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A Diffusive Model for Evaporation of Spherical Water Drops at Room Temperature and Standard Pressure

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Evaporation of drops at room temperature and atmospheric conditions is mainly impelled by diffusion of vapor. Diffusion of vapor is a function of vapor concentration gradient (VCG) at the drop surface. The developed model in this paper modifies the relations used for finding the VCG for drops. The relations in literature for evaporation of millimetric drops are based on the study of Maxwell, which was originally for evaporation from a wet bulb. The VCG according to Maxwell based models is stationary and a function of the inverse of the bulb radius. However, where one uses this model for millimetric drops, the VCG becomes time dependent and increases in time (as during the evaporation, drop radius decreases). Intuitively it is understandable that the VCG should decrease in time (notwithstanding the Kelvin effect for very small microscopic drops). In this study a diffusion model is developed which uses a time dependent VCG that decreases in time. The developed diffusion model is able to predict the evaporation time of millimetric water drops studied in literature as well as the ones studied in this study. It should be noted that Maxwell based models could not predict the evaporation time of such drops.