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TRANSFER COEFFICIENTS ON THE SURFACES OF A TRANSVERSE PLATE SITUATED IN A DUCT FLOW

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Abstract—Experiments have been performed to determine the heat-/mass-transfer coefficients on the upstream and downstream faces of a wall-attached transverse plate which partially blocks the flow cross section of a square duct. The experiments involved mass transfer and were carried out via the naphthalene sublimation technique, with air as the working fluid. By virtue of the analogy between heat and mass transfer, the results are also relevant to heat transfer. The transverse plates employed in the experiments gave rise to blockages which ranged from one-sixth to two-thirds of the duct cross section. The duct Reynolds number was varied from 5000 to 30 000. It was found that at a given Reynolds number, both the upstream-face and downstream-face transfer coefficients were quite insensitive to the extent of the blockage. The upstream-face coefficients were generally higher than those for the downstream face, but the differences diminished with increasing Reynolds number. The coefficients exhibited a power-law dependence on the Reynolds number, the power being approximately one-half for the upstream face and two-thirds for the downstream face.

NOMENCLATURE

A, surface area of naphthalene coating;
D_e, equivalent diameter of duct;
$\mathscr{D}$, naphthalene–air diffusion coefficient;
H, side dimension of square duct;
h, height of transverse blockage plate, Fig. 1;
K, surface-averaged mass-transfer coefficient, equation (1);
$\dot{M}$, mass-transfer rate;
Re, Reynolds number, equation (3);
Sc, Schmidt number, $\nu/\mathscr{D}$;
Sh, surface-averaged Sherwood number, $KD_e/\mathscr{D}$;
Sh', modified Sherwood number, equation (5);
$\bar{u}$, mean velocity in duct;
ν, kinematic viscosity;
ρ_{nb}, concentration of naphthalene vapor in the bulk flow;
ρ_{nw}, concentration of naphthalene vapor at the plate surface.

INTRODUCTION

THIS paper is concerned with the heat- and/or mass-transfer characteristics of a wall-attached transversely positioned plate which partially blocks the flow cross section of a duct. The complex flow field induced by such a transverse plate affects the heat transfer at the duct walls, both upstream and downstream of the plate, and these effects have been studied to a moderate extent. The plate itself is also subjected to a highly complex flow which is of a decidedly different character adjacent to its upstream and downstream faces. The heat/mass transfer on the surfaces of such a crossflow plate has yet to be investigated and is the subject of the experimental study to be described here.

The experiments were performed for a plate situated in a square duct as pictured schematically in the upper diagram of Fig. 1. As shown there, the plate serves to block the lower part of the cross section, so that the free flow area is in the upper part. Although neither velocity nor heat-transfer studies have been made for this or related internal flows, it is possible to qualitatively envision the general features of the flow field on the basis of available boundary-layer experiments (e.g. [1]).

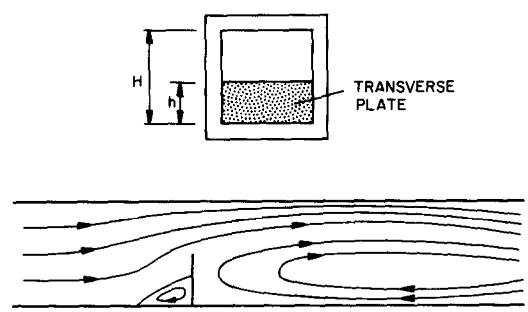

FIG. 1. Schematic of the transverse blockage plate (upper diagram) and of the expected streamline pattern (lower diagram).

A sketch of the expected streamline pattern is shown in the lower diagram of Fig. 1. As indicated there, a small separated region containing recirculating fluid extends upstream from the plate. An appreciable portion of the upstream face of the plate is exposed to the separated flow (about 60% in the experiments of [1]). The remainder of the upstream face is washed by a flow which is rapidly turning and accelerating as it makes its way toward the free flow area. Thus, the upper and lower parts of the upstream face are respectively subjected to fundamentally different flows. As pictured in the diagram, the boundary between these two flows is a streamline which stagnates at the plate surface.

The separation zone situated downstream of the plate is appreciably larger than the upstream separated region. Furthermore, owing to the upward velocity imparted to the flow by the blockage effect of the plate, the height of the downstream separation bubble exceeds that of the plate. The entire downstream face of the plate is washed by a recirculating flow. Additional complexities, beyond those depicted in the diagram, may well exist owing to the presence of the side walls of the duct.

To gain further perspective on the special nature of the flow field, it may be contrasted with that for a plate positioned transversely to an unbounded external flow. In that case, in contrast to the present, there is no region of separation upstream of the plate ([2], pp. 5–6). Furthermore, the wake is characterized by periodic vortex shedding and transverse oscillations. In the present flow configuration, these wake processes are eliminated by the presence of the duct wall downstream of the plate [3]. Owing to these major differences in the flow fields, no particular relationship is expected to exist between the heat-transfer characteristics of the two problems.

The present experiments were performed for mass transfer, but the results are directly relevant to heat transfer in accordance with the well-established analogy between the two processes. The mass-transfer studies were carried out with the naphthalene sublimation technique, using air as the working fluid. Compared with heat-transfer experiments, the naphthalene technique offers a number of advantages. With reasonable precautions, it provides a well-defined, standard boundary condition at the transfer surface. In addition, it is virtually free of extraneous end losses of the type commonly encountered in heat-transfer experiments. In the present research, it afforded a special advantage in that the rates of transfer at the upstream and downstream faces of the plate can be determined separately. Also, the passive nature of a naphthalene test element results in a much simpler fabrication process than that required for a heat-transfer test element, which is necessarily active.

Each transverse plate test element employed in the present study was a composite consisting of a structurally supportive thin metal plate, coated with a film of naphthalene on one of its faces. The fabrication of the test elements will be described shortly. The heights h of the test plates (see Fig. 1) were selected to enable four blockage ratios $h/H = 1/6, 2/6, 3/6$, and $4/6$ to be investigated. For each blockage ratio, the mass flow of the air was varied so that the duct Reynolds number (based on the mean velocity and hydraulic diameter) covered the range from 5000 to 30 000. Separate data runs were made with the naphthalene-coated surface facing upstream and facing downstream. Mass-transfer coefficients were evaluated and presented in terms of the Sherwood number, which is the mass-transfer counterpart of the Nusselt number.

THE EXPERIMENTS

Experimental apparatus

The experiments were performed for a transverse plate situated in a duct of square cross section, 4.435 cm (1.746 in) on a side, with an overall length of 62 hydraulic diameters. The plate was positioned 40 hydraulic diameters downstream of the inlet to ensure hydrodynamic development of the flow. The 22-diameter length of duct downstream of the plate was provided so that the flow could reattach and then redevelop before it entered a square-to-round transition section. From the transition section, the flow passed successively through a rotameter and a control valve, and then to a blower.

Air was drawn into the apparatus from the temperature-controlled ($\sim 20°C$), windowless laboratory room and was exhausted at the roof of the building. The outside exhaust ensured that the concentration of naphthalene vapor in the entering air was zero. To make certain that heat generated by the blower did not affect the constancy of the air temperature during a data run, the blower was positioned in a service corridor adjacent to the laboratory. The precautions that were taken to maintain a constant temperature were motivated by the fact that the vapor pressure of naphthalene is very sensitive to temperature level (about 10% per °C).

The duct was fabricated from 0.953 cm (0.375 in) thick aluminum bar stock, especially selected for smoothness and straightness. Tolerances were closely held during fabrication so that the internal dimensions did not vary by more than ± 0.007 cm (± 0.003 in) over the entire 274 cm (9 ft) length. To provide a well defined inlet condition, the entrance plane of the duct was framed with a large baffle plate whose upstream face was flush with the exposed upstream edges of the duct walls.

Pressure taps were installed along the length of the duct to help detect the character of the flow. Auxiliary data runs indicated that hydrodynamically developed flow, as evidenced by a linear pressure variation, was established within 12 hydraulic diameters of the entrance cross section. In addition, the separated flow downstream of the transverse test element was found to reattach within a length equal to about eight hydraulic diameters.

A unique feature of the apparatus design and fabrication was the provision made for rapid, convenient installation and removal of the transverse test elements. The need to accomplish the installation and subsequent removal with a minimum time lapse is related to the avoidance of extraneous sublimation of the naphthalene coating. In addition, the large number of individual data runs, each involving installation and removal of a test element, motivated a design which provided precise positioning of the test element without the need for complex adjustments and multiple assembly operations.

The details of the installation/removal arrangement are described elsewhere [4] and only a broad outline will be given here. In essence, a narrow vertical gap was left in each of the side walls at the axial station where the test element was to be located. Immediately upstream of the respective gaps, a precisely machined block was affixed to the outside surface of each side wall. These blocks contain cut-outs for receiving and positioning a test plate. Once a plate had been threaded through the gaps and fixed in place by tightening a pair of knobs on one of the blocks, the gaps were closed by inserts. The inserts and the mating faces of the duct side walls had beveled edges, so that the implanting of the inserts tightly sealed the gaps and positively positioned the test plate. The inserts were held in place by a specially machined C-clamp tightened by a single knob.

With the access arrangement discussed in the foregoing paragraph, it was possible either to install or to remove a test element in less than a minute. Measurements showed that the extraneous sublimation mass transfer during that period, due primarily to natural convection, was entirely negligible.

Naphthalene-coated test plates

As noted earlier, each test element was a composite consisting of a naphthalene coating on a metal plate. Inasmuch as the present experiments constituted the first thin-plate studies involving the naphthalene sublimation technique, it was necessary to develop a procedure for producing thin naphthalene coatings of high surface quality.

To provide the requisite stiffness and strength, the metal plates were made of 0.071 cm (0.028 in) thick mild steel. As a preparatory step to promote adhesion, the plate face area to be coated with naphthalene was sand blasted. The coating was accomplished in two stages (see [4] for details). In the first stage, the area to be coated was placed horizontally, facing upward, and then framed with metal bars so as to form the sides of a mold. Molten naphthalene was poured into the mold through the open top and allowed to solidify. It was found by experiment that a poured layer having a thickness of about 0.2 cm (0.080 in) consistently adhered well to the metal plate.

The second stage was a machining procedure performed with a vertical milling machine and a fly-cutter attachment. The tool speed was maintained constant throughout the entire machining operation, but it was found advantageous to reduce the feed speed of the milling machine table as the final passes were made to achieve the desired coating thickness of 0.0254 cm (0.010 in).

When the machining was completed, the cast surface was immediately covered with a glass plate and the entire test element wrapped in plastic to minimize sublimation. The thus-wrapped element was then placed in the laboratory room to attain thermal equilibrium with its surroundings.

The quality of the coated surface was evaluated with a sensitive dial gage and the average roughness found to be about 0.00025 cm (0.0001 in). All aspects of the casting and machining procedures were performed with a high standard of cleanliness in order to avoid contamination of the surface of the coating.

Instrumentation and measurements

The amount of naphthalene that was sublimed during a data run was determined from measurements of the mass of the test element made immediately before and immediately after the run. The measurements were performed with a precision balance capable of being read to 0.05 mg. The duration of each data run was selected so that the change of the mean thickness of the naphthalene during the course of the run was about 0.0025 cm (0.001 in). The corresponding change in mass ranged from about 10 to 30 mg, depending on the run.

The rate of flow through the duct was measured by either of two rotameters, respectively for the higher and lower Reynolds number ranges. A laboratory grade thermometer with a smallest scale division of 0.1°C was used for the air temperature measurements. Static pressures along the length of the duct and at the rotameter were measured relative to ambient with a capacitance-type sensor which provided a digital readout, and the ambient pressure was obtained from a barometer situated in the laboratory room. The duration of the respective data runs was recorded by a digital timer.

Data reduction

The sublimation mass transfer for each data run, when divided by the duration of the run, yielded the mass transfer rate $\dot{M}$. Then, with A as the surface area of the naphthalene coating exposed to the flow, the surface-averaged mass flux $\dot{M}/A$ was evaluated. With this, a surface-average mass-transfer coefficient K can be defined as

$$K = \frac{\dot{M}/A}{\rho_{nw} - \rho_{nb}} \tag{1}$$

where ρ_{nw} and ρ_{nb} are, respectively, the densities of the naphthalene vapor at the plate surface and in the bulk flow. In view of the precautions taken to avoid the presence of naphthalene vapor in the air drawn into the duct from the laboratory room, $\rho_{nb} = 0$. To determine ρ_{nw}, the naphthalene vapor pressure at the plate surface was evaluated from the Sogin vapor pressure–temperature relation [5] in conjunction with the perfect gas law. For the evaluation, the plate temperature was taken to be equal to the air temperature, as has been established in related experiments by the authors and their co-workers.

The dimensionless representation of the mass-transfer coefficient is the Sherwood number Sh, which is the mass-transfer counterpart of the Nusselt number. As will be discussed shortly, various candidates can be considered for the characteristic length that appears in the Sherwood number. The most general correlation of the results was obtained when the equivalent diameter D_e of the duct was used as the characteristic dimension, so that

$$Sh = KD_e/\mathscr{D} \tag{2}$$

in which $\mathscr{D}$ is the naphthalene–air diffusion coefficient and $D_e = H$ for a square duct. The diffusion coefficient was evaluated via the Schmidt number $Sc = \nu/\mathscr{D}$, with $Sc = 2.5$ [5] and ν as the kinematic viscosity of air. Since K is a surface-averaged quantity, so also is Sh.

With regard to the Reynolds number, there are various possibilities for the characteristic dimension and for the characteristic velocity. The Reynolds number definition which, together with the Sherwood number of equation (2), leads to the most general correlation is based on the duct hydraulic diameter and mean velocity. That is,

$$Re = \bar{u}D_e/\nu. \quad (3)$$

RESULTS AND DISCUSSION

Sherwood numbers for the upstream and downstream faces of the transverse plate element were evaluated from data runs respectively made with the naphthalene-coated surface facing upstream and facing downstream. A comparison of the upstream-face and downstream-face Sherwood numbers for a given blockage ratio h/H is presented in Figs. 2 and 3. These figures respectively correspond to $h/H = 1/6$ and $4/6$,

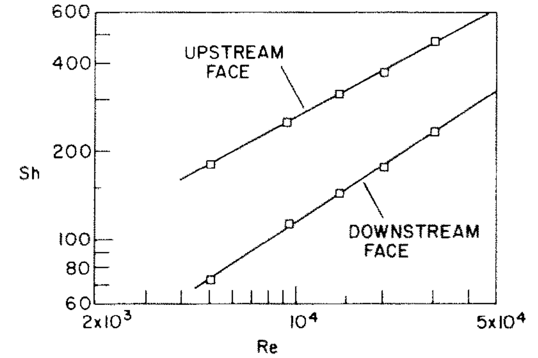

FIG. 2. Comparisons of upstream-face and downstream-face Sherwood numbers, blockage ratio $h/H = 1/6$.

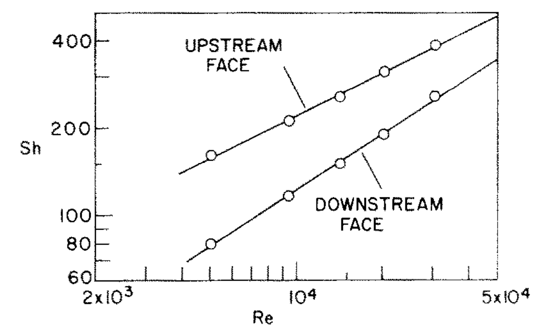

FIG. 3. Comparisons of upstream-face and downstream-face Sherwood numbers, blockage ratio $h/H = 4/6$.

which are the smallest and largest blockage ratios that were investigated. In each figure, the Sherwood number is plotted as a function of the Reynolds number over the range from 5000 to 30 000. Lines have been passed through the data to provide continuity.

The figures show that for a given Reynolds number, the upstream-face Sherwood number is larger than the downstream-face Sherwood number. The difference between the respective Sherwood numbers is greatest at lower Reynolds numbers and diminishes as the Reynolds number increases. Furthermore, the differences are accentuated at smaller blockages. Thus, for the $h/H = 1/6$ blockage, the ratio of the upstream to downstream Sherwood numbers decreases from about 2.5 to 2 as the Reynolds number varies from 5000 to 30 000; the corresponding ratio for the $h/H = 4/6$ blockage decreases from 2 to 1.5.

The fact that higher Sherwood numbers are encountered on the upstream face has been observed in related flows, as has the closing of the gap between the upstream and downstream Sherwood numbers with increasing Reynolds number. For instance, for the cylinder in crossflow, it has been found (e.g. see [6], Fig. 9-9) that at lower Reynolds numbers, the Nusselt number in the forward stagnation region is appreciably larger than that in the rear stagnation region. As the Reynolds number increases, the latter Nusselt number increases more rapidly than the former. At sufficiently high values of Reynolds number, the rear-region Nusselt numbers are larger than those of the forward region.

These trends are fully plausible for cases where the upstream face is washed by a boundary-layer type flow and the downstream face is washed by a recirculating flow. The latter tends to be quite lethargic at lower Reynolds numbers, with resulting low values of Nusselt or Sherwood number. The recirculation is, however, quite responsive to the Reynolds number, as witnessed by the fact that $Nu \sim Re^{2/3}$ in a separated region downstream of an enlargement in flow cross section. On the other hand, the Nusselt number for a laminar boundary layer flow is less responsive to the Reynolds number, i.e. $Nu \sim Re^{1/2}$.

The foregoing plausibility discussion is generally pertinent to the flow situation being studied here, but there are complications because the upstream face of the plate is washed partially by a recirculation zone and partially by a boundary-layer type flow. A more complete discussion must await detailed information on how the Nusselt or Sherwood number for a forward-facing recirculation zone responds to changes in Reynolds number.

As a final observation with respect to Figs. 2 and 3, it may be noted that the data fall very naturally along straight lines. The respective slopes of the lines for the upstream and downstream faces are approximately 1/2 and 2/3.

Attention may now be turned to the effect of blockage ratio (i.e. plate height h) on the mass-transfer coefficients. When the transfer coefficients for all blockage ratios were brought together and examined, a rather unexpected finding emerged, namely, that the transfer coefficients were very nearly independent of the blockage ratio. This result has to be regarded as surprising because the streamline pattern, the size of the recirculation zones, the velocity in the free flow area, etc. are all affected by the plate height. In view of this, a large number of duplicate data runs were made in order to ensure the validity of the results.

Since the mass-transfer coefficient was found to be insensitive to the blockage ratio, it appeared unreasonable to use a characteristic dimension which would give rise to an artificial variation of the Sherwood number with the blockage ratio. It was on this basis that the Sherwood number definition of equation (2) was adopted. Furthermore, since the use of a blockage-related dimension in the Reynolds number would also have artificially separated the data, the definition given in equation (3) appeared to be appropriate.

The Sherwood number results for the upstream face of the transverse plate are presented in Fig. 4. The figure includes data for all of the blockage ratios that were investigated. Aside from the data for the smallest blockage, the Sherwood numbers for the other cases fall together with only a slight scatter. The segregation of the data for the smallest plate height is not an isolated finding. In the velocity boundary-layer experiments of [1], it was noted that the relative upstream influence of a transverse plate increased markedly as the plate height was reduced. Furthermore, Wieghardt ([2], pp. 275–276) observed an increase in "vortex strength" as the ratio of plate height to boundary-layer thickness decreased. It is also known that small inserts, which trip the viscous sublayer, are a highly effective technique for obtaining heat-transfer augmentation [7].

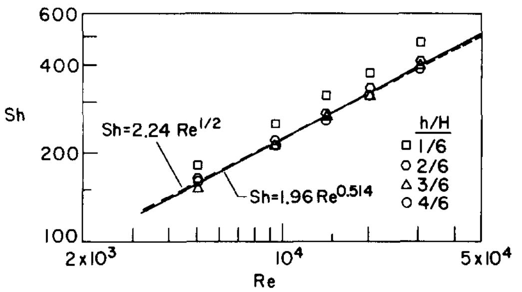

FIG. 4. Upstream-face Sherwood number results.

The data for the $h/H = 2/6$, 3/6, and 4/6 blockages have been fitted with least squares straight lines of the form

$$Sh = CRe^n. \tag{4}$$

For the solid line, both C and n were determined by the fitting procedure, whereas for the dashed line n was fixed at a value of 1/2. As can be seen from the figure, either of the lines provides a very good representation of the data. It appears that the half power is a valid Reynolds number dependence.

With a view to bringing together the data for the $h/H = 1/6$ blockage with that for the other cases, an additional curve fitting procedure involving h/H yielded a modified Sherwood number Sh' defined as

$$Sh' = [1.28+0.354\log(h/H)]Sh. \tag{5}$$

A graph of Sh' vs Re, Fig. 5, shows that the dependence on h/H has been successfully eliminated. Either of the least squares straight lines shown in the figure are effective representations of the data.

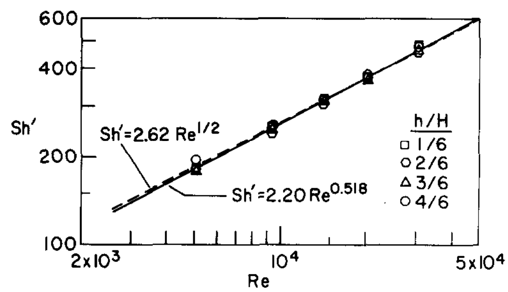

FIG. 5. Upstream-face Sherwood number correlation accounting for blockage ratio.

The downstream-faced Sherwood number results are presented in Fig. 6. The data for the largest blockage lie somewhat above the others, but there is no consistent trend with blockage since the data for the second largest blockage tend to lie on the low end of each cluster. In view of this, a correlation involving h/H was not attempted. Furthermore, since the overall scatter band at each Reynolds number was confined to 10–15%, it was deemed unnecessary to segregate the results for $h/H = 4/6$ from the others during the curve fitting process.

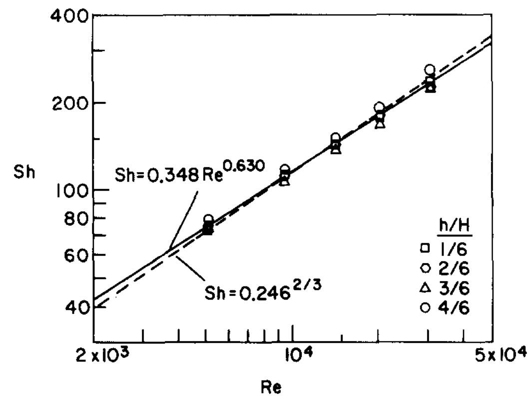

FIG. 6. Downstream-face Sherwood number results.

The least squares straight lines that were fitted to the data are shown in the figure. The line with the 0.630 slope appears to be a slightly better representation of the data than that with the 2/3 slope, but both are satisfactory. Although the 2/3 slope is rather commonly employed in the literature for separated regions downstream of an enlargement in flow cross section, a 0.6 slope has also been used [8].

It is interesting to speculate on the factors contributing to the insensitivity of the transfer coefficients to the blockage ratio. Of importance for the upstream face is the fact that the fractions of the surface respectively washed by recirculating flow and boundary layer flow are unaffected by changes in plate height. This finding was revealed by the boundary-layer experiments of [1], where h ranged from 0.476 to 10 cm (0.1875 to 4 in).

With regard to the downstream face, it is believed that the insensitivity is a result of trade-offs among competing factors. For a given Reynolds number, the velocity in the free flow area above the plate will increase with increasing plate height, and this tends to drive the recirculating flow at higher speed. On the other hand, the recirculation bubble is enlarged as the plate height increases, which tends to elongate the flow path of the backflow which washes the downstream face of the plate. As a result of the greater resistance associated with the longer path, it is unlikely that higher speeds are attained by the flow which washes the downstream face.

CONCLUDING REMARKS

The present experiments have provided results for the separate transfer coefficients for the upstream and downstream faces of a transverse plate situated in a square duct. Air was the working fluid, and the measurements were made with the naphthalene sublimation technique. The upstream-face coefficients were generally higher than those for the downstream face, but the differences diminished with increasing Reynolds number owing to the greater Reynolds responsiveness of the latter ($Re^{2/3}$ compared with $Re^{1/2}$). Perhaps the most remarkable finding of the study is the near insensitivity of the results to the extent of the blockage caused by the plate.

The separate upstream-face and downstream-face transfer coefficients can, under proper conditions, be added together to yield an overall transfer coefficient for the entire plate. The main constraint is that the increase in bulk naphthalene density ρ_{nb} (or, analogously, in the bulk temperature) due to mass (or heat) transfer at the upstream face be negligible. This constraint was fully satisfied in the present experiments, where the increase in ρ_{nb} due to upstream-face mass transfer was a few tenths of a percent of ρ_{nw}.

The heat/mass transfer analogy can be employed to transform the Sherwood-number results to Nusselt numbers. Further, if the Colburn analogy is assumed to hold, then the Nusselt number corresponding to a fluid with Prandtl number Pr can be obtained from the relation $Nu = (Pr/2.5)^{1/3}Sh$, where 2.5 is the Schmidt number for the naphthalene–air system.

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COEFFICIENTS DE TRANSFERT SUR LES FACES D'UNE PLAQUE TRANSVERSALE PLACEE DANS UN ECOULEMENT EN CONDUITE

Résumé—Des expériences sont faites pour déterminer les coefficients de transfert de chaleur et de masse sur les faces en amont et en aval d'une plaque transversale attachée à la paroi et qui bloque partiellement la section de passage d'une conduite carrée. Les expériences de transfert massique utilisent la technique de sublimation du naphtalène dans l'air en circulation. Par application de l'analogie des transferts de chaleur et de masse, le résultat est aussi valable pour le transfert thermique. Les plaques transversales employées dans les expériences provoquent des blocages qui s'étendent d'un sixième à deux tiers de la section droite du conduit. Le nombre de Reynolds pour le conduit est compris entre 5000 et 30 000. On trouve que pour un nombre de Reynolds donné, les coefficients de transfert pour chacune des faces sont insensibles à l'importance du blocage. Les coefficients pour la face avant sont généralement supérieurs à ceux de la face arrière, mais les différences diminuent lorsque le nombre de Reynolds augmente. Les coefficients varient selon une loi puissance approximativement un demi pour la face avant et deux triers pour la face arrière.

ÜBERGANGSKOEFFIZIENTEN AN DER OBERFLÄCHE EINER PLATTE, DIE QUER IN EINEM STRÖMUNGSKANAL ANGEBRACHT IST

Zusammenfassung—Versuche wurden durchgeführt zur Bestimmung der Wärme-/Stoffübergangskoeffizienten beiderseits einer Platte, die querstehend in einem quadratischen Kanal an dessen Wänden angebracht ist und den Durchflußquerschnitt teilweise blockiert. Die Versuche befaßten sich mit Stoffaustausch; sie wurden mittels des Naphthalin-Sublimations-Verfahrens mit Luft als Arbeitsmittel durchgeführt. Unter Anwendung der Analogie zwischen Wärmeübertragung und Stoffaustausch sind die Ergebnisse auch für die Wärmeübertragung gültig. Durch die im Versuch verwendeten Querplatten konnte der Durchflußquerschnitt im Bereich zwischen 5000 und 30 000 variiert werden. Dabei wurde festgestellt, daß bei einer gegebenen *Re*-Zahl die Übergangskoeffizienten sowohl der stromaufgewandten als auch der stromabgewandten Seite relativ unempfindlich gegenüber dem Ausmaß der Sperrung sind. Ganz allgemein waren die Koeffizienten an der stromaufgewandten Seite größer, aber die Unterschiede wurden kleiner mit steigender *Re*-Zahl. Die Koeffizienten zeigten eine exponentielle Abhängigkeit von der *Re*-Zahl, wobei der Exponent an der stromaufgewandten Seite ungefähr 1/2, der an der stromabgewandten Seite 2/3 beträgt.

КОЭФФИЦИЕНТЫ ПЕРЕНОСА НА ПОВЕРХНОСТЯХ ПЛАСТИНЫ ПРИ ЕЁ ПОПЕРЕЧНОМ ОБТЕКАНИИ В КАНАЛЕ

Аннотация — Экспериментально определены коэффициенты тепло- и массопереноса на лобовой и кормовой поверхностях пластины при её поперечном обтекании в канале. Пластина крепилась к стенке прямоугольного канала, частично загромождая его поперечное сечение. Эксперименты по определению коэффициентов переноса массы проводились по методу сублимации нафталина с использованием воздуха в качестве рабочей среды. В силу существующей аналогии между переносом тепла и массы полученные результаты по определению коэффициента переноса массы могут быть распространены на теплоперенос. Используемые в экспериментах пластины занимали от 1/6 до 2/3 поперечного сечения канала. Значения критерия Рейнольдса для канала изменились в пределах от 5000 до 30 000. Найдено, что в указанном диапазоне чисел Рейнольдса степень загромождения поперечного сечения канала не оказывает существенного влияния на коэффициенты переноса на обеих сторонах пластины. Вообще значения коэффициентов на лобовой поверхности оказывались выше, чем на кормовой, однако эта разность уменьшалась с увеличением числа Рейнольдса. Для коэффициентов переноса характерна степенная зависимость от числа Рейнольдса с показателем степени 1/2 для лобовой поверхности и 2/3 для кормовой.