The Sherwin-Williams Company
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February 8, 1972

Research Proposal
(Explanation)

There seems to be little doubt that paint films containing 0.5% Pb on the dried solids would be toxic to a child if:

1) The child ingested ~ 11 cm^2 of thick (0.089 gm./cm^2) paint films per day for long periods of time.

2) All of the lead in the paint film could be extracted from the paint film by digestive fluids.

3) Toxicity is defined as any increase in blood lead level above 40 μg/100 ml, the maximum normal level.

The questions, then, that should be answered by a definitive research project would seem to at least include the following:

1) How much loose paint chips does a child who has pica and has paint chips available actually eat?

2) How well can the digestive fluids extract lead from a paint chip that has been pulverized only to the extent that a child with pica would pulverize a paint chip when eating it?

3) Can mental retardation (which seems to be the clinical symptom most suspected from low -- 50-60 μg/100 ml -- blood lead-levels) be studied in test animals?

There are other questions that should be posed - particularly with respect to the toxicological effects of substitute driers and to the effect of lead "free" paint films on old high lead paints - but these will be discussed later.

The arguments advanced by Dr. Barry King supporting the ingestion of ~ 11 cm^2 of thick paint film per day by children with pica appear to be subject to a good deal of possible error. One argument depends on the density (Grade 3) of x-rays of children who have eaten "rubbish" and the assumption that all of the density results from the presence of lead in the stomach. Obviously many other components of rubbish could contribute to the x-ray density such as calcium from chalk or barium from barytes in old paint films or titanium from titanium dioxide in paint films or even iron from rust. The other argument depends on the fecal lead content of a child suffering from lead poisoning who had eaten paint containing 9.5% lead and calculating back to determine how much lead paint the child had eaten to

0007-SWP-037118

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give that fecal lead content (180 mg.). This appears to be about 2 grams or 11 cm^2 of thick (0.163 g/cm^2) paint film. Nevertheless, other experts have suggested one or two cm^2 as a normal amount of paint film eaten daily by a child with pica.

Tests in our laboratories have shown that 0.5% HCl will extract about 40% of the lead in thin films (25 - 50μ) during 24 hour extraction tests. Work by Gage and Litchfield (JOCCA, 1968) indicated that rat stomachs extracted about 90% of lead from lead drier and 25% lead from lead pigments contained in well pulverized paint films that were fed to the rats.

If we take the factor of 5 (11 cm^2/2 cm^2) times the factor of 2-1/2 (100% sol./40% sol.) and multiply these times the 0.06% (lead level advocated by the American Academy of Pediatrics based on ingestion of 11 cm^2 of paint per day containing completely soluble lead) we get a figure of 0.750% Pb. This is well above the level of 0.5% advocated by the Food and Drug Administration and supported by the paint industry

This points out the importance of obtaining accurate data on the amount of paint a child will eat and on the solubility of lead in paint chips in digestive fluids.

The Food and Drug Administration has proposed a lead limit in paints for inhabited dwellings of 0.5% and the paint industry has supported this level. Why 0.5% instead of 0.3% or 0.7%? A good answer is that this is the lowest level of lead that will not require the use of substitute driers in paint films. Substitute driers are bad for two reasons: 1. They have unknown toxicological effects. 2. They have unknown effects on paint films.

Therefore, it is proposed that the research project should include the study of the toxicology of cobalt and calcium. This can be done at a reasonable cost since these driers can (and should) be used in the low lead paints at levels above which they are used in lead containing paints.

It also is proposed that effects on the paint films should be studied. One possible or even probable effect from using higher levels of cobalt is greater shrinkage, and less ability to relax for these paint films compared to similar films containing lead driers. This combination of shrinkage and stiffness will apply more stress on old paint films when such paints are used on walls with subsequent greater chances of causing the old paint to peel. Thus, if the old paint happens to be high lead paint we could be making lead more available to children with pica by using lead "free" paints.

Paint films based on oil or alkyds dry by oxidation and polymerization. As a drier lead promotes polymerization rather than oxidation whereas cobalt promotes oxidation rather than polymerization. Packard (Sci. Sect. Cir. 404, 1951) showed that increasing amounts of lead drier in linseed oil decreased the volatile loss from linseed oil (which could be expected to decrease shrinkage). The Montreal

Paint Production Club (Official Digest, 1948) showed cobalt and manganese caused increased weight losses with linseed oil (and presumably increased shrinking). They also showed that Co and Mn driers led to cracking of exposed linseed oil films (indicating shrinkage). In "Film Formation, Properties, and Degradation" (Interscience - 1958) it was shown that pure oil films shrank as much as 16 - 17% in 180 days aging in the laboratory.

Thus, there is considerable evidence that paints using cobalt as a drier will shrink more and will be more rigid than those using lead. Admittedly many paints are now formulated with cobalt as the primary drier. But do we know what their affect has been on old, weak paint films? It would seem that a research project on lead should consider these factors.