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Lets talk about...

## Flooded Evaporation

How to build an efficient flooded ammonia system with a semi-welded Alfa Laval unit, and a liquid separator

**October 15th , 2020**



# Energy efficiency

# Energy efficiency

– Reason for using Ammonia



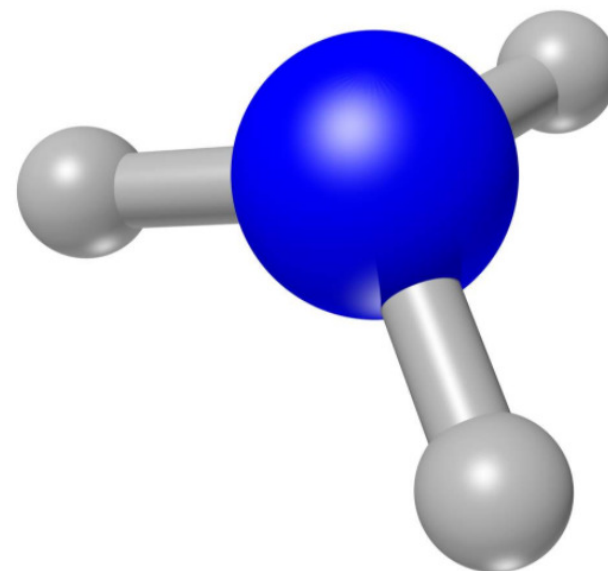
## Why Ammonia?

Main benefits using ammonia as a refrigerant are:

- Unique thermal properties – very efficient
- Stable physical properties
- 100% environmentally correct
  - low GWP (Global Warming Potential) low
  - ODP (Ozone Depletion Potential)
  - ZERO impact
- Easy to handle
- Low cost
- Inbuilt detection – self alarming

Some disadvantages though:

- Toxicity
- Fear, caused by misinformation and rarely related to the use as a refrigerant



# Energy efficiency

– Reason for using Semi-Welded technology



NH<sub>3</sub>

## Why Alfa Laval Semi-Welded technology?

Main benefits using SWPHE's as a heat exchanger are:

- Very high heat transfer efficiency. Close approach<sup>\*)</sup> is possible to reach, 2K or less in evaporators, 0K or less in condensers
- Forgiving construction, the gaskets will take the forces
- High fatigue resistance
- Freezing causes no damages
- As we brought the technology to the market already in the last century, we have a long experience in ammonia applications. Market standard since the mid 1990's



<sup>\*)</sup> Difference between e.g. the evaporating temperature and the leaving cooled water temperature or the difference between the condensing temperature and the leaving heated water temperature.



# Flooded evaporation

# Flooded evaporation

– Reason for using flooded evaporation



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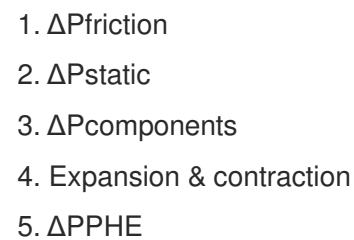
## Why Flooded Evaporation?

Main benefits using flooded evaporation are:

- A simple system using the laws of physics - laws of nature
- A constant wet surface will enhance the efficiency in the evaporator
- It will allow close approach - less compressor power needed
- Just a few control devices are needed if the condenser is water cooled
- If used in a well-designed thermosyphon system, the waste energy can be eliminated



- The thermosyphon system



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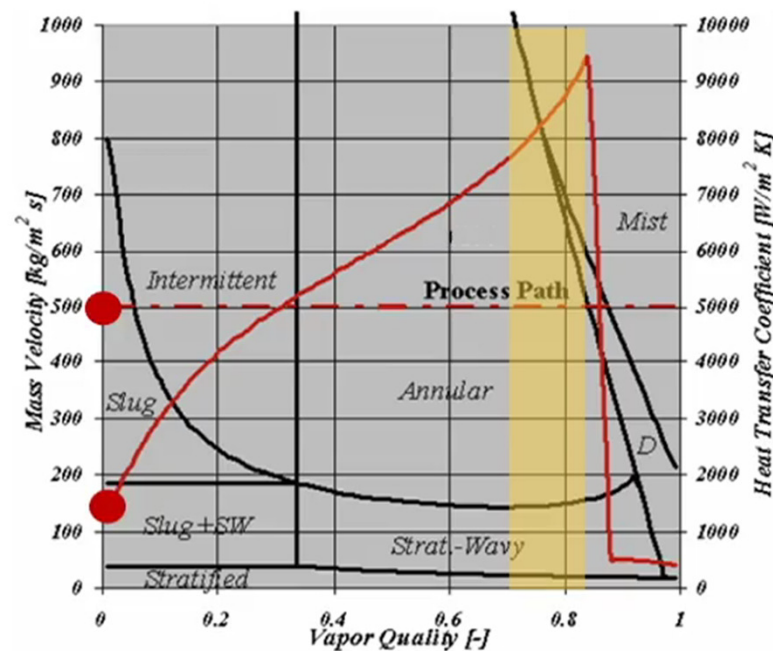
# Flooded evaporation

– Optimum heat transfer



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- Adopt outlet vapour fraction for optimum heat transfer
  - Minimum pressure drop in wet return line => high outlet vapour quality
  - Vapour quality 0.7 to 0.85 => CR 1.2 to 1.4
- Highest  $T_{\text{evap}}$  possible
- Optimum efficiency at all loads



Source: Prof. Thome, Wolverine engineering data book



# Flooded evaporation

– Design to avoid trouble with the performance...or maybe cause the trouble



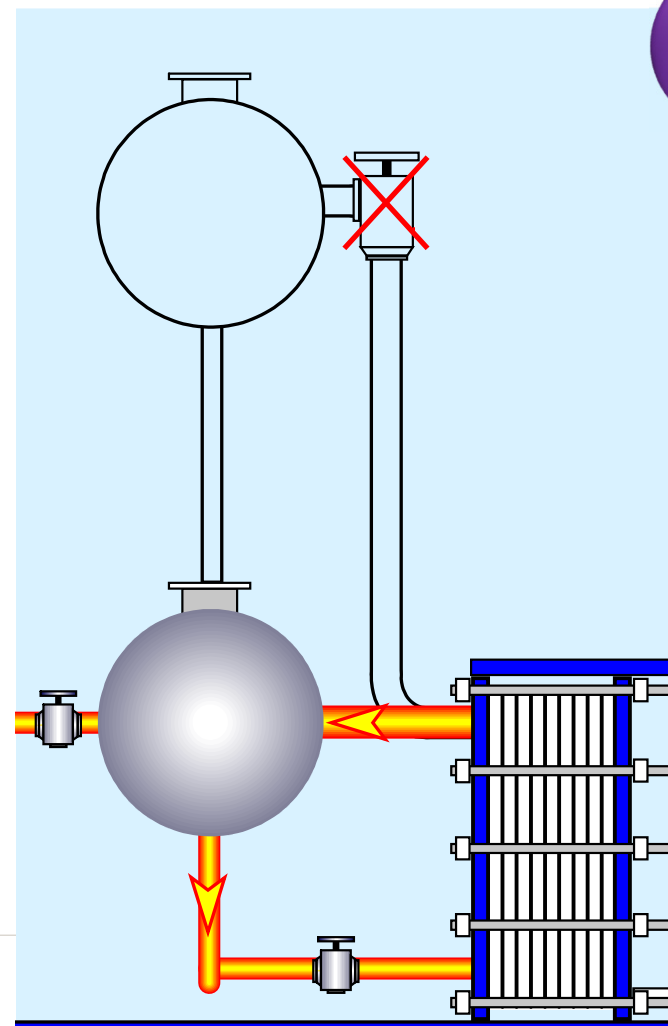
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**The separator should be placed as low as possible and with a return leg as short and straight as possible and preferably with no valves or other fittings:**

- ▶ The pre-heating zone will be shorter, which means an increase of the MTD. This is especially pronounced the lower the temperature is.
- ▶ The driving head does not need to produce a lift of the liquid in the return leg.
- ▶ The separator must not be placed that low that the circulation is affected. Driving force?
- ▶ An evaporator with a horizontal exit to the separator, will have excellent part load properties.
- ▶ An elevated separator will have a very large return leg pressure drop, i.e. a large difference between the evaporator and separator temperatures.
- ▶ Keep the separator design as simple as possible. Avoid extra baffles, distributors, guide vans, etc.
- ▶ The danger of backflow and hunting is diminished.

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# Flooded evaporation with Alfa Laval U-turn

– Termosyphon system in the Alfa Laval way



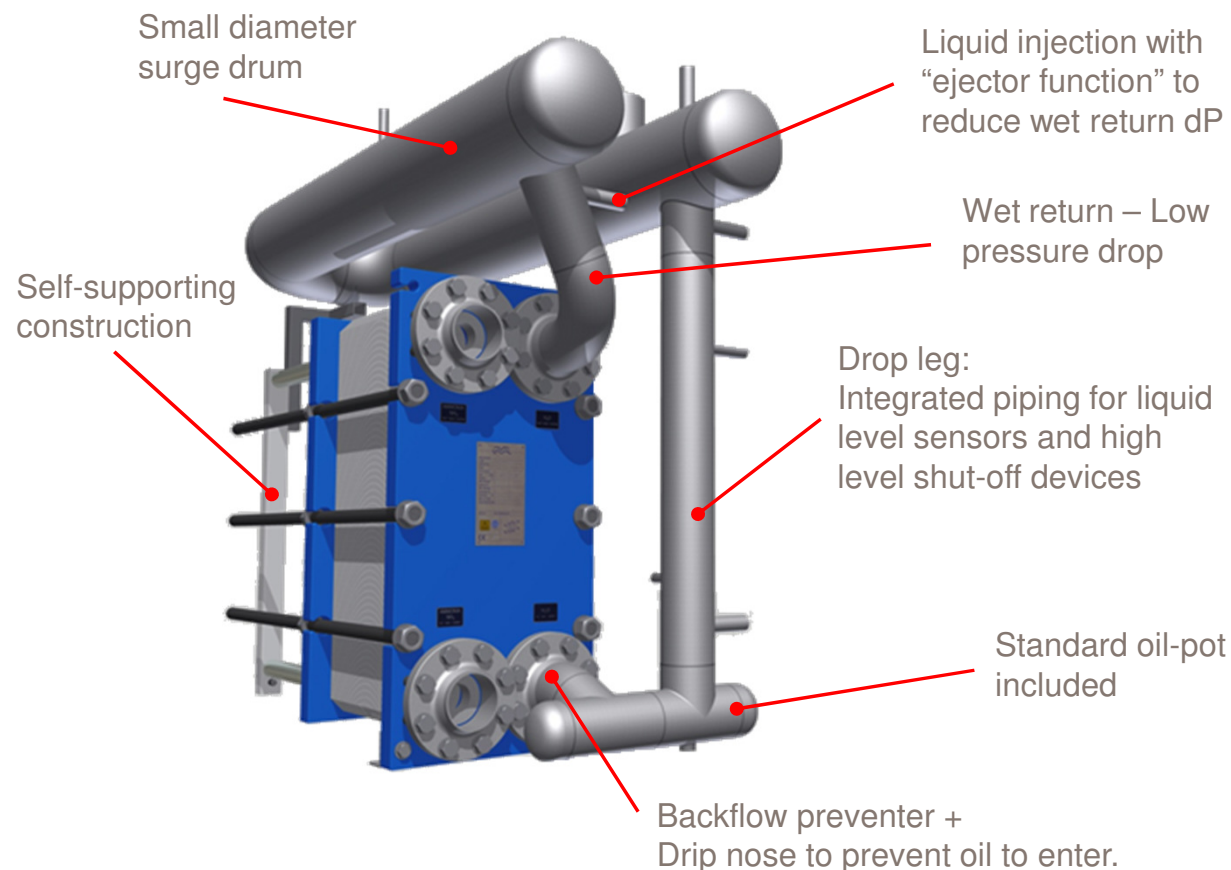
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## Advantages

- Very energy efficient
- Very high separation efficiency
- Low charge in the evaporator part of the system
- Low weight
- Compact, compared to traditional separators
- “Plug’n’play”

## Disadvantages

- Very small volume for liquid hold up



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# Reliable R717 Heat Exchangers

– Available as standard from our factory in Lund Sweden



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Industry can increasingly benefit the advantages of this kind of system for industrial refrigeration with:

- **A no global warming refrigerant, R-717**
- **High energy efficiency**
- **High reliability**
- **High safety**
- **Future safe**



THANK YOU FOR LISTEN IN!



Ready to go...



...any questions?

