Erratum

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Erratum to “Numerical study of mist film cooling on a flat plate with various numbers of deposition” [35 (1) (2021) 351~360]

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There is one correction to make to the original article. Fig. 15 in the original article was erroneously given. Fig. 15 along with its explanation in Sec. 3.7 and (6) in Sec. 4 should read as follows:

3.7 Study on coolant injection angle

A higher injection angle may have a favourable or an adverse effect on the film cooling performance. The coolant injection angle always plays an important role in the flow trajectory of the coolant. The larger the injection angle, the more the upward trajectory of the coolant flow. It uplifts the mainstream flow and keeps the hot fluid further away from the target surface. An increase in the turbulent kinetic energy can also be observed for the higher injection angles. It increases fluids mixing. However, the increasing fluids mixing does not affect the surface protection for an initial range of injection angles. Therefore, a rise in the film cooling effectiveness can be obtained for the initial increment of injection angle. Later, If the injection angle is increased to a very large angle, then it will allow the coolant to penetrate more into the mainstream flow. As a result, a vast amount of the coolant will mix with the hot fluid; and the coolant will be unable to form an effective film barrier above the surface. Thus, a very large injection angle may adversely affect the film cooling effectiveness.

In the present study, the injection angle was investigated for three angles, $\alpha = 35^\circ$, 50° and 65° , for the geometry having five numbers of depositions towards the downstream. It can be figured out that the film cooling effectiveness starts to increase for the larger injection angles as referred to in Fig. 15. Therefore, the highest mist film cooling performance can be noticed for $\alpha = 65^\circ$ while it is lowest for $\alpha = 35^\circ$.

Fig. 15. Comparison of mist film cooling effectiveness at different injection angles.

Fig. 17 represents the non-dimensional velocity contours with vectors which show the upward trajectory of the coolant flow for different injection angles. Additionally, the turbulent kinetic energy is presented in Fig. 16, which depicts the highest turbulence at $\alpha = 65^\circ$. And $\alpha = 35^\circ$ shows the lowest turbulence in Fig. 8(c). As discussed earlier, a higher turbulent kinetic energy is responsible for the boosting of fluids mixing. Thus, the fluids mixing is maximum for $\alpha = 65^\circ$. But the film cooling effectiveness increases with the larger injection angles as the effect of the uplifting of mainstream fluid by the coolant is more dominant in the present study. Furthermore, it can also be observed that the increment rate of the film cooling from $\alpha = 50^\circ$ to 65° is less than that from $\alpha = 35^\circ$ to 50° . It means that the rate of increment of cooling performance reduces with the higher injection angles as the turbulent fluids mixing starts to increase. And finally, it can be noted that despite having the higher fluids mixing, the mist film cooling effectiveness increases for the expansion of injection angle from $\alpha = 35^\circ$ to 65° .

4. Conclusions

(6) The largest injection angle of coolant can provide the best cooling performance while it is worst at the smallest injection angle. After the exit of secondary hole, the coolant approaches with the more upward trajectories for the higher injection angles and despite having a higher turbulent mixing of fluids, the coolant can keep the mainstream fluid more away from the target surface. It results in improved film cooling performance.