PROBLEMS-PINCH TECHNOLOGY

PROBLEM #1

Consider the following data

FCp (KW/C)	Initial Temperature	Target Temperature
1.5	170	60
2	45	30
2.7	20	132
1.5	80	140
0.4	160	195

a) Make a graph of the minimum heating utility and pinch temperature as a function of the minimum temperature difference in the network.

b) Choose one value of minimum temperature difference and draw the grand composite curve. Consider that you have available utility at 100 ^{o}C, at 120 ^{o}C and at 260 ^{o}C with increasing price with increasing temperature. Determine the optimum utility usage.

c) Assume that your cooling water is available at 15 ^{o}C. Determine the outlet temperature that will minimize its usage. Is there any penalty paid for this decreased usage? Discuss solutions in the case where the cooling water to be returned to the cooling tower cannot exceed 35 ^{o}C.

PROBLEM #2

Consider the following data corresponding to a Crude Unit

Hot Streams

	TCR	MCR	LCR	KER	LGO	HGO	LR1	LR2	LR3	LR4	NAP
Fcp [kW/C]	1007.80	356.19	403.31	120.03	44.43	70.57	139.55	70.65	236.3	77.23	1460.04
Tin [C]	134.0	227.7	268.1	232.7	238.2	279.3	335.9	335.9	239.4	186.2	115.2
Tout [C]	108.2	190.8	198.8	40	45	68	262.7	186.1	186.2	90.00	56.00

Cold Streams

	C1	C2	C3	C4
Fcp [kW/C]	523.35	619.8	585.68	175.8
Tin [C]	39.00	153	155.3	150
Tout [C]	153	165.2	348	270

a) Choose one value of minimum temperature difference and draw the grand composite curve. Consider that you have available utility at 100 ^{o}C, at 120 ^{o}C and

at 400^{o}C with increasing price with increasing temperature. Determine the optimum utility usage.

b) Assume that your cooling water is available at 15 ^{o}C. Determine the outlet temperature that will minimize its usage. Is there any penalty paid for this decreased usage? Discuss solutions in the case where the cooling water to be returned to the cooling tower cannot exceed 35 ^{o}C.

c) Assume that hot oil at 390^{o}C is available as utility. Determine the outlet temperature of this oil, if its usage is minimum. Discuss the costs associated with the usage of heating oil. Is it always advisable using the lowest possible flowrate? Why?

d) Assume that all hot utility has to be satisfied using a furnace. What are your stack losses? What is the real utility consumption? What would be a suitable flame temperature to use?

Use Excel

PROBLEM #3

Use super-targeting to get the right minimum heat recovery approach temperature (HRAT) for the data of problem 2. Use the following cost data.

COST OF HOT UTILITY =2996 $/Kw

Hot utility temperature change 600 ^{o}C $\rightarrow$580 ^{o}C

COST OF COLD UTILITY =1198 $/Kw

Cold utility temperature change 20 ^{o}C $\rightarrow$40 ^{o}C

FIXED COST PER UNIT: 18,572 $

COST OF AREA= 224.63 $/m^2

U=0.31 kW/(^{o}C m^2)

To calculate total **annualized cost**, simply multiply the cost of utility by the amount (in Kw), plus the number of exchanger times the cost per unit, plus the cost of area times the total area.

PROBLEM #4

Consider the data of problem 2. Use the Pinch design method to construct a MER using the HRAT that you obtained as optimum in Problem 3.