DROP VAPORIZATION IN SPRAY

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Standard models of drop vaporization utilized in computational fluid dynamics codes do not explicitly take into account the screening effects of neighboring drops on the vaporization rate. This paper describes the detailed solution of the conjugate problem of drop vaporization in spray to identify the spray effects and their manifestation in dense sprays. The concept of the elementary spheres surrounding liquid drops has been introduced to account for the screening effects of neighboring drops by imposing zero mass and energy fluxes on the surfaces of the spheres. Based on the detailed calculations of drop vaporization within the elementary sphere, a new approach is suggested to account for the spray effects. The essence of the approach is to properly redistribute the mean temperature and mean vapor concentration within the elementary sphere so that the spray effects do not manifest themselves at the beginning of the evaporation process (before the diffusion fluxes reach the elementary sphere boundary) and start strongly manifesting themselves after the diffusion fluxes reach the elementary sphere boundary. It has been shown that implementation of this approach resulted in a better correlation of the predicted drop lifetime with the detailed solution and in a weaker dependence of the computational results on the size of the computational cell, as compared with standard models.