Process fluid: Air
Tube dimensions: 3.6-in. I. D. by 15 in. length
Packing: 0.3-in. alumina spheres
Mass flow rate: 230 lb./(hr.)(sq. ft.), based on empty tube
Linear velocity: 1.0 ft./sec., based on empty tube

	Baffle dimensions, in.					Temperature, °F.				
Trial no.	Baffle to baffle spacing	Diam. of disks	Inner diam. of annuli	Chord to opposite edge	Wall at inlet	Inlet air	Wall at exit	Exit air	h_e, B.t.u./(hr.) (sq. ft.) (°F.)	Bed pressure drop, in. Hg
1	Unbaffled bed				136	77	201	177	8.4	7.0
				Disk and doughnut baffles						
2	2.0	1.75	2.5		132	76	210	178	7.8	7.0
3	2.0	2.5	2.5		133	77	197	175	8.9	7.5
4	2.0	3.25	2.5		121	77	201	189	15.0	
5	1.0	3.25	No Annuli		123	77	201	182	11.3	
6	1.0	3.25	2.5		125	77	201	195	19.2	8.4
7	1.0	3.25	1.0		108	77	200	193	23.7	
				Staggered horizontal partitions						
8	3.0			3.0	111	77	192	158	7.8	
9	2.0			3.0	137	77	204	186	10.3	
10	1.0			2.0	132	76	203	183	10.1	7.5
11	1.0			2.5	121	76	193	174	10.8	8.0
12	1.0			3.0	109	77	197	189	21.3	8.0

transfer measured by the effective wall film coefficient.

The effect of annulus inner diameter was shown in trials 5, 6, and 7. The value of a traversing bulk flow from center-to-wall was again apparent. Neither large disk baffles nor large annular baffles were anywhere near as effective alone as was their combination in trials 6 and 7.

The small rise in bed pressure drop associated with baffling suggested that the actual fluid path length and flow cross section were little affected by the presence of the baffles. The flow pattern was altered to favor lateral transport without increasing the dissipation of mechanical energy. This finding was modified however by the increase in bed void fraction which undoubtedly accompanied increased baffling.

CONCLUSIONS

Exploratory studies have shown that transverse baffles placed in a packed bed can double the effective lateral transport of heat, and presumably of mass also, while increasing the bed pressure loss by about 20%. The baffles should impress a traversing lateral bulk flow on the normal flow regime. To improve heat transfer to the surroundings the baffles should pinch the fluid flow at the wall.

NOTATION

A = inside wall area of packed bed, sq. ft.
C_p = mass heat capacity, B.t.u./(lb.) (°F.)
h_e = effective wall film coefficient, B.t.u./(hr.) (sq. ft.) (°F.)
q = total heat transfer rate, B.t.u./hr.
t = temperature, °F.
Δt = temperature difference between wall and bulk fluid, °F.
Δt_m = logarithmic mean temperature difference, °F.
W = flow rate through apparatus, lb./hr.

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2. Hoffman, Paul, S.M. thesis, Mass. Inst. Technol., Cambridge, Massachusetts (1960).
3. Ranz, W. E., *Chem. Eng. Progr.*, **48**, 247 (1952).
4. Wilhelm, R. H., *ibid.*, **49**, 150 (1953).

Dear Editor:

In a recent Communication to the Editor Holm (*1*) treated the effect of nonuniform vapor distribution on distillation plate efficiency and showed that when vapor rate increases along the direction of flow of the liquid phase, Murphree plate efficiencies are in general greater than those for uniform vapor distribution as given by Lewis (*2*).

There appears to be an error in the author's derivation which renders his results invalid.

In arriving at the expression for E_{mv}/E [the author's Equation (4)] the author used the following expression for the average vapor concentration above the tray:

$$\overline{y} = \int_0^1 y\,dw$$

Correctly, $\overline{y}$ is the mass average concentration and should be given by

$$\overline{y} = \int_0^1 y \frac{g}{\overline{G}} dw \qquad (1)$$

Using this we arrive at

$$\frac{E_{mv}}{E} = \int_0^1 \frac{g}{\overline{G}} \, e^{E\lambda}\left(1 - \int_0^w \frac{g}{\overline{G}} dw\right) dw \qquad (2)$$

Since $g/\overline{G}$ is a function of w, we may write

$$\int_0^w \frac{g}{\overline{G}} dw = \phi(w) \text{ and}$$

$$\frac{g}{\overline{G}} = \frac{d\phi}{dw} = \phi'(w) \qquad (3)$$

and Equation (2) now becomes

$$\frac{E_{mv}}{E} = e^{E\lambda} \int_0^1 \phi'(w)\, e^{-E\lambda\phi(w)}\, dw$$

$$= \frac{e^{E\lambda}}{E\lambda} \left[e^{-E\lambda\phi(w)}\right]_1^0 \qquad (4)$$

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INFORMATION RETRIEVAL

Key Words: Dialysis-I, Separation-I, Transport-I, Mass Transfer-I, Membranes-I, Rates-I, Ion Exchange-I, Exchanging-I, Transferring-I, Electrodialysis-I, Diffusion-H, Solutions (Mixtures)-H, Aqueous-, Ions-H, Anions-H, Cations-H, Laminar Flow-H, Currents-H, Limiting-H, Predicting-H, Movement-H, Cations-A, Silver Nitrate-A, Nitrates (Inorganic)-A, Nitric Acid-A, Acids (Inorganic)-A, Water-E, Ion Exchangers-J, Exchangers-J, Membranes-J.

Abstract: As part of a study of the behavior of nonideal permselective membranes, this work has been carried out to determine the applicability of the Nernst-Planck equations to the behavior of ions in aqueous solutions surrounding such a membrane during electrodialysis. Attention was confined to stagnant and laminar flow systems. The processes studied were the transfer of hydrogen ions, silver ions, and mixtures of the two through the cation exchanging membrane Nepton CR-61. The only anions present were nitrate ions. Limiting currents and relative transport rates were determined and compared with predicted values.

Reference: DiBenedetto, Anthony T., and Edwin N. Lightfoot, **A.I.Ch.E. Journal, 8,** No. 1, p. 79 (March, 1962).

Key Words: Physical Properties-H, Properties (Characteristics)-H, Fluids-H, Gases-H, Equation of State-I, Mixtures-I, Binary-, Polarity-I, Compressibility-I, Density-I, Volume-I, Interactions-I.

Abstract: Methods are presented for calculating the second virial coefficients of binary gas mixtures containing one or two polar components. In the case of polar-polar mixtures, a modified Stockmayer potential is employed; techniques are proposed for estimating the interaction coefficients of polar-nonpolar mixtures. Applications to typical chemical engineering problems are illustrated.

Reference: Blanks, R. F., and J. M. Prausnitz, **A.I.Ch.E. Journal, 8,** No. 1, p. 86 (March, 1962).

Key Words: Mixing-I, Stirring-I, Agitation-I, Suspensions-I, Mass Transfer-I, Particles-H, Liquid Phase-H, Baffling-H, Power-H, Correlations-H, Diameter-F, Size-F, Diffusion-F, Viscosity-F, Density-F, Physical Properties-F, Properties (Characteristics)-F, Mass Transfer-G, Coefficients-, Rates-G, Correlations-J, Theories-J, Penetration-, Tanks-J, Baffles-J.

Abstract: Mass transfer coefficient ratios have been measured for particles suspended in agitated, baffled tanks. Measured coefficients are compared with those predicted from correlations for fixed particles. A modified penetration theory is used to describe the measured effects of particle diameter, diffusivity, viscosity, and density difference.

Reference: Harriott, Peter, **A.I.Ch.E. Journal, 8,** No. 1, p. 93 (March, 1962).

Key Words: Flow-H, Fluid Flow-H, Fluid Mechanics-H, Turbulence-H, Liquid Phase-I, Water-I, Turbulence-I, Intensity-, Wakes-I, Eddies-I, Intensity-I, Distribution-, Aerodynamics-I, Cylinders-J, Tunnels-J, Water-.

Abstract: Results from an investigation of the fully developed wake of a circular cylinder are presented. The study was conducted in the liquid phase, in the controlled flow field of a water tunnel. A technique was developed for measuring the intensity of turbulence in water. The decay of turbulence intensity downstream from a series of fine-mesh wire screens was measured and compared with aerodynamic decay laws. Profiles of the turbulence intensity in the cylinder wake were also obtained.

Reference: Sparks, Robert E., and H. E. Hoelscher, **A.I.Ch.E. Journal, 8,** No. 1, p. 103 (March, 1962).

Key Words: Flow-I, Fluid Flow-I, Capillaries-I, Mass Transfer-I, Solids-I, Porosity-, Fluids-H, Gases-H, Diffusion-H, Porosity-H, Properties (Characteristics)-H, Physical Properties-H, Pressure-H, Parameters-J, Structural-, Resistance-J.

Abstract: The steady state diffusion of gases through capillaries or through the pores of a solid when the total pressure in the system is constant is considered. A diffusion equation is derived to describe the diffusion rate as the nature of the process changes from ordinary mutual diffusion to Knudsen diffusion. A structural parameter of the porous solid, the diffusion ratio, is calculated from experimental measurements of diffusion rates, and is compared with the experimental value of the same ratio found from electrical resistance ratios and from flow measurements.

Reference: Scott, D. S., and A. L. Dullien, **A.I.Ch.E. Journal, 8,** No. 1, p. 113 (March, 1962).

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(*Continued from page 135*)

From the definition of $\phi(w)$, Equation (3), we see

$$\phi(w)]_{w=0} = 0, \text{ and } \phi(w)]_{w=1} = 1$$

Thus Equation (4) becomes

$$\frac{E_{mv}}{E} = \frac{e^{E\lambda}}{E\lambda}(1 - e^{-E\lambda}) = \frac{e^{E\lambda} - 1}{E\lambda} \tag{5}$$

We come to the conclusion that, regardless of the form of the vapor distribution function, the ratio E_{mv}/E is identical to that which is obtained for uniform vapor distribution, from Lewis.

We may rationalize the present results as follows: On the basis of the assumptions of (1) one dimensional slug flow of the liquid phase, and (2) constant point efficiency unaffected by vapor distribution, it follows that the liquid phase, in flowing across a tray, sooner or later contacts all the vapor phase, and variations in the local flux of vapor throughput do not alter the over-all concentration change in the liquid between tray inlet and outlet, although, indeed, the conservation of matter does dictate a direct relation between vapor distribution and point to point, or local, concentration changes in the liquid. In fact it appears that this conclusion is not contingent upon a well-mixed vapor under the tray, and we suggest that it is valid for the other two cases originally treated by Lewis (vapor not mixed, liquid flow parallel; and vapor not mixed, liquid flow opposite) as well.

Notation: [after Holm (1)]

E = Murphree point efficiency
E_{mv} = Murphree plate efficiency
g = point value of vapor flow rate
$\bar{G}$ = vapor flow rate averaged over entire tray
w = distance along tray, as a fraction of the total
y = vapor phase composition
$\bar{y}$ = mass average vapor phase composition
λ = $m\bar{G}/L$ (ratio of equilibrium and operating slopes)
$\phi(w)$, $\phi'(w)$ = functions of w as defined by our Equation (3)

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2. Lewis, W. K., Jr., *Ind. Eng. Chem.*, **28**, 399-402 (1936).

Very truly yours,

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