DESIGN FEATURE

PREDICTION OF TUBE SIDE HEAT TRANSFER COEFFICIENT FOR COMMON GASES BY NOMOGRAPH

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TRANSFER of heat from hot flue or process gases is often encountered in industrial processes e.g. fire-tube boiler operation, waste-heat recovery from flue gas etc. A simplified equation for the calculation of tube side heat transfer coefficient for common gases has been given as [1]

$$h_i = 0.0144\, c_p \frac{G^{0.8}}{D^{0.2}} \qquad (1)$$

Where, h_i = inside film coefficient for heat transfer, Btu/hr. ft². °F

C_p = heat capacity, Btu/lb. °F

G = mass velocity of gas, lb/hr. ft²

D = tube diameter, ft

Equation - 1 has been rewritten in S.I. unit as,

$$h_i = 12.58\, c_p \frac{G^{0.8}}{D^{0.2}} \qquad (2)$$

where h_i = inside film coefficient for heat transfer, $\frac{W}{m^2 K}$

c_p = heat capacity, $\frac{KJ}{Kg.K}$

G = mass velocity of gas, Kg/Sec. m²

D = tube diameter, m

In order to make the use of equation - (2) more convenient and meaningful for design calculations, a nomographs (figure - 1) has been prepared.

Range of applicability of the nomograph :

The range of applicability of the nomograph is presented below (table - 1).

Table - 1 : Range of applicability of the nomograph :

Variable	Unit	Range of applicability
C_p	KJ/kg.K	0.2 – 16.0
G	Kg/Sec. m²	0.01 – 100.0
D	m	0.005 – 0.050

The ranges of variables cover the working range for industrial heat transfer involving common gases.

Accuracy of the nomograph :

The values of tube side heat transfer coefficient for common gases obtained from figure -1 have been found to agree well with their respective values calculated with the help of equation - 2 which is evident from an example given below:

Example:

For the following case calculate the tube side heat transfer coefficient for a common gas and compare the value with that obtained from nomograph.

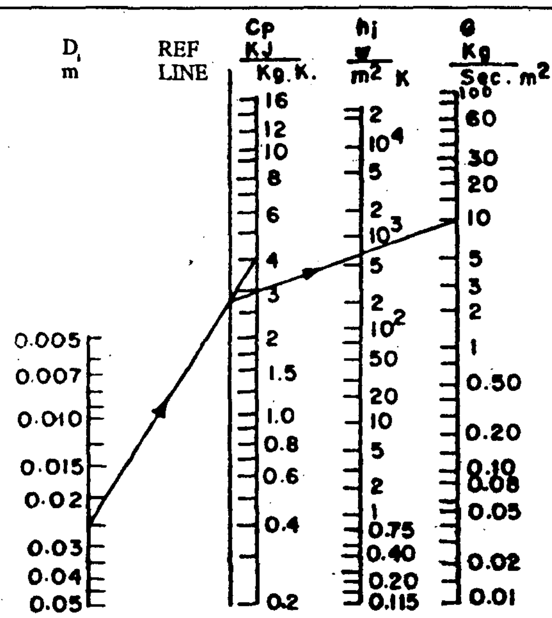

Fig. 1 **Prediction of tube side heat transfer coefficient for common gases by nomograph**

Heat capacity (C_p) = 4 KJ/Kg K

Mass velocity of gas (G) = 10 kg/sec. m²

Tube diameter (D) = 0.025 m

Solution :

From equation - 2,

$$h_i = 12.58 \times 4 \times \frac{10^{0.8}}{(0.025)^{0.2}}$$

$$= 664 \frac{W}{m^2 K}$$

From nomograph (figure - 1)

$$h_i = 625 \frac{W}{m^2 K}$$

% deviation of nomograph value from calculated one

$$= \frac{664 - 625}{664} = 5.87$$

Reference:

1. *WHMcAdams, "Heat Transmission" Mc Grow Hill Book Co. Inc.Third Edition, P-226.*

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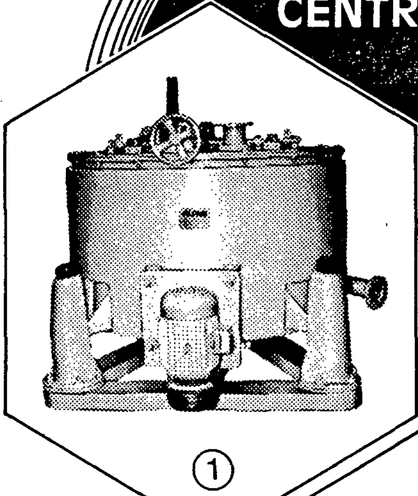

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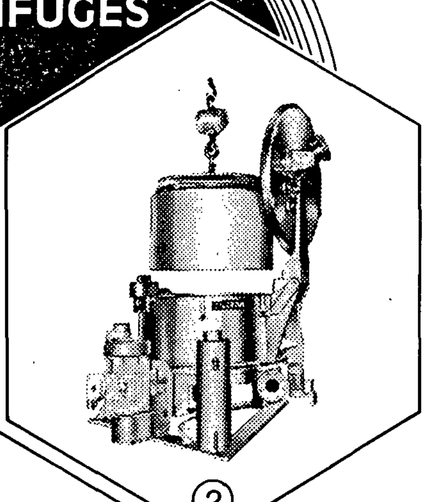

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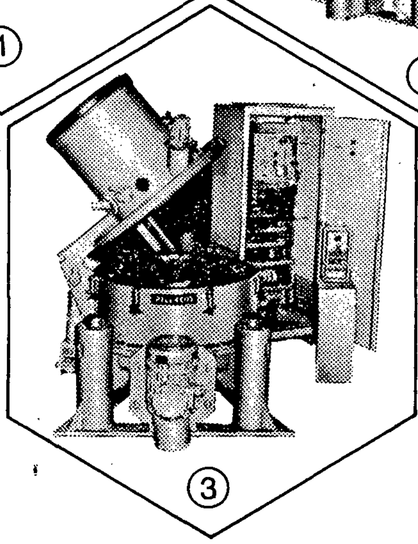

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