Lets talk about Industrial Ammonia Heat Pumps

Superior Energy Efficiency with Alfa Laval Plate heat exchangers
Low value heat sources
- Reason for using Heat Pumps

Why Heat Pumps?

*Industrial Heat pumps makes it possible to use waste or natural low temperature heat for space or industrial process heating.*

Typical heat sources are sea water, ground water or waste heat from industries, refrigeration plants and data centers mainly used for:

**Industrial Process**
They are connected to dehumidification, distillation and evaporation processes, but also for water heating and combined heating and cooling.

**District heating**
Heat pumps are successfully connected to district heating systems or in combined district heating and cooling systems.

**Commercial buildings**
Heat pumps are connected to water loops (hydronic) for heat and cold distribution.
Why Ammonia

- Highly efficient future proof refrigerant

Why Ammonia:
• GWP=0
• ODP=0
• High volumetric capacity
• More effective and cheaper than synthetic alternatives
• Lowest total lifetime cost
• Known for centuries as a refrigerant and will stay

Remember:
• Classified as Fluid Group 1 in PED (toxic, corrosive, and moderately flammable), so special legal requirements may apply
• No ATEX requirements for normal ammonia plants except for machine-room ventilation in special cases
• Copper and its alloys are not allowed as material
• Oil draining required
Industrial Heat Pump-example of application
- Recovering waste heat from a datacentre feeding a district heating network

While being cooled, a data centre serves as low temperature ~30 °C heat source for an industrial ammonia heat pump
Heat Pump Impact – How Alfa Laval semi welded plate heat exchanger increases the COP
Efficiency (COP) of the Heatpump

Heat source - low value heat

Ammonia Separator

Compressor

Valve

Electricity

Condenser

Flooded ammonia evaporator

Heating supply

Efficiency of the heat pump = COP
Coefficient of performance

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\text{COP} = \frac{\text{Heat Energy supplied (kW)}}{\text{Electricity Power Consumed (kW)}}
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In general it is possible to obtain 2K closer approach than with other heat exchanger technologies at comparable size and cost

- every K higher Tevap (evaporation temperature) saves 3-6% of the heat pump power consumption.
Condenser with integrated Subcooling
- SWPHE with Subcoolcondense™ is compact and efficient
T10 EW Condenser with integrated Subcooling
- Enables high energy efficiency and a compact installation

Subcoolcondense™

- T10- EW with this feature allows Condensing, Desuperheating, and Subcooling in same plate heat exchanger with the benefits of:
  - Enabling high efficiency (COP) of the Heat Pump
  - Avoiding the use multiple heat exchangers on hot side
New features to increase efficiency

**CurveFlow™ distribution area**
- Fully utilizes available surface area.
- Provides perfect distribution inside channel for best heat transfer and surface stays cleaner.

**OmegaPort™ noncircular port holes**
- Better distribution of media
- Pressure drop better utilized for heat transfer.
References
District heating - heat recovered from sea and wastewater

– Joint venture of HOFOR, CTR and VEKS for Copenhagen City

Inaugurated in April 2019
5 MW full scale ammonia heat pump test
Servicing 1100 households
Heat sources: seawater and wastewater
Power source: wind mills at sea
COP = 3.2

Alfa Laval supplied:

- Flooded Ammonia Evaporators for heat recovery from sea-/wastewater 4°C → 0.5°C: Alfa Laval semi-welded TK20-BWFG
- Condensers delivering hot water from 50°C → 80°C: Alfa Laval semi-welded MK15-BWFT and Alfa Laval semi-welded TK20-BWFX
- Sub-cooling duties: Alfa Laval ANH76 and Alfa Laval ANXP52

Environmental friendly District Heating from sea and sewage water with clean electricity
District heating in Broager DK
4 MW Ground water heat pump started operation end 2016

End User: Broager District heating company
System builder: ICS - Industrial Cooling system a/s   Consultant: PlanEnergi
Purpose: Using 250 m deep ground water at 9 °C as heat source delivering district heating supply of hot water at 70 °C. The total capacity of 4 MW covers approximately ¾ of the heating need for Broager or about 18,000 MWh/year.
Refrigerant: Ammonia
Alfa Laval supplied: Semi Welded Plate Heat exchangers as evaporators cooling/recovering the ground water heat from 9° C to 2° C  evaporating ammonia of the heat pump at 0° C
COP Heat pump = 4,1
Semi Welded Plate Heat Exchangers
- For Ammonia Heat pumps

Major benefits
- High efficiency.
- Space saving
- Minimizes Ammonia charge
- Reliable operation