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**Laboratory Study of
Lead-Cleaning Efficacy**

Executive Summary

The United States Environmental Protection Agency (EPA) has recommended the use of trisodium phosphate (TSP) detergent to clean lead-contaminated dust from surfaces, both after residential lead hazard control work to achieve post-abatement clearance standards and in general. This recommendation has often been assumed to apply to the general cleaning of lead-contaminated dust during ongoing exposure reduction activities. Because of the negative impact of phosphate detergents on the ecology of aquatic ecosystems, questions have arisen as to the scientific basis of recommending TSP and about the effectiveness of other cleaners. The objective of this laboratory study was to compare the cleaning efficacy of many commercially available cleaners that could be used to remove lead-contaminated dust from residential surfaces.

Thirty-four cleaners were tested in this study: 32 commercially available cleaning agents, TSP, and tap water of average hardness. Most brands were general all-purpose cleaners, hand or machine dishwashing products, laundry detergents, and bathroom, floor, and glass cleaners, while some brands were lead specific cleaners. The cleaning agents were selected to represent the range of commercial cleaning products that would reasonably be available to a consumer. Most of the cleaning agents were purchased at a full line grocery store. Although high purity TSP was used in this study, TSP for cleaning walls and lead abatement activities is available at home/builders supply stores. Two of the cleaners were purchased from a professional janitorial supply house, principally to have all-purpose cleaners with "high" phosphate content.

The cleaning agents were selected in an attempt to span a wide range of (1) phosphate content, (2) pH, and (3) active ingredients. It was found that most cleaning agents available to household consumers are (1) low or zero phosphate content, (2) high pH (basic), and (3) contain various active ingredients, often more than one surface active chemical. The cleaning agent formulations are nearly always considered proprietary, and the information on the cleaning agent label varies in content, particularly for the surface active ingredients that enhance the cleaning performance. In some cases, the phosphate content varies according to the geographical region in which the product is to be sold.

The tests were conducted using five types of surfaces selected to represent those commonly found in residential settings: vinyl tile, latex paint on drywall, enamel paint on birch, lacquer (Fabulon) on oak, and latex paint on birch. In addition to varying the types of surfaces tested, two types of leaded soil were used. One soil type contained vegetable oil (oily soil); the other contained no

vegetable oil (dry soil). Each lead-containing soil mixture was mixed in a solvent, wiped on a test surface in a standardized manner, and allowed to dry before the surfaces were cleaned.

Each of the 34 cleaning agents was tested on all combinations of surfaces and soil types using the test procedures. First, the cleaner was mixed with water according to the manufacturer's instructions and the mixture's surface tension was measured, then the sponge and the cleaner solution were used to clean lead from the prepared surfaces. Baby wipes were used to sample the cleaned surface in order to measure the lead left behind after the cleaning process with the cleaner solution and sponge. This test procedure was repeated three times.

Lower surface tension cleaners were associated with better cleaning; however, differences among cleaning agents were small. Because all tested cleaning agents have lower surface tension than tap water alone, household cleaning using one of these cleaning agents is likely to remove more leaded soil and dust than does water alone. Phosphate content was not linked to cleaning efficacy. In particular, several of the lower phosphate cleaners had overall cleaning efficacy similar to or better than TSP. Differences in cleaning efficacy also depended on which laboratory technician performed a test, suggesting that the physical effort put into cleaning may be more important than the choice of cleaner.

Based on the primary conclusions of this study, EPA recommends that either a general all-purpose cleaner or a cleaner made specifically for lead should be used for both general cleaning and for post-intervention cleaning. Household cleaning using one of these cleaning agents is likely to remove more leaded soil and dust than does water alone. Finally, the study indicates that the effort put into the cleaning may be more important than the choice of cleaner.

The extent to which these conclusions, based on laboratory investigation, apply to homes in real-life situations is a matter of judgment. For example, the lead-containing soil material used in this study was mixed in a solvent, wiped on the test surfaces, and allowed to dry before cleaning. This application method might have resulted in soil lead that is more closely bound to a surface than loose soil or settled dust in a home. At the same time, the soil applied to the test surfaces was not ground in, as might occur as a result of foot traffic in a home. Regardless of the potential differences between experimental conditions and real-life settings, the results of this comparative study do not support the recommended use of TSP for the reduction of lead dust exposure.