

ASHRAE Ottawa Valley Chapter

Chapter Meeting #3 – 19 November 2019

Meeting Date:	19 November 2019
Location:	Centurion Conference & Event Center, 170 Colonnade Rd, Ottawa, ON
Attendance:	Total: 53
	Members: 31 Guests: 16 Students: 6
Theme:	Research Promotion and Donor Recognition
Tour:	None
Tech Session:	Cooling Systems 101 by Joel Primeau
Table Top:	LMP Systems
Program:	Transcritical CO2 Systems
Speakers:	Frederick Lavallee-Trubiano
Prepared by:	Ryan Dickinson

Tech Session (16:30 – 17:30)

Social (17:30 – 18:30)

Business Session (18:30 – 18:50)

- President Aaron Dobson called the meeting to order.
- Aaron introduced the Executive, Board of Governors and Chapter Chairs and Volunteers.
- Secretary Ryan Dickinson introduced the guests for the evening.
- Andrew Brown, the membership promotion chair, welcomed two new members to the Chapter.
- Elizabeth Primeau, Student Activities Chair talked about the upcoming Career Fair at Carleton University Fenn Lounge, March 10 from 3-6pm. It's expected to have a similar turn-out as last year, with 200 students and 15-17 booths; 10 booths are still available.
- Michael Callaghan, student activity committee, talked about the upcoming annual ASHRAE bowling tournament at the Merivale Bowling Lanes.
- Past President and Regional Vice Chair, Daniel Redmond, and Jacob Hough, presented the first place CTTC award for the 2018-2019 chapter competition to Daniel Roy of CIMA+ for the Giant Tiger, as well as first place for the New Commercial Buildings category in Region II.
- Adam Moons, President-Elect and Research Promotion Chair, talked about the reasons to invest in ASHRAE, and presented the major donor awards.
- There was one table top for the evening. Frederick Lavallee-Trubiano from LMP talked about his table top as a manufacturer of refrigerant systems, specializing in CO2.

Business Session Finished at 18:50

Dinner (18:50 – 20:00)

- Dinner was served at 18:50.
- Dinner was salad with chicken with vegetables and potatoes, with cake and coffee served for dessert.

Evening Program (20:00- 20:56)

- Evening program started at 20:00.
- Raffle tickets were sold to win two tickets to the Ottawa Senators vs. the Columbus Blue Jackets donated by Longhill Energy. A total of \$570 was raised for ASHRAE research. Evans Mutua was the lucky winner of the Senators tickets.
- President Aaron Dobson announced the program topic for the evening, Transcritical CO2 Refrigeration Systems, and introduced the speaker, Frederick Lavallee-Trubiano from Montreal. Frederick is the Director of Engineering at LMP systems.
- Frederick started off by talking about the regulations of refrigerants. The Montreal Protocol is phasing out refrigerants by 2020 and 2025, and the allowable limit on the global warming potential (GWP) will differ depending on the type of system installation. R404 has a GWP around 4000 and is being replaced with R448A and R449A with a GWP around 1000. R-410A has a GWP around 2000. R-134A has a GWP around 1500, and is being replaced with R513A with a GWP around 600. Natural refrigerants with a GWP of 1 or 2 include ammonia, propane and CO2. Ammonia is toxic, propane is flammable, and CO2 is high pressure, CO2 is a class A1 non-flammable non-toxic refrigerant.
- CO2 has a critical point of 87 degrees Fahrenheit. Above that point, it becomes transcritical, and the supercritical fluid is a foggy gas. Standard refrigerants operate around 400psi, while CO2 operates under 2 stages, with low pressure up to 600psi, and high pressure up to 1600psi.
- A typical CO2 schematic includes medium pressure compressors, a gas cooler/condenser, throttling valve, flash tank, flash gas by-pass valve, expansion valves, medium and low temperature evaporators, and low pressure compressors. On the P-h diagram, from points 1-2, CO2 passes through the medium pressure compressors where it becomes a supercritical fluid. From points 2-4, CO2 passes through the gas cooler at constant pressure, and from points 4-7, CO2 passes through the throttling valve to reduce the pressure where the fluid becomes part liquid and part gas. The flash gas by-pass valve takes all the gas back into the medium pressure compressors, while the subcooled liquid goes to the expansion valves and evaporators.
- The medium temperature CO2 evaporator operates between -4F (285psi) to 68F (830psi), and the low temperature CO2 evaporator operates between -58F (98psi) up to 5F (332psi). The maximum CO2 condensing temperature is 60F.
- On the gas cooler/condenser side, under subcritical conditions, the gas cooler return temperature is 70F (852psi) with an air temperature of 60F. As the outdoor air temperature rises above 80F, the CO2 becomes transcritical. The advantage of operating in the transcritical range is that the CO2 doesn't condense, so there's no latent heat, only sensible heat. This reduces the required temperature difference between the air and gas cooler return to 5F, which also reduces the size of the equipment. At an air temperature of 110F, the gas cooler return temperature is 115F (1513psi).
- Above 110F, there is a lot of capacity since the CO2 is not condensing and there is no phase change. Heat reclaim can use a heat exchanger between the gas cooler and

- medium temperature to increase efficiency.
- Another point that is particular with CO2 systems, is that since the temperature in the flash tank is around 30F, if the system stops running, heat will enter the flash tank from the surrounding mechanical room which may be around 70-80F. The CO2 liquid will start boiling and pressure will increase. To maintain the temperature and keep the pressure low in the flash tank, a small condensing unit connected to a backup generator is used to keep the liquid cool.
 - Ways of increasing the energy efficiency of the CO2 system include:
 - o Parallel compression using dedicated separate (auxiliary) compressors to remove the flash gas from the receiver tank instead of using the medium temperature compressors for this purpose. Advantages are that the parallel compressors work at a higher suction group up to 45F, while the other compressors work on the medium temperature suction group of 20F. This is more efficient in warm periods, and increases the efficiency by 15%. Disadvantages are more suction groups and VFD application is required for parallel compressors.
 - o Mechanical sub cooling uses another refrigerant, like propane or ammonia, which moves points 4-7 on the P-h diagram further to the left, resulting in more liquid to the flash tank and a very small amount of flash gas. Parallel compressors are not needed. This results in a 17% reduction in energy consumption, 35% improvement of the EER of compressors operating in transcritical mode, and a decrease in the number of refrigeration compressors dedicated to keeping the system in positive temperature mode.
 - o Ejectors may be used to replace the throttling valve and take CO2 from the medium temperature compressors and injects it into the parallel compressors, resulting in 10% in energy savings in transcritical phase. Parallel compressors and VFDs are also required.
 - Using two examples, Frederick demonstrated how transcritical CO2 systems are more efficient with higher EER values and lower peak energy consumption when compared to R404A systems.
 - Installation of transcritical CO2 systems consists of Type L and Type K copper, XHP 90 and XHP 130 copper-iron alloy, and schedule 40 or 80 stainless steel, depending on the pipe size and pressure. Fittings need high pressure CRN ratings, and all lines need to be insulated including liquid lines.
 - Stuart Parson, President of Parson Refrigeration, presented a case study on the Sysco Tannis facility in Ottawa, which consisted of 120,000SF of new refrigerated space. The system was originally intended to be ammonia, but a transcritical CO2 system was installed. The design included 6 racks, 4 on the freezer and 2 on the medium temperature side. The freezer has a penthouse style evaporator system, with sixteen 12.5 ton capacity air handlers, and the evaporators ducted down into the space.
 - President Aaron Dobson thanked Frederick Lavalley-Trubiano and reminded attendees of the survey which will be emailed. The next meeting is scheduled for Thursday January 23rd at the Centurion Conference and Event Center.

Meeting adjourned 20:56.

