

RS50 Performance Test in Water Source Heat Pump

Results

The results showed a significant increase in efficiency by the use of RS50 (R442a) as compared with the use of R404a. The capacity of the compressor when using the two gases did not change significantly.

	Capacity (kW)		
	404A	442A	% Increase
Heating	89.64	86.4	-4%
Cooling	70.34	70.7	1%

	COP		
	404A	442A	% Increase
Heating	4.64	5.51	19%
Cooling	3.64	4.51	24%

On the particular heat pump tested, the 19% COP increase will translate to an energy savings of about 23,000kWh/year (about \$2100 per year in 2015 electrical energy costs in Nova Scotia industrial facility).

Situation Appraisal

Aqua Production Systems (APS) has been supplying chillers and heat pumps for fish farms that have had unparalleled efficiency ratings. Tests have consistently given a COP of 4.0 to 4.8 with R22 and similar gases even when chilling fluids near zero degrees Celsius. Given the phase out of R22, APS is searching for an alternative that would keep its efficiency with reduced global warming potential. RS50 (R442a) has surfaced as a possible solution given that others have found between 10% and 40% greater efficiencies in various applications.

Test Method

A water-to-water heat pump was built for a fish farm customer in Advocate Harbour, NS. The customer desires to heat well water to 12°C year round. However, their wells dip down to 2°C during winter months. The test was performed in April 2015 when well water was 2.0°C. Effluent from the facility is used as a heat source by pumping it through the heat pump evaporator. The new water entering the building is pumped through the heat pump condenser. The condenser and evaporator are both shell

and tube titanium exchangers with PVC shells. Refrigerant flows through the tubes and process water through the shell.

There is a heat recovery system in place as well which pre-heats the water entering the facility. During the test heat source water entered the evaporator at about 3.5°C and exited at about 1°C. Water entered the condenser at 4°C and exited at about 5.5°C.

Once the heat pump was operating, the following parameters were measured:

1. Flow rate in L/s
2. Temperature entering the condenser in degrees Celsius
3. Temperature exiting the condenser in degrees Celsius
4. Heat pump electrical energy in kilowatts
5. Heat pump electrical current in amperes
6. Heat pump head pressure psig
7. Heat pump suction pressure in psig

Using the data gathered, the COP and heat pump capacity were calculated.

R404a data was gathered from the compressor manufacturer, Emerson Climate Technologies, who produce a performance table for the compressor in question – a Copeland 4DJ3R28ME-TSE. Using the evaporator and condenser process fluid temperatures, the performance table can be used to predict the actual performance of the compressor with accuracy. Past predictions have shown to be within 3% of the published data.

RS50 Efficiency Test Partners

The following companies supported the efficiency test and made it possible:

1. Aqua Production Systems supplied test equipment and analysis of data.
2. Hatt Refrigeration developed and built the heat pump technology and was present for the test.
3. CanAqua Seafoods is the owner of the heat pump and the facility in which they operate.
4. Refrigerant Solutions provided the RS50 for the heat pump.

For more information, contact the author.

Philip Nickerson, P.Eng.
President, Aqua Production Systems
Ph: 902-746-3855
Email: philipnickerson@gmail.com