Abstract

Process Economics Program Report 59C

BIO-BASED ANIONIC SURFACTANTS

(November 2010)

Sustainability, “development that meets the needs of the present without compromising the ability of future generations to meet their own needs,” is a growing issue with consumers in the United States. Western European and Japanese consumers, who seem to be better informed about environmental concerns surrounding surfactant use, are adopting non-petroleum based products the quickest. The large increases in the price of crude oil during 2007–2008 further drove the interest of consumer product formulators as well as consumers to oleochemical-based surfactants.

Anionic surfactants command the largest share of the commodity surfactant market, which includes laundry and dishwashing applications. The three largest volume anionic surfactants, linear alkylbenzene sulfonates (LAS), alpha olefin sulfonates (AOS) and alcohol ether sulfates (AES), are all totally or largely ethylene based.

The two potentially largest volume, sustainable anionic surfactants, methyl ester sulfonate (MES) and alcohol ether sulfate (AES) are produced from palm oils or coconut oil. MES is biodegradable and can substitute for LAS. AES, besides replacing petroleum-based AES, can substitute for some other ethylene-based surfactants. Both MES and AES contribute desirable surfactant properties to detergent and personal care products.

This PEP Report first provides a brief overview of the sustainability issue and market trends for the raw material supply chain from natural oils through intermediate methyl esters and fatty alcohols to the final MES and AES surfactants. Reaction chemistry and MES and AES production processes are reviewed next. We then develop the process economics of integrated plants for the production of two bio-based anionic surfactants:

- Solid MES (86.3% active matter) from C_{16} palm oil methyl ester feedstock by sulfonation with gaseous SO_3, bleaching and neutralization, followed by drying into a product suitable for dry blending into detergent formulations, and
- Liquid AES (70% active matter) from C_{12} lauryl alcohol derived from coconut oil by ethoxylation with gaseous ethylene oxide, sulfation with gaseous SO_3 and neutralization.

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CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

FIGURES

FIGURES (Concluded)

TABLES

TABLES (Continued)

TABLES (Continued)

TABLES (Continued)

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