Use of Field Tests in Evaluating Detergents

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Can the evaluation tests for dishwashing detergents be used under practical field conditions?

What equipment and how much chemical knowledge is needed?

Can the tests be easily demonstrated to the restaurant operator?

Will the results be of practical value?

Sanitarians attending the New York State Public Health Environmental Sanitation Field Training Center at Buffalo, N. Y., are getting the answers to these and other questions concerning tests for dishwashing detergents. In the food and restaurant portion of the 12-week field training course, they are obtaining practical experience in evaluating detergents, experience which will aid them in making their routine inspections of restaurants and in helping the restaurant operator select a detergent for his particular needs.

Laboratory Evaluation Studies

Much work has been done on the laboratory level to evaluate detergents and to test their performance in dishwashing machines. Such recognized authorities as the National Sanitation Foundation at Ann Arbor, Mich., and the Environmental Health Center, Public Health Service, Cincinnati, Ohio, have made some excellent studies of these problems. Their tests, however, have been made with the use of rather elaborate testing and control equipment—photometers, analytical balances, experimental dishwashing machines, and other complicated laboratory equipment—and therefore cannot be carried out by the sanitarian in his routine inspection or by the restaurant operator.

A detergent that has been determined to be satisfactory under laboratory conditions in all probability will be satisfactory under field conditions if such factors as mechanical condition of the dishwashing machine, length of washing time, temperature of the water, and concentration of the detergent are at the recommended level. In addition, the actual use-value of the detergent will depend upon the efficiency of the operator and how much "elbow grease" and effort has been put into scraping and prerinsing the dishes. Since the laboratory test cannot control all of these variable factors, there is a need for a simple field performance-use test.

In our field training course we have developed a series of simple demonstrations to evaluate detergent properties, and a dish-soiling mixture for test-plate demonstration use in the single-tank dishwashing machine, the type most commonly used in restaurants that have mechanical dishwashers.

Detergent Properties

Sodium carbonate, a host of alkali cleaners, water softeners, balanced detergents, wetting agents, and synthetic cleaners are among the almost unlimited number of substances that are detergents. In our field demonstrations, the detergents are evaluated on the basis of tests for the following properties:

1. Ease with which the detergent dissolves in the water used.
2. Control of water hardness and film deposit.
3. Foaming ability.
4. Wetting ability.
5. Emulsification ability.
6. Ability to dissolve and deflocculate proteins.

Demonstration of Detergent Properties

The demonstration of detergent properties, using the basic chemicals usually found in a balanced detergent, illustrates dramatically that no single chemical has a high degree of all the desired properties. A good general purpose detergent must be a mixed and properly balanced product.

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The usual recommended detergent concentration ranges from 0.25 to 0.5 percent. For these simple tests, this is about one-half teaspoon of detergent powder in one-half pint of water. This measure is only approximate, but if all measurements are similar and the detergents have nearly the same specific gravity, the results will be comparable.

If detergents being tested vary from heavy granular materials to light fluffy particles, such differences should be taken into consideration in comparing the results of the tests. Measure by weight is, of course, more accurate than measure by volume.

Warm water should be used for these tests, to approximate actual operating conditions. The detergent solution may be mixed in a half-pint milk bottle, a glass, or any clear container.

The demonstration of detergent properties should proceed as follows:

1. *Ease with which it dissolves in the water.* Add one-half teaspoon of a basic chemical or a detergent to one-half pint of warm water and stir 25 times. A good detergent will be completely soluble and will yield a clear solution.

2. *Control of water hardness and film deposit.* Examine the solution carefully for cloudiness and sediment. Such deposits may be from the detergent itself, or they may be precipitated water hardness or insoluble soaps. These deposits can form films on dishes, making rinsing difficult. A well-balanced detergent will control water hardness by sequestering the hardness and keeping it in suspension or solution.

3. *Foaming ability.* After the detergent solution has been mixed and stirred, examine it for foam. Foaming ability is desired in detergents for washing by hand but must be limited for machine washing, since a high-foaming detergent will be quickly pumped out of a machine and spilled onto the floor.

4. *Wetting ability.* This property is desired in detergents to help separate soil from the dish. It can be demonstrated by putting a drop of the detergent solution on waxed paper. Water, with high surface tension and low wetting ability, will stand up in a spherical droplet. A detergent high in wetting ability will have a drop that flattens out over the waxed paper. Again, the difference may be demonstrated by allowing the drops to roll off the paper and examining the tracks. Water alone will not wet the waxed paper and will not leave a track. A good wetter will leave a wet track film. Plastic dishes may be used instead of waxed paper.

5. *Emulsification of fats.* Emulsifying ability may be shown by adding one-half teaspoon of vegetable salad oil to the detergent solution and stirring 25 times. A count in seconds of the time required for the oil to separate out at the surface will meausre this property of the detergent.

6. *Ability to dissolve and deflocculate proteins.* Although the above solution may be used for this test, a better test can be made with a fresh solution. Again add one-half teaspoon of detergent to one-half pint of warm water. To this add a few grains of dry cottage cheese. Then stir the mixture until it shows complete deflocculation and/or dissolving of the cheese. The number of times the solution is stirred is the measure of the ability of the detergent to dissolve and deflocculate proteins.

As each detergent is given each of the six tests, the results are recorded. After all the detergents under consideration have been tested, classification and selection is made by examining the scores of the products. Although small differences between detergents cannot be distinguished, the products can be classified as poor, fair, good, or excellent. The product scoring high in the greatest number of properties is the best of the group. In our classes, the trainees selected detergents from a group of over 25 commercial products for use in a single-tank dishwashing machine after seeing the demonstrations with the basic detergent chemicals.

The sanitarian and the restaurant operator are interested in selecting a suitable detergent for the available water supply. The chemical and physical characteristics of water, of course, vary in different parts of the country and at different times of the year. Even in a community in which the water supply is under competent water-plant-treatment control, the characteristics of the water may change during the year.

In addition to the basic water problem, the type of restaurant will influence the selection

of a detergent. The full-course-dinner restaurant will have use for several types of detergents, while a short-order bar may need only a single detergent.

The final selection of a detergent for use in a particular restaurant is not a simple problem. In addition to the above factors, availability and ease of handling must be considered.

Test-Plate Demonstration

It is generally agreed that the best test of a detergent is a use-performance test under normal operating conditions. This test can be made by using separate soils and a series of tests as given above, or by using a standard test soil applied to a plate. The latter method is the accepted practice. It has been used in laboratory and field appraisal of mechanical dishwashing installations. This method, however, presents two problems: (1) What should be the composition of a standard soil? (2) How should the soil be applied to the test plate? Breakfast, lunch, and dinner dishes all differ in the number of dishes per meal, the types of dishes, and the soil residue to be removed.

There is a difference of opinion as to whether dishes are soiled by separate food soils or by mixtures of food soils. From our experience here we have concluded that the soil on dishes is usually a mixture; it may be a mixture of fats, proteins, and carbohydrates, or of only two of these food substances. For our use-performance test, we made a simple standard test soil of these three food substances. The mixture is composed of easily obtainable materials, which can be mixed by simply stirring and shaking. Although the materials may separate after long standing, they may be easily remixed by simply shaking the mixture a few times. If a preservative such as sodium benzoate is used, the mixture has good keeping qualities.

The standard soil was made by mixing—

1 medium-sized whole egg
50 ml. evaporated milk
50 gm. white flour
100 ml. vegetable salad oil
100 ml. distilled water
5 gm. activated carbon
5 gm. sodium benzoate (as preservative)

The performance test is made by putting 1 ml. or 1 dropperful of the soil onto a plate, spreading it evenly over the central area, and drying by hot air, or the mixture may be placed on a hot plate. The test plate is then put into a tray of scraped and prerinsed dishes for the machine dishwashing. After the washing process, the test plate is examined for soil removal.

A properly operating dishwashing machine using the proper detergent and the recommended water temperature will completely clean the plate in the recommended washing time. In our single-tank dishwashing machine, the test-soiled plate was completely cleaned by washing at 140° F. for 30 to 45 seconds.

This test is a severe test of both detergent and machine. If the plate is not completely cleaned, one or more of the variable factors should be investigated. Failure may be due to the type of detergent, concentration of detergent, temperature, length of washing time, or mechanical condition of the machine.

Summary

Practical evaluation of detergents can be made by simple tests for each of six detergent properties. The six properties are: (1) ease of solution, (2) foaming ability, (3) control of water hardness and film deposit, (4) wetting ability, (5) emulsification of fats, and (6) dissolving and deflocculation of proteins. These tests can be made with very elementary measuring tools—a teaspoon, a half-pint milk bottle, and visual observation of results. A knowledge of sanitary chemistry is not needed for the tests to be demonstrated by a sanitary inspector or to be understood by the restaurant operator.

Although fine differences in detergents cannot be detected by these simple tests, the detergents can be classified broadly as poor, fair, good, or excellent.

After a detergent has been selected for use in a machine dishwasher, its performance can be tested by a test-plate demonstration, using a standard test soil. The test soil is easy to make up and use. The results show the over-all effectiveness of machine, operator, and detergent.

These simple tests are tools to be used by the sanitary inspector in his routine inspection work and by the restaurant operator in evaluating his detergents.