CONVECTIVE HEAT TRANSFER TO FUSIBLE LINKS

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On reading the paper on the performance of fusible links by Chow and Cheng [1] in a recent issue of this journal I have two points to raise in relation to it.

In the theory on pages 4 and 5 the assumption is made that the convective heat transfer coefficient (h, units W $m^{-2}K^{-1}$) is proportional to the square root of the fluid speed. This can be expressed:

$h \propto v^{0.5}$

where v is the fluid speed, units ms^{-1}. In fact the generalised correlation for forced convection is [2]:

$Nu = hL/k = f(Re,Pr)$

where Nu is the Nusselt number, equivalent to the dimensionless convection coefficient, k the thermal conductivity of the fluid at the film temperature, L the dimension of the body experiencing convection (e.g., the diameter in the case of a sphere), Re the Reynolds number and Pr the Prandtl number. Now the definition of Re is:

$Re = vL/\upsilon$

where υ is the kinematic viscosity, units m^2s^{-1}. Clearly then the convection coefficient h is proportional to v raised to whatever power Re is raised to in the above correlation in the particular form in which it is being used. This varies between such correlations and there is no reason at all to assign it a single value as in the work under discussion. I appeal to the authors of [1] to address this point.

Secondly, even though the tests in [1] were in a wind tunnel there is no justification for assuming that convection was entirely forced to the exclusion of natural. Whether natural convection also contributes can be ascertained by calculation of Re and of the Grashof number Gr [2]. It would have added to the value of [1] if this had been done.

REFERENCES

1. W.K. Chow and A.C.K. Cheng, "Preliminary studies on thermal sensitivity of fusable links with a wind tunnel", International Journal on Engineering Performance-Based Fire Codes, Vol. 9, No. 1, pp. 1-6 (2007).
2. J.P. Holman, Heat transfer, McGraw-Hill, any available edition.