direct.