First of two articles . . .

Replacing Lead Takes Time And Cooperation

By Abel Banov
Senior Editor

JUSTIFIABLE as they certainly are, the industry's complaints about the Food and Drug Administration's action to restrict lead content of packaged retail paints to the absurdly low 0.06 per cent level won't roll back time and erase the rulings that are certain to be enforced.

Reality demands that everyone concerned with reformulating get out his recipe books and try to develop products that can be tested and readied for the market place by the time enforcement is undertaken, as of the start of 1974, according to present timetables. For those supplying the Chicago market, a "particularly "generous" span of time has been allowed—July 1, 1972.

(see editorial on page 49)

By the first of 1973, the lead limit in packaged paints for use around households, including those for toys, will be 0.5 per cent.

Another problem, mainly financial, will be the need to select and buy atomic absorption analytic equipment to test for lead contaminents.

That means all companies making trade sales paint have to find ways not only to eliminate chrome yellows, molybdate chrome orange, and chrome greens (which have been slated for removal from these paints ever since Congress passed legislation last year limiting lead content to one per cent), but also must replace lead driers, which may prove far more difficult to banish than the prescribed lead-bearing colorants.

(Replacing lead-containing colorants will be the subject of a succeeding article.)

To bring the problems of lead driers into focus, *American Paint Journal* approached a number of companies and individuals for their ideas about getting the lead out—of their ascertained paints.

The results are presented in the following paragraphs.

Experts in the drier field, in general, felt that zirconium driers are able to achieve the through-dry obtained by lead salts if cobalt and/or manganese are used to get quick surface dry.

However, when carbon black or those pigments that tend to nullify drier action are used, loss-of-dry becomes a problem without lead.

Some progress has been made in reducing loss-of-dry through introduction of driers made with synthetic acids rather than conventional ones, but the end-result is not quite good enough.

Lead driers will be sorely missed in formulations troubled by loss-of-dry.

At the present time, loss-of-dry is aided by 1,10 phenanthroline, a proprietary compound that is costly; but, even worse, this material causes varying degrees of discoloration in paints stored on the shelf. Many paint chemists hesitate to use this chelating agent in white paints, particularly, because of this fear of discoloration.

While much is heard about the cost of 1,10 phenanthroline—$10 a pound—so little is used per gallon that estimates put the added RMC at about 2-3 cents gallon at the most.

T.I.D. position

William Stewart, of Tenneco Chemicals' Intermediates Division, and a veteran in the drier field, appraised the advantages of using zirconium driers rather than calcium. He said that the former at the same metal concentrations as those for lead give comparable performance and possibly less brittleness of film, plus better gloss and gloss retention. Calcium's drying properties, he said, are not quite as good as lead's, which is its disadvantage, while zirconium, which he regards as comparable to lead, is more costly.

Mr. Stewart stated that a cobalt compound is available for overcoming loss-of-dry in colored paints, where the problem is most pronounced, but that this material must be approached with caution for whites and pastels because it may discolor.

He offered the following recommended drier combinations to replace lead-containing combinations, which are listed on the left in table below.

Charles Gardner, now heading Gardner Chemicals Co., in New York, and a long-time development man in the drier field and active in pioneering zirconium driers, observed that the Philadelphia Society for Paint Technology some years ago determined that cobalt, calcium, and manganese are adsorbed by untreated titanium dioxide substantially more than are lead driers.

It was found that TiO_2 treated with either alumina or alumina silicate will absorb 50 per cent of the drier present, while an untreated white will absorb 65 per cent. "By percentages," Mr. Gardner reported, "cobalt calcium, and manganese are absorbed twice as much as lead."

Mr. Gardner's observation about the relative absorption by different grades of titanium dioxide suggests that some help in avoiding loss-of-dry to a greater

	Typical Drier Recipes (%)	Proposed Lead Free Drier Recipes (%)	Advantages
Linseed Oil House Paint	0.03 Mn, 0.2 Pb	0.03 Mn, 0.2 Zr	Better color and low temperature drying
	0.01 Co, 0.02 Mn, 0.4 Pb	0.01 Co, 0.02 Mn, 0.4 Zr	
Trim Paints			
Linseed Alkyd	0.02 Co, 0.2 Pb	0.02 Co, 0.3 Zr	
Soya Alkyd	0.04 Co, 0.4 Pb	0.04 Co, 0.4 Zr	
Phenolic Spar Varnish	0.02 Co, 0.3 Pb	0.02 Co, 0.2 Zr	Improved Hardness
Tall Oil Alkyd Enamel	0.1 Co, 0.1 Ca, 1.0 Pb	0.1 Co, 0.6 Zr	Better gloss, drying and color
Long Oil Soya Enamel	0.03 Co, 0.03 Ca, 0.3 Pb	0.03 Co, 0.02 Ca, 0.3 Zr	Better through dry & hardness
Medium Oil Alkyd Enamel	0.03 Co, 0.02 Ca, 0.2 Pb	0.03 Co, 0.02 Ca, 0.2 Zr	Better through dry & hardness
Light Color Label Varnish	0.09 Co	0.05 Co, 0.3 Zr	Better color, equal dry
Urethane Varnish	0.04 Mn, 0.2 Ca, 0.4 Pb	0.04 Mn, 0.2 Zr	Better color, equal dry

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or lesser degree may be had by careful selection of types of TiO_2. It may be worthwhile to test TiO_2-containing formulations with pigments having various surface treatments. This is a line of research that may be right for the various manufacturers of TiO_2 who would like to establish a special value for their proprietary materials.

Among Mr. Gardner's observations was the help obtained in overcoming loss-of-dry by use of calcium or zinc naphthenate for white paints and iron naphthenate for carbon blacks and iron oxides.

The need for at least a year of testing was also recognized at a meeting called by the National Paint and Coating Association, and attended by Dr. Raymond R. Meyers, director of Paint Research Institute, (see separate story) and Dr. Garamond Schurr, of Sherwin-Williams, among others, to consider how to oppose efforts of the Federal Government to tighten lead restrictions.

At this meeting, as was the case at most meetings of this kind in the last two years, the agenda was devoted to fighting federal and local efforts to cripple the industry. Attention was totally occupied with that critical problem and little time, if any, was available to explore ways to prepare for the situation if the axe fell, as it was deeply feared it eventually would fall.

Dr. Schurr, it was learned, presented a program involving studies of lead toxicity levels in primates, which NPCA is hoping to carry out if circumstances warrant.

Until a year-long development program for testing Dr. Meyers' complexing material has been carried out, which was not mentioned at the NPCA meeting, the industry will be in somewhat of a bind, now that the regulation to restrict lead use to 0.06 per cent of the dried film has been set up.

TROY POSITION

William Singer, of Troy Chemical Co., agrees with Mr. Stewart that no adequate method of completely replacing lead is available.

He claims that zirconium is no more valuable than calcium as a drier. He believes that calcium with cobalt provides faster dry than zirconium and that calcium driers have the edge over zirconium when it comes to preventing loss-of-dry.

He observed that zirconium has some of the limitations of zinc driers in that they slow down top dry, although they do permit greater through-dry.

In regard to o-phenanthrolenes, Mr. Singer says that in his laboratory work he had no luck in preventing loss of dry with carbon black, although he followed directions and used manganese. It did work well with other materials, he said.

He characterized some organic reds as moderate to moderately bad in causing loss-of-dry, and said titanium dioxide was not quite as bad as these. He put carbon black in a class by itself as the worst offender, saying that paints with that pigment sometime lost their drying ability overnight.

Another question comes up here: How much carbon black paint is used within reach of children?

Checking around the industry—among dried suppliers, paint manufacturers' technical directors, and, in the case of Dr. Meyers, the highest level of scientific and technical competence, the conclusion is inescapable that the industry is not fully ready for early imposition of harsh lead restrictions.

It is probable that with a research program into existing compounds, of which Schiff-based amine complexing compounds are one, the industry can be fairly ready within a year—but this is far from certain.

In any event, it is clear that the industry cannot afford to limit its research to defensive programs to study whether or not lead is toxic when used in the form and in the quantities present in some paints.

While that sort of research may be useful, a project aimed at finding out how to cope with rigid lead restrictions appears more practical.

Second in series . . .

FDA's 0.06 Per Cent Lead Limit: Is It Based on Fact or Fancy?

By Abel Banov
Senior Editor

HERE'S THE SITUATION. A prominent senator from an opposition party is sitting on a potential hot issue relating to lead poisoning and he's evidently going to milk it to the limit. He sets a hearing for a Thursday to consider amending a law known as the Lead Paint Poisoning Prevention Act.

You're a party strategist, and your job is to grab the play away from the opposition. You have a trump card: The Food and Drug Administration, controlled by your party, is charged with administration of the Federal Hazardous Substances Act, under which lead limits in paint can also be controlled.

What do you do? You strike first, even if it means violating all the rules of the game.

In essence, that's the scenario for the recent suprise ploy whereby the FDA on Friday, March 10 — one day after Senator Edward Kennedy of Massachusetts held hearing on the subject — issued a regulation setting a two-stage limitation on lead content in paints that are sold in containers that could eventually end up for household application.

Now, what about violating the rules of the game?

The FDA itself had set a deadline for submitting information to help set its standards — April 8, three weeks after the day it issued its fiat. The rules weren't meant to work that way.

Knowledgeable people in FDA were reported to have objected to imposing the low lead levels sought by Senator Kennedy's committee. Was the switch instigated from on high?

Is this another manifestation of the definition of politics as the art of the possible? And are slum children, black, brown, yellow and white, pawns in the play for power?

The cliffhanger in this scenario is: Will Ted really do something practical to get funds for solving the real problem — safeguarding slum children from 50-year-old lead laden tenement walls? And will Richard figure a way to take the ball away from Ted?

While we wait for next week's episode in the current farce series, let's examine the facts and theories behind the various lead limits that are under discussion for coatings.

Several weeks of study (within the limits of a non-existent medical education) have shown that the claims of the authorities that lead limits should be controlled have some foundation.

Dismissing their claims as arrant nonsense is as foolish as accepting them at 100 per cent face value.

But you can't fight 'em if you don't understand what they're trying to say, and why.

So far, the opposition to official claims has been distinguished by pained reaction to what it will mean to "the small manufacturer." Very little has been said about the claimed facts.

This article will try to present the facts, according to the American Academy of Pediatrics, which presented the technical basis for Senator Kennedy's case, and the spotlight-grabbing play of the clever FDA.

Blood Limit of Safety

The actual facts, as distinguished from the claimed facts, are that Dr. R. A. Kehoe of the University of Cincinnati did pioneer work in determining toxic blood-lead levels. Working with adult human subjects in actual feeding tests, he determined that 80 micrograms of lead per 100 grams (or milliliters) of blood was the upper limit of safety.

The second fact is that the National Academy of Science, with the collaboration of Dr. J. Julian Chisolm of Johns Hopkins University Medical School, a highly regarded pediatric researcher and scientist, decided, after further exhaustive studies, that 80 micrograms was too high a level for safety. The Academy said 40 micrograms should be the limit.

And why 40 micrograms? Because that's the blood-lead level which, when exceeded, is accompanied by a marked increase in the urinary level of delta amino levulinic acid, a blood component.

That doesn't mean that children get sick the instant the blood-lead level climbs to 41 or even 50 micrograms. It's the point where a surge in ALA occurs after each increment of lead.

So, why is increased ALA so bad? Well ALA is supposed to be converted by an enzyme, ALA-dehydrase, to porphobilinogen, which is involved in production of hemoglobin. Lead blocks the enzyme's action, and the unused ALA builds up in the blood and ends up flowing away in the urine.

So 40 micrograms of lead per gram of blood, the point where ALA begins to increase rapidly in the urine as more lead is added, is the upper limit of safety, according to the National Academy of Sciences.

Rather than try to fight that august body, try fighting City Hall—and you know where that got us in Chicago.

Granted that 40 micrograms is now the gospel, let's see how they came up with 0.06 per cent of the dried paint film as a permissible level.

The logician who helped reach that conclusion is Dr. Barry King of the U.S. Public Health Service, Cincinnati. Information developed by Dr. King and others caused the American Academy of Pediatrics to hold that total lead intake of children should be limited to 300 micrograms of lead a day, which is one-half of the 600 micrograms that Dr. Kehoe felt was safe for adults after his study.

Now, we must remember that of the 300 micrograms of permissible intake about 150 mcgms. are normally taken into the system from food, air and water. Therefore, the child only has another 150 mcgms./day margin for indulging in paint ingestion.

How Logical Is Research?

Dr. King painted some surfaces with a variety of lead-containing paints and came up with several interesting facts. For example, one square centimeter of six coats of paint film weighs 40 milligrams. Using six and 10 coats as possible chip depths, he worked out a table showing the contributions of lead to the diet of children. (See Market Section for complete table.)

He found that six coats of paint with 0.1 per cent lead, taken in 1 sq. cm sections, yielded 40 mcgms. of lead. With 0.05 per cent lead, the contribution would only be 20 mcgms./sq.cm.

But there are 6.25 sq. cms. in