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Determination of surface tension of water and interfacial tension of water-kerosene interface by light diffraction

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Light diffraction by capillary waves, generated on the surface of a liquid is a very precise and none destructive method of finding the surface tension and other related physical parameters. In this research diffracted laser light patterns formed by the generation of surface capillary waves were used to find the surface tension of distilled water and the interfacial tension between thin kerosene films floating on distilled water as a function of film thickness. A pin attach to the diaphragm of a speaker was served as the exciter to generate surface capillary waves by the center of a dish which was filled with distilled water up to a certain level. A semiconductor laser (wavelength = 660 nm) was used as the coherent light source for the experiment. The diffracted light from the liquid surface was obtained on to a distant vertical wall, which served as the screen for the experiment. The diffraction patterns were observed by changing the oscillating frequency of the exciter pin. Obtained value of surface tension for distilled water was recorded as (0.0766 ± 0.0015) Nm^{-1}. By adding known amount of kerosene and following the same procedure the interfacial tension was calculated for several thicknesses (0.07, 0.14 and 0.21 mm) of kerosene film as 0.0470 ± 0.0022, 0.0404 ± 0.0025 and 0.0362 ± 0.0010 Nm^{-1}. The sudden drop in interfacial tension even for a slight kerosene film is observed and further study of film thickness against interfacial tension is proposed to model the effect of kerosene on natural water resources.

Keywords: Interfacial tension, Light diffraction method, Surface tension.

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