

Improved Efficiency Chiller/AC System Comprising of Desuperheater and Air Pre-Cooler

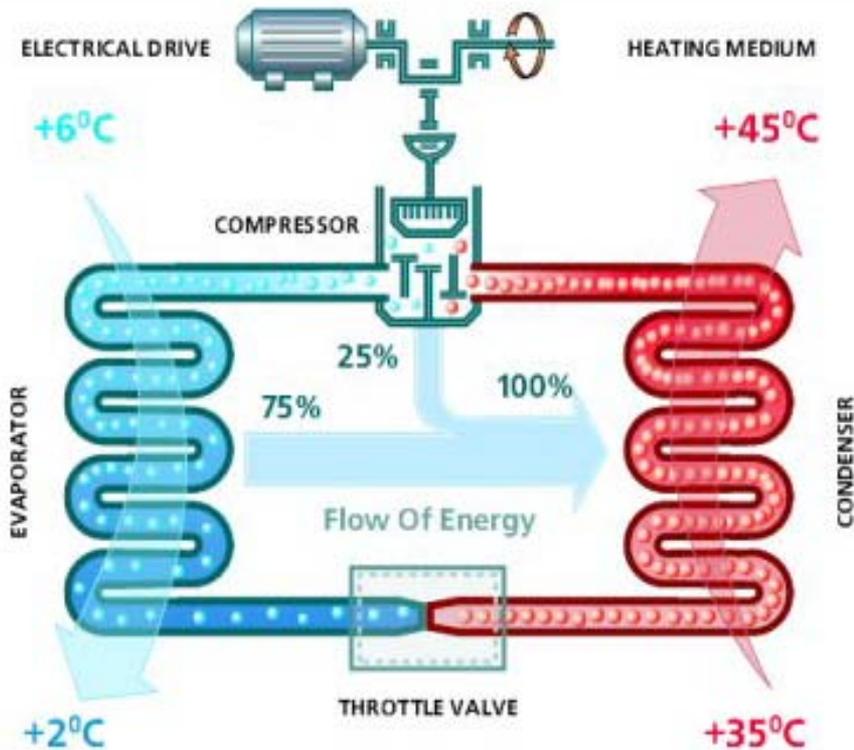
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Conventional Refrigeration Cycle



Basic Components:

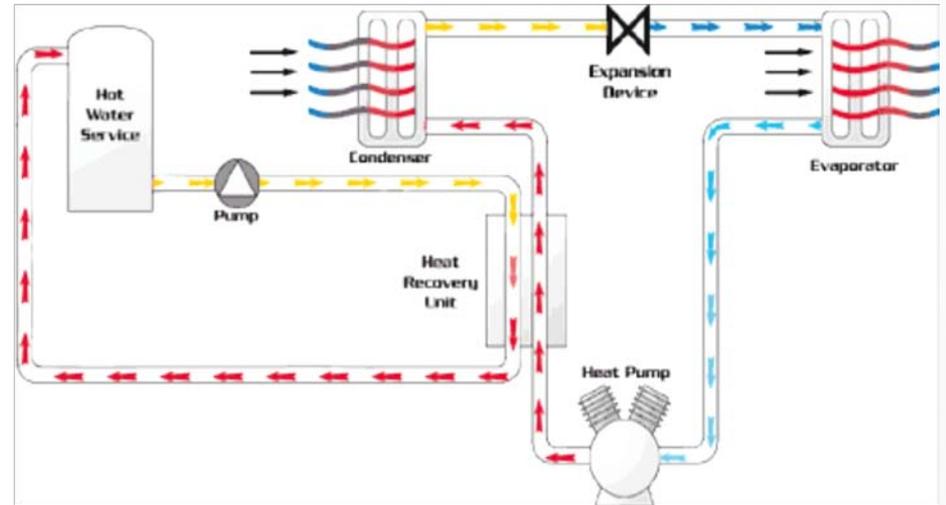
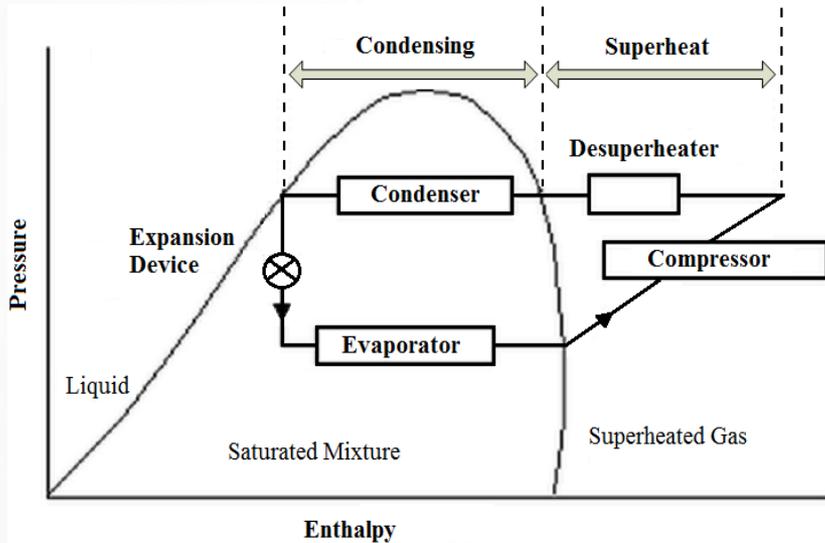
- Compressor
- Condenser
- Throttle valve
- Evaporator

Two modifications to the condensers on the existing system: Desuperheater and Air Pre-cooler

1. Desuperheater: To obtain hot water from the system
2. Air Pre-Cooler: To increase condenser cooling and thus the system efficiency

* These modifications are external attachments and could be implemented together or individually

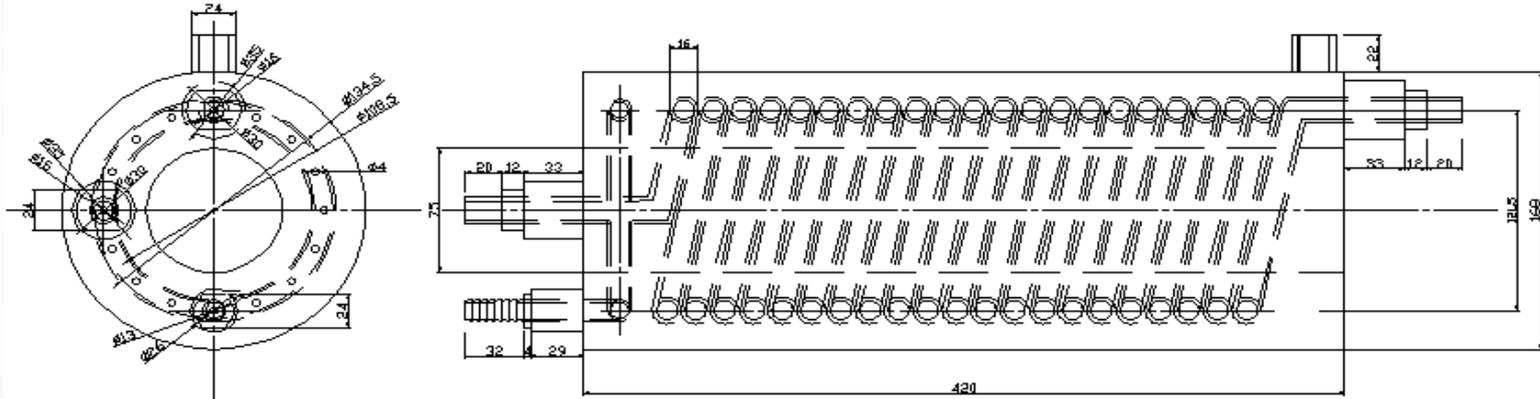
Desuperheater



- Scope of heat recovery
- Actual heat recovery

•Type of Heat Exchanger: "Cross flow type Shell and Coil".

Desuperheater used in our experiment (For a 1.5 ton split AC unit)

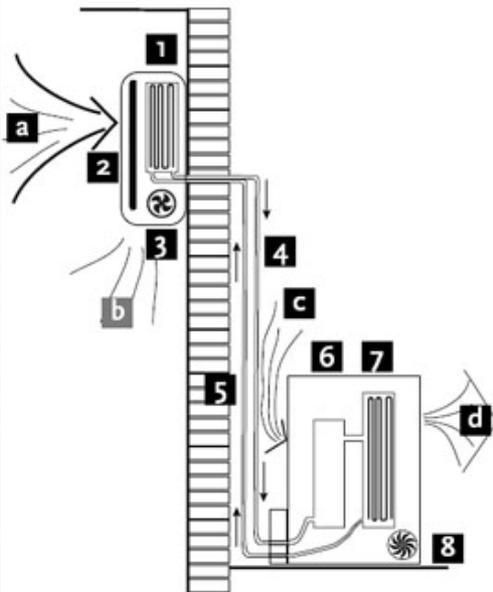


Desuperheater in the final assembly

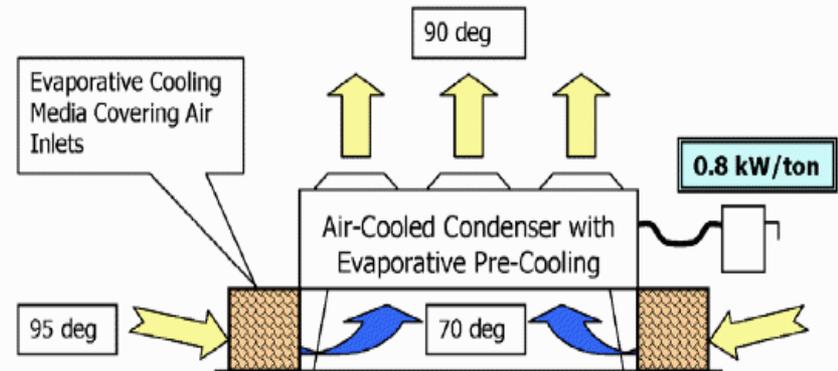
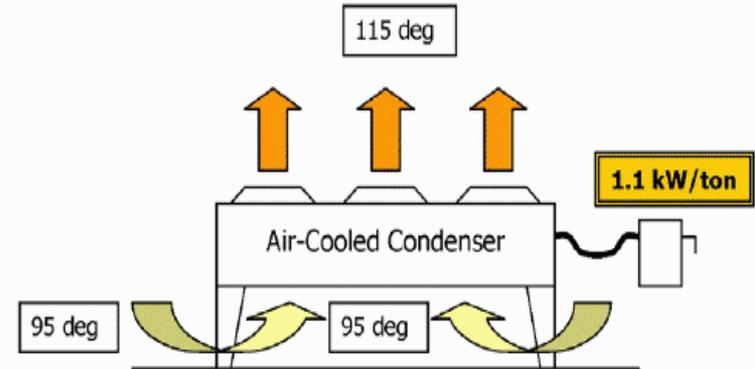


Air Pre-Cooler

What is Pre-Cooler?
Need for Pre-Cooler
Advantages.....

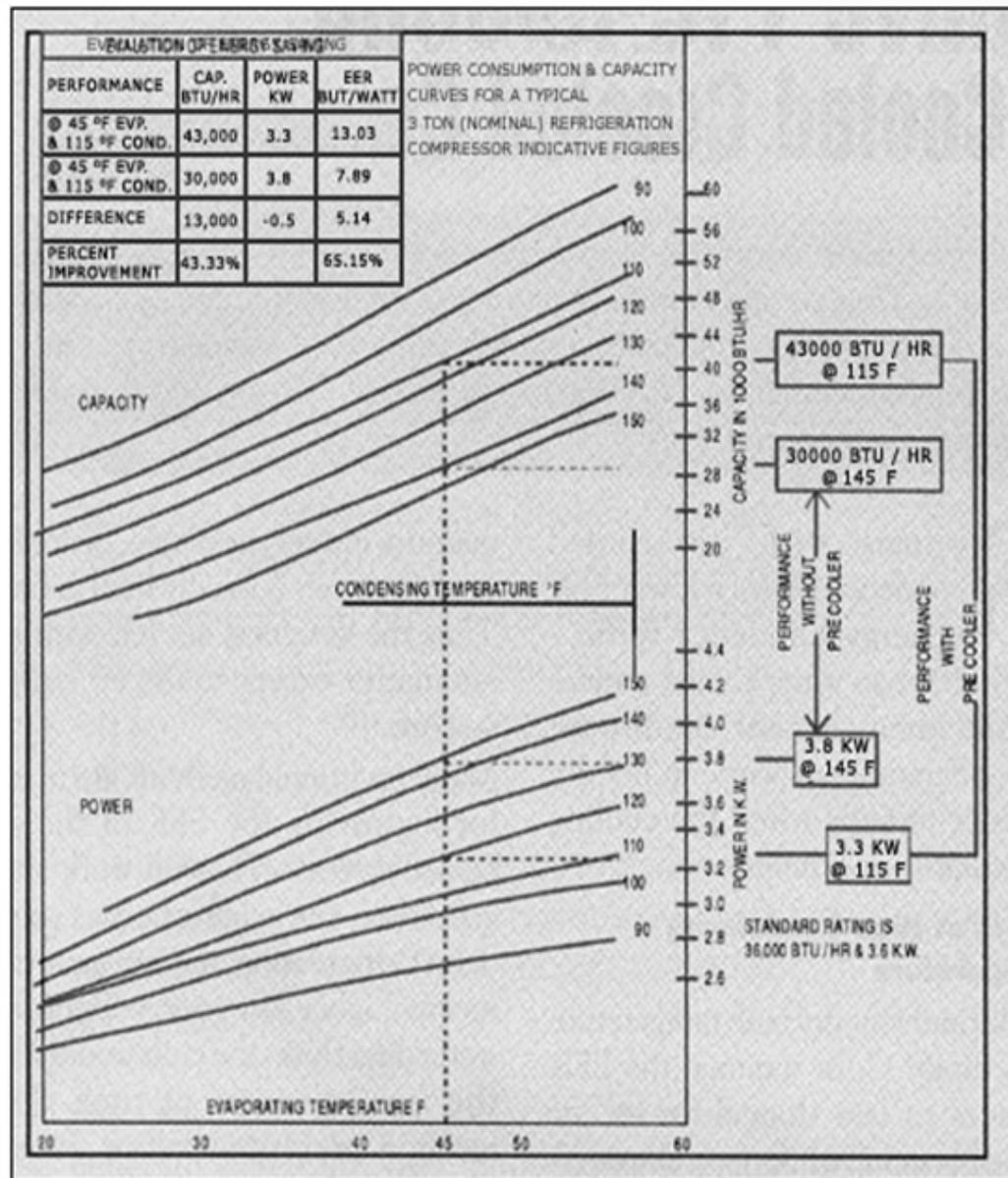


- | | |
|---------------|----------------|
| 1. Evaporator | 5. Liquid line |
| 2. Filter | 6. Compressor |
| 3. Fan | 7. Condenser |
| 4. Gas line | 8. Fan |



Energy Savings and Demand Reduction Using Evaporative Pre-Cooling

Evaluation of energy savings with decrease in condensing air temperature



Air Pre-Cooler (partly manufactured)



The 1.5 ton split AC system before modification



Desuperheater and Air Pre-Cooler assembled to the AC



Desuperheater- Cost / Payback

- Manufacturing cost per ton (approx.):
 - Industrial applications: \$120 to \$150/ton
 - Domestic applications: \$200 to \$220/ton
- Water flow rates (approx.):
 - Industrial applications: 1 to 3 gal/hr-ton
 - Domestic applications: 5 to 8 gal/hr-ton
- Hot water temperature available: 140°F (max.)
- Payback period: 0.5 to 3 years

Air Pre-Cooler- Cost / Payback

- Manufacturing cost: \$150
(For 1.5 ton experimental unit)
- Reduction in condensing air temperature: 7°C
- Thumb rule:
1°C reduction → 3% decrease in compressor load
- Efficiency increase made possible $\geq 7\%$
- Payback period ≈ 6 months

Recent recommendations from OSU- IAC

- Recommended in 2 plants in last 8 months.
- Recently recommended at food plant with chiller capacity 2,240 tons
- Savings of 11% made possible only from desuperheater
- Food processing plants most common recommendation due to simultaneous requirement of hot water

Recent recommendations from OSU- IAC (contd....)

- Meat processing plant
- Implemented desuperheater on 1400 tons
- Plant required steam for processes
- Hot water from desuperheater was used as pre-heated water for the steam boiler
- Savings made from desuperheater were 5.5% of total plant energy consumption

Data collection during the plant audit

Desuperheater:

- Tonnage for individual air chiller/AC units
- Hot water requirements (quantity, temperature)

Air Pre-Cooler:

- Tonnage for individual chiller/AC units
- Condenser air suction dimensions
- EER value

Concerns with actual implementation

- Buyers refrain from making modifications to existing/standard systems
- Both systems need plumbing/piping modifications which is a concern with many
- Desuperheater is a commercially available product but is not popular due to above reasons
- Air Pre-Cooler is not a commonly available commercial product. However, it can be easily designed and manufactured to suit the application

Economic Feasibility

- Good payback in applications where there is a simultaneous use of chillers and hot water
- Energy consumption for production of domestic hot water:
 - 4% in non residential buildings
 - Up to 30% in buildings like hotels, hospitals, etc.
- Savings depend on heating source that will be actually replaced

References

- <http://www.ishrae.in/journals/1998oct/article06.html>
- http://www.alabamapower.com/energy_knowhow/desuperheaters.asp

THANK YOU...!