ON THE EQUAL AND OPPOSITE CONCEPT IN FIRE EXTINGUISHMENT WITH WATER

J.C. Jones
School of Engineering, Fraser Noble Building, University of Aberdeen, King's College
Aberdeen AB24 3UE, Scotland

In a book from a few years ago [1], the present author introduced the concept of 'equal and opposite' in water supply for fire fighting. It has the following basis. The heat of vaporisation of liquid water at its normal boiling point is 2257 $kJkg^{-1}$. The heat required to raise a kilogram from a supply temperature of 30°C to the boiling point is:

$$4.2 \times (100 - 30) \text{ kJ} = 294 \text{ kJkg}^{-1}$$

which when added to the latent heat gives 2551 $kJkg^{-1}$.

In order to be 'equal and opposite' to a fire at 1 MW, water would need to be supplied at a rate:

$$1 \text{ MJs}^{-1}/(2.551 \text{ MJkg}^{-1}) = 0.39 \text{ kgs}^{-1}$$

In a recent article on the topic of water supply for fire fighting, a figure of 0.58 litre per second is given as 'required to suppress a 1 MW fire'. A litre and a kilogram of water are of course equivalent for the purpose of a calculation such as this, indicating a value of 0.58 kgs^{-1} compared with the equal and opposite value of 0.39 kgs^{-1}. That the required value is almost 50% higher is intuitively reasonable and this provides a basis for adjusting the 'equal and opposite' value to a value for practical conditions where there will be some water loss. The latter is obtained by multiplying the former by 1.5, a result appealing in its simplicity.

REFERENCES

1. J.C. Jones, "Numerical exercises in fire protection engineering", xi + 78pp., Whittles Publishing, Caithness (2006).

2. P. Grimwood, "Flow method", Fire Risk Management, pp. 46-50, March (2010).