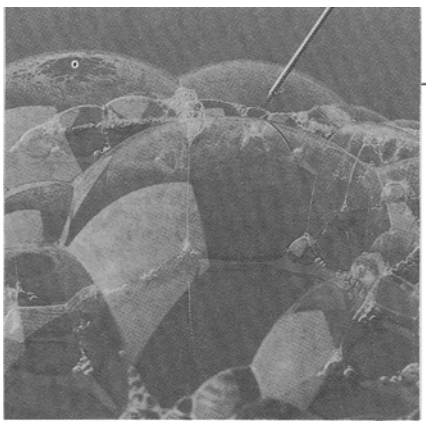

Detergency testing

The nine articles in this section are based on talks presented in a panel session on detergency testing, held at the 1988 AOCS annual meeting in Phoenix, Arizona, on May 10, 1988. Ted P. Matson of Vista Chemical Co. served as moderator for the session.

Terg-O-Tometer testing

The following is based on a talk given by William S. Gilman of the United States Testing Co. Inc., Chemical Services Div., Hoboken, New Jersey.

The Terg-O-Tometer is one of the most basic laboratory instruments for the evaluation of a laundry detergent product in conjunction with standard laboratory soil cloths. Using this machine, it is possible to determine the soil removal and redeposition properties of detergent products at various water hardnesses, temperatures and detergent concentrations.

The Terg-O-Tometer was developed over 40 years ago, with the United States Testing Co. Inc. acquiring sole rights to its manufacture and distribution. The company markets this device in both a four-pot or four-unit device (Model 7243) and a six-pot or six-unit device (Model 7243-S). In addition, testing services using this device are available for clients who require such data or for substantiation or corroboration of their data.

The Terg-O-Tometer makes it possible to reduce a wash load from 8 to 9 pounds to approximately 50 grams and the detergent water system or bath from 20 gallons to one liter.

The apparatus

The Terg-O-Tometer, or Terg, is a versatile washing machine that replicates the action of an agitator-type washing machine on a miniscale. The dimensions of a four-pot unit are 34 inches long by 24 inches wide by 34 inches high. The six-pot unit's dimensions are 53 inches long by 28 inches wide by 34 inches high.

The Terg has a self-contained water bath into which the washing vessels are set for temperature control ranging from room temperature to 90°C and controllable to ±1°C by a thermostat in front of the unit. The water bath capacities of the four-pot and six-pot units are 22 liters and 33 liters, respectively. The washing vessels or pots are stainless steel with a 2000-ml capacity, with a center mounting pin for the agitators. The agitators, with three fins or blades, are similar to those in an agitator-type washing machine.

The water tank is filled to approximately one-half the height of the pots or beakers in their respective wells. The bath has a drain plug, immersion heater and a stirrer. An external thermometer is used to monitor the temperature of the bath.

The control box has an on/off motor switch that engages the timer and starts the drive motor. A pilot light indicates when the drive motor and the timer are on. There are a heater switch and timer control. The timer is provided with

a range of 0–30 minutes for the respective wash or rinse cycles. It is equipped with a signaling buzzer to alert the technician as to time cycles. There also is a variable-speed drive which delivers an oscillating motion to the agitators. The speed range is 50 to 200 cycles per minute. Changes in speed are made by a control wheel on the right side of the unit. The number of cycles per minute is registered on the panel-mounted tachometer.

The scaled-down replication of a household agitator type washing machine now becomes apparent with each pot serving as a washer.

Test protocols

The detergency value of any soap or synthetic washing material is determined by washing soiled fabrics and measuring the amount of soil removed and/or redeposited. This is usually done by washing Standard Soiled Fabrics and measuring the soil removal by determining the reflectance before and after washing. Standard Soiled Fabrics for these tests are made by a number of companies and are widely used by detergent and washing machine manufacturers.

The operation of the instrument for the detergency test is carried out in the following manner. The heating bath of the Terg-O-Tometer is filled with water, the heaters are turned on and the thermostat is adjusted to hold the bath at the required temperature. Solutions of the desired water hardness and detergent concentrations are prepared following ASTM D-3050. They are heated to a temperature of 5°F higher than required for the actual test.

With the stainless steel beakers in position in the water bath and the agitators connected, one liter of test solution is poured into the beakers. The Terg-O-Tometer is operated for a minute or two to equalize the detergent solution temperature with that of the bath. Swatches of soiled and unsoiled fabrics of known reflectance are then placed in a beaker with the agitators in motion. The operation of the machine is continued for the prescribed length of time.

Upon completion of the wash cycle, the machine is turned off and the agitator is removed and rinsed. The solution is decanted from the beaker and the fabric is squeezed out by hand. The empty beaker is rinsed, the swatches are replaced and the beaker is put back in the bath. One liter of rinse water of the proper temperature and hardness is poured in the beaker, and agitation is continued for the desired length of rinse. Further rinsing, if desired, is done by repeating the operation just described.

After the last rinse, the fabric swatches are dried, ironed if necessary and the reflectance re-determined.

Conditions of test

Typical conditions are:

- Machine speed—100 rpm
- Water temperature—120°F
- Water hardness—150 ppm
- Wash cycle—15 minutes
- Rinse cycle—two 5-minute rinses
- Concentration of detergent—per specification
- Fabric—Test Fabrics oily printed soil, 100% cotton; 65/35 polyester/cotton with finish; 100% polyester; Scientific Services Dust/Sebum soil, 100% cotton; 65/35 polyester/cotton with finish; 100% polyester.
- The maximum wash load is six 4-inch × 4-inch soiled and six 4-inch × 4-inch white fabrics to one liter of wash water.

In a typical protocol, the parameters measured are the cleaning ability or detergency on various standard soiled fabrics and the ability of the detergent to maintain soil in suspension rather than redepositing it upon clean fabrics in the wash load.

Replications

Tests generally are carried out in triplicate. The ability of the Terg-O-Tometer to give controlled simulation and reproducible results is the key to its usefulness as an accurate, practical pilot-plant device. A large number of identical Terg-O-Tometers are in use in industrial laboratories, each one operating with the same close control. Test data are repeatable for interlaboratory, interplant and vendor-buying controls.

Calculations

Soil removal is calculated for each fabric swatch by inserting the reflectance values obtained into the equation:

$$\frac{A - B}{C - B} \times 100 = \% \text{ Soil Removal}$$

Where:

A = Average reflectance of soiled cloth after washing.
B = Average reflectance of soiled cloth before washing.
C = Average reflectance of white cloth before soiling.

For soil removal, the higher the percentage of soil removed, the better the detergency or soil removal ability of the product.

Redeposition index or white retention is calculated by use of the equation:

$$\frac{RA}{RB} \times 100 = \text{Redeposition Index}$$

Where:

RA = Average reflectance of unsoiled cloth after completion of test.
RB = Average reflectance of unsoiled cloth before testing.

The redeposition index represents the ability of the detergent to hold in suspension the soil that has been removed by washing; soil removal indicates washing ability or efficiency. In each case, the higher the value, the better the product performance. Values presented are the average from the three test runs.

References available that represent good guidelines are ASTM D-3050 (Standard Method for Measuring Soil Removal and Reflectance Retention of Fabrics) and ASTM D-4008 (Standard Method for Measuring Anti-Soil Deposition Properties of Laundry Detergents). The latter, however, is not suitable for detergent ranking.