Client Meeting Agenda

Topic: ME 476C Team Client Meeting

Monday 25, 2024
~6:00pm-6:30pm

Meeting called by: Janelle Peña

Attendees: Janelle, Courtney, Aaron, Steven, Maciej and Dr. Tom Acker

Please bring: Deliverables for Presentation 3, CAD Model,

5:30pm-5:35pm	Summary of Meetings with Acker	Room
5:35pm-5:45pm	Prototype Demo - Aaron and Maciej modeling with Wade, which materials we are using - Virtual model only ○ Water in front of an AC (PEX), heater core ○ CAD	
5:45pm-6:10pm	Steps for this week Questions -FMEA (Steven and Maciej) -QFD (Janelle) -Calculations Presentation 3 - Sizing Calculations (Janelle) - FMEA (Steven)-Factor of Safety - Latent Heat Calculations (Courtney) - IRR and NVP (Maciej) - Finite Difference (Aaron) - Buying Materials Field Trip to Room 244 for textbooks (Write out who and when they'll bring it back)	
6:10pm-6:15pm	Where are we in comparison? Are we behind? What do we need to do to catch up?	

<u>For Next Meeting:</u>

- Get the different models on a slide or in a CAD model to compare
- Wade stated how there is a building on campus that uses PCM (Email her)

Notes from Meeting:

PCM Room is on north campus; Green Fund Website
Send a follow up email to NREL
Lab that uses the PECKS Pipes
Heater Core, transient heat transfer analysis temperature probes, Yes we can use this Start working out details of how we are going to make this. Lots of simulations and modeling
Worlspo brand PEX (Can be pretty big)
PEX doesn't have great thermal conductivity
Don't focus on the finite details
What happens if something freezes that shouldn't freeze

We are the farthest group behind, Our analysis are going to tell us a lot
How much of cost is going towards prototype-
Best way to budget, less than 5% on prototype
Make sure Acker is aware of what we are doing and buying
Where are sensors going, wiring diagrams,

Analyzing an Actual Vapor-Compression Refrigeration Cycle

Reconsider the vapor-compression refrigeration cycle of Example 10.2, but include in the analysis that the compressor has an isentropic efficiency of 80%. Also, let the temperature of the liquid leaving the condenser be 30°C. Determine for the modified cycle **(a)** the compressor power, in kW, **(b)** the refrigeration capacity, in tons, **(c)** the coefficient of performance, and **(d)** the rates of exergy destruction within the compressor and expansion valve, in kW, for $T_0 = 299$ K (26°C).

SOLUTION

Known: A vapor-compression refrigeration cycle has an isentropic compressor efficiency of 80%.

Find: Determine the compressor power, in kW, the refrigeration capacity, in tons, the coefficient of performance, and the rates of exergy destruction within the compressor and expansion valve, in kW.

Schematic and Given Data:

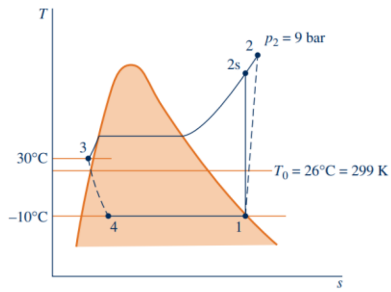


Fig. E10.3

Engineering Model:

1. Each component of the cycle is analyzed as a control volume at steady state.
2. There are no pressure drops through the evaporator and condenser.
3. The compressor operates adiabatically with an isentropic efficiency of 80%. The expansion through the valve is a throttling process.
4. Kinetic and potential energy effects are negligible.
5. Saturated vapor at −10°C enters the compressor, and liquid at 30°C leaves the condenser.
6. The environment temperature for calculating exergy is $T_0 = 299$ K (26°C).

Analysis: Let us begin by fixing the principal states. State 1 is the same as in Example 10.2, so $h_1 = 241.35$ kJ/kg and $s_1 = 0.9253$ kJ/kg · K.

Owing to the presence of irreversibilities during the adiabatic compression process, there is an increase in specific entropy from compressor inlet to exit. The state at the compressor exit, state 2, can be fixed using the isentropic compressor efficiency

$$\eta_c = \frac{(\dot{W}_c/\dot{m})_s}{\dot{W}_c/\dot{m}} = \frac{(h_{2s} - h_1)}{(h_2 - h_1)}$$

Material Properties	Heat of Fusion (kJ/kg)	Density (kg/m^3)	Specific Heat (kJ/kgC)	Thermal Conductivity (W/mK)
Paraffin	200	900	2.1	
Water	334	997	4.18	
Glass [1]		2700	0.84	0.78
Stainless Steel [1]		8010	0.5	7.7
Tin [1]		7304	0.226	64
Aluminum Mixed [1]		2659	0.867	137
Aluminum [1]		2707	0.896	204
Copper [1]		8954	0.383	386

Latent Heat	Material Volume Needed (m^3)	
Paraffin	0.3	
Water	0.162163136	

Sensible Heat	Specific heat (kJ/kgC)	Density (kg/m^3)	Temperature Change	Material Volume Needed (m^3)
Concrete	1.17	2400	20	0.961538462
Ethel Glycol	1.744	1110	20	1.394743367
Paraffin	2.1	900	20	1.428571429
Water	4.18	997	20	0.647876644

CRITERIA DESCRIPTION	Is it realizstic for the average home buyer, Pre-Build	How Hot/Cold will it make the house of the customer	How efficient is it	The expected compound annual rate of r eturn that will be earned on a	The difference between the present va lue of cash	Does it need monthly/yearly/Every 5 year maintance. Refills, Parts, Repairs, Ease of Access,	Saves Power because it doesn't use prime time power/How well does it ease the load off of the grid during peak time,	Is it realizstic for the average home buyer,pre-existing structure,	Does it explode, catch fire, freeze someones hand if touched	
	Cost Pre-Build	Comfort Level	Efficiency	Internal Rate of Return (IRR)	Net Present Value (NVP)	Ease of Maintenance	Power Saving/Grid Assistance	Cost pre-existing	Safety	WEIGHTED SCORE
WEIGHT	7	3	2	6	8	4	1	7	5	43
	16%	7%	5%	14%	19%	9%	2%	16%	12%	100%
OPTIONS										
Datum: Baltimore Air Coil- TSU-		5	5			4	3		4	1.488
Integrating into an AC cycle		4	5			6	3		6	1.837
Panel Placed Directly on AC		3	4			6	2		6	1.698
Material in Wall		3	4			5	3		6	1.628

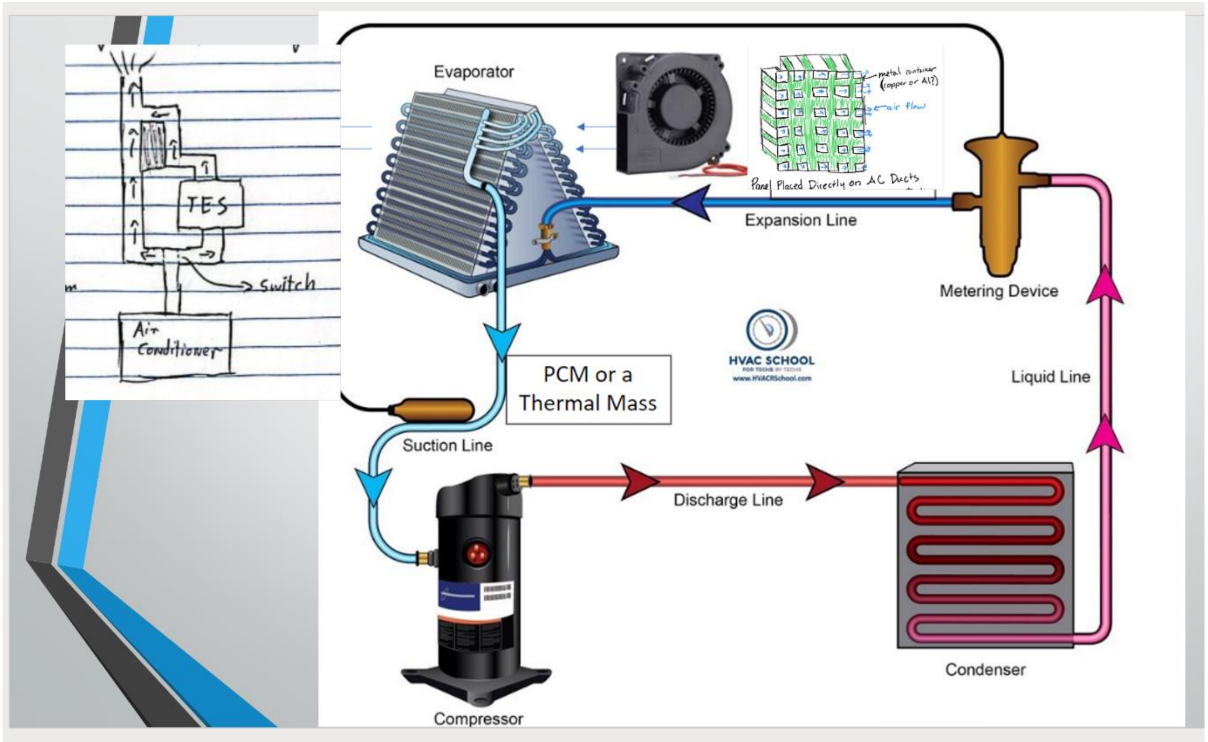
Medium	Fluid Type	Temperature Range (°C)	Density (kg/m^3)	Specific Heat (J/(kg·K))
Rock	–	20	2560	879
Brick	–	20	1600	840
Concrete	–	20	1900–2300	880
Water	–	0–100	1000	4190
Calorie HT43	Oil	12–260	867	2200
Engine oil	Oil	≤160	888	1880
Ethanol	Organic liquid	≤78	790	2400
Propane	Organic liquid	≤97	800	2500
Butane	Organic liquid	≤118	809	2400
Isotunaol	Organic liquid	≤100	808	3000
Isopentanol	Organic liquid	≤148	831	2200
Octane	Organic liquid	≤126	704	2400

PCM	Melting Temperature (°C)	Melting Enthalpy (kJ/kg)	Density (g/cm^3)
Ice	0	333	0.92
Na-acetate trihidrate	58	250	1.30
Paraffin	−5–120	150–240	0.77
Erytritol	118	340	1.30

Name of Material	Thermal Conductivity (W/(m·°C))	Density (kg/m^3)	Specific Heat (kJ/(kg·°C))
Glass	0.78	2700	0.840
Stainless steel	7.70	8010	0.500
Tin	64	7304	0.226
Aluminum mixed	137	2659	0.867
Aluminum	204	2707	0.896
Copper	386	8954	0.383

Presentation 3				4/1/24
Drawing Views of Designs	Aaron	0%	3/24/24	3/27/24
Top Level Design functions	Steven	0%	3/24/24	3/27/24
Important sub assemblies	Aaron	0%	3/24/24	3/27/24
Flow Charts	Courtney	0%	3/24/24	3/31/24
Project Description	Courtney	50%	3/24/24	3/31/24
QFD	Janelle	50%	3/24/24	3/31/24
Engineering Calculations	Janelle, Steven	0%	3/24/24	3/31/24
Analysis Tools (Arduino, Materi	Courtney	0%	3/24/24	3/31/24
Analysis Tools (Ansys)	Steven	0%	3/24/24	3/31/24
Analysis Tools (SIMULINK)	Janelle	0%	3/24/24	3/31/24
ER and CR's yet to be quantifie	Janelle	0%	3/24/24	3/31/24
FMEA/list potential failures	Steven, Maciej	0%	3/24/24	3/31/24
Testing Procedures	Maciej, Aaron	0%	3/24/24	3/31/24
List equipment needed	Maciej	0%	3/24/24	3/31/24
Schedule for next term	Courtney	0%	3/24/24	3/31/24
Project Budget	Maciej	0%	3/24/24	3/31/24
Physical Copies of Diagrams/Drawings		0%	3/31/24	4/1/24

Prototype Demo				4/1/24
Physical Prototype	Aaron, Maciej	0%	3/19/24	4/1/24
Virtual Prototype	Steven, Janelle	0%	3/19/24	4/1/24


TES
switch
Air Conditioner
Evaporator
metal container (copper or Al?)
air flow
Panel Placed Directly on AC Ducts
Expansion Line
Metering Device
HVAC SCHOOL
www.HVACRSchool.com
PCM or a Thermal Mass
Liquid Line
Suction Line
Discharge Line
Condenser
Compressor