Big is beautiful, except for condensers

Chemical Industry | **Case story**

Three Compablocs (top right) with 50% higher capacity replaced three S&Ts (lower left) on half the footprint.

A major European chemical company increased production reliability by replacing shell-and-tube (S&T) condensers with Alfa Laval Compabloc condensers. Utilising only half the space of the old shell-and-tube installation, the Compablocs solved a corrosion problem and at the same time generated considerable savings in capital cost. “Big is not beautiful anymore at this site”, says the plant engineer.

In all capital-intensive industries, plant decisions are of major importance. This is nowhere more true than in the chemical industry. A major European chemical company solved production problems, which were also having unacceptable environmental knock-on effects, by replacing existing shell-and-tube (S&T) condensers with modern Alfa Laval Compabloc condensers. The plant upgrade increased reliability, showed a considerable capital saving over re-tubing the old S&T condensers and saved about half the space occupied by the old units.

Process plant

One of the products of this company, which has a multi-billion Euro turnover, is hydroxylamindisulphanate (Hydramin) used in the production of Caprolactam. The process is exothermic and excess heat is removed in a normal refrigeration loop using ammonia as refrigerant.

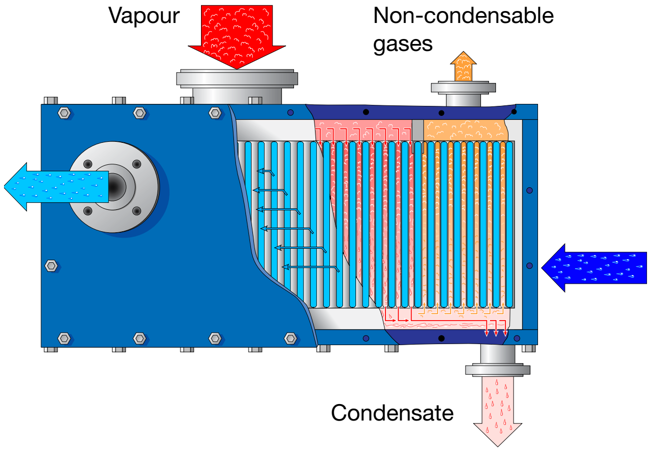
After evaporation and compression to between 14 bar(a), the ammonia was condensed in six parallell S&T condensers - three using cooling tower water and three using brackish dock water as cooling medium. Each had 1 300 m^2 of heat transfer area, consisting of 3 000 tubes of carbon steel, with a corrosion-resistant coating. The ammonia was condensed on the carbon steel shell side.

Corrosion problems

The water side needed to be cleaned by high pressure water jet every two years as performance deteriorated. This operation stripped off the protective coating which allowed the tubes to corrode and led to ammonia leaking into the cooling water system, which was totally unacceptable.

Drop in production

The condenser, which was giving trouble, had to be identified and taken out of operation while the corroded tubes where plugged. During the summer, loss of cooling capacity meant a significant drop in production. In addition, cooling capacity gradually reduced as tubes became plugged.



Compabloc two-pass condenser. The second pass is used to subcool and extract the non-condensable gases.

Plant comparison

In 1996 the plant and process engineer began making price and performance comparisons to solve the corrosion problems which were causing high maintenance costs and reducing plant efficiency. The cost of re-tubing three of the existing carbon steel S&Ts with AISI 316L stainless steel tubes was compared with installing three new Alfa Laval Compabloc condensers with plates in AISI 316L.

Higher capacity at half the space

Like many sites in the chemical industry, the space available at the plant is very valuable. The Compabloc condensers having about 50% higher capacity still only required half the space occupied by the original S&Ts. This gives options for plant modification or expansion in future years with minimum cost and disruption. Experience has shown that the heat transfer coefficient of Compabloc condensers are around two to four times higher compared to S&T condensers depending on application.

Cost savings

In the price comparison, the Compablocs cost considerably less than re-tubing the carbon steel S&Ts with 316L stainless tubes. If the comparison is made between Compablocs and new S&Ts in 316L, the cost difference is even greater. For a Compabloc in titanium the savings are even greater compared to a S&T with titanium tubes and a carbon steel shell. This is important because titanium condensers are needed when harbour water is used as cooling medium. One Compabloc in titanium is installed and two others are planned.

Fully-welded and fully accessible

The Compabloc is fully-welded and is fully accessible for inspection and maintenance. There is a vent on the ammonia side to purge the system of nitrogen. This gas is used as a seal in the compressor to avoid compressor oil leaking into the ammonia.

Operation

The Compabloc units run 24 hours a day, 8 400 hours a year with the ammonia at a pressure of 14 bar(a) and the cooling tower water at 3 bar(g). In August 1999, about a year after commissioning, they were inspected on the cooling tower water side and found to be clean. Since there have been no other problems, no maintenance has been required. The S&Ts were cleaned every two years.

Key facts about Compabloc

The Compabloc is a high-efficiency, all-welded compact heat exchanger designed for aggressive or hazardous process services. It is available in six sizes, with heat transfer areas in the range 0.7–320 m² (7–3450 sq ft). The heat transfer area is made up of a pack of corrugated plates welded alternately to form the media channels. The plate pack is supported by an upper and lower head and four side panels, which accommodate the connections. The fully welded plate pack extends design limits and provides improved reliability. Because there are no inter-plate gaskets, compatibility concerns are eliminated, and maintenance and operating costs are reduced. Access for inspection and cleaning is fast and easy.

Plate materials

- 316L, 304L, 317L, 904L, 254 SMO and AL6XN stainless steels
- Titanium, Pd-stabilized titanium
- C-2000, C-276, C-22 and B3 alloy.

Specifications

Design pressure:	min. vacuum/max. 35 barg (500 psig)
Design temperature:	min. –30°C/max. 350°C (-20/660°F)
Connections:	PED and ASME (with or without U-stamp)

PPI00025EN 0610