

## Diffusivity and Solubility of Water in Palm Oil

Martijn M.P. Zieverink, Unimills BV, Zwijndrecht, The Netherlands

[m.zieverink@unimills.nl](mailto:m.zieverink@unimills.nl)

Eva de Rijke, Kees C.G. de Kruijf and Peter M.T. de Kok

NIZO Food Research, Ede, The Netherlands

[peter.de.kok@nizo.nl](mailto:peter.de.kok@nizo.nl)

Knowledge and control over the water content in vegetable oils is of great practical importance: the water content of an oil determines the amount of free fatty acids that can be formed through hydrolysis. 0.1 wt% of water in a vegetable oil can result in 0.7-1 wt% of free fatty acids, depending on the chainlength of the fatty acids. An amount of oil stored at a given temperature in contact with air of a certain humidity will slowly equilibrate with the water in the air through the process of diffusion. The rate at which this process takes place is dependent on the dimensions of the storage container and the diffusivity of water in the oil.

The equilibrium water content of palm oil was determined as a function of the relative humidity at 30°C, 40°C and 50°C using gravimetrics. The rate of water release / uptake of a palm oil sample of known dimensions was used to estimate the diffusion constant of water. It was found that the rate of diffusion of water is of the same order as gases dissolved in vegetable oils (Table 1).

Table 1: Diffusivity of different molecules in vegetable oil ( $\times 10^{-10} \text{ m}^2 \text{ s}^{-1}$ )

molecule	medium	temperature (°C)				reference
		25	30	40	50	
hydrogen	soybean oil		28			Fillion et al, 2000
hydrogen	olive oil	28				Davidson et al, 1952
nitrogen	soybean oil		16			Fillion et al, 2000
nitrogen	olive oil	6				Davidson et al, 1952
oxygen	olive oil	8				Davidson et al, 1952
water	palm oil		7	13	32	this work

With the results of this work, an estimate can be made of the rate by which a large stationary volume of palm oil (e.g. in a storage tank) picks up moisture from the air with which it is in contact.