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CH18B020

CH4010 Assignment-2

[Excerpts from HW1 for using some of the values found out there]

Given stream data:

Stream No.	Type	Heat Capacity* Flow Rate kW / K	Supply Temperature °C	Target Temperature °C
1	Hot	2.1	180	40
2	Hot	4	150	40
3	Cold	3	60	180
4	Cold	2.6	30	130

Since $(\Delta T)_{min}$ = 9 degrees C (even roll number), we can shift the hot stream below by 9/2 = 4.5 degrees and the cold stream above by 4.5 degrees. This results in:

Modified stream data:

Stream No.	Type	Heat Capacity* Flow Rate kW / K	Supply Temperature °C	Target Temperature °C
1	Hot	2.1	175.5	35.5
2	Hot	4	145.5	35.5
3	Cold	3	64.5	184.5
4	Cold	2.6	34.5	134.5

Part-1: Pinch-point, Q_C, Q_H and composite curves

Using the problem table algorithm, one can arrive at the following table:

	2.1	4	3	2.6	Σ ($FC_{p,\ hot}$) (in kW/C)	Σ($FC_{p,\ cold}$) (in kW/C)	ΔT (in C)	ΔH (in kW)	$q_{transfer}$ (in kW)
184.5	0	0	1	0	0	3	9	27	0
175.5	1	0	1	0	2.1	3	30	27	-27
145.5	1	1	1	0	6.1	3	11	-34.1	-54
134.5	1	1	1	1	6.1	5.6	70	-35	-19.9

64.5	1	1	0	1	6.1	2.6	29	-101.5	15.1
35.5	0	0	0	1	0	2.6	1	2.6	116.6
34.5	0	0	0	0	0	0			114

We can see the lowest $q_{transfer}$ is -54 kW. So if we provide a heating of 54 kW, all heat transfers will be non-negative (and hence heat won't flow from lower temperature to higher temperature).

	2.1	4	3	2.6	Σ ($FC_{p,\ hot}$) (in kW/C)	Σ($FC_{p,\ cold}$) (in kW/C)	ΔT (in C)	ΔH (in kW)	$q_{transfer}$ (in kW)
184.5	0	0	1	0	0	3	9	27	54
175.5	1	0	1	0	2.1	3	30	27	27
145.5	1	1	1	0	6.1	3	11	-34.1	0
134.5	1	1	1	1	6.1	5.6	70	-35	34.1
64.5	1	1	0	1	6.1	2.6	29	-101.5	69.1
35.5	0	0	0	1	0	2.6	1	2.6	170.6
34.5	0	0	0	0	0	0			168

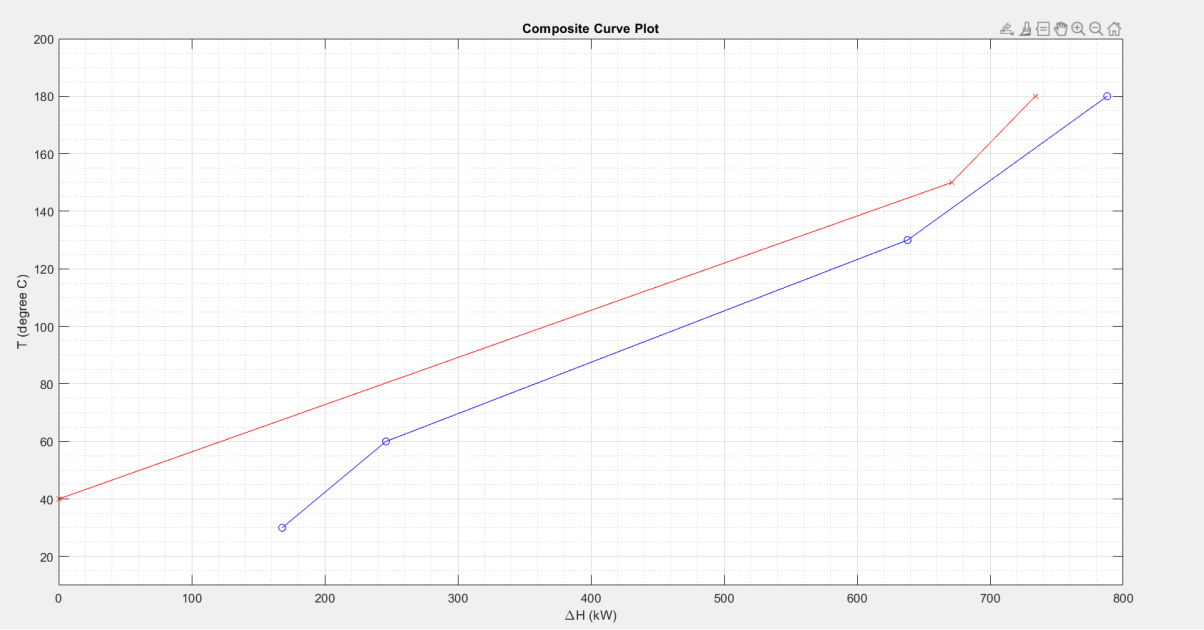
Hence from the above Problem Table we obtain the following:

Pinch point: i) cold stream pinch = 145.5°C – 4.5°C = **141°C**

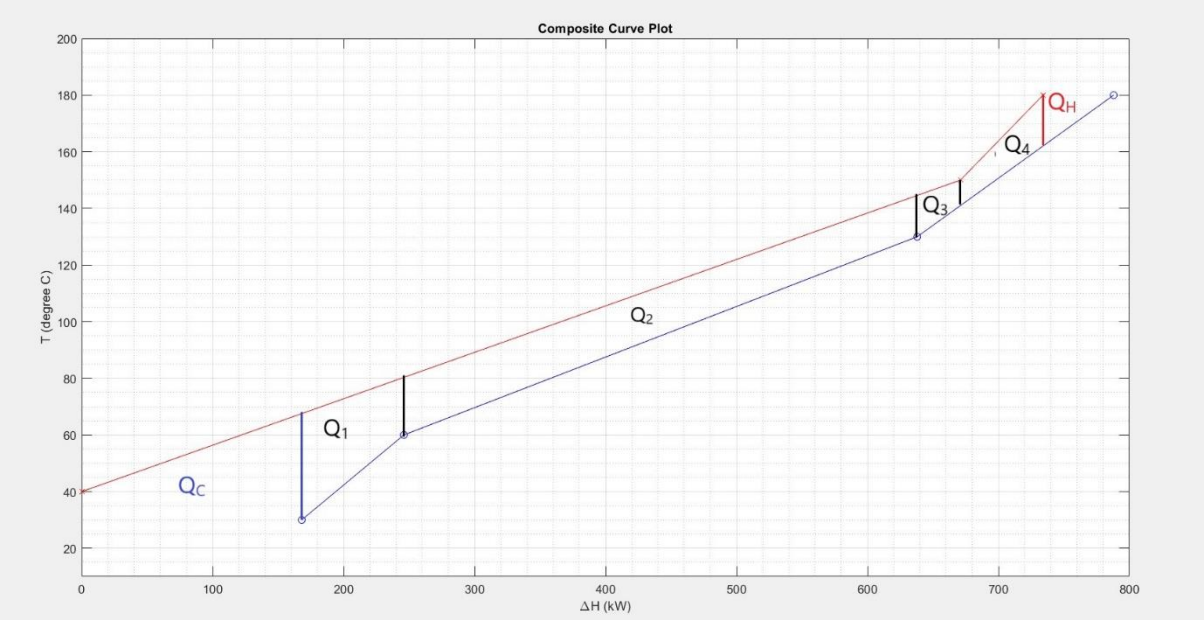
ii) hot stream pinch = 145.5°C + 4.5°C = **150°C**

Heating utility required, $\mathbf{Q_h}$ = **54 kW**

Cooling utility required, $\mathbf{Q_c}$ = **168 kW**



Plot 1: Composite curves. Red: hot curve; blue: cold curve



Plot 2: Showing different segments of the heat exchanger network used for Spaghetti Design

[Excerpts over]