

# Phosphate and Non-Phosphate Detergents

*Sir:* In their presentations at the October meeting of the AOCS in Atlantic City, Eric Jungermann and H.C. Silberman, authors of "Sound and Safe Detergent Builders," and R.C. Steinhauer, A.J. Wysocki and E. Jungermann, authors of "Performance of Non-phosphate and Phosphate Heavy Duty Laundry Detergents," stated that a highly alkaline, sodium carbonate-built laundry detergent tested by them is essentially equivalent to typical phosphate-built detergent products as regards safety to humans. Their conclusion was based upon data presented in a paper entitled "Safety of Phosphate and Non-Phosphate Based Heavy Duty Laundry Detergents" by J.B. Williams and David Taber at the Lake Placid Short Course sponsored by AOCS earlier last year, as well as data presented by Armour-Dial to the Federal Trade Commission.

Attending the Lake Placid Short Course, I commented on Williams' and Taber's presentation indicating that our data are in disagreement with their conclusion. Because their conclusion has been restated subsequently at the Atlantic City AOCS meeting in October, as well as in Armour-Dial presentations to the Federal Trade Commission and elsewhere, I would like to register formally my disagreement with their position and present data in support of my position.

The compositions of the products we tested were (by analysis): (a) Highly-Alkaline Detergent: sodium carbonate, 68%; nonionic surfactant, 12%; sodium silicate (not metasilicate), 7%; moisture and minor ingredients, balance; and (b) Typical Phosphate-Built Detergent: sodium tripolyphosphate, 50%; anionic surfactant, 17%; sodium sulfate, 13%; sodium silicate (not metasilicate), 6%; nonionic surfactant, 2%; moisture and minor ingredients, balance.

The product referred to in this letter as the highly alkaline detergent is representative of the Type 1 non-phosphate detergent tested by Williams and Taber, and which they claimed was essentially equal as regards human safety to the leading phosphate detergents.

In a report by the Cornell Aeronautical Laboratory, Inc., to the National Commission on Product Safety, C.J. Schneider, Jr., described a method for determining the potential for injury through alkaline destruction of tissue by automatic dishwasher products ("The Ingestion Hazard of Dishwasher Detergents and Liquid Waxes and Polishes," CAL Report No. VZ2926-D-7, March 1970). In this screening test the potential for tissue damage is referred to as "causticity" and is determined by titrating a solution of the test product with acid from its initial pH to pH 9.5. Using this technique, the carbonate-built product was shown to have a "causticity" value per unit volume 50 times greater than that of the phosphate-built product.

In the rabbit eye irritation test described in the regulations to the Federal Hazardous Substances Act, both the highly alkaline and the phosphate-built detergents produced essentially equal ocular involvement within the specified 3 day observation period. However by the conclusion of the 3 day period the eyes treated with the phosphate-built detergent began to return to normal; those treated with the highly-alkaline product remained essentially unchanged. Data presented to the Federal Trade Commission by the Monsanto Company has shown that

within 2 weeks, eyes treated with the phosphate-built detergent had returned nearly to normal, whereas effects on eyes treated with the highly alkaline product progressed to permanent loss of vision and destruction of ocular tissue.

Rabbit eye irritation tests performed in our laboratories corroborate the results of the Monsanto studies as did tests with monkeys (whose eyes are more similar to human eyes than are rabbit eyes). Monkey eyes treated with the typical phosphate-built detergent developed signs of slight superficial irritation that cleared completely within 3 days; whereas eyes treated with the highly alkaline, high carbonate detergent developed prolonged irritant effects which in some animals proceeded to permanent damage.

In comparing the highly alkaline and the phosphate-built detergents for acute oral toxicity, as one test in assessing the human accidental ingestion safety of them, groups of two beagle dogs each were given 2.5 cc of product per kilogram body weight. The total dose per beagle was approximately 30 cc. The test products were administered to the dogs by gastric intubation to insure that the entire amounts given reached the stomachs.

Although children may take materials into their mouths in the dry form, ingested substances would be mixed with saliva and other body fluids before entering their stomachs. To simulate the physical characteristics of the test materials as they would be expected to reach the stomachs, and to insure accurate dosing for reproducible results, they were administered as 40% w/w aqueous slurries.

Emesis occurred promptly following the administration of the products. Emesis from the phosphate-built product continued for a few minutes only, and the dogs appeared grossly normal upon the cessation of emesis. Emesis from the highly alkaline product was protracted—lasting ca. 2 hr. These dogs appeared debilitated upon cessation of vomiting.

Gastrosocopy employing an American Cystoscope Makers, Inc., Esophago-Gastro-Duodenscope was performed on the dogs, and photographs of the stomachs and esophagi were taken. The experiment was observed and the effects graded on a double blind basis by a board-certified gastroenterologist.

The highly alkaline product produced grade 3-plus effects (bleeding, ulceration, sloughing) which the gastroenterologist termed alarming and most serious. The stomach tissue was judged to be quite friable. One of the two dogs treated with the product died 10 days following treatment.

In sharp contrast, the phosphate-built detergent produced transient erythema and edema only (grade 1-plus), which cleared completely.

The above results are substantiated by the revelation by Armour-Dial to the Federal Trade Commission that scarring ulceration was produced in the stomach of one of four dogs given only 1 teaspoonful of the highly alkaline product, whereas the three dogs given the typical phosphate-built detergent displayed no signs of irritation at all. None of the several phosphate-built granular laundry detergent formulations reported by Armour-Dial produced scarring ulceration such as reported for the highly alkaline product.

Furthermore, data from rabbit tests submitted by them

to the FTC showed the highly alkaline, carbonate-built product to be more corrosive than any of the remaining 12 products tested. Specifically, as regards this discussion, the typical phosphate-built granular laundry detergents produced no corrosion in any of the rabbits tested.

These data, generated at an independent consulting laboratory, at our own toxicology laboratory, and by Armour-Dial, demonstrate that the highly alkaline, carbonate-built detergent is much more hazardous than the phosphate-built product. It seems clear that sound assessment of toxicologic data proves that the highly alkaline, carbonate-built product is clearly not as safe as the

phosphate-built product. The phosphate-built, granular laundry detergents have established an outstanding safety record in the 20-plus years they have been in widescale use, despite the thousands of instances in which they have been ingested by small children.

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