(iv) Combined convective and radiative heat Transfer.

Overall heat transfer coefficient (HTC)

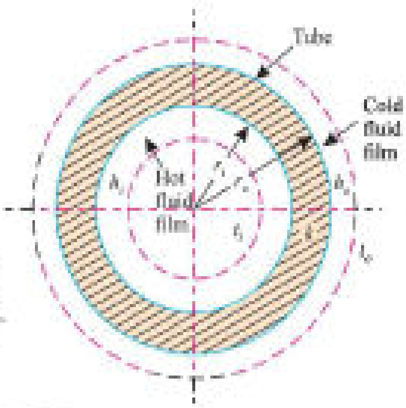
In the heat transfer analysis of heat exchanger various thermal resistances in the path of heat flow from hot to cold fluid are combined into an overall heat transfer coefficient. For an heat exchanger. the area of heat flow in. radial direction depends on the radius 'r', for which the overall heat transfer coefficient can be either based on inside surface area (or) outer surface area. Thus,

U_i = Overall HTC based on inside surface area

U_o = Overall HTC based on outside surface area.

Then, $Q = U_i A_i (T_i - T_o) = U_o A_o (T_i - T_o)$ → ①

Ⓧ $UA = \frac{1}{R_{total}}$, then.



$$U_i A_i = \frac{1}{\frac{1}{A_i h_i} + \frac{1}{2\pi k L}\ln\left(\frac{r_o}{r_i}\right) + \frac{1}{A_o h_o}}$$

$$U_i = \frac{1}{\frac{A_i}{A_i}\frac{1}{h_i} + \frac{A_i}{2\pi k L}\ln\left(\frac{r_o}{r_i}\right) + \frac{A_i}{A_o}\frac{1}{h_o}}$$

$A_i = 2\pi r_i L$

$A_o = 2\pi r_o L$.

$$U_i = \frac{1}{\frac{1}{h_i} + \frac{r_i}{k}\ln\left(\frac{r_o}{r_i}\right) + \left(\frac{r_i}{r_o}\right)\frac{1}{h_o}} \rightarrow ②$$

From ①

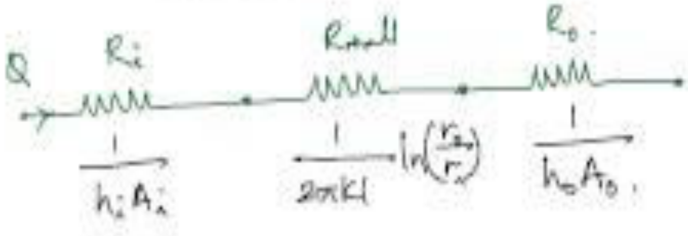
$U_i A_i = U_o A_o$.

lly.

$$U_o = \frac{1}{\left(\frac{r_o}{r_i}\right)\frac{1}{h_i} + \frac{r_o}{k}\ln\left(\frac{r_o}{r_i}\right) + \frac{1}{h_o}} \rightarrow ②$$

Topic - Overall Heat Transfer Coefficient

Resistance circuit



Representative values of the overall heat transfer coefficients in heat exchangers

Type of heat exchanger	U, W/m^2 · °C*
Water-to-water	850–1700
Water-to-oil	100–350
Water-to-gasoline or kerosene	300–1000
Feedwater heaters	1000–8500
Steam-to-light fuel oil	200–400
Steam-to-heavy fuel oil	50–200
Steam condenser	1000–6000
Freon condenser (water cooled)	300–1000
Ammonia condenser (water cooled)	800–1400
Alcohol condensers (water cooled)	250–700
Gas-to-gas	10–40
Water-to-air in finned tubes (water in tubes)	30–60*
	400–850*
Steam-to-air in finned tubes (steam in tubes)	30–300*
	400–4000*

References:

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2. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, New Jersey,6th Edition1998(Unit I,II,III,IV, V)
3. MIT open courseware – https://ocw.mit.edu/courses/mechanical-engineering

Other web sources