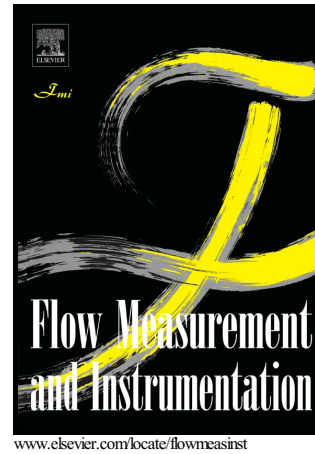


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# Enhancement of inline mixing with lateral synthetic jet pairs at low Reynolds numbers: The effect of fluid viscosity

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## Abstract

In this paper, mixing between two liquid streams of the same flow rate in a planar mixing channel enhanced by means of three lateral synthetic jet pairs is examined using PLIF and PIV at net flow Reynolds numbers of  $Re_n=2, 10$  and  $83$ . The changes in the flow Reynolds numbers are produced with the use of fluids with different dynamic viscosities. The synthetic jet pairs are operated  $180^\circ$  out-of-phase and at a range of actuation frequencies (characterized by the dimensionless Strouhal number  $Str$ ) and displacements (characterized by the dimensionless stroke length  $L$ ). It is found that at a sufficiently high frequency or dimensionless stroke length, a homogenous mixing can be achieved. Our experimental evidence shows that the synthetic jet pairs enhance mixing via two key mechanisms, i.e. vortex interaction and entrainment; tearing and stretching of liquid interface. A functional relationship among  $Re_n$ ,  $Str$  and  $L$  to ensure a nearly homogenous mixing is also obtained by best fitting the experimental data. It can be used for selecting the synthetic jet operating conditions to ensure a good mixing for a scaled version of this fluid mixer. This correlation indicates that the effectiveness of mixing has a weak dependence on  $Re_n$ , implying that the fluid mixers of such a design can be effective over a wide range of net flow Reynolds numbers and for fluids of different viscosities.

**Keywords:** Synthetic jets, jet mixing, liquid mixing, PLIF, PIV, low Reynolds numbers

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