

Further Investigation of the Extraction of
Lead from Glazed Ceramic Surfaces

Our report of July 12, 1961, indicated that six of thirty five tested glazes released lead to hot 5 per cent acetic acid to yield concentrations of lead in excess of 1 mg. per liter (1 ppm). It was also observed that deeply colored glazes gave up lead more readily than did the white or pastel colored glazes. These findings were used to design a further program of testing, the initial portion of which is the subject of this report.

Materials and Procedures

Two series of tests were carried out. In test #1, glazes Ba and Bb were treated with hot (boiling) Heinz's vinegar and hot (boiling) 5 per cent acetic acid to determine the extent of the extraction of lead by these materials. In test #2, these two glazes, along with glaze Az, were subjected to the action of Heinz's vinegar at temperatures ranging from that of the laboratory to the boiling point.

All tests were conducted on fresh ware taken from batches prepared and fired at different times. The different batches of the same glazes are identified by their code name and by differences in the shape of the articles under test. Each test was carried out with three cups from the same batch of glazed ware. In every case, before the ware was subjected to contact with the leaching solution, it was given a preliminary wash with a calgonite preparation (one tablespoon per gallon of luke-warm water). One hundred and fifty milliliters of the leaching solution at a specific temperature were then poured into each cup and allowed to remain therein for one-half hour. At the end of this time the solutions from each series of three

cups were combined to give one sample of 450 ml., the effect of this procedure being that of averaging the three results (prior observations had shown that this would not be a means of masking a high degree of variability in the individual results).

Results

In Table #1 are recorded the concentrations of lead extracted when glazes Ba and Bb were treated with hot (boiling) 5 per cent acetic acid or hot (boiling) Heinz's vinegar. The quantities of lead extracted by Heinz's vinegar at various temperatures, from cups coated with glazes Ba, Bb and Az are recorded in Table #2.

Discussion

As shown previously by the initial observations reported on July 12, 1961, more lead was extracted by the hot extraction solutions from glaze Az than from glaze Ba. The average quantities extracted, however, were approximately half of those which were obtained in the initial testing program with hot 5 per cent acetic acid. Lead was also extracted from glaze Bb by hot acetic acid in the present series of tests at about half the rate noted in the initial tests.

It is significant that the extraction of lead from the glaze by the vinegar was hastened as the temperature of the vinegar was increased. It should also be noted that the extractability of the lead varied from batch to batch of the same glaze, and that the ranking of the batches remained the same throughout the various tests. For example, batch Rhythm, of glaze Ba, consistently gave up the least lead to the extraction media, while, batch C and P Georgian, of glaze Ba, consistently gave up the most lead.

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Future programs of investigation include depletion tests, and tests of the glazes with coffee which is to be retained in cups for various periods of time. These tests will be carried out on glazes to be selected by the committee after this report has been reviewed.

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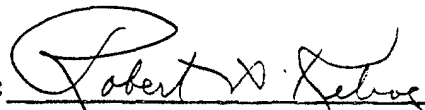
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Table 1

Solubility of Glazes in Hot 5 Per Cent Acetic Acid and Hot Heinz's Vinegar

Glaze	Shape	Hot 5% Acetic Acid (a)		Hot Heinz's Vinegar (b)	
		Pb ppm		Pb ppm	
Ba	Fiesta	2.35		2.54	
Ba	Harlequin	3.12		2.91	
Ba	Rhythm	2.04		1.09	
	Average	2.50		2.18	
Bb	Rhythm	0.24		0.29	
Bb	Nautilus	0.11		0.19	
Bb	C + P Georgian	0.42		0.64	
	Average	0.26		0.38	
Az	Fiesta			2.45	
Az	Harlequin			3.33	
	Average			2.89 (c)	

(a) Control 0.00 ppm
 (b) Controls 0.02 ppm, 0.00 ppm, 0.007 ppm
 (c) Control 0.048 ppm

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Table 2

Solubility of Glazes in Heinz's Vinegar at Various Temperatures

<u>Glaze</u>	<u>Shape</u>	Ppm Pb in Vinegar after standing 30 minutes			
		Room T	40°C	60°C	80°C
Ba	Fiesta	0.98	0.89	1.66	1.69
Ba	Harlequin	0.73	1.07	1.50	1.86
Ba	Rhythm	0.10	0.21	0.30	1.25
	Averages	0.60	0.72	1.15	1.60
Bb	Rhythm	0.09	0.14	0.33	0.032
Bb	Nautilus	0.06	0.06	0.26	0.21
Bb	C + P Georgian	0.19	0.17	0.27	0.41
	Averages	0.11	0.12	0.29	0.31
Az	Fiesta	0.65	1.05	1.22	2.20
Az	Harlequin	0.71	1.11	1.64	2.20
	Averages	0.68	1.08	1.43	2.20

(a) All values in this column are taken from Table #1.