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## Silica micro- and nanoparticles reduce the toxicity of surfactant solutions

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### HIGHLIGHTS

- Silica particles reduce toxicity of ether carboxylic derivative surfactants
- Silica particles reduce toxicity of alkyl polyglucoside surfactants
- Toxicity reduction depends on the ionic character of the surfactants
- Silica particles reduce the CMC of anionic surfactants
- Silica particles increase the CMC of non-ionic surfactants

### Abstract

In this work, the toxicity of hydrophilic fumed silica micro- and nanoparticles of various sizes (7 nm, 12 nm, and 50  $\mu\text{m}$ ) was evaluated using the luminescent bacteria *Vibrio fischeri*. In addition, the toxicity of an anionic surfactant solution (ether carboxylic acid), a nonionic surfactant solution (alkyl polyglucoside), and a binary (1:1) mixture of these solutions all containing these silica particles was evaluated. Furthermore, this work discusses the adsorption of surfactants onto particle surfaces and evaluates the effects of silica particles on the surface tension and critical micellar concentration (CMC) of these anionic and nonionic surfactants. It was determined that silica particles can be considered as non-toxic and that silica particles reduce the toxicity of surfactant solutions. Nevertheless, the toxicity reduction depends on the ionic character of the surfactants. Differences can be explained by the different adsorption behavior of surfactants onto the particle surface, which is weaker for

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