Technical Journal, 6 (1979) 13 — 17

DETERMINATION OF LEAD IN PAINT AS AN AID IN THE CONTROL OF LEAD PAINT POISONING IN YOUNG CHILDREN

N. ERENTÜRK

Ankara Nuclear Research and Training Center

ABSTRACT

The lead content in four different paint samples were determined by atomic absorption spectrophotometry and they were found 5114, 2651, 1630, 1350 ppm. Lead paint poisoning usually occurs in children at teething age from about one to three years old and ingested peeling, flaking and scaling paint from walls, woodworks, toys, cribs and other furniture that is heavy in lead content. According to literature totally 100 μg per day would appear to be a sensible maximum dose [1].

ÖZET

Dört ayrı marka yağlı boyadaki kurşun miktarı atomik absorpsiyon spektrofotometresi yöntemiyle tayin edilmiş ve 5114, 2651, 1630, 1350 ppm bulunmuştur. Kurşun boya zehirlenmesinin kurbanları daha ziyade diş çıkarma, 1-3 yaşlarındaki çocukların duvar ve ahşap kısımlardaki kavlayan parçaları yemeleri, oyuncak, karyola ve diğer mobilyaları ısırmaları sonucu içinde çok miktarda kurşun bulunan boyayı yutmalarıyla ortaya çıkmaktadır. Literatüre göre toplam 100 μg günlük doz çocuklar için max doz olmaktadır [1].

INTRODUCTION

Paint is a metallo-organic additive compound which is composed by driers and diluting chemical materials with drying oils, pigments and filling materials. In paint, driers are added to produce a serviceable film within a reasonable period of time. Stabilizers, counteract the liberation of hydrogen chloride and prevent degradation and discolaration. Others (fungicides) are added to inhibit the growth of mildew [2]. Paint is used extensively in the coating industry to confer specific properties.

One of the major users of lead is the paint industry. Many inorganic and metallo-organic lead compounds are added into paint as driers, stabilizers and pigments. Uses of some lead compounds are as follows; lead dioxide, lead molybdate, lead chromate, lead orthophosphate, lead sulfate, lead antimonate; as pigments, lead dioxide, lead chloride, lead tetraoxide, lead thiocyanate; as dyes, lead acetate, lead brote, lead monoxide, lead

linoleate, lead naphthenate, lead oleate, lead resinate, lead stereate; as driers, and basic lead carbonate is the most important of all stabilisers.

It is well-known that heavy metals, such as lead, cadmium and mercury, constitute a serious health hazard even in quite small amounts. Much of the survey has been concerned with contamination of food and water supplies or of the atmosphere. Unfortunately there is not much survey about the problem of young children who face a greater risk in view of the susceptibility of the immature central nervous system, particularly to lead poisoning [1]. Its victims are most often children between the ages of 1 and 3 who eat bits of crumbling plaster or peeling paint or bite their toys, cribs and other furniture that is heavy in lead content. In addition to the atmospheric lead concentrations, ingestion of street dirt, ethnic diet or genetic or cultural factors contribute to increased suspestibility.

The sample of liquid paint was prepared for analysis by dry ashing with ash-aid. The content of lead of an acid extract of the ash was diluted with water and then aspirated into the flame of a Varian Techtron Model 1200 atomic absorption spectrophotometry.

EXPERIMENT

Four different types of paint samples were used in the experiments. Approximately 5 g of the well-mixed paint was put onto constant weight petri dish and weighed. Sample was placed under a 250 w infrared heat lamp until the surface begen to char. Ten mililiters of ash-aid (magnesium nitrate solution 10 % w/v in 95 % ethanol) was added and alcohol was evaporated by warming petri dish on a steam bath [3]. Drying of the sample was completed in an oven for 1 hr at 140-150°C. The ashing took place in a muffle furnace 20 min. at 315°C, 40 min at 425°C and 1 hr at 500°C [4]. Organic material was throughly charred, resulting in a white ash. The sample was placed in a desiccator to cool to the room temperature and weighed to determine the percentage of ash.

At this point the sample was divided into five portions. Each portion was transfered into a 50 ml pyrex beaker and accurately weighed to 0,25 g of ash. 5 ml aqua regia were added to each sample, beakers were covered and heated on a steam bath nearly to dryness. The ash residue was then dissolved by adding 5 ml of aqua regia, heating until vapors appeared, adding 5 ml of water and reheating [5]. This was followed by the filtration of the beaker contents through Whatman No 41 paper into a 50 ml volumetric flask. Beaker and filter paper were washed several times with distilled water and the washings collected into 50 ml flask and diluted to the mark with distilled water. The concentrations of lead were found greatly varied from sample to sample, it was not feasible to establish a single analytical

working range for all paint samples. The latter aliquot of the sample solutions were diluted to a suitable volume with water in the range of the calibration curve.

Standard addition tecnique was used to overcome matrix effects of the standards with the samples. Considerable amount of time was saved by using a modification of the standard addition technique - secondary standardization. In this case, one of the five portions was taken and analysed by using multiple addition method. This sample and the solutions made with addition were then used as standards for the remainder of the other four portions. The use of this technique provides standars which were closely matched to the sample with respect to chemical and physical properties.

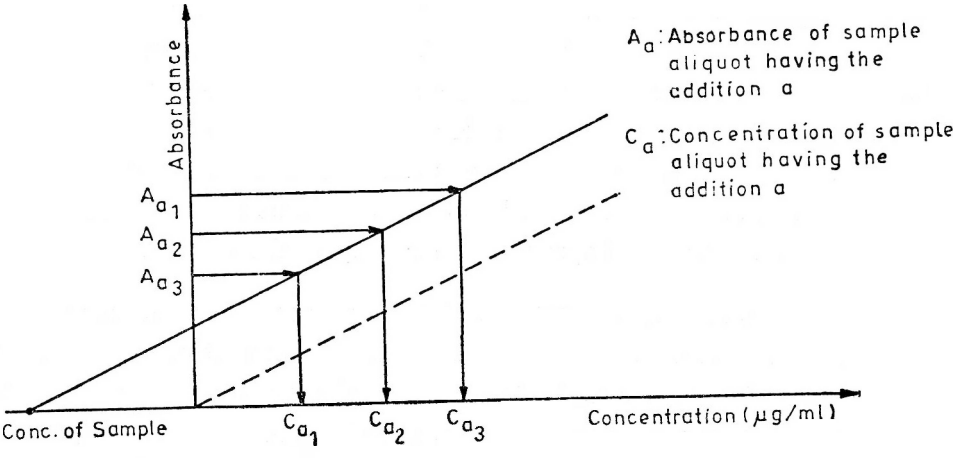

Fig. 1. Calibration curve.

The calibration curve, given in Fig. 1., was prepared for each type of paint sample.

According to the literature, normal dry - ashing procedure causes lose of some more volatile elements. To avoid this, the use of sulfated ash, ashing aids for destroying organic matter has been becommended [3]. Dry ashing conditions were selected for minimizing the metal loses and achieving complete oxidation at the same time. Magnesium nitrate in ethanol was used as an ashing aid in the experiments. The use of ethanol aids wetting of the sample and it is easily evaporated at low temperatures without causing excessive frothing. The use of an aid (magnesium nitrate in ethanol) enables complete oxidation of the organic material at 500°C without loss of lead.

RESULTS and CONCLUSION

TABLE — 1. Lead concentrations found in paint samples

Paint	Pb %	ppm Pb	Standart deviation % (n 5)
A	0.51	5114	0.06
B	0.27	2651	0.06
C	0.16	1630	0.03
D	0.14	1350	0.02

The results are given in Table — 1. These results indicate that the determination of 0.1 % lead in a sample of 1 - 2 grams of paint could be accomplished with an atomic absorption spectrophotometry. In ASTM D 3335-76 Standart Test Method for low concentrations of lead and cadmium in paint by A.A.S, procedure is given for paint containing app. 500 ppm lead based on the solid. Our survey showed that the paint available in Turkey have high lead level. The standard addition technique and secondary standardization were used to improve the accuracy of the analysis.

A child who ingests a few flakes of peeling or scaling paint may absorb vastly greater quantities of lead than the daily dose of the adult living in urban area. This shows that primary cause of acute pediatric lead poisoning is pica [6]. The studies on the biochemistry of lead have been concerned with the inhibition by lead of the enzymes responsible for red blood cell formation. Absorbed and carried lead by the blood is accumulated in liver, kidney, and bone [7]. It also occur in spleen, pancreas and lungs. Symptoms may be very mild or quite severe. In the very young child, symptoms may come on shortly after exposure to the lead.

Limiting the use of lead in paints would be helpful and it would be prudent to exclude them as far as possible from interior surfaces of a dwelling or of a place used for the care of children or on window sills, toys, cribs or other furniture. Some ordinances prohibit the use of paints for interior painting of a dwelling unless the paint is free of lead pigment [8].

No one knows for sure just how many children suffer from the disease, advanced brain damage or nervous disorders.

REFERENCES

[1] Eaton, D. E., Fowles, G. W. A., Environmental Science and Technology, 9 (1975) 769.

[2] Eider, N. G., Applied Spectroscopy, 25 (1971) 313.

[3] Friend, M. T., Smith, C. A., and Wishart, D., Atomic Absorption Newsletter, 16 (1977) 46.

[4] ASTM, Part 21, January (1967).

[5] Menden, E. E., Brockman, D., Choudhur, H., and Petering, H. G., Anal. Chem., 49 (1977) 1644.

[6] Pitts, J. N., Metcalfand, Jr. and R. L., and Lloyd, A. C., Advanced in Environmental Science and Technology, 3 (1974) 79.

[7] Kinnison, R. R., Environmental Science and Tchnology, 10 (1976) 649.

[8] Kaplan, E., F. A. P. H. A., and Shaull, R. S., American Journal of Public Health, 51 (1961) 65.