possible, since real physical systems saturate under conditions of resonance.

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NOTATION

A = amplitude of sinusoidal speaker input
a = velocity of propagation of sound
d = length of sound tube
g_c = gravitational constant
i = output of microphone (current or voltage)
i_{RMS} = root mean square value of i
$K_1 = \frac{\sqrt{2}\beta}{2} \rho A \sqrt{g_c RT}$
$K_2 = (\omega d)/\sqrt{g_c RT}$
M = molecular weight of gas in sound tube
p = excess pressure due to sonic vibrations
R = gas constant
t = time
T = absolute temperature
u = velocity of gas particles due to sonic vibrations
x = axial coordinate in sound tube

Greek Letters

α = constant as defined in Equation (17)
β = constant as defined in Equation (10)
γ = ratio of specific heats
θ = displacement of gas particles due to sonic vibrations
ρ = density of gas under conditions at which a is measured
Φ = velocity potential as defined in Equation (3)
ω = angular frequency

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The Maximum Velocity Locus for Axial Turbulent Flow in an Eccentric Annulus

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Deissler and Taylor (*1*) and Heyda (*3*) present analytical solutions for the turbulent flow of incompressible fluids in plain annuli containing eccentrically positioned cores. Comparison of these solutions with experimental observations is not offered by these authors. It is the purpose of this note to compare the results of a recent experimental study (*8*) of flow in annuli containing a fixed eccentric core with the calculated solutions of the above mentioned authors.

Deissler and Taylor devised an interative procedure in which the locus of maximum velocity and the velocity gradient lines are assumed such that they satisfy force balances calculated employing the equations of Eckert (*2*) for velocity distribution in turbulent flow. Heyda solved the Navier-Stokes equations for laminar flow and used the resulting laminar maximum velocity locus as the basis for his iterative nongeometric procedure for the description of turbulent flow. Heyda's assumption that the laminar and turbulent loci of maxima are identical has support in the results of studies of flow in concentric annuli. These studies (*4, 5, 6, 7*) indicate that the radius of maximum velocity for Reynolds numbers somewhat less than 10,000, based on the hydraulic radius, is identical to the radius of maximum velocity for laminar flow, and that the maximum velocity radius moves slightly toward the inner wall as the Reynolds number increases.

In a recent experimental study isovelocity lines and the locus of maximum velocity were determined for the turbulent flow of air (Reynolds number 20,000, maximum velocity 40 ft./sec.). Impact tube measurements were used to determine point velocities in an annular system consisting of a 3.00 in. I.D. smooth aluminum tube with a 2.00 in. O.D. eccentric aluminum core ($\epsilon = 0.25$). Calming lengths of 15 ft. upstream and 6 ft. downstream from the test section were employed. Point velocity data was reproducible within 1%.

In Figure 1 the experimentally determined maximum velocity points are plotted along with points of maximum velocity predicted by the solution of the Navier-Stokes equation for laminar flow. Also presented is the locus of maximum velocity predicted by a simple approximate solution of the Navier-Stokes equation suggested by Noyes (*3*) in conjunction with the work of Heyda. A comparison between experimentally determined maximum points

TABLE 1.

	Angle θ						
	10	40	80	120	180	200	240
	% difference						
Navier-Stokes	2.4	1.8	11.4	6.7	7.2	10.0	14.3
Noyes approximation	0.0	0.0	0.0	0.0	7.2	10.0	6.6

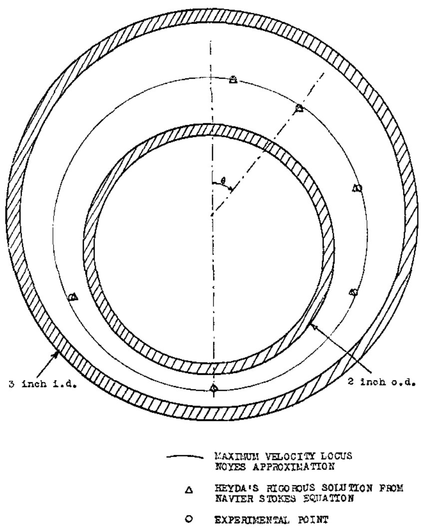

Fig. 1. Maximum velocity in an eccentric annulus.

and those predicted by Heyda's rigorous solution of the Navier-Stokes equation and the Noyes approximation locus is presented in Table 1. In this table the distances between experimentally determined points and those calculated using the Navier-Stokes equation and the Noyes approximation locus are reported in percentage of total traverse distance measured along a perpendicular to the shell wall. The measured maximum velocity locus and the velocity gradient lines satisfied the force balances employed in the method of Deissler and Taylor.

The agreement between experimental and calculated points indicates that Heyda's assumption is valid for the flow investigated and that the Noyes approximation is a good first estimate for the location of the maximum locus. It might also be noted that the Noyes approximation affords a simple starting point for the geometric procedure of Deissler and Taylor.

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INFORMATION RETRIEVAL

Effective interfacial area in packed columns for absorption with chemical reaction, Yoshida Fumitake, and Yoshiharu Miura, **A.I.Ch.E. Journal, 9,** No. 3, p. 331 (May, 1963).

Key Words: Mass Transfer-8, Absorption-8, Interfaces-9, Carbon Dioxide-1, Oxides (Inorganic)-1, Sodium Hydroxide-1, Potassium Hydroxide-1, Alkalies-1, Bases (Chemical)-1, Caustics-1, Hydroxides-1, Water-5, Rates-6, Areas (Surface)-7, Interfaces-7, Effectiveness-7, Columns (Process)-10, Packed- .

Abstract: Experimental studies have been made of the absorption of carbon dioxide into aqueous solutions of sodium and potassium hydroxides with packed columns and with columns of spheres. Physical absorption experiments also were performed with the same apparatus to obtain the bases for correlation. The effective interfacial area for chemical absorption in packed columns depends on the rate of the controlling reaction. For absorption with a very rapid chemical reaction only the moving part of the interface is effective; for absorption with a moderately fast or slow reaction the whole interfacial area is effective.

Agitation of liquid systems requiring a high shear characteristic, Fondy, Philip L., and Robert C. Bates, **A.I.Ch.E. Journal, 9,** No. 3, p. 338 (May, 1963).

Key Words: Agitation-8, Dispersing-8, Emulsification-8, Homogenizing-8, Mixing-8, Impellers-9, Shear-9, Drops (Droplets)-9, Power-6, Peripheral Speed-6, Circulation-6, Rates-6, Capacity-6, Size-7, Effectiveness-7, Impellers-10, Dynamometers-10, Meters-10, Photomicrographs-10, Photographs-10.

Abstract: A basic study of high shear agitation has been made to develop a better understanding of the mechanism of fluid shear and to correlate the several variables. The system nack-mineral oil was studied experimentally and data relating particle size and time to shear rate, circulating capacity and power input are presented. This study indicates that impeller peripheral speed is the only variable affecting ultimate particle size, and further, that the time of attainment is a function of the effective circulating capacity. Performance of a number of commercially available impellers is compared and the evolution of a new design, which minimizes power consumption by optimizing the shear-flow ratio is described. Scale-up factors for the general case are discussed.

Flow and diffusion characteristics of alumina catalyst pellets, Robertson, J. L., and J. M. Smith, **A.I.Ch.E. Journal, 9,** No. 3, p. 342 (May, 1963).

Key Words: Diffusion-8, Flow-8, Porous Media-5, Catalyst Pellet-5, Alumina-5, Catalyst Density-6, Nitrogen-1, Helium-1, Macropore-5, Micropore-5.

Abstract: Steady state, constant pressure diffusion measurements were made on a series of alumina pellets using the nitrogen-helium system at 1 atm. and 80°F. The pellets were prepared from the same alumina powder but compressed to different densities. Pore-size distribution data indicate that all the pellets had approximately the same micropore sizes and volume, but different macropore volumes. Flow measurements with nitrogen were also carried out for the same pellets over a pressure range (up to 1 atm.). The data show that the pellet density (or macropore volume) has a pronounced effect.

Simultaneous heat and mass transfer in a falling laminar film, Modine, A. D., E. B. Parrish, and H. L. Toor, **A.I.Ch.E. Journal, 9,** No. 3, p. 348 (May, 1963).

Key Words: Benzene-1, Methanol-1, Energy Balance-2, Mass Balance-2, Interfacial Temperature-2, Nitrogen-5, Helium-5, Axial Distance-6, Heat Flux-6, Nusselt Number-7, Temperature Gradients-6, j Factors-7, Heat Transfer-8, Mass Transfer-8, Liquid Films-9, Wetted-Wall Column-10, Computer-10, Gas Chromotograph-10.

Abstract: The energy equation is solved for a falling laminar film with an adiabatic wall and an arbitrary heat flux at the free film surface. Satisfactory values of gas side mass transfer coefficients are obtained when the solution is used to compute the interfacial temperature for nonisothermal experiments in a wetted-wall column.

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