Evaluation Test for Scouring Agents: Fatty Soil on a Hard Surface[1]

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Abstract

A method has been developed to rate the scouring ability of abrasive cleaners on a tough fatty film which is baked onto an aluminum panel. Results were obtained on a comparative basis, and are best determined by one person using as few panels as possible for each investigation. The soiled surface was prepared by spreading 5 ml of a lard-chicken fat mixture on one side of the panel, and baking for 5 min at 575F. Three classes of scouring agents were studied, steel wool with soap, silex which was resin-bonded to nylon fiber and silex on a dish cloth. Results can be expressed as Scouring Efficiency, and related to an arbitrary standard designated as 100%.

Introduction

DURING THE PAST DECADE, the American housewife has encountered a large variety of cleaning jobs at home. To help her cope with daily problems, industrial research departments have produced a bewildering assortment of products that foam and don't foam, contain ammonia or other miracle ingredients, and appear in many sizes in the form of liquids, powders, creams, tablets, etc. Nevertheless, two simple types of cleaning agents have persisted from ancient times, and in modern terms we could call them sands and strands. Our ancestors of thousands of years ago rubbed dirty dishes with a handful of sand and grass at the end of their meal. Hence, in this day and age we still find simple scouring agents such as silex and steel wool competing successfully with chemical products that depend on complex soil removal processes (1).

However, civilization again has started to complicate the housewife's task, and cleaning by scouring begins to include a broad field of dirt and surfaces including porcelain or metal sinks and tubs, tiles, bathroom and kitchen fixtures, dishes, pots and pans. As new scouring agents enter the household and industrial market, we find a greater need for some way of rating these products in terms of their scouring ability. The current study was limited to evaluating scouring agents on surfaces covered with a hard or tough fatty soil. In this surface category we would include the inside and outside of food ovens, fry pans, cooking pots, kitchen duct work and barbeque grills.

Preparation of Fatty Soil

The types of fats and oils which enter into cooking, frying and broiling are rather large, and include different degrees of unsaturation from animal, vegetable and marine sources. Two criteria were used for selection of a standard, a) the fat or oil should be representative of actual usage, and b) the surface film should be fairly resistant to scouring to allow the measurement of differences in abrasive action. Utensil grade aluminum was used for the hard surface background in the form of 6 x 6 in. squares, 3/64 in. thick. Meincke (2) has previously reported on abrading coated plywood and steel panels with a Bischoff rotating wheel.

Choice of fatty soil was arbitrarily restricted to mixtures of lard and chicken fat, two very common products found in the kitchen. Several studies were made during development of the test surface, one with various mixtures, and the other over a range of baking temp.

Preparation of test panels was carried out as follows:

1) Clean a 6 x 6 in aluminum panel with a soap or detergent, rinse and dry with a soft paper towel.
2) Apply 2.5 ml of molten-fat mixture on panel with a glass medicine dropper, and smooth on with a 2-in. paint brush.
3) Apply an additional 2.5 ml of molten fat, and brush at right angles to the first application.
4) Bake panel for 5 min in a muffle furnace held at a constant temp.

Baking time for preparation of the fatty film was set at 5 min in order to have speed in sample preparation. It is realized that residence time of spattered fats on hot surfaces in the home could be an hr or more, hence the reason for testing a range of temp at the shorter bake time.

A muffle furnace was heated to a set and constant temp, a coated panel was inserted for 5 min, removed and cooled to room temp. Figure 1 shows the appearance of 8 panels prepared between 350 and 700F at intervals of 50F. Panels held at 350 and 400F show no color darkening and were covered with a greasy film which had almost no hardness. The 700F sample ignited during baking. Color of the baked film changed from a deep tan to a black between 550 and 600F. Therefore, as a result of visual examination, fingernail testing and subsequent scouring tests the baking temp was set at 575 ± 10F.

Mixtures of chicken fat and lard were prepared, melted and applied to separate panels. These compositions were then tested with a scouring agent for the effect of composition on film resistance. Since no significant difference was observed, an arbitrary ratio of 80% lard to 20% chicken fat was established.

Test Method for Scouring

Conventional test equipment such as a Gardner Abrasion Machine and a Taber Abrader were found inadequate to equal the high pressure that a housewife would exert when working on a stubborn spot or coating (3). Readings of 35, 32, 30 and 34 lb, respectively, were observed for a technician who ran several tests on the platform of a dial scale. Although the application pressure could change appreciably between two people, indications were that one person could develop a knack for applying a fairly constant scouring pressure.

Hence, a comparative test was evolved which would minimize film variations among test panels, and application pressure between people, by having one per-

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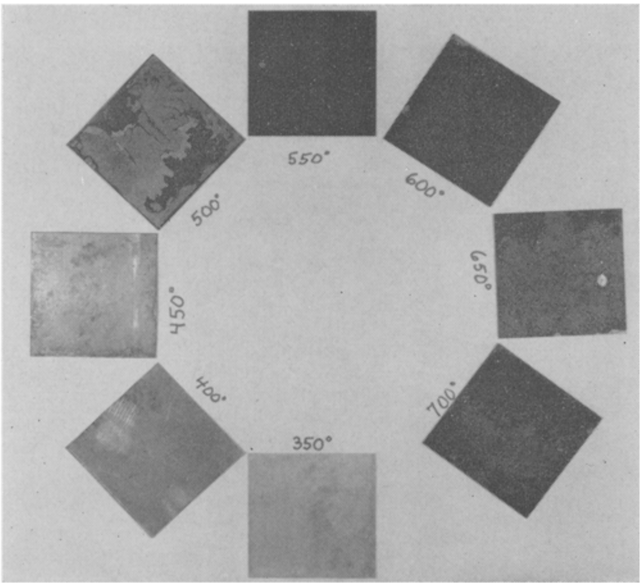

FIG. 1. Effect of baking temp on fatty soil.

son make all his comparisons on a single test panel. A specific scouring agent is designated as the control with a rating of 100%, and other agents are rated on a relative percentage. A value of less than 100% means a poorer scouring ability than standard. Figure 2 shows the panel before and after baking, after testing, the panel holder and two scouring pads.

Details of the test methods are as follows:

1) Mount the coated aluminum test panel in a rubber tile frame.
2) Wet the standard scouring agent with water and squeeze several times. Foam should be obtained from agents which contain soap or detergent. Silex can be sprinkled on a wet dish rag for application. Wet the test panel with water.
3) Rub the standard scouring agent over a couple of square inches of panel surface with a controlled pressure until about one square inch of bright metal surface is visible. Count a back and forth motion as one stroke.
4) Repeat the above procedure with the test scouring agent on the same panel and count strokes to obtain one square inch of bright metal surface.

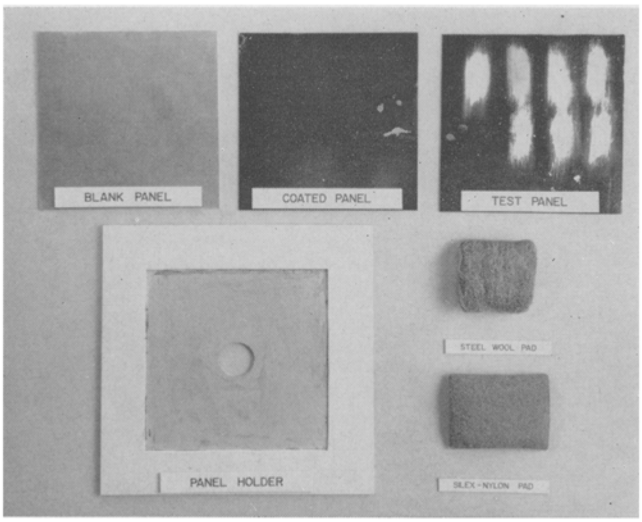

FIG. 2. Test apparatus.

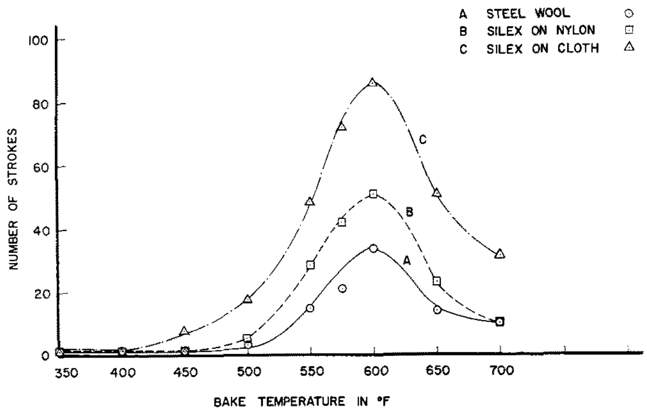

FIG. 3. Scouring efficiency vs. soil baking temp.

5) Rate "Scouring Efficiency" of the test agent by dividing its strokes into the number obtained with the control, and multiplying by 100. For example:

Control pad = 20 strokes
Test pad = 50 strokes

$$\text{Scouring Efficiency} = \frac{20}{50} \times 100 = 40\%$$

Note that the standard scouring agent will always represent a 100% reading during the test.

Discussion

Three scouring agents were tested on soiled panels to establish the baking temp, namely,

A = steel wool pad with soap.
B = silex bound to nylon fiber with resin, plus soap.
C = silex scouring cleanser on a dish cloth.

Figure 3 shows the scouring effort required to obtain soil removal from panels baked at fixed temp, and also relates two scouring agents to the selected standard (steel wool pad with soap). Lower temp of 350–450F left greasy or soft films which scoured very easily. As the bake temp increased, so did the film toughness. The greatest work effort was required with the 600F sample. Higher bake temp increased the tendency towards charring and ignition, and resulted in black films that were easy to scour.

The curves show that steel wool requires less strokes than the other two agents for bake temp between 500F and 650F. In this range, the Scouring Efficiency for silex on nylon was ca. 60%, while silex on a cloth averaged ca. 30% relative to steel wool.

Table 1 presents scouring data for various ratios of lard and chicken fat baked at 575F. Check results show that reproducible data can be obtained on several sections on the test panel, and Scouring Efficiency averaged 53% for the entire range of composition when silex-nylon was compared with steel wool.

Table 2 presents experimental data for assorted

TABLE I
Effect of Fat Composition on Film Toughness

Lard %	Chicken fat %	Scouring strokes for clean area		Scour. eff., % (A/B) 100
		A = Steel wool	B = Silex on nylon	
0	100	18, 17	37, 35	49
50	50	15, 15, 15	31	48
70	30	17, 17	41, 38	43
80	20	19, 15	27	63
90	10	17, 17	29	59
100	0	15, 15	26	58

TABLE II

Experimental Scouring Data

(Bake Temp = 575F Lard-Chicken Fat Ratio of 80:20)

Scouring agent	Scouring strokes	Scouring eff., relative to A
Steel wool & soap = A	21	100
Steel wool after 8 use cycles	20	105
Silex on nylon = B	41	51
Silex on nylon after 32 use cycles	48	44
Silex on cloth = C	71	30
Steel wool & soap on paper	26	81
Steel wool & soap on sponge	20	105

scouring agents when run on a 575F panel made from an 80–20 mixture of lard and chicken fat. Results indicated that steel wool performs well even when used on paper or sponge backings. Silex on nylon and cloth showed essentially the same scouring efficiency, 51 and 30%, as was obtained in the previous studies. Steel wool was found to maintain its efficiency with usage, and silex bonded to nylon showed only a slight decrease with usage.

It is concluded that a testing method has been developed to measure the Scouring Efficiency of abrasive cleaners on a test panel by wearing away a tough fatty film. Results are based on comparisons with a set standard, and are best run by one person on a single test panel. Experimental work indicates the method may have value in other studies, such as efficiency after usage, and the effect of various supporting media for the abrasive proper.

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An Amperometric Titration Method for Bleach Evaluation

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Abstract

An analytical method has been devised as a rapid screening procedure which predicts how effective an active chlorine containing compound will be as a bleaching agent. The method is based on an amperometric titration which indicates bleaching performance from both the increase in whiteness and fabric tendering standpoints. Excellent correlation was obtained between amperometrically determined data and practical bleaching data for several extensively used bleaching agents. In connection with this amperometric titration method, a polarographic method is also presented which provides good correlation between the polarographically determined data and practical bleaching data.

Introduction

WITH THE AID of a newly developed amperometric titration method the bleaching performance of an active chlorine compound can be predicted. The procedure is based on a method suggested in the Operational Manual of Wallace and Tiernan, Inc. (7,8, 13). An E. H. Sargent Ampot Amperometric Titrator, equipped with a rotating platinum electrode and external saturated calomel electrode, is used. Good correlation between polarographically determined current readings and practical bleach tests has also been obtained.

All active chlorine compounds in aqueous solutions form hypochlorous acid by hydrolysis. The bleaching action of hypochlorous acid in solution may follow any of three types of reactions: chlorination, oxidation or chlorhydrination. At pH levels below 4, an appreciable portion of the available chlorine is present as free chlorine (9,10).

At higher pH levels, oxidation and chlorhydrination are the predominant reactions. Saturated compounds are oxidized, while unsaturated compounds are chlorhydrinated, thereby destroying the resonating structure of the molecule with a resulting loss of color (1).

Bleaching with hypochlorite solutions is seldom a reversible reaction. Some sources hold that bleaching is an oxidation reaction caused by oxygen liberated from hypochlorite (8–10).

Active chlorine compounds may be divided into two general groups. The first consists of the relatively simple inorganic hypochlorites. The second comprises the organic *N*-chloro compounds. When *N*-chloro compounds are dissolved in water (it should be noted that solubility is rather limited with most of the organic compounds), the *N*-Cl bond is partially hydrolyzed (3–5, 14):

$$RR'NCl + H_2O \rightleftarrows RR'NH + HOCl$$

The HOCl on the right side of the equation is referred to as free available chlorine, the RR'NCl on the left side of the equation is referred to as combined available chlorine.

The proposed method differentiates between the free available chlorine content and the combined available chlorine content of a solution. Differentiation of the two forms of available chlorine is based on the concept that *N*-chloro compounds (combined available chlorine compounds) are activated by potassium iodide in acid media (pH 4), while the free available chlorine compounds can be reduced in a neutral pH range (6.5–7.5) without potassium iodide present (7). Using the E. H. Sargent Ampot Amperometric Titrator, equipped with a Sargent Synchronous Rotator Platinum and a saturated calomel electrode pair, titration data were obtained for solutions containing a low concn of bleaching compound (usually 10 ppm total available chlorine). It was determined polarographically that an applied voltage of zero volts was the most suitable for our procedure.

Experimental

One hundred ml of a 10 ppm total available chlorine solution of bleach were placed in a cell and the pH adjusted to 7, using a mixed phosphate buffer. The electrodes were immersed in the solution and a reading was obtained from the ammeter at the zero applied voltage. This was identified with the initial free available chlorine content. The solution was titrated with a reducing agent, in this case a 0.00563 normal phenylarsene oxide solution, and the decreasing