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Wetting dynamics of polyoxyethylene alkyl ethers and trisiloxanes in respect of polyoxyethylene chains and properties of substrates

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HIGHLIGHTS

- ► Spreading of aqueous solutions of trisiloxanes and polyoxyethylene alkyl ethers.
- ► Wetting of Parafilm and Teflon AF surfaces in a wide range of concentrations.
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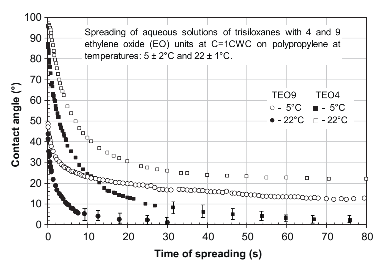
GRAPHICAL ABSTRACT



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ABSTRACT

Wetting performance of aqueous solutions of trisiloxane surfactants (TEO_n) and polyoxyethylene alkyl ethers ($C_{10}EO_n$) on polypropylene, Parafilm and Teflon AF surfaces in a wide range of concentrations has been investigated. Surfactants $C_{10}EO_n$ only facilitate partial wetting of water on all surfaces, but TEO_n surfactants induce superspreading on polypropylene and Parafilm at room temperature (22 °C) at critical wetting concentration (CWC). Influence of the length of EO chains on wetting ability has a completely different character for $C_{10}EO_n$ and TEO_n surfactants. In the case of $C_{10}EO_n$ the final contact angle increases on all substrates used with increasing number of EO units. However, the final contact angles for droplets of TEO_n solutions decrease with increasing of n(EO) reaching a minimum values at n(EO) = 6 at the critical aggregation concentration (CAC), or show complete spreading (the final contact angle is nearly zero) for n(EO) = 5–8 at 1 CWC on moderately hydrophobic substrates. Temperature-dependent spreading behaviour of both TEO_n and $C_{10}EO_n$ surfactant solutions has also been studied. It has been shown for the first time, that tuning of spreading performance with temperature for polyoxyethylene alkyl ether surfactants is possible. The increase of spreading capability for both trisiloxane surfactant solutions and polyoxyethylene alkyl ethers solutions is observed at temperature close to the cloud point for a given surfactant.

1. Introduction

The improvement of spreading ability of water-based solutions over hydrophobic surfaces is of great importance in such industrial processes as herbicide spreading [1–3], paper and plastic recycling processes [4,5], and other applications [6]. To enable water to spread over low-energy substrates surfactants are used as additives decreasing the interfacial tension of air–water and solid–water interfaces through energetically favourable adsorption of surfactant molecules at these interfaces.

Nonionic ethoxylated alcohols (polyoxyethylene alkyl ethers, C_mEO_n) can lower the surface tension of aqueous solutions down to 30 mN/m [1,7] at the CMC and facilitate wetting of hydrophobic surfaces. Spreading behaviour of aqueous solutions of the homologues $C_{12}EO_n$ over hydrophobic surfaces have appeared to be the

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