LETTERS TO THE EDITOR

COMMENTS ON THE ARTICLE "INVESTIGATION OF HYDRAULIC RESISTANCE IN LONGITUDINAL FLOW OF AIR OVER A STAGGERED TUBE BUNDLE" (IFZh, 7, No. 11, 1964) BY A. I. MIKHAILOV ET AL

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The authors of [1], on the basis of several experimental items of work (including their own data for a staggered bundle with pitch s/d = = 1.2), put forward a formula for calculating the resistance coefficient for bundles of smooth tubes as a function of Re number and relative pitch s/d. This formula is as follows:

$$\zeta = (0.316\, s/d - 0.176)\ \mathrm{Re}^{-0.2},$$

$$1 \leqslant s/d \leqslant 1.46;\ 0.1 + 3\ s/d \leqslant \lg \mathrm{Re} \leqslant 0.9 + 3.3\ s/d.$$

In our opinion, because it is not well founded, this formula cannot be used for practical calculations of resistance in the flow in the intertube spaces of bundles.

We shall determine the range of Re number in which, according to the assertion of the authors of the above article, the proposed formula is valid for two extreme cases:

$$s/d = 1.0, \quad 1.26 \cdot 10^3 \leqslant \mathrm{Re} \leqslant 1.58 \cdot 10^4,$$

$$s/d = 1.46, \quad 3.02 \cdot 10^4 \leqslant \mathrm{Re} \leqslant 5.25 \cdot 10^5.$$

It is somewhat surprising that the dependence on Re number for such substantially different ranges of its variation should be the same.

We shall examine the papers on which the above authors drew in deriving their relation.

In reference [2] the data on the resistance of a staggered bundle with pitch s/d = 1.0 in the range of Re number investigated depends on $\mathrm{Re}^{-0.25}$, apart from the low Re region, $\mathrm{Re} \leq 2 \cdot 10^3$ where the dependence is intensified. As regards the data of [2] on the resistance of a bundle with relative pitch s/d = 1.13, the results of the measurements are in agreement with the dependence for staggered tubes, and lie significantly above the Blasius line and the relation proposed by the authors of [1]. It remains unclear why the point corresponding to this bundle turned out so low on Fig. 2 of [1].

In [3] a bundle was examined with relative pitch 1.12 ($6.10^3 < \mathrm{Re} < 10^5$). The resistance data lie about 5% below the Blasius line, apart from some points for $\mathrm{Re} > 7 \cdot 10^4$.

Regarding the data of the authors of [1], it should be noted that up to $\mathrm{Re} = 3 \cdot 10^4$ the line which averages the experimental points also has a slope corresponding to $\mathrm{Re}^{-0.25}$ and only when $\mathrm{Re} > 3 \cdot 10^4$ does the slope begin to decrease. In our opinion, this may be the result of the influence of roughness. However, the authors of the paper simply pass a line of lesser slope through all the available points, and then draw the unfounded conclusion that their dependence of resistance coefficient on Re number proved to be considerably weaker than for smooth tubes: $\zeta = 0.160\ \mathrm{Re}^{-0.181}$ for $\mathrm{Re} = 4.4 \cdot 10^3 - 10^5$.

The authors of [1] also do not attempt to explain the circumstance that their data lie noticeably below the experimental data of other authors and theoretical calculations. For example, in the range $5 \cdot 10^3 < \mathrm{Re} < 2 \cdot 19^4$ their data are located among or even somewhat below the data for a bundle with s/d = 1.12 [3].

If we add to this the fact that the data obtained in [4] for a bundle with pitch s/d = 1.46 have very substantial scatter, it then becomes clear, that the attempt to construct a general dependence of resistance on Re number and pitch on the basis of the data brought in by the authors of [1] is incorrect. A convincing example of this is reference [5], also referred to by those authors. The data of [5] for bundles with pitch s/d = 1.76, 2.05 and 2.37 practically coincide with the data of [4] for a bundle with pitch s/d = 1.46. The fact that the authors of [1] put forward a dependence only for s/d ≤ 1.46 cannot release them from the obligation to take this fact into account.

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