

Freshwater generation technology delivers energy efficiency

Equipment manufacturers continue to drive down power consumption

by Clive Woodbridge

ONE of the key requirements of cruise ship operators with regard to onboard freshwater generation in recent years has been to achieve significantly lower levels of power consumption. There are, however, differing views among manufacturers about the kind of technology that can best achieve this goal, with suppliers of both conventional evaporator and reverse osmosis solutions staking their claims.

Alfa Laval is one of the leaders in the marine desalination sector and has supplied its multi-effect plate (MEP) evaporators to a number of the biggest cruise ships afloat. These are now said to be achieving very low rates of electrical power consumption when producing fresh water on board.

The company has equipped both *Quantum of the Seas* and *Anthem of the Seas*, delivered in 2014 and 2015 respectively, with freshwater generation plant. These two 4,100 passenger capacity vessels are reported to be achieving power consumption of between 2.3 kWh and 2.94 kWh per cubic metre for fresh water, depending on the seawater temperature.

Alex Jönsson, Alfa Laval regional business manager for freshwater generators in the marine and diesel sector, says: "The freshwater plant on board these two new cruise ships has the lowest power consumption of any desalination plant currently in service. However, they will only hold the record until next year, when *Carnival Vista* will start sailing. Its plant will only consume between 2.26 kWh and 2.69 kWh per cubic metre when producing fresh water."



Two Alfa Laval high efficiency evaporators, type MEP-6-900, have been installed on board Norwegian Breakaway. These are each capable of producing 900m³ per day

These low levels of energy consumption reflect Alfa Laval's ongoing commitment to research and development, which has enabled the company to develop solutions whose performance is now being validated in the field.

Making optimum use of surplus heat is one of the keys to Alfa Laval's success in this field. Mr Jönsson explains: "We consider surplus heat as a resource, not as waste, and something that has to be utilised in the best and most economical way. One example is the way in which we have enhanced our MEP evaporators with feed water pre-heaters to lower thermal power consumption."

This technology is not new and Alfa Laval says it has been offering such pre-heaters to the market for many years. "Initially there was little enthusiasm but now shipyards are keen and ask how many pre-heaters can be included in the evaporator design," says Mr Jönsson.

Typical specifications being set out at the cruise ship design stage tell the story of evolving customer requirements and an enhanced focus on energy saving. Mr Jönsson says: "10 years ago cruise ship specifications tended to call for evaporators with a specific heat consumption of 190 kWh per cubic metre. In 2010 the specifications started to call for 147 kWh and today we are seeing specifications for specific heat consumption of 135 kWh. We can meet such specifications thanks to

our energy efficient MEP design and the fact that we incorporate a certain number of pre-heaters."

Mr Jönsson also points out that the Alfa Laval evaporators for cruise ships have been able to demonstrate efficient and reliable part load operations. "Most of the time you think that when a ship slows down its freshwater generating capacity will also be reduced accordingly," he says. "However, we have seen the opposite trend with a cruise ship on which we have recently installed freshwater generators. When water temperature increased by 4°C, the MEP evaporators' freshwater capacity increased by a remarkable 20 per cent."

Over the past year the company has received MEP evaporator orders for the third Quantum class liner, *Ovation of the Seas*, the 600 passenger capacity *Seabourn Encore* and the fourth vessel in the Oasis class series. The company indicates that it is also anticipating a number of further orders from repeat clients before the end of 2015.

The German manufacturer Triton-Evac also puts energy savings at the top of its agenda, but is pursuing this goal through the development and marketing of reverse osmosis (RO) based technology. Managing director Ljubo Jurisevic says: "When it comes to freshwater generation systems there is a trend in the market towards two-stage RO plant. The main reason is that evaporators have a higher electrical consumption than RO equipment, which

freshwater generation

also has a smaller footprint and is easier to install and operate."

Triton-Evac's RO plant is available in systems generating from 30m³ per day up to 1,200m³ a day and further enhancements to the range are planned. Mr Jurisevic says: "We are working on a standardised RO plant with a modular construction that can be used for small amounts of freshwater generation. With this new product line we will be responding to a growing requirement from the market that even relatively small ships should be able to benefit from RO technology."

Over the past year Triton-Evac has been particularly successful in the retrofit market, for customers including Royal Caribbean Cruises and Carnival Cruise Lines, involving the installation of RO plant generating from 200m³ to 600m³ per day. One of the most challenging projects was the retrofit of a 600m³ per day RO plant to replace an existing 200m³ per day unit on a Carnival vessel in 2014.

Triton-Evac project manager Georg Schumacher says: "This installation took place during a cruise and our installation team had to carry the plant through a small door that led to the engine room and which was only 800mm wide. This challenge could only be met because the Triton-Evac RO plant was tailor made and adapted to conditions onsite. The plant is modular and allowed individual sections to be carried through the door and put together afterwards."

The company has also been working on newbuildings for TUI Cruises and has installed water treatment solutions on *Mein Schiff 3*, *Mein Schiff 4* and *Mein Schiff 5*. In these cases the company supplied systems for bunker water,

service chlorination and potable water distribution, which are all handled through a single process control system. Triton-Evac engineers were able to meet the customer's requirement for integrating these systems by creating an interlinked network controlled by a powerful industrial computer.

Another marine freshwater systems supplier, Salt Separation Services, similarly claims that cruise lines are specifying RO more often, compared with thermal desalination technology based on the use of evaporators. "More customers and equipment specifiers now have a greater understanding of RO as a desalination technology and the specifics of different energy consumption and pumping technologies," says director Daniel Shackleton. "There is also a tendency to want improved water quality, which sometimes requires the use of two-pass RO systems."

The British company has recently delivered its biggest ever export contract awarded by the German shipbuilder Meyer Werft for the design, manufacture and commissioning of RO plant for three new 4,200 passenger capacity cruise ships. Each of these vessels will be fitted with three of Salt Separation Services' RO plant, each capable of producing 800m³ per day of desalinated fresh water from sea water.

The solution developed by Salt Separation Services for this customer includes two-pass technology to produce RO permeate to a very high quality. The systems will also feature isobaric energy recovery technology which will significantly reduce the power requirement of the RO plant on board these ships.



Triton-Evac retrofitted a reverse osmosis plant on a Carnival cruise ship

Mr Shackleton says: "These will be among the most energy efficient RO plant on board a passenger ship and will give improved water quality of less than 30mg per litre of chlorides. We have also worked with the client to deliver a small footprint, enhanced nozzle positions and improved maintenance characteristics."

Another notable passenger vessel project for Salt Separation Services has involved upgrading equipment on board the P&O Cruises ship *Oriana*. The existing 250m³ per day RO plant was upgraded to 400m³ per day by adding new membrane areas and using an isobaric energy recovery device. Reduced energy consumption has been an added benefit of the investment to increase capacity. Indeed, Salt Separation Services reports that the plant is operating at about 3 kWh per cubic metre since the upgrade, compared with around 6 kWh per cubic metre before. **PST**



Salt Separation Services has completed its biggest cruise ship contract to date, delivering reverse osmosis plant capable of producing 800m³ per day