

*Director's  
Digest*



---

WERNER R. BOEHME  
Technical Director

---

2720 DES PLAINES AVENUE  
DES PLAINES, ILLINOIS 60018  
AREA CODE 312-827-0139

---

April, 1974

No. 118

---

LSDA - SOAP DETERGENTS TESTED FOR BIOLOGICAL ACCEPTABILITY

Laundry detergents based on soap and a tallow-derived lime soap dispersing agent (LSDA) were tested for biodegradability and toxicity according to a recent publication from the Eastern Regional Research Center of the U. S. Department of Agriculture. Reporting in the Journal of the American Oil Chemists' Society, a team of investigators headed by Dr. W. M. Linfield found three LSDA-containing soap detergents to be biodegraded readily under aerobic and microaerophilic conditions. Toxicity tests conducted on mammals and fish indicated the soap-based formulations to be as safe as conventional commercially available detergents.

The effectiveness of tallow soap is severely reduced in hard water due to the presence of calcium, magnesium and other polyvalent ions. Studies conducted at the Eastern Regional Research Center demonstrated that the detergency of soap in hard water can be increased by addition of a lime soap dispersing agent and sodium silicate to equal the performance of commercial detergents containing phosphates. The investigation of new lime soap dispersing agents at the Eastern Regional Research Center has been supported for several years by the Fats and Proteins Research Foundation.

The detergent formulations consisted of 62% tallow soap, 21% LSDA, 16% sodium silicate, 1% carboxymethylcellulose and a small amount of optical brightener. Three LSDAs were examined: tallow methyl sulfonate (TMS), tallow isopropanolamide sulfate (TAM) and methyl sulfoethyl tallowamide (IGT). Tallow soap and a commercial detergent based on linear alkylbenzenesulfonate (LAS) were the reference standards.

Tallow soap and the three experimental formulations containing lime soap dispersing agents degraded readily under aerobic conditions by the Esso controlled nutrient procedure. The reduction in soap concentration was measured by the decrease in carbon and oxygen content of the solution, by reduction in methylene blue-active substance, by change in turbidity as bacterial growth first increased and then fell off again and by the gradual increase in surface tension as soap was consumed. The course of microaerophilic degradation under an atmosphere of nitrogen in moderately hard water was monitored by the change in surface tension and methylene blue active substance.

In general, bacterial growth in solutions of the LSDA-containing detergents reached a maximum in 3-6 days under aerobic biodegradation conditions. Carbon content and methylene blue active substance fell gradually over several weeks. Based on the rate of carbon reduction, detergents containing TMS and TAM were biodegraded as efficiently as tallow soap itself, and to a greater extent than the IGT-containing formulation. All three detergent compositions were degraded by at least 80%. Under these bacteriological conditions 97-98% of the tallow soap and 56% of the linear alkylbenzenesulfonate were consumed. Under microaerophilic conditions, however, the rate of biodegradation of the TMS formulation was considerably slower than that of formulations containing TAM or IGT when measured by the change in surface tension and methylene blue active substance.

Acute oral toxicity studies conducted on soap formulations containing TMS and TAM showed them to be about half as toxic in mice ( $LD_{50} = 5-8$  g/kg) as the control, a commercial detergent based on LAS and phosphate ( $LD_{50} = 2.5-3.5$  g/kg). Toxicity to fish, however, was greater for the LSDA-containing formulations (TLM = 6.5-9ppm) than for the control (TLM = 14ppm).

Skin irritation measurement conducted on rabbits indicated the experimental formulations and the control to be mildly irritating. In the rabbit eye 10% solutions were slightly irritating and the dry powders caused a severe but reversible irritation. Irritation due to the control detergent was more intense than that of the experimental formulations. There was no indication of sensitization upon intracutaneous administration to guinea pigs. The authors conclude that the toxicity of the LSDA-containing soap formulations is of the same order of magnitude as a leading commercial detergent containing phosphates (E.W. Maurer, T.C. Cordon, J. K. Weil and W. M. Linfield, Journal of the American Oil Chemists' Society, 51, 287 (1974)).