U S Chemical

Providing Exceptional Quality Since 1962

Total Test Kit & Troubleshooting

In a Warewash Environment

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One of the most important tools a sanitation specialist can have in an institutional laundry is the U S Chemical Total Test Kit (TTK). The TTK can be used to do basic water quality tests, fabric troubleshooting, and testing of critical performance parameters during the laundry cycle. Proper use of the TTK can often be the difference between keeping and losing business. The TTK is used in doing a survey, troubleshooting, regular preventative maintenance calls, and sometimes for demonstrations.

This brochure will explain how to perform and interpret the results of the laundry tests in the Total Test Kit. When reading this brochure, it is easier to understand the brochure with a Total Test Kit and Total Test Kit Instruction Manual (© 2015) for reference. Later versions of the Total Test Kit Instruction Book may not correspond with the page numbers given in this brochure. Since complete test procedures are given in the TTK Book, the procedures are not repeated in this brochure. This brochure is designed to provide a more comprehensive level of information than is provided in the TTK Book.

TOTAL TEST KIT LAYOUT

The Total Test Kit is a collection of bottles of chemicals, titration vials, test strips, and other miscellaneous pieces. When the TTK is opened, it is apparent that the TTK is composed of 2 halves. The drawing below shows all of the materials as they are correctly placed in the TTK. The top half consists of 2 rows of small (1/2 oz) bottles of chemicals. The bottles of chemicals in the top half of the test kit are in the "A" row if they are in the row closest to the top edge of the TTK, or in the "B" row if they are in the row closer to the center of the TTK. The bottles in the A and B rows are also numbered from 1 to 7 within a row. The bottle in the top left corner of the TTK is bottle A1. The sixth bottle from the left in the second row is B6 (methyl orange) and is the only orange colored liquid in the TTK.

The bottom half of the TTK is a collection of bottles of chemicals, test strips for the 4 types of sanitizers, titration vials (empty plastic cylinders with markings on them), eyedroppers, a black plastic scoop, and pH papers. All of the bottles of chemicals have a letter code on them as well as the chemical name. Bottle codes are used so that reordering of chemicals can be done without needing to know the chemical names.

TOTAL TEST KIT BOOK

The TTK Book is a booklet that explains how to perform the tests and other relevant information for using the TTK. Before using the TTK, read and understand the safety information (Precautionary Statements) on page 3 of the book.

On the inside cover of the TTK Book is a table of all of the mechanical warewash detergents available under a specific label group and the factors for them. Use of the chart is explained later in this brochure. Below is a table showing the bottle codes and chemical names for all of the chemicals in the TTK.

Total Test Kit Layout

(Back)

Capped Hard Water Vial and Capped Chlorine Vial	pHydrion pH Papers	Clear Test Tube	Anionic Indicator Powder W	pHydrion Chlorine Test Paper	Iodine Test Papers	pHydrion Sanitizer Test Paper (QT-10)	Hardness Reagent Powder X
Phosphoric Acid (75% Solution) B1	Potassium Iodide B2	Starch Indicator (For Color Indication) B3	Sodium Thiosulfate 10X B4	Sodium Thiosulfate 1X B5	Methyl Orange (Color Indicator) B6	Cationic Titrate Solution B7	Hydrochloric Acid (.2 N HCl) Y
pH Indicator (Color Indicator) A1	Iodine Solution A2	Phenophthalein (Color Indicator) A3	o-Tolidine A4	Ninhydrin A5	Hydrochloric Acid (5% Solution) A6	Ammonium Thiocyanate (10%) A7	Hardness Titrate Z

(Front)

CHEMICAL SAFETY

Many of the chemicals in the TTK are hazardous. All of the chemicals in the TTK should be treated as though they are hazardous and handled with appropriate caution. Avoid skin contact and eye contact. The use of protective glasses or goggles is recommended. Inhalation or ingestion can cause irritation or burns. Treat all the chemicals in the TTK with respect. If skin contact occurs, rinse the skin immediately for 15 minutes. If eye contact occurs, holding the lids open, rinse the eye for 15 minutes in the nearest eyewash station. If eye contact, inhalation, or ingestion occurs, seek medical attention immediately.

TEST METHOD AND TECHNIQUE

Page 4 of the TTK Book describes how to properly hold bottles and perform the tests to achieve accurate results. The tests in the TTK fall into one of three groups: fabric tests, titrations, and test strip usage. Fabric tests involve putting chemicals directly onto the washed fabric. Titrations involve taking a dilute solution of chemical to be tested and filling a small plastic container (titration vial) to a particular mark with this solution. A chemical is added to the vial to serve as an indicator. The indicator changes color when the titration is completed. Another chemical is added drop by drop until the indicator changes color. While titrating (adding drops), the titration vial must be mixed after each drop. Each plastic titration vial has a plastic snap locking cover to allow a vial to be mixed without spilling. The number of drops needed to perform the titration is then used either directly or in a formula to get the information needed.

Test strip usage involves collecting a dilute solution of chemical and then immersing a test strip to observe the change in color of the strip. All test strips involve a color change. Directions are different for each type of test strip, so be sure to read and follow the procedure in the TTKI Manual.

WATER QUALITY PARAMETERS

The water quality at an account affects the choice of detergent and rinse aid used in the dishmachine. Desired water quality parameters appear in the chart below.

Total Dissolved Solids (TDS)

TDS is a measure of all of the minerals present in the water supply. High TDS can contribute to problems with soil removal and poor rinsing. Where there is high TDS, detergents with good water conditioning can help with the wash and higher quality rinse aids can help with the rinse.

pH

pH is a measure of the relative alkalinity or acidity of the water supply. The lower the pH, the less problems expected in rinsing. In general, it is difficult to achieve excellent results in rinsing with water having a pH over 8.0.

Calcium and Magnesium

Water hardness (lime scale) is made up of calcium and magnesium. Where there is heat, cold or alkalinity, water hardness will become insoluble and attach itself to surfaces. In a dishmachine, heat and alkalinity are present, so water hardness can cause problems. Where there is high water hardness, a mechanical warewash detergent with good water conditioning ability is needed. This will provide for chelation or sequestration of the hardness, which means that the hardness is being held in suspension and prevented from depositing onto the ware. Poor water conditioning ability of the detergent can lead to white films on glasses, plates and flatware. Water softeners are often installed in foodservice operations to remove the water hardness so that it doesn't have to be dealt with in the dishmachine as well as throughout the kitchen.

DESIRED WATER QUALITY PARAMETERS

Total Dissolved Solids (TDS)	< 500 ppm
pH	6-8
Silica	< 50 ppm
Iron	0 ppm
Copper	0 ppm
Manganese	0 ppm
Chlorideees	< 50 ppm
Sulfates	< 200 ppm
Bicarbonate Alkalinity	< 200 ppm

Calcium & Magnesium Hardness	**gpg**	**Classification**
(gpg = grains per gallon)	0.0-2.0	Soft
(1 gpg = 17.1 ppm hardness)	2.0-4.0	Slightly Hard
	4.0-7.0	Moderately Hard
Softening recommended for water above 7 gpg hardness.	7.0-12.0	Hard
	12.0-20.0	Very Hard
	20.0 and up	Extremely Hard

Silica

Silica in the water supply can contribute to the formation of a nonremovable white film on glasses. This nonremovable white film is called a silica film. Silica filming is accelerated by rinse temperatures over 185°F, high levels of silica in the water supply, detergent residues on glassware, and improper drying, where moisture is allowed to remain on the glass for prolonged periods of time. Silica also is found naturally in glass. Anything that attacks the surface of the glass (removing silica from the glass itself) can leave a hazy film that is nonremovable. Proper rinse aid selection helps control silica filming, but over time, especially in a high temp dishmachine, glassware surfaces will break down and become hazy. This is a natural occurrence for glassware and is not correctable.

Iron

Iron can cause a rust colored or bluish residue inside the dishmachine. Chlorine will react with the iron in the water supply, causing it to precipitate as rust. Low-temp dishmachines have this problem frequently because chlorine is always present in the dishmachine. In high temperature dishmachines, using a non-chlorinated detergent can help minimize the problem.

Copper and Manganese

Although these metals are part of a standard water analysis, they are rare. They don't generally cause problems in warewash, only in laundry.

Chlorides

Chlorides are salts that can cause corrosion of metal parts in the dishmachine and can cause filming and streaking problems on glassware. High levels of chlorides are usually caused by water softener malfunctions. Better quality rinse aids help control the problem of poor rinsability normally associated with naturally occurring chlorides.

Sulfates

Sulfates are generally not a problem in warewash, although at high levels (>200 ppm) they can cause rinsing problems similar to those encountered with high chloride levels.

Bicarbonate Alkalinity

Bicarbonate alkalinity (bicarb) is inactive alkalinity naturally occurring in the water supply. The water supply picks up these minerals as water is filtered through the ground into the water table. Bicarbonate alkalinity tends to raise the pH of the water supply and can cause spots and filming on the ware, especially glasses. Bicarbonate alkalinity is not removed by using a water softener. As the water table changes during the year, it is very common for the bicarb levels to change as well. Using a better quality rinse aid helps to control spotting and filming problems when high bicarb levels are a problem.

Water Quality Rules

To summarize, there are three main water quality rules, which affect the selection of the products in a laundry.

1. Water hardness over 12 grains per gallon (gpg) dictates the use of a separate break and suds rather than a built detergent. This allows for increasing the amount of break to increase the amount of water conditioning being added without increasing the amount of suds being added. Overuse of suds can cause several problems. If suds builds up in the fabric, this can contribute to graying, a rough feel to the fabric, and problems getting the fabric softener to adhere to the fabric. If the additional suds is not giving additional cleaning, then the cost of the suds is being wasted.

2. Bicarbonate alkalinity over 200 ppm dictates the use of a separate sour and softener rather than a combination sour/soft. This allows for increasing the amount of sour being added without increasing the amount of fabric softener, which could cause waterproofing of the fabric.

3. Iron in the water dictates the use of separate sour and softener products rather than a combination sour/soft. This allows for the use of an iron inhibiting sour. Additional information on these and other laundry parameters can be found in the "U S Chemical Laundry Formulas and Laundry Cycle Functionality" brochure.

WATER QUALITY TESTS

As part of a survey of a warewash account or as part of a PM, the water hardness and the bicarbonate alkalinity of the water supply should be tested. The water hardness test is on page 6 and the bicarbonate alkalinity test is on page 7 in the TTK Book. The result of the water hardness test (in grains per gallon, or "gpg") tells us how much water conditioning ability the mechanical warewash detergent needs to have. The bicarbonate alkalinity and the water hardness together determine the quality of the rinse aid needed to get good results.

While water hardness and bicarbonate alkalinity are both alkaline water minerals, adding a water softener to the account changes the hardness, but not the bicarbonate alkalinity. As a result, adding a water softener may allow the use of a detergent with less water conditioning. However, since the bicarbonate alkalinity is not affected by the water softener, the need for an appropriate quality rinse aid does not change.

Water hardness and bicarbonate alkalinity can cause spotting and filming problems on ware in a dishmachine. Being alkaline minerals, they can both be removed by an acid cleaner such as a delimer. When white spots or white films are seen on ware, one of the first things to check is the water hardness (and the water conditioning ability of the detergent) and the bicarbonate alkalinity (and the water hardness and bicarbonate alkalinity parameters for the rinse aid being used). In 99% of accounts, proper selection of detergent and rinse aid allows us to control the minerals in the water and prevent spotting and filming.

CHLORINE TEST FOR LOW TEMP DISHMACHINES

On page 17 of the TTK Book, there is a titration for chlorine. This test can be used in working with a low temp dishmachine to verify that the chlorine concentration at the end of the machine cycle is acceptable. 50 ppm of chlorine needs to be detectable at the end of the cycle. While this can be tested with a chlorine test strip, the titration gives a more accurate result. If there are any questions about the actual result, titration is always a preferred method of testing. A version of this test, found on page 31, can be used to test the strength of a pail of chlorine sanitizer. Never try to use test strips on a pail of concentrated sanitizer. The high chlorine concentration will bleach out the test strips, giving no reading.

DETERGENT ALKALINITY TEST

By taking a sample of the detergent solution from the wash tank of the dishmachine, a detergent alkalinity test can be performed to determine the concentration of detergent present in the wash tank. The test is on page 9 of the TTK Book. The number of drops obtained by the titration is multiplied by the factor for the detergent to yield the concentration (ppm) of detergent present.

Drops x Factor = ppm Detergent

A ppm (part per million) is a measure of strength or concentration. One ppm is approximately one drop of water in 10 gallons of water. Dishma-chines typically operate with 1000 to 2500 ppm detergent in their 11 to 30 gallon wash tanks. With this low level of detergent, it is easy to see that the water in a dishmachine does a large portion of the cleaning through the mechanical action of the dishmachine. This test can also be used in troubleshooting. If a customer complains of excessive detergent usage, it is helpful to test the wash tank and see if the concentration is the same as it was when it was last checked.

A factor for a mechanical warewash detergent can be thought of as a “fingerprint” for that product. Like a fingerprint, it is unique for the product. While the detergent alkalinity test, strictly speaking, measures the active alkalinity of the dishmachine tank, the water conditioning, metal protection and chlorine levels all play a part in the factor for a detergent. If product A has a factor of 100 and product B has a factor of 200, it can be said that product A has more active alkalinity (twice as much), but it cannot be said that product A is twice as strong or twice as good as product B. Water conditioning ability plays at least as important a role as the amount of active alkalinity in the wash tank in getting good results.

The factor for a detergent can be obtained by making a 2500 ppm solution of the detergent and titrating it using the detergent alkalinity test. Before calculating a factor is explained, here is a quick review of the math behind the concept. One ounce of detergent in 3 gallons of water is approximately 2500 ppm.

This is shown as follows:

$$\frac{1\text{ oz}}{3\text{ gal}} = \frac{1\text{ oz}}{(3 \times 128)} = \frac{1\text{ oz}}{384\text{ oz}}$$

First convert the ratio to ounces. There are 128 fl ounces in a gallon, so there are 384 fl oz in 3 gallons. Dividing out the fraction 384 ounces yields the decimal.

$$\frac{1\text{ oz}}{384\text{ oz}} = 0.002604$$

To convert this number to ppm, move the decimal point 6 places to the right. 0.002604 = 2604 ppm Round this to 2500 ppm.

The reason for rounding 2600 ppm down to 2500 ppm is for simplicity, as 2500 ppm = 0.25%, and is easy to remember. The reverse of this mathematical procedure gives both a ratio for any given concentration and an amount of product present in the dishmachine if the size of the wash tank is known. This five step procedure is show in detail below. Please note that this procedure and these calculations do not distinguish between liquid, powdered, or solid mechanical dish detergents. This system works for any mechanical warewash detergent, regardless of the form of the detergent.

Step 1: Convert the ppm to a decimal by moving the decimal point 6 places to the left. Set this number equal to 1/X.

Example: 1500 ppm = 0.001500 $0.001500 = \frac{1}{X}$

Step 2: Flip-flop the decimal and the X.

Example: $X = \frac{1}{0.001500}$

Step 3: Divide out the right-hand side of the equation.

Example: X = 667 (oz)

Step 4: Convert the oz back to gallons by dividing by 128.

Example: $X = \frac{667\text{ oz}}{128\text{ oz/gal}} = 5.2\text{ gal}$

This gives us the first answer. 1500 ppm is 1 ounces in 5.2 gallons.

Step 5: Take the tank capacity in gallons and divide by the answer in step 4. Here it is assumed that the dishmachine has a 15 gallon wash tank. The answer is the number of ounces of detergent needed to charge the dishmachine tank.

Example: $\frac{15\text{ gal}}{5.2\text{ gal}} = 2.9$ oz of detergent

If 2.9 ounces of detergent is put in a 15 gallon wash tank and then the wash tank is titrated using the detergent alkalinity test, the result will be 1500 ppm of detergent. This approach can be used to take any concentration and express it as a use dilution for the detergent. Again, it doesn’t matter if the detergent is a liquid or a powder. This method works for either form. Use of this method is often helpful in discussing with a customer how much detergent the customer can expect to use. This can also be used for cost analysis purposes.

DETERMINING A FACTOR

When surveying an account, it is helpful to know at what concentration the dishmachine is being run. If the factor for the detergent is known, the dishmachine wash tank can be tested immediately. If not, the factor must first be determined. To determine the factor for an unknown mechanical warewash detergent, mix 1 ounces of detergent in 3 gallons of water. Accurately measuring an ounce of detergent is of critical importance to this test. This 2500 ppm solution can then be titrated using the detergent alkalinity test. Using the following formula, the factor can be determined. The procedure for this is on page 10 in the TTK Book.

$\text{Factor} = \frac{\text{ppm}}{\text{drops}}$ $\text{Factor} = \frac{2500}{\text{drops}}$

Once the factor for a detergent has been determined, unless the formula changes, the factor never changes. All of the U S Chemical mechanical warewash detergent factors are listed in a table on the inside cover of the TTK Book. We also have calculated factors for products produced by our large national competitors. Once the factor for the detergent is known, the dishmachine wash tank solution can be titrated. After doing the detergent alkalinity test, the standard formula below can be applied to determine the amount of detergent in the wash tank.

Drops x Factor = ppm Detergent

When a PM at an account is done, the wash tank will be tested and the detergent concentration recorded. If a survey of a competitor's account were being done, the factor for the competitor's detergent must first be determined and then the dishmachine can be titrated. In this way the concentration the competitor is running in the dishmachine can be determined.

WAREWASH TROUBLESHOOTING

When ware is spotted, filmed, or results are otherwise unacceptable, the TTK provides several tests to help identify the cause of the problem. In most cases troubleshooting will be of spotted or filmed ware, especially glasses. The first step is always to look at the ware and try to classify the type of problem. Is the problem a film or spots? Are there removable specks? Can the film be easily scratched off? The next step is to do the pH test on page 10. The results of the test often lead to an understanding of where the problem lies. Food soils turn the pH indicator red, yellow, or orange. Water hardness turns the indicator green. Detergent residues and bicarbonate alkalinity turn the pH indicator blue.

If a white film on glassware is nonremovable, it could be silica film or etching. If the film is on plastics, the film could be styrene etching. In either case, the film is nonremovable. Let's look at each possible result in turn. The chart below shows a general troubleshooting procedure.

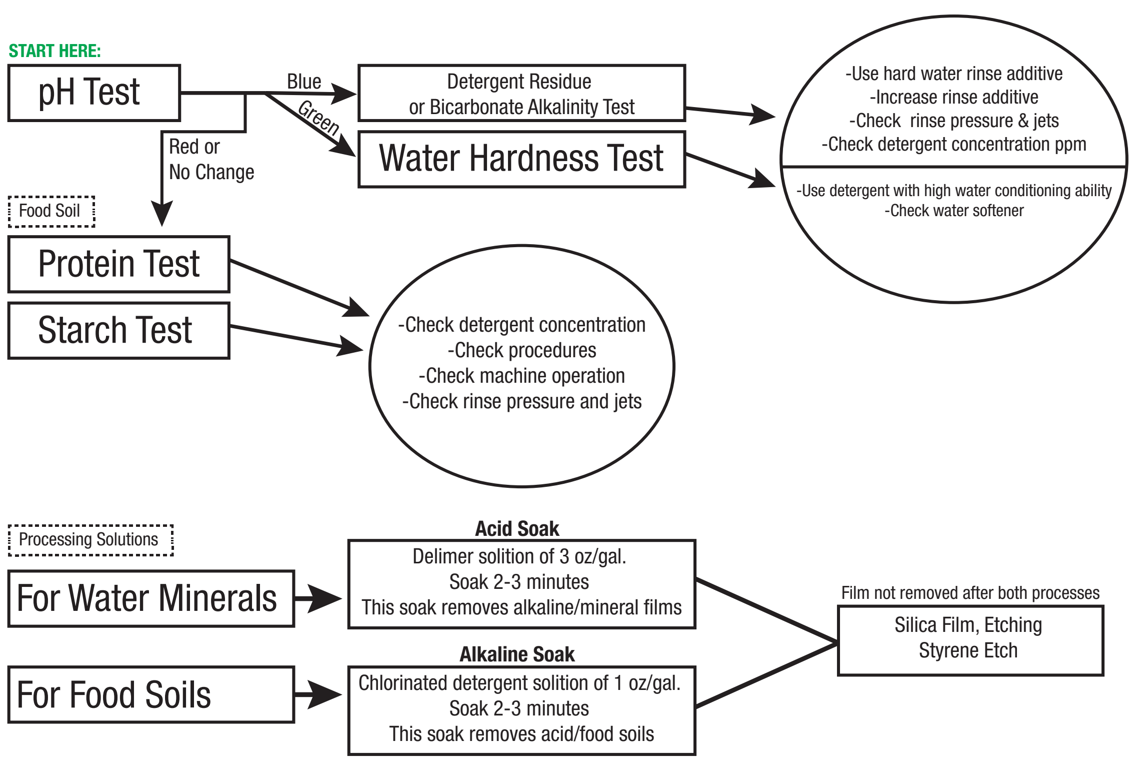
Water Hardness Problem

If the film on a glass turns the pH indicator green, the cause could be a water hardness buildup. Soak the glass in a delimer solution. If the film is removed by this method, then water hardness is the most likely cause of the mineral buildup on the glass.

Possible reasons for this include:

- Water conditioning ability of the detergent is too low or detergent concentration level is too low.
- Water hardness of the water supply has suddenly increased or the water softener is not working.
- Low quality or wrong rinse aid being used.
- Low final rinse pressure.

WAREWASHING TROUBLESHOOTING GUIDE USING THE TOTAL TEST KIT



- Final rinse temperature over 185°F.
- End cap is off the rinse arm.
- Rinse arm jets are plugged or limed up.
- Rinse aid is not being dispensed; pail is empty, squeeze tube is bad, injection tube is pinched.
- Rinse aid injection is uphill into the water flow.
- Rinse arm won't turn (bad bearing).
- Rinse arm installed improperly (upside down on conveyor machines).

If the film on the glass turns the pH indicator blue, the problem is either detergent residue or bicarbonate alkalinity. To tell the difference between the two, use the test on page 11 of the TTK Book. This test involves putting drops of acid on the film and observing the bubbling. High amounts of sustained bubbles or foam indicate a bicarbonate alkalinity buildup. Low amounts of quickly dissipating bubbles or foam indicate a detergent residue.

Bicarbonate Alkalinity Problem

If the film on a glass turns the pH indicator blue and the foaming from the acid test indicates bicarbonate alkalinity, then soak the glass in a delimer solution. If the film is removed by this method, bicarbonate alkalinity is causing a mineral buildup on the glass.

Possible causes for this include:

- The bicarbonate alkalinity of the water supply has suddenly increased.
- Low quality or wrong rinse aid being used.
- Low final rinse pressure.
- Final rinse temperature over 185°F.
- End cap is off the rinse arm.
- Rinse arm jets are plugged, limed up, or not in place.
- Rinse aid is not being dispensed; pail is empty, squeeze tube is bad, injection tube is pinched.
- Rinse aid injection is uphill into the water flow.
- Rinse arm won't turn (bad bearing).
- Rinse arm installed improperly (upside down on conveyor machines).

Detergent Residue Problem

If the film on a glass turns the pH indicator blue and the foaming from the acid test indicates detergent residue, then correct the problem and rewash the glass. In rare cases soaking the glass in a delimer solution may be needed.

Possible causes for this include:

- Too much detergent - limed up probe, probe wire loose, incorrect flowrate to dispenser of encapsulated products.
- Low final rinse pressure.
- Final rinse temperature over 185°F.
- End cap is off the rinse arms.
- Rinse arm jets are plugged or limed up.
- Rinse arm won't turn (bad bearing).
- Rinse arm installed improperly (upside down on conveyor machines).
- Water temperature in the wash tank is too low.
- Detergent is on the rinse pump.
- The final rinse solenoid is burnt out.

Food Soil Problem

If the pH indicator indicates a food soil (acidic pH), there are two tests in the TTK for specific food soils. Even if the pH indicator is green, specks may be food soil. In some cases there are only small specks of food, not a film as well. The films are what give the best pH test result. If the pH indicator is green, but there are reasons to believe that the problem is caused by food soil, try a processing solution as described below. Page 12 of the TTK Book describes the specific food soil tests. For the protein test, note that the ware must be heated above 120°F. For the starch test, note whether the specks change color or merely become coated with the iodine. If starch is present, the specks will actually change color. The larger the specks and the drier the specks, the longer the contact time needs to be before the starch will change color.

Food soil problems can be caused by:

- Poor prescrapping and other procedure problems.
- Dirty dishmachine and excessive food soil in the wash tank.
- Low detergent concentration in the dishmachine.
- Detergent pail is empty or has been replaced with a pail of another product such as rinse aid or pot & pan detergent.
- Squeeze tube on the detergent pump is bad.
- Plugged wash arms or scrap trays.
- Plugged or obstructed pump impeller.
- Improper racking.
- Clogged pump impeller screen.
- Low water level in the wash tank.
- Obstructed drain.
- Plugged rinse jets.
- Low rinse pressure.
- Too high of a wash tank temperature.

If none of these tests seems to help identify the problem, try a processing solution soak test. Make up a solution of 1 ounce mechanical warewash detergent per gallon of water and soak the ware for 15 minutes. Be sure to wear rubber gloves and eye protection when working with mechanical warewash detergent solution. If the filming is removed, the problem was food soil. If that doesn't work, try soaking in a delimer solution of 1 ounces delimer per gallon of water. Soak the ware for 15 minutes. If the filming is removed, it was an alkaline soil caused by water minerals. Do not mix these processing solutions as a violent reaction will result. After use, flush each processing solution down the drain with plenty of fresh water.

When a plate becomes scratched or cracked and starch food soils get into the scratches or cracks, the iodine test will always show starch, regardless of how well the plate is washed. Your competitor can do no better, so it is important to address this with a customer if a competitor makes the claim that they can remove the starch from the plate. Plates with cracks or serious scratches should be discarded as they cannot be sanitized properly with either heat or chemicals. Metal marks will often show up on plates and sometimes on other ware as well. This is caused by dragging a plate across a metal surface. Washing in the dishmachine will not remove these marks. Scrubbing the plate with a nylon scouring pad and using a solvent based degreaser may remove the marks, but the next time the plate is dragged across a metal surface, the marks will reappear.

In addition to the troubleshooting problems addressed previously, there are many other things that can cause results problems. What follows is a short list of some general problems and some specific possible causes.

Rinse Pressure, Spray Pattern & Temperature Problems

Improper rinse pressure can cause a variety of problems. As stated previously, poor rinse pressure can cause a water hardness, bicarbonate alkalinity, or detergent residue problem. When final rinse pressure is below the acceptable range of 15 to 25 psi, the amount of water used in the final rinse is insufficient to properly rinse the ware. This causes poor rinsing which can leave residues on the ware. If the rinse pressure is too high, either the spray pattern changes, or the water starts to mist from the pressure and doesn't form droplets properly. Both of these problems result in improper rinsing which can leave films on ware.

When a problem with rinsing is suspected, a pattern test can be run on the dishmachine. A glass rack is loaded with several glasses in an "X" pattern. The glasses should have paper napkins, peanut butter, mayonnaise or a similar material placed inside them. The rack is then run through the dishmachine and the glasses are checked to see if the soils were removed. If all of the glasses are clean, the rinse pressure and spray patterns are fine. Where specific glasses don't come clean, this implies a problem with the wash or rinse jets being plugged. The jets should then be checked. If none of the glasses come clean, a low rinse pressure or other washing problem may be causing the problem. On some dishmachines, there is a rinse pressure balance that acts as a flow restricter on the bottom wash and rinse arms to reduce the water pressure from the bottom arms. Check the owner's manual for the machine to determine how this is adjusted.

Low rinse temperature can cause poor rinsing, leaving films on the ware, either from the rinse aid or water minerals. If the final rinse temperature is too high, the ware may actually dry too quickly before the water has had a chance to sheet properly, leaving a film on the ware.

Greasy Films

Greasy films can be caused by lack of detergent, low detergent concentration, running the dishmachine with the fill valve open (on a manual fill dishmachine), plugged overflow tube, plugged wash arms, or too low of a wash tank temperature.

Spotty Greasy Films

Spotty greasy films can be caused by wash water splashing on the dishes during the final rinse, curtains missing in conveyor machines and improper wash and rinse spray patterns caused by plugged jets.

Grit or Granular Feel

Gritty or a granular feel to ware is caused by tank wash temperatures being too high, plugged rinse jets, or too high of a rinse pressure. All of these causes can leave food soils or mineral deposits on ware.

Rinse Aid Residue Problem

Rinse aids do not work on dirty ware. For a rinse aid to work properly, the ware must be clean. Rinse aid residues can result from ware being dirty. Rinse aid residues can cause white films on ware and a bluish haze on flatware, especially if protein is also present.

Foaming in the Dishmachine

Foaming in a dishmachine can be caused by flatware presoak or pot & pan detergent contamination, high total dissolved solids (TDS) of the water supply, or excessive food soils in the wash tank, especially proteins such as milk, eggs and meats.

Bakery machines are large machines designed to do pans and trays used in a bakery. Because all of the ware washed is metal, rinse aid is rarely used. The lack of rinse aid in the machine makes foaming in the machine a common problem. Large amounts of food soil frequently go into a bakery machine, causing the foaming. With no rinse aid present, the food soil foams.

One of the best ways to control foaming in the dishmachine is by frequent water changes. The wash tank water should be changed at least once per meal or more frequently if food soils are heavy. When food soils build up in the wash tank, this causes foaming and poor results.

Silica Filming, Etching & Styrene Etching

If a white film on glassware is nonremovable, it is usually silica filming or etching. If the ware is plastic, it can be styrene etching. Silica filming is caused by rinse temperatures over 185°F, high silica levels in the water supply, poor rinsing, detergent residues and improper drying. Etching will often look like silica filming, but is caused by rubbing the glass with another surface (even other glasses). Plastics have a shiny protective coating called a styrene finish. If this finish becomes damaged, such as by soaking in chlorine bleach, scratching, or just through normal use, the underlying plastic can become stained or turn white. This white film is called styrene etching. If plastic becomes stained by a foodsoil, never soak in a chlorine bleach solution to remove the staining because of the damage to the plastic that chlorine can cause. Always use an oxygen bleach based product instead. There is a test called the "pencil test" to help diagnose styrene etching. A #2 pencil is used to make a mark on both sides of a plastic plate (or bowl or glass). If the mark can be wiped away with a finger, the styrene finish is intact. If the mark cannot be wiped away, the styrene finish is damaged and the pencil mark is penetrating into the plastic.

When problems exist, one of the considerations is procedural problems that cause the bad results. Glassware and flatware procedures are especially critical in getting good results. Once glassware is damaged, which is usually caused by improper handling procedures, the damage is irreversible. Next is an explanation of proper glassware and flatware handling procedures.

Glassware Procedures

Glassware procedures include 4 basic rules: don't nest (stack) the glasses, don't stack flatware in glasses, use the proper racking procedures, and don't use glasses to scoop ice. Glassware problems are often caused by poor procedures or by improper handling. Stacking (nesting) glasses can cause scratches (also called etching). While glass is thought to be hard, it is really quite soft. Because of this, it damages easily. A common cause for scratching is scooping ice with a glass. The ice is hard enough to scratch the surface of the glass. Anything that repeatedly rubs the surface of a glass can also cause etching. Glasses should not be scrubbed with a nylon scouring pad.

Cups made from plastics will tend to last longer because they are more durable, but plastic cups tend to look worse near the end of their life because they are being used and washed so many additional times. A cup made of glass generally breaks before it has lasted long enough for the surface to etch as plastics often do.

It is also important to use proper glass racks for washing. These racks are specially constructed to allow a high volume of water in from the bottom of the rack. Some glasses have a concave base that can allow a puddle of water to collect. If the rack is not tipped or shaken to remove this puddle, the glass will cool and then when the rack is moved the puddle will drip down the side of the glass causing a streak. To avoid this, glassracks should be tipped or shaken to remove the puddle before it cools. In this way, the rinse aid can do its job and sheet the water off of the glass.

Some glasses have ribs around the middle of the glass to protect the rest of the glass surface. The ribs are designed to be the contact points for the glass. Wear occurs on the ribs, thus protecting the rest of the glass surface. These ribs cannot be cleaned up.

Flatware Procedures & Problems

Flatware procedures vary greatly from facility to facility. Often spotty, filmed or damaged flatware is the result of poor procedures. When poor results occur with flatware, troubleshooting can be performed in the same manner as with glasses or other ware.

For the best results, follow these handling procedures.

1. Collect soiled ware as soon as possible and immediately place into a presoak solution.
2. After soaking for a minimum of 15 minutes, place assorted flatware on a flatware rack. Flatware should be 1" - 2" deep.
3. Rinse flatrack to remove the presoak solution.
4. Wash in the dishmachine.
5. Sort flatware by type and place into flatware cups with the eating surface up. Do not overpack the cups. They should be loosely packed (roughly 20-30 pieces).
6. Place the flatware cups onto a flatrack and rewash to sanitize the ware after the contamination from sorting.
7. When the rack comes out of the dishmachine for the second time, allow to air dry.
8. After the ware is dry, invert the flatware into an empty flatware cup. Avoid touching the eating surface when doing this.

The flatware is now ready to be stored with the eating surface protected. As the staff handles the flatware, only the handles are touched. This procedure will ensure excellent looking flatware on a consistent basis. It also helps comply with the strictest health codes by protecting the eating surfaces after sanitizing.

There are three main types of problems to watch for: food soils, minerals deposits causing white films and rusting or pitting of the flatware. Food soil problems are caused by low detergent concentrations, overloading the flatrack, or a mechanical problem with the machine that causes the detergent solution to not be sprayed over the ware.

Mineral films can be caused by flatware drying while lying down in the flatrack, poor rinsing caused by the water hardness and bicarbonate alkalinity not being handled properly by the rinse aid, or a mechanical problem with the rinsing (low water temperature or pressure).

Rusting or pitting of flatware does not happen to high quality stainless steel flatware. Low quality flatware is made by taking a base metal, such as iron and plating it with a stainless steel finish. This flatware is magnetic. Using a magnet will aid in the determination of the quality of the flatware. When the finish on the flatware is damaged, the base metal will rust causing rust marks on the flatware or pitting and black marks on the ware. If concentrated presoak, especially the powdered presoak, is allowed to contact the plated flatware, the finish can be damaged. Low quality flatware can easily be damaged through routine use as the surfaces of the flatware are scraped and rubbed.

Silver plated flatware can become tarnished through normal use. Burnishing machines can restore the natural look, but a nonchlorinated flatware presoak may also remove the tarnish. A buspan is lined with aluminum foil and then filled with water and an appropriate amount of presoak. The ware is added and allowed to stand for 15 minutes. The aluminum foil will pull the tarnish off of the ware and onto the aluminum foil. Letting the silver plated ware sit in the presoak for longer than 15 minutes can start to reverse the process, so time is important.

Metal Ware Damage

Metals can be categorized into several groups. Chemical safe hard metals include most varieties of stainless steel. Soft metals include aluminum, gold, tin, copper, lead, silver and pewter. Mechanical warewash detergents can be either heavy duty or metal safe. Heavy duty detergents contain high active alkalinity in the form of caustic soda (or caustic potash in liquids). This strong alkalinity will damage any soft metal by pitting or blackening it. If any of the listed soft metals are being washed, use a metal safe detergent.

SANITIZER TESTING PARAMETERS

Sanitizer Type	Minimum Concentration	Test Paper Type	Immersion time
Quaternary	200 ppm	QC-1001	10 seconds
Acid-Anionic	pH less than 4.5	Short Range	10 seconds
Chlorine	50 ppm	Chlorine	Dip & Read
Iodine	12.5 ppm	Iodine	20 seconds

Many of the soft metals, especially gold and silver, are also damaged by chlorine. If anything with gold or silver trim or silver plated flatware is being washed, use a nonchlorinated, metal-safe detergent. A chlorinated detergent may be metal safe and be safe on soft metals, like aluminum, but not be safe on precious metals. This distinction is very important, as doing it wrong can be very expensive. When aluminum or another soft metal starts to pit or blacken, the most likely cause is that a heavy duty detergent is being used. This process in not reversible.

Stained Tea and Coffee Cups

Many beverages, including coffee, tea and hot chocolate can cause brown stains in cups. Higher detergent concentrations can help control this, but the presence of chlorine in the dishmachine will help even more. However, in some cases the stain is made worse by iron in the water. Iron reacts with chlorine to precipitate rust. This rust can stain ware or the dishmachine itself. If the detergent is switched to a nonchlorinated detergent, the destaining ability of the chlorine is lost, so a trade-off may be necessary. Running higher concentrations of a nonchlorinated detergent may give similar results to running a lower concentration of a chlorinated detergent. If a cup is stained and there is iron in the water, scrub the cup with mechanical warewash detergent and then destain the cup with an oxygen destainer. This procedure is outlined on page 15 of the TTK Book. When oxygen destainers are used, a minimum water temperature of 120°F is required for good results.

SANITIZER TESTING & PH TEST STRIPS

Any time a chemical sanitizer is used, there is a minimum concentration of the sanitizer that must be maintained to comply with health codes. The chart on page 16 of the TTK Book lists the 4 types of sanitizers and the concentration required under federal law. However, each state has the option of raising this level. Page 18 of the TTK Book describes how to use each of the test strips for the different sanitizers. Using the correct strip is important. A chlorine strip will give no reading if a quat sanitizer is actually being used. Using the correct contact time is critical. If a test strip must be immersed for 10 seconds, reading it immediately after immersing the strip will give a false low reading. Above is a table of the sanitizers, the minimum concentration needed to sanitize, the test paper to use and the time the strip must be immersed before a reading can be made.

Chlorine and iodine sanitizers are typically dosed at higher concentrations than are required for sanitizing. This is due to the unstable nature of chlorine and iodine sanitizers. By dosing chlorine at 200 ppm, the chlorine can break down over a period of time, but still maintain the 50 ppm necessary for germ kill. Many states require 50 ppm of chlorine in the dishmachine, but 100 ppm in the 3 tank sink, so it is important to be familiar with the health code for your accounts state. Note that sanitizers are only used on food contact surfaces to kill germs, not to clean.

Another type of antimicrobial are disinfectants, which are used in bathrooms, toilets and other nonfood contact surfaces. Disinfectants require different test strips than sanitizers. For quat disinfectants, a QC-1001 strip is used. Disinfectants should never be used on food surfaces. A common problem in food service establishments is the use of disinfectants on food contact surfaces, which causes a hazardous chemical residual. U S Chemical has published a brochure on this topic called “Sanitizers vs. Disinfectants”.

Apart from the sanitizer test strips, there is a tube of pH papers in the Total Test Kit. These test strips are designed to be dipped in a liquid and read immediately after immersion to determine the pH of the liquid.

SOLID CRYSTAL™

Solid Crystal are encapsulated pot and pan detergents. They can be tested using a titration found on page 19 of the TTK Book. Because dispensing these products is time controlled, variances in water temperature and pressure will affect the titration result. To increase the concentration, increase the time that the water solenoid is open.

MARQUIS™ & SOLID MARQUIS™

Marquis and Solid Marquis are encapsulated presoaks. They can be tested using the titrations found on pages 20 and 21 of the TTK Book. Because dispensing these products is time controlled, variances in water temperature and pressure will affect the titration result. To increase the concentration, increase the time that the water solenoid is open.

Presoaks can cause problems with ware including pitting and blackening. This occurs on silverplated ware and lower quality plated stainlessware. To avoid these types of problems, always dilute the presoak before adding the ware. Dropping presoak directly onto ware often causes damage. The presoak with the lowest concentration of active alkalinity is Solid Marquis, so if there is a potential for problems, using Solid Marquis gives the most safety.

TECHNICAL SERVICE PROCEDURES

U S Chemical provides free technical service support to its customers. If there is a problem with ware at an account, a sample of that ware may be sent to the Training Department at U S Chemical for analysis. Water quality can be tested as well. Water samples should be one quart in size and packed in a clean glass bottle. Both ware and water samples should be wrapped and packed carefully to avoid the possibility of breakage in shipping. Within 2 weeks of receipt, results of the testing will be communicated to the sender.

Send all packages to:
Attn: Training Department
U S Chemical
316 Hart Street
Watertown, WI 53094

To check on a service request in process, call 1-(800)-424-1075 and ask for the Training Department.

SUMMARY

The Total Test Kit includes a variety of tests to help the service specialist in a warewash environment. This brochure explains the basics of the warewash tests. Water quality and troubleshooting can be done with accuracy rather than guessing by using the tests in the TTK. This leads to quicker problem resolution and proper product selection the first time.