NUMERICAL MODELLING OF GAS-JET WIPING

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Gas jet wiping or air knife is a technique to meter off an excess amount of liquid dragged by an upward moving strip to reduce its thickness to a desired value. After the interaction with the air jet, the final result is a thinner film carried by the substrate. The final thickness h_f depends on the velocity U of the web, the nozzle pressure P_N, the nozzle to plate distance z and the nozzle slot D.

For cost reduction, for industrial application, a very small thickness is sought. This can be achieved working at high nozzle pressure P_N and/or small distance z. The objective of this report is the modelling and the validation of the jet wiping at small stand off distances $z/D<8$.

An engineering model, the 1D Model, has been developed to compute the shape of the liquid interface. It requires that the pressure gradient $\nabla P(x)$ and the shear stress $\tau(x)$ distributions are known. Therefore, numerical simulations have been carried out in order to obtain such correlations. The simulations have been carried out using the commercial code Fluent. The wiping model has been also coded in Matlab.

Further, the influence of the liquid film has also been investigated. Numerical simulations have been carried out to check if the film affects the distributions for $\nabla P(x)$ and $\tau(x)$. The results in term of pressure gradient and shear stress were compared showing a good agreement with data found in literature as shown in the figure 1.

Finally, the interaction of the air jet and the liquid film has been investigated. The unsteady VOF model has been used. For this issue, VOF is very sensitive because the presence of instabilities on the liquid film. Guidelines for an approach to simulate numerically the interaction have been given.

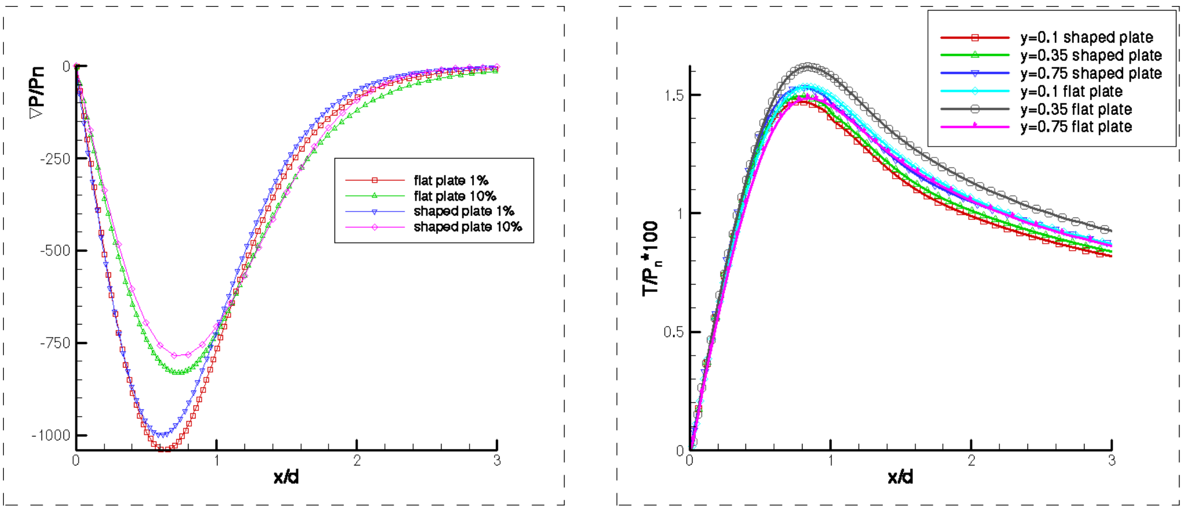

Figure 1 Pressure gradient (left) and shear stress (right) distributions.