



Tecumseh Products Company

Innovative Hydrocarbon Solutions
Beer Cooler Application

Beer Cooler - Case Study

SYSTEM

- Refrigerant R134a
- Refrigerant Charge 320g
- Capillary Tube (D=1.93mm, L=1.4m)

EVAPORATOR

- Copper coil immersed in water
- D = ½ in
- L = 13.2m
- Agitator (propeller)

CONDENSER

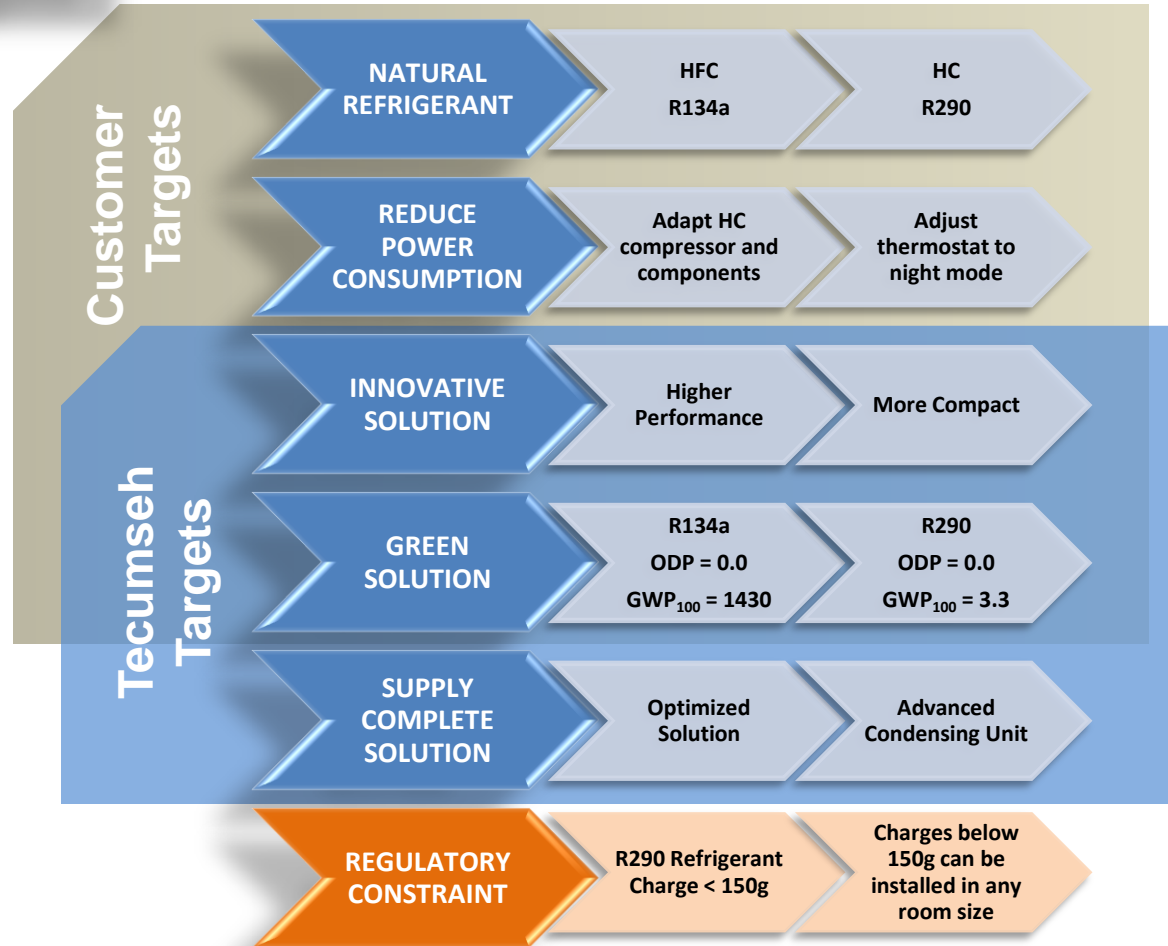
- Tube (Cu) and Fin (Al)
- Fan (forced convection)

COMPRESSOR

- Reciprocating Compressor
- Tecumseh CAJ4461Y (AE²4460U)



Advantages / Targets



Evaluation Criteria

Original system (R134a) Results

TIME
60min

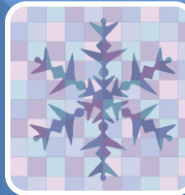
COOLING CAPACITY
1122W
(3832 BTU/h)

Condensing Unit
CONSUMPTION
7903 Wh/day



PULL DOWN

- Time to Water Temperature Reduction
- From 25C (77F) to 3C (37F)
- Time is measured



CONTINUOUS RUNNING

- Electric heater keeps $T_{\text{water}} = 3\text{C}$ (37F)
- Capacity & Power are Measured



NORMAL CYCLING

- Thermostat Set Temperature: $T_{\text{water}} = 3\text{C}$ (37F)
- Electrical Heater in the water (580W)
- Consumption is measured

Evolution of the Conversion

| | Original | Intermediate 1 | Intermediate 2 | Final |
|------------------------------|-------------|-----------------------|-----------------------|-----------------------|
| Compressor | CAJ4461Y | AE ² 4460U | AE ² 4460U | AE ² 4460U |
| Refrigerant | 134a | R290 | R290 | R290 |
| Refrigerant Charge [g] | 320 | 189 | 149 | 148 |
| Condenser | Finned Tube | Finned Tube | Finned Tube | Micro Channel |
| Capillary Tube Diameter [mm] | 1.4 | 1.2 | 1.2 | 1.2 |
| Capillary Tube Length [cm] | 193 | 220 | 190 | 190 |

CONTINUOUS RUNNING TEST
 * T_{WATER} kept at 3C (37F) by the heater

| | | | |
|---------------------------------|------|------|------|
| Cooling Capacity [W] | 1122 | +16% | 1298 |
| Condensing Unit Power Input [W] | 615 | 612 | 574 |
| COP [W/W] | 1.8 | +33% | 2.4 |

PULL DOWNTTEST
 * T_{WATER} reduced from 25C (77F) to 3C (37F)

| | | | |
|------------|----|------|----|
| Time [min] | 60 | -13% | 52 |
|------------|----|------|----|

Evolution of the Conversion

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CYCLE RUNNING TEST
 - Water Temperature Set Point 3C (37F)
 - Electrical Heater in the Water (580W)
 - Ambient Temperature 25C (77F)

| | | | | |
|--------------------------------------|------|---|------|------|
| Gas Return Temperature [C] | 25.6 | - | 21.3 | 19.8 |
| Running Time [%] | 57.5 | - | 54.6 | 50.7 |
| Condensing Unit Consumption [Wh/day] | 7903 | | 6129 | |
| TOTAL Consumption [Wh/day] | 8521 | - | 7825 | 6133 |



- A significant reduction of 22% of System Energy Consumption was achieved using HC (R290) refrigerant.
- Green Solutions can improve System Performance (+16% in this case).
- Charge reduction and more efficient compressor allowed for a more compact system solution.
- The maximum limit of 150g of R290 Refrigerant Charge was achieved, in addition to a COP increase of 33%.
- Tecumseh application expertise and certified labs, applied in close collaboration with customer engineers, enabled a winning solution.



Thank you!