# Influence of contact angle and temperature on evaporation of droplets

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It was shown experimentally earlier, that the rate of change of the volume of an evaporating droplet depends linearly on the radius of the droplet base [1, 2]:

$$\frac{\mathrm{d}V(t)}{\mathrm{d}t} = -\alpha L(t), \tag{1}$$

where $t$ is time, $V(t)$ is the droplet volume, $\alpha$ is a proportionality constant, $L(t)$ is the radius of the droplet base. The latter means proportionality of total flux of vapour from the surface of a droplet, $J$, to the radius of the droplet base, $L$.

Computer simulations were carried out to verify the above experimental dependency (1), as well as to investigate the dependency of proportionality coefficient $\alpha$ on contact angle, $\theta$, and average temperature, $T_{av}$, of the droplet surface.

The following phenomena were taken into account in our simulations: a heat conduction in the substrate, liquid droplet and surrounding air; the latent heat of vaporisation; vapour diffusion in the surrounding air; viscous flow in a droplet caused by thermocapillary tangential stress.

Convection in the air was neglected because experiments [3] have shown that there is no influence of a forced convection in the surrounding air on the evaporation rate. The Soret effect also was neglected due to small range of temperatures (less than 3 degrees) in the system under investigation.

The simulation has revealed that the proportionality coefficient $\alpha$ substantially depends on the contact angle, $\theta$, as well as directly proportional to the difference of saturated and ambient vapour concentrations, $C_{sat}(T_{av}) - C_{\infty}(T_{\infty})$, at the droplet surface and in ambient air respectively. The results of simulations are in an agreement with the analytical solution obtained by R.G. Picknett and R. Bexon [4]. The only influence of the average temperature, $T_{av}$, of the droplet surface on $\alpha$ is the change of saturated vapour concentration $C_{sat}(T_{av})$.

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[1] K.S. Lee, C.Y. Cheah, R.J. Copleston, V.M. Starov, K. Sefiane, *Colloids and Surfaces A* **2008**, *323*, 63 – 72.
[2] S. David, K. Sefiane, L. Tadrist, *Colloids and Surfaces A* **2007**, *298*, 108 – 114.
[3] V. Starov, K. Sefiane, *Colloids and Surfaces A* **2009**, *333*, 170 – 174.
[4] R.G. Picknett, R. Bexon, *Journal of Colloid and Interface Science* **1977**, *61* (2), 336 – 350.