U S Chemical

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Laundry Total Test Kit

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INTRODUCTION

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 (PM) 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 (version 5) for reference. Later versions of the Total Test Kit Instruction (TTKI) Manual may not correspond with the page numbers given in this brochure. Since complete test procedures are given in the TTKI Manual, 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 TTKI Manual.

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 INSTRUCTION MANUAL

The TTKI Manual 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 5 of the TTKI Manual.

On the inside cover of the TTKI Manual is a table of all of the mechanical warewash detergents available under a specific label group and the factors for them. This chart does not apply to the laundry. Page 3 is a Table of Contents to help in locating a test. Page 4 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 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. Before using the TTK, read and understand the safety information (Precautionary Statements) on page 5 of the TTKI Manual.

TEST METHOD AND TECHNIQUE

Page 6 of the TTKI Manual 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 products used in the laundry machine. Desired water quality parameters are as follows:

A. 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, breaks and built detergents with good water conditioning can help suspend the minerals. Higher amounts of sour may be needed in the final rinse. There is no specific test for TDS in the TTK, but TDS meters are available from laboratory/testing supply companies if determination of TDS is critical.

Total Dissolved Solids (TDS)	<500 ppm
pH	6 - 8
Calcium and Magnesium Hardness	
gpg	**Classification**
(gpg = grains per gallon, 1 gpg = 17.1 ppm hardness)	
0 - 0.5 gpg	Soft
0.5 - 3.5 gpg	Slightly Hard
3.5 - 7.0 gpg	Moderately Hard
7.0 - 12.0 gpg	Hard
12.0 - 20 gpg	Very Hard
20+ gpg	Extremely Hard
Softening is recommended for water above 7 gpg hardness	
Silica	<50 ppm
Iron	0 ppm
Copper	0 ppm
Manganese	0 ppm
Chlorides	<50 ppm
Sulfates	<200 ppm
Bicarbonate Alkalinity	<200 ppm

B. pH

pH is a measure of the relative alkalinity or acidity of the water supply. In general, the higher the pH the more bicarbonate alkalinity in the water and the more sour needed to reduce the final pH of the fabric to 5.5 – 6.5.

C. 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 laundry machine, heat and alkalinity are present, so water hardness can cause problems. Where there is high water hardness, a break or built 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 fabric. Poor water conditioning ability of the break or built detergent can lead to poor soil removal, a buildup of minerals in the fabric, odors in the fabric, and graying of fabrics.

High amounts of water hardness often dictate that separate break and suds products be used instead of a built detergent. This allows for increasing the amount of water conditioning, by increasing the amount of break, without increasing the amount of suds being used, which might not provide any additional cleaning. Water softeners are often installed in laundries to remove the water hardness so that it doesn't have to be dealt with in the laundry

machine. When testing the water at an account, both the hot and cold should be checked for hardness. Some facilities soften only the hot water.

D. Silica
Silica is not a problem in a laundry. It is a warewash issue only where it can cause nonremovable white films on glassware.

E. Iron
Iron can build up in fabrics causing other soils to become entrapped or cause rust stains to the laundry machine interior. When iron builds up in the fabric, it can lead to yellow, orange, or brown/rust stains in fabric. Chlorine will react with the iron in the water supply, causing it to precipitate as rust. Using an oxygen based (nonchlorine) bleach can help minimize the problem. The use of an iron inhibiting sour is also often necessary. Iron concentrations over 0.1 ppm can precipitate the rust into the fabric. Iron in the water dictates that a separate sour and softener be used instead of a combination sour/soft. This allows for the use of a sour with iron inhibiting properties. This type of sour, called a "sour and rust remover," prevents the buildup of iron in the fabric. No liquid sour/soft can inhibit iron because the acid that inhibits iron, in concentrated form, is not compatible with a fabric softener. The iron entrapped in the fabric prevents the removal of other soils, which would otherwise be removed. It is noted that 75% of the laundry technical service requests performed by the U S Chemical Training Department discover iron to be the culprit in poor appearing fabric.

Some water softeners will trap iron temporarily. Once a sufficient concentration of iron has built up on the inside of the softener, large amounts of iron will begin to leach out into the water. Some water softeners will actually remove the iron by use of an iron removing salt. This type of salt is usually twice as expensive as regular water softening salt. Given the severity of the problems caused by iron in the laundry water supply, this additional cost is generally well worth it.

F. Copper and Manganese
Copper can cause green stains and manganese can cause black stains in fabric. The minerals behave in a similar manner to iron in that they entrap other soils, which can cause other types of staining problems.

G. Chlorides
Chlorides are salts that can cause corrosion of metal parts in the laundry machine. They can also contribute to graying by building up in the fabric. This can be eliminated as a problem by souring the fabric to a pH of 5.5 – 6.5. High levels of chlorides in the water supply can be caused by water softener malfunctions or a contamination of the fresh water supply with sea water.

H. Sulfates
Many sulfates are natural laxatives. This can cause an increase in incontinence in hospitals and nursing homes, which can cause an increase in staining problems with adult diapers and pads. When the sulfate level rises over 600 ppm, the laxative effect usually starts to become pronounced to the average person. Water with over 200 ppm sulfates will usually have a bitter taste.

I. Bicarbonate Alkalinity
Bicarbonate alkalinity (bicarbs) 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. Bicarbs tend to raise the pH of the water supply and can cause mineral buildups in the fabric that cause staining or lead to a rough feel. Bicarbs are 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. High bicarbonate alkalinity levels (over 200 ppm) dictate that a separate sour and softener should be used, rather than a combination sour/soft product. This allows for additional sour to be used without increasing the amount of softener. Excessive softener usage can cause waterproofing of the fabric.

J. 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 laundry 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 26 and the bicarbonate alkalinity test is on page 27 in the TTKI Manual. The result of the water hardness test (in grains per gallon, or "gpg") tells us how much water conditioning ability the break or built detergent needs to have. The bicarbonate alkalinity determines whether a sour/soft or a separate sour and softener will be used.

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 break or built detergent with less water conditioning. However, since the bicarbonate alkalinity is not affected by the water softener, the need for separating the sour and softener does not change.

Water hardness and bicarbonate alkalinity can build up in fabrics causing graying and other staining problems. When staining becomes an issue, some of the first things to check are the water hardness (and the water conditioning ability of the break or built detergent) and the bicarbonate alkalinity (and the type of sour, quantity of sour being used, and the pH of the finished fabric).

TESTING DURING A LAUNDRY CYCLE

During the laundry cycle, there are a series of tests that can be run to insure that the cycle is within the acceptable parameters. After the wash bath, the wash water should be sampled during the drain. The pH of this wash water should be between 11 – 12. After the bleach bath, the water should be sampled during the drain. The pH of this water should be 10 – 11. The chlorine concentration should be between 50 – 150 ppm. After the final extract, a sample of fabric should be removed from the washer and tested for pH, chlorine residual and iron residual. The pH should be between 5.5 – 6.5. There should be no chorine or iron residual. When doing the initial installation or troubleshooting an account, all of these tests should be performed. During a normal PM, only the fabric tests would be performed. If the test results are acceptable and the fabric is clean, then no further testing need be done. If the test results are not acceptable or if the fabric is not being cleaned acceptably, the results of the fabric tests give a starting point in troubleshooting the environment. The other tests performed during the cycle may need to be performed as well. For a brief discussion of proper laundering parameters, see page 28 of the TTKI Manual. A complete discussion of proper laundering parameters can be found in the U S Chemical Training Department publication “U S Chemical Laundry Formulas and Laundry Cycle Functionality.”

CHLORINE TEST

On page 19 of the TTKI Manual, there is a titration for chlorine. This test can be used to check the chlorine concentration at the drain after the bleach bath to verify that the chlorine concentration is acceptable. Between 50 – 150 ppm of chlorine should be present. While this test can be performed using a chlorine test paper, the titration gives a more accurate result. If there are any questions about the result when using the test paper, titration is always a preferred method of testing. A version of this test, found on page 34, can be used to test the strength of a pail of liquid chlorine destainer. Never try to use test papers on a pail of concentrated destainer. The high chlorine concentration will bleach out the test papers, giving no result. If the color of the chlorine destainer is yellow, there is generally no reason to suspect that it is under strength. If the color is water clear (no yellow), it is probably past its effective life.

RESIDUAL ALKALINITY TEST

On pages 30 – 31 of the TTKI Manual, there is a test for residual alkalinity. This is a troubleshooting test and is not routinely performed. To do this test, sample the wash water as the wash bath drains and perform the test. This test is helpful for several reasons. When adding alkalinity, we need to check the pH to insure that there is enough alkalinity for safe, effective bleaching. If you are trying to raise the pH over the course of several loads, but the pH papers don’t appear to be changing, this test can be used to put a number to each increase in alkalinity. If the residual alkalinity goes from 150 ppm in one load to 250 ppm in the next, you know that you have more alkalinity, even if the pH doesn’t appear to change. Further increases in alkalinity concentration will eventually raise the pH of the wash water.

This test is also useful because it allows for a measurement that can be compared to the chart on page 31 in the TTKI Manual. This chart lists the range for residual alkalinity for various soil classifications. If staining is a problem, the residual alkalinity can be checked to see how much alkalinity is left after the wash bath. If 400 – 600 ppm were left, this amount of alkalinity would handle a heavy soil load. Increasing the amount of alkalinity will probably not improve the results and other product changes should be considered.

FABRIC TESTS

After the extract, the damp fabric should be taken out and tested for pH, chlorine and iron residuals. Never perform the tests on dry fabric as the chemicals used in performing the tests may permanently stain the fabric. Wetting the fabric with tap water isn’t a good procedure either as it will raise the pH of the fabric to the pH of the water supply. The tests are explained on page 29 of the TTKI Manual.

A. pH Test

The pH of finished fabric should be between 5.5 – 6.5. If the pH is too low, this may be caused by:

1. Too much sour being injected or a “double shot” from the dispenser
2. An overloaded or underloaded machine
3. A mechanical malfunction of the machine, especially a water level problem
4. Product drip from the supply discharge, especially during the extract
5. The bicarbonate alkalinity or pH of the water supply may be much lower than it was previously
6. The final rinse may be too short
7. If the softener pail was empty, it may have been replaced with another pail of sour
8. A high amount of acidic soils may be present that were not removed during the wash cycle

Too low of a pH can lead to skin irritation and fabric damage. If the pH of the finished fabric is too high, this may be caused by:

1. Too short rinse times

2. Low water level during the rinses
3. Too few rinses in the cycle
4. Break or built detergent being injected during the final rinse
5. The bicarbonate alkalinity or pH of the water supply may be much higher than it was previously
6. Too much break or built detergent may be being injected, or at the wrong time
7. There is no sour being injected
8. Overloading or underloading the machine
9. Mechanical or drain malfunction
10. Product drip from supply tube, especially during the extract
11. A chlorine residual in the fabric
12. The final rinse may be too short, or programmed with a high water level

Too high of a finished fabric pH can cause skin irritation and fabric damage. To correct a pH problem with fabric, rewash it in a normal cycle with the problem corrected.

B. Chlorine Residual

A chlorine residual in the finished fabric may be caused by:

1. Too much chlorine bleach being injected
2. Low water level during the rinses
3. Too few rinses in the cycle, rinses are too short, rinses are at a low level
4. Chlorine being injected during the final rinse
5. Overloading or underloading the machine
6. Mechanical or drain malfunction
7. Product drip from supply tube, especially during the extract
8. Improper pH during the bleach bath
9. Improper temperature during the bleach bath
10. Using hot water for the rinses instead of warm
11. Mixing fabric types (polyester sheets and terry towels washed together)
12. Presoaking in chlorine bleach
13. Highly chlorinated water supply

A chlorine residual in the fabric can cause skin irritation, yellowing, and fabric damage. To remove the yellow color from the test, apply bottle B4 and the yellow will disappear. This is a sodium thiosulfate antichlor, which will neutralize chlorine or iodine in the fabric. To remove a chlorine residual rewash the fabric in a normal cycle with the problem corrected. In some cases, an antichlor may be desired to remove heavy buildups.

C. Iron Residual

An iron residual in the fabric may be caused by:

1. Iron naturally occurring in the water supply
2. Old pipes leaching iron into the water, especially due to water pressure changes
3. An employee working with metal shavings which are then washed in the fabric
4. Iron supplements or medications causing staining of adult pads or diapers
5. Concentrated chlorine bleach being exposed to stainless steel and the fabric was used to wipe the spill
6. Makeup with an iron oxide base being removed from a person with the fabric
7. Rusting equipment being wiped with the fabric
8. The iron inhibiting sour is not being injected
9. High levels of chlorine reacting with the iron
10. Using a sour/soft, not an iron-inhibiting sour
11. Tools left in uniform pockets
12. Blood not being removed from the fabric

An iron residual can cause staining or graying of the fabric as the iron entraps other soils. To remove an iron residual, run a reclaim formula, hand feeding the IND/COM Rust Remover. If there is iron in the water supply, there are three basic ways to deal with it. Iron filters can be installed on the water supplies. Iron removing salt can be used in the water softener, but both hot and cold must be softened. Finally, reclaim loads can be run as stained fabrics accumulate at an account.

GENERAL TROUBLESHOOTING IN A LAUNDRY

In the day to day operation of a laundry, there are many quality problems than can occur. Assuming that, in general, the laundry is being washed acceptably, occasional problems will still occur. This section will list four typical problems and some possible causes for the problems.

A. Poor Soil Removal

This can be caused by a number of factors including low product concentrations (empty pails), leaking water valves, overloading of the machines, reduced mechanical action (belt slipping), or a sharp drop in temperature. This problem is often seen as an increase in staining.

B. Soil Redeposition

Possible causes include, low product concentration (empty pails), incomplete rinsing, sharp drop in temperature, and an increase in water hardness (often caused by a faulty water softener). This problem is often seen as graying of fabrics. To test for redeposition, wet the fabric and apply a small amount of a prespotter or surfactant based product to a small area of the fabric. Rub vigorously for several minutes and rinse. If the area that had the chemical applied is lighter or brighter in color, the treatment has removed some of the buildup of soils from the fabric. Rewash the fabrics in a heavy soil formula.

C. Discoloration Due to Poor Bleaching

A slight gray color to whites can be easily confused with a redeposition problem. If the chlorine concentration was too low, bleach bath temperature was too low, or bleach bath pH was too high, the result is poor bleaching. The presence of high amounts of oxidizable soils can also contribute to this problem. To test for this, dilute a teaspoon of bleach in a quart of water and apply to a small area on the fabric. Let sit for several minutes and rinse the fabric. If the area that had the bleach on it is lighter in color, proper bleaching will restore the whiteness to the fabric. Do not do this procedure on colored fabric or any fabric specifically labeled as bleach intolerant.

D. Color Loss

Most new colored fabrics will lose some dye in the first several washings. For this reason, colored fabrics should be washed only in cold water several times. After the break-in period, normal washing conditions can be resumed. Over the life of the fabric, color loss is expected to occur. Using chlorine bleach, high temperatures, and a buildup of soils or minerals will all accelerate color loss. Once it occurs, it is rarely reversible. Some dyes are sensitive to the alkalinity in breaks or built detergents. When washed in normal alkaline wash baths, the alkalinity can cause color loss. If alkalinity is applied directly to fabric, it can cause localized color loss, which is seen as white spots. Streaking of colors on the fabric can be cause by washing an alkaline sensitive dyed fabric in a high temperature, high alkalinity formula.

SUMMARY

The Total Test Kit includes a variety of tests to help the service specialist in a laundry environment. This brochure explains the basics of the laundry 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.

TECHNICAL SERVICE PROCEDURES

U S Chemical provides free technical service support to its customers. If there is a problem with fabric at an account, a sample of that fabric 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 fabric 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 St.
Watertown, WI 53094

To check on a service request in process, call 1-(800)-558-9566 and ask for the Training Department.