I am indebted to Dr. K. Rangadhama Rao for the specimen of germanium.

Central College,
Bangalore, S. RAMACHANDRA RAO.
January 10, 1945.

* All susceptibility values are given in 10^{-6} unit.

Owen, *Ann. der. Phys.*, 1912, **37**, 657. Angus, *Proc. Roy. Soc.*, 1932, **136**, 569.

A NEW METHOD OF DESIGNING PACKED COLUMNS

PACKED columns have been designed using almost exclusively overall transfer coefficients and overall H.T.Us rather than individual film coefficients and individual H.T.Us. Since the overall transfer coefficients and overall H.T.Us are defined (for distillation) as follows:—

$$\frac{1}{K_G a} = \frac{1}{k_G a} + \frac{m}{k_L a}$$

$$\frac{1}{K_L a} = \frac{1}{k_L a} + \frac{1}{m\, k_G a}$$

$$H.T.U_{OG} = H.T.U_G + H.T.U_L \frac{mG}{L}$$

$$H.T.U_{OL} = H.T.U_L + H.T.U_G \frac{L}{mG}$$

where G = the rate of flow of the vapours in $\frac{lb.\ moles}{hr. \times sq.\ ft.}$

L = the rate of flow of the overflow in $\frac{lb.\ moles}{hr. \times sq.\ ft.}$

m = the slope of the equilibrium curve.

their use for design purposes can only be justified when they are constant. For example this happens to be so (1) when the resistance of one of the films predominates over that of the other, so that the resistance of the second can be neglected, (2) when the value of "m" remains constant. When both the films are controlling, and the vapour-liquid equilibrium curve is not a straight line, then $K_G a$, $K_L a$ H.T.U_{OG} & H.T.U_{OL} are functions of the slope m; and since m is a variable they cannot be used for design purposes. They are, nevertheless, used (incorrectly) as no alternative method of approach has been presented to the Chemical Engineer.

If the reasonable assumption be made that the slope of the equilibrium curve is constant over small distances:—

$$m = \frac{dy_i}{dx_i} = \frac{dy^*}{dx} = \frac{dy}{dx^*},$$

where y_i and x_i are the interfacial compositions in any differential section of a packed column.

y^* is the composition of the vapour in equilibrium with liquid of composition x present in the differential section.

x^* is the composition of the liquid in equilibrium with vapour of composition y present in the same section

then equations can be derived by means of which the height of any packed column can be computed:—

$$h = \frac{G}{k_G a}\int_{y_F}^{y_D} \frac{dy}{(y - y)} + \frac{L}{k_L a}\int_{y_F^*}^{y_D^*} \frac{dy^*}{(y^* - y)} \quad (1)$$

$\leftarrow N_{G_1} \rightarrow$ $\leftarrow N_{G_2} \rightarrow$

$$h = \frac{G}{k_G a}\int_{x_F}^{x_D} \frac{dx}{(x - x^*)} + \frac{L}{k_L a}\int_{x_F^*}^{x_D^*} \frac{dx^*}{(x - x^*)} \quad (2)$$

$\leftarrow N_{L_1} \rightarrow$ $\leftarrow N_{L_2} \rightarrow$

The integrals N_{G_1}, N_{G_2}, N_{L_1} & N_{L_2} can be evaluated graphically. However, if both $k_G a$ & $k_L a$ are unknown, the height can be expressed either in terms of $k_G a$ or $k_L a$. This is done by solving the above as simultaneous equations

$$h = \frac{G}{k_G a}\left[\frac{N_{G_1} N_{L_1} - N_{G_2} N_{L_2}}{N_{L_1} - N_{G_2}}\right] = \frac{L}{k_L a}\left[\frac{N_{G_1} N_{L_1} - N_{G_2} N_{L_2}}{N_{G_1} - N_{L_2}}\right] \quad (3)$$

Full details of the derivation and applications of the above equations will be published elsewhere.

My thanks are due to Dr. M. A. Govinda Rau, at present Reader in the Alagappa Chettiar College of Technology, University of Madras, for the help that he has given me in this investigation.

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November 29, 1944.

A NEW ANTI-SNAKE-VENOM SERUM

THE anti-snake-venom serum in use in India at present is effective only against the venoms of cobra and Russell's viper. Lamb (1903, 1904, 1905) when he prepared this bivalent serum showed that it did not neutralise the venoms of any snakes other than the two (cobra and Russell's viper) against which it was prepared. The only improvement introduced in recent years has been the concentration of the anti-snake-venom serum (Maitra *et al.*, 1933, and Greval, 1934). Thus we have lacked a remedy against the bite of krait and the saw-scaled viper—two snakes as common as cobra and Russell's viper.

We have been working on the preparation of a polyvalent anti-snake-venom serum which would be effective against the poison of all the four common poisonous snakes of India—cobra, Russell's viper, common krait, and saw-scaled viper. In this we have succeeded and have taken up its manufacture at the Haffkine Institute.

We have also worked out a method for assaying our polyvalent anti-snake-venom serum on the lines of Ipsen's method (1938) sponsored by the League of Nations Permanent Commission on Biological Standardisation. We have assayed four batches of our polyvalent serum and find that 1 ml. of our serum neutralises not less than the following quantities of dried venoms, when the serum along with the venom is injected intravenously into white mice: cobra 0·6 mg.; common krait 0·45 mg.; Russell's viper 0·6 mg.; and saw-scaled viper 0·45 mg.

We are arranging to issue our polyvalent serum in lyophilised form, *i.e.*, preserved by drying from the frozen state. In this form the serum does not require to be stored in a refrigerator. It may be stored in any cool dark place and may even be carried in a haversack