CL312

Lab Report 6

Name: Shalin Jain, Shree Kumar Sundaray, Shridam Mahajan, Shubham Kumar Gupta, Shubham Raj

Roll No.: 180107055, 180107056, 180107057, 180107058, 180107059

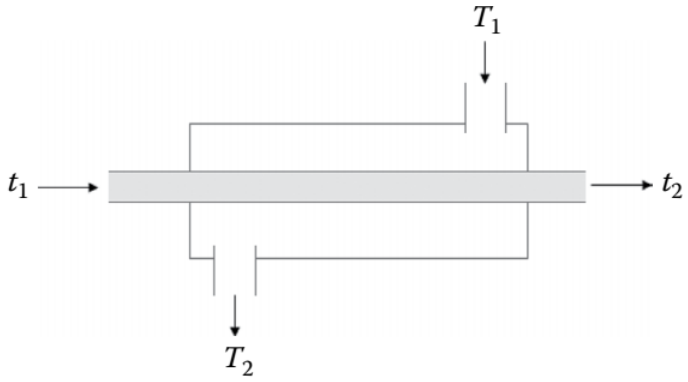
Group: 11

Assignment

Number of Shells and Log-Mean Temperature Difference

Example: A hot fluid is cooled by cooling water in a countercurrent shell-and-tube heat exchanger. Determine the number of shells required, the correction factor F, and the updated log-mean temperature difference (LMTD).

Data: hot fluid inlet temperature (T1) = 250°F, hot fluid outlet temperature (T2) = 100°F, cooling water inlet temperature (t1) = 80°F, cooling water outlet temperature (t2) = 120°F.



Solution:-

Algorithm:-

- Firstly, we input required data namely hot fluid inlet and outlet temperatures, and cold fluid inlet and outlet temperatures.
- Then we calculate Δt_1, Δt_2, P and R.
- Next we initialize number of shells as N = 1 and compare the value of R with 1.
- If $R \neq 1$, then we calculate P′ and A:
  i. If A > 0, we calculate correction factor F and go to step 5.
  ii. If A < 0, we increment N by 1 and go to step 3.
- Else if R = 1, then we calculate P″ and B:
  i. If B > 0, we calculate correction factor F and go to step 5.
  ii. If B < 0, we increment N by 1 and go to step 3.
- If $F \leq 0.75$, we increment N by 1 and go to step 3.
- If $\Delta t_1 = \Delta t_2$, we assign LMTD = Δt_1.
- Else if $\Delta t_1 \neq \Delta t_2$, we calculate LMTD.
- We update LMTD as uLMTD by multiplying it with F.
- Finally we display the output values N, F and uLTMD.

Code:-

```
T1 = 250;  %Hot fluid inlet temperature (deg.F)
T2 = 100;  %Hot fluid outlet temperature (deg.F)
t1 =  80;  %Cold fluid inlet temperature (deg.F)
t2 = 120;  %Cold fluid outlet temperature (deg.F)
N = 1; % Initializing N
Delt1 = T2 - t1; Delt2 = T1 - t2;    %calculating delta t1
and delta t2
% Computing P and R
P = (t2 - t1)/(T1 - t1); R = (T1 - T2)/(t2 - t1);
% Testing for F and R
A = -1; B = -1; F = 0.1; % Initializing F
while (F <= 0.75)
```

```
 if ( R > 1 || R < 1)
 while (A < 0)
 P_ = (1 - ((P*R-1)/(P-1))^(1/N)) / (R-((P*R-1)/(P-
1))^(1/N));
A = (2/P_ - 1 - R + sqrt(R^2 +1)) / (2/P_ - 1 - R -
sqrt(R^2 +1));   %calculating P' and A
if (A < 0)
 N = N + 1;       %Updating N
 end
 end
F = ( sqrt(R^2 +1) * log10((1-P_)/(1-P_*R)) / (R-1) ) /
(log10(A));   %Updating F
 else % R = 1
 while (B < 0)
 Pd = P / (N-P*(N-1));
B = (2/Pd - 2 + sqrt(2)) / (2/Pd - 2 - sqrt(2));
%Calculating P'' and B
if (B < 0)
 N = N + 1;
 end
 end
F = ( sqrt(R^2 +1) * Pd / (log(10*(1-Pd))) ) / (log10(B));
%Updating F
 end
if (F <= 0.75)
 N = N + 1;           %Updating N
 end
end
% Compute LMTD
if (Delt1 == Delt2)
 LMTD = Delt1;
else
 LMTD = (Delt1-Delt2)/(log(Delt1/Delt2));      %calculating
LMTD
end
uLMTD = F*LMTD; %Updating LMTD
% Output
fprintf('\nNumber of shells required = %2d\n', N);
fprintf('Correction factor F = %9.6f\n', F);
fprintf('Updated LMTD = %9.6f\n', uLMTD);
```

Results:-

Number of shells required = 2
Correction factor F = 0.918934
Updated LMTD = 54.002919