HOME ECONOMICS

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THE LAUNDRY SYSTEM

Home laundering has become physically easier over the years, but the mental side of laundering has become more difficult. The amount of information to be considered is increasing, and what was once thought to be the correct way to launder clothes may no longer be acceptable. Decisions regarding laundering often involve compromise. Adequate information and a clear sense of priorities are required in making satisfactory decisions. This bulletin will help provide that information; what is important to you, your values, will determine the choices that you make.

Laundering involves a whole system. The interacting parts of the system are the operator, the fabrics to be washed, the soil to be removed, and the water, detergent, and machine in which the clothes are washed. In all this the operator is central and very important, because the operator is the person who makes the decisions about all the other factors. The other parts cannot be ignored, however, since factors relating to them are needed in making decisions about home laundering.

In considering the various parts of the laundry system, it would be convenient and logical to discuss each topic individually and completely before progressing to the next part of the system. However, because of the interdependence of the parts of the system, no topic stands alone. Therefore, while the focus of a section will be on one part of the system, reference may be made to other parts.

The Operator

The operator, or decision maker, is the center of the system. The success of the laundry operation depends to a great extent on the decisions made by the operator.

Although women previously were the main operators, the current division of responsibilities among family members may result in men and teenagers or even younger children being responsible for doing the laundry.

Many older homemakers learned to wash clothes when cotton and linen were the important fibers in the laundry basket, soap was the only cleaning agent, and precise laundering techniques were passed from mother to daughter. Currently, laundering *principles* or techniques are not commonly taught within the family. This bulletin provides background on which both new operators and experienced ones can base their decisions and achieve satisfactorily laundered clothes.

General rules to aid the operator in making decisions follow:

1. Wash clothes before they become heavily soiled; wash them before the soil has been in place too long.
2. Sort clothes into similar categories with respect to color, fabric type, and degree of soiling.
3. For greatest soil removal use soft water, the hottest water appropriate for the clothes, an effective detergent, and ample detergent.
4. Pretreat heavy soil, protein soil, grease spots, and stains before washing the clothes.

This bulletin explains these rules and indicates when and how they can be modified and still produce satisfactory results.

Fabrics

Fabrics provide the surfaces from which the soil is to be removed during the washing. Properties of fabrics that influence laundering are the fiber content, color, construction, and finish.

Common classifications of fibers in washable fabrics include the natural (cotton, linen, silk, and wool) and man-made (nylon, polyester, rayon, and acrylics). The wash load today is primarily made up of cotton, nylon, polyester, and blends of natural and man-made fibers.

Cotton can easily withstand the rigors of washing. It is not harmed by high wash temperatures or by heavy-duty, alkaline detergents, nor does it lose strength when it is wet. It can be bleached with either chlorine or oxygen bleaches.

Nylon and polyester fibers are not damaged by high wash temperatures; but because they are more

pliable when hot, wrinkles form if the fabrics are spun while they are hot. For that reason a warm, rather than hot, wash is usually recommended. Also, automatic washer cycles for use with man-made fibers include cool-down rinses after the wash cycle to minimize wrinkling. Nylon and polyester fabrics can be washed in heavy-duty laundry detergents and be bleached with either chlorine or oxygen bleaches.

Silk and wool usually require more gentle handling. Use lukewarm water, minimum agitation, and mild detergents. Some wool is treated to make it less susceptible to shrinkage from the washing process. Check hang tags and the care label for specific information. Do not use chlorine bleach on either silk or wool.

For best soil removal white fabrics should always be washed with the hottest water available and appropriate to the fibers. A compromise in temperature can be made to decrease the chance for wrinkling. For colored fabrics the solubility of the dye influences the proper choice of temperature. In general, light or pastel colors can be washed in warm-to-hot water without significant color loss. For dark or intense colors, minimizing color loss may be more important than more thorough cleaning. Therefore, lukewarm-to-cold water may be chosen to protect the color. Less soil is removed at lower temperatures, but on darker colors residual soil is less apparent than on white or light-colored fabrics.

Fabrics that are in themselves fragile, such as lace and sheer fabrics, satin, nubby fabrics, and knits or garments with seams or ornamentation that require limited mechanical action should be separated for washing from more durable fabrics. The vigor and the length of agitation selected should be appropriate for the fabric and the garment structure.

For some finishes, such as durable-press or flame-retardant finishes, limitations on laundry procedures may be specified on the label. For example, there may be restrictions on use of chlorine bleach or the use of hot water.

Care labels on clothing and household items provide minimum instructions for washing. Use the instructions as guidelines in choosing laundry procedures.

Soils

Soils are the materials that cause us to do the laundry. Although many materials appear as soils, a good working definition is, "Soil is matter out of place." Tomato soup in the bowl is food, but on the child's shirt, it is soil. If all of the materials commonly found as soil were listed, an extremely long list would result, and an equally long list of rules for removing soil would evolve. For simplicity, soils can be divided into groups based on their characteristics, and recommendations for soil removal can be discussed for each group. Table 1 summarizes information on soils.

Stains

Stains differ from soils in that stains are not removed by ordinary laundry procedures. They require treatment specific to the type of stain. Consult a stain removal guide or chart for special instructions. Ask your local Cooperative Extension office for a publication on stain removal.

Soaps and Detergents

The dictionary defines detergents as cleaning agents. Using that meaning, the word "detergent" covers both soaps and synthetic detergents. In common practice, however, the word detergent has come to refer to synthetic detergents. Although soap cleans well in soft water, it is unsatisfactory in hard water. The soap curd that forms in hard water sticks to fabrics, holds other soils, and makes cleaning more difficult.

Most detergents also clean less well in hard water than in soft, but no curd is formed; an increase in amount of detergent used can usually compensate for the reduced cleaning in hard water.

Cleaning agents, whether soaps or detergents, can be divided into mild or heavy-duty cleaners. Typical mild or light-duty detergents include the liquid detergents used for hand dishwashing. These are also appropriate for washing wool and for much of the hand washing of lightly soiled synthetics. To meet consumer needs, detergent manufacturers have provided a wide selection of heavy-duty laundry detergents for use in any kind of water. These include both built and unbuilt formulations and may be in either powdered or liquid form.

The composition of laundry detergents varies with type of detergents and brand. In general, however, all laundry detergents contain surface-active agents and other ingredients to improve cleaning characteristics. Each manufacturer selects ingredients to make up a complete cleaning system. See Table 2 for a listing of the components and their functions for built detergents.

In general, nonionic surfactants are better for removing oily soil, and anionic surfactants are better suited for clay-type soil. However, because most laundry soils are mixtures of both oily and clay-type soils and because other components also contribute to soil removal, manufacturers formulate detergents

TABLE 1

Common Laundry Soils

Soil Groups	Examples	Suggestions for Removal
Water soluble soils	Salt, sugar, fresh tea and coffee, some components of perspiration, some proteins	Easily removed by water alone; hot water aids in dissolving soils.
Insoluble, organic soils -- saponifiable*	Oils, fats, fatty acids from food, the skin, hair dressings, cosmetics	Removal more difficult as soil ages. Soap or detergent required for removal; heavy duty laundry detergents more effective than mild detergents. Builders in detergents react with this soil; abundant detergent required to react with, solubilize, and emulsify this soil. Hot water speeds soil removal and results in more complete soil removal.
Insoluble, organic soils--not saponifiable**	Mineral oil, car grease, some body oil, lint, skin particles, tar, wax, protein, dyes	Removal more difficult as soil ages. Soap or detergent required for removal; abundant detergent required to solubilize and emulsify this soil. Hot water speeds removal and results in more complete removal.
Insoluble, inorganic soils	Dust, mud, clay, smoke, soot, mineral ash, metals, metal oxides	These soils are often held on fabric by oily soils; need detergent to remove oil and release this soil. Soil not soluble in wash water; requires much agitation by washer for removal and adequate suspending agent in detergent to prevent redeposition.

*The alkaline builders in detergents or soap react with the soil to form a soluble substance, soap. As the new soap is washed away, it helps to remove the other soil.

**These soils do not react with alkaline builders in detergents.

TABLE 2

Components of Laundry Detergents

Component	Function	Comments
Surfactants (surface active agents)	Allow water to wet both the fabric and the soil quickly and thoroughly. Remove oily soil and emulsify or solubilize it. Remove clay-type soil and help suspend it.	Both anionic and non-anionic surfactants are used. Hard water diminishes cleaning ability of anionic surfactants. When the concentration is sufficiently high, surfactants form groups, called micelles, that solubilize oily soil.
Builders	Control water hardness. Increase and maintain alkalinity of wash water. React with (saponify) some oily soils. Suspend clay-type soil.	Polyphosphates have been the preferred builder because they serve all functions well and control hardness without forming a precipitate. Where use of phosphates in detergents is prohibited, as in Virginia, sodium carbonate, sodium aluminosilicate, and sodium citrate may be used as builders. In hard water, carbonates form a crystalline precipitate, which adheres to fabrics, makes fabrics feel stiff and harsh and changes the appearance of colored fabrics.
Suspending agents	Prevent redeposition of clay-type soil.	A special component called carboxymethylcellulose (CMC) helps to suspend soil. The carbonates are not effective in preventing redeposition of soil.
Corrosion inhibitor	Protects metal parts of washer.	Without a corrosion inhibitor,the detergent solution would attack or corrode some metal parts in washing machines.
Fluorescent whitening agents	Make white fabrics look whiter and colored fabrics brighter. Cover up yellowing of white fabrics.	Fluorescent whitening agents (FWA) "work" in the presence of ultraviolet light, such as is present in sunlight and light from fluorescent lamps. Invisible ultraviolet light is converted by FWAs to blue light, which improves the appearance of fabrics.
Coloring matter and fragrance	Provide a distinctive color and fragrance for a detergent product.	These are added for aesthetic purposes only.

to remove satisfactorily a wide variety of natural soils.

A relatively new category of laundry detergents does not contain a builder, and the products are referred to as unbuilt laundry detergents. All the unbuilt detergents are sold as liquids. Comparison of built and unbuilt detergents is shown in Table 3.

TABLE 3

Comparison of Built and Unbuilt Laundry Detergents

Component	Built detergent	Unbuilt detergent
Surfactants	Lower concentration, perhaps half as much as in unbuilt detergents. Anionic surfactants likely to predominate.	Higher concentration, perhaps twice as much as in built detergents. Nonionic surfactants likely to predominate.
Builders	High concentration of builders, usually alkaline.	No builders
Soil suspending agents	Carboxymethyl-cellulose (CMC).	Higher concentrations of CMC likely than in built detergents.
Fluorescent whitening agents	Built and unbuilt detergents similar.	
Coloring matter and fragrance	Built and unbuilt detergents similar.	

Some detergents contain additional special ingredients such as enzymes to decompose protein soil, or fabric softeners to improve the feel of the fabric and to reduce static problems.

Although most detergents produce copious suds, a few are designed to provide only a limited amount of suds. These are often referred to as low-sudsing or controlled-sudsing detergents. They can be used in any type of washer, but only the low- or controlled-suds detergents should be used in front-opening, rotating-cylinder washers because high suds cushion the washing action in that design of washer.

A common cause of poor results in laundering is use of an inadequate amount of detergent. When insufficient detergent is present, soil removal is incomplete, and the soil that is removed may be redeposited on the fabric. If laundry results are not satisfactory and clothes appear dingy or gray, the first suggestion is to increase the amount of detergent used.

How Much Detergent to Use

Labels on detergent containers usually suggest the amount of detergent to use. The recommended quantity is based on average conditions for size of wash load, amount of soil, size of washer, and hardness of water. The operator should make adjustments in the quantity used as specific conditions vary from the average. Use more detergent if the washer is larger, or the soil greater than average. Use less detergent if conditions are less severe.

Water

Water is the laundry supply used in the largest quantity. It does its job by dissolving or suspending soil and carrying it away from the fabric. In most households, water is readily available and inexpensive.

To be good for laundering, the water can be characterized by a list of "should nots." The water should not be hard, turbid, or colored and should not contain iron or manganese.

Water hardness is related to the amount of calcium and magnesium ions in the water. The degree of hardness is usually reported in grains of hardness per gallon of water, as well as in descriptive words. Hardness can also be expressed as parts per million: 1 grain per gallon equals 17.1 parts per million. Table 4 shows the relationship between the words describing the water and the hardness measurement.

TABLE 4

Water Hardness

Water Type	Hardness Measure	
	(grains per gallon)	(parts per million)
Soft	0 - 3	0 - 60
Medium Hard	4 - 7	61 - 120
Hard	7.1-11	121 - 180
Very Hard	above 11	above 180

Information on the hardness of public water supplies can be obtained from the supplier. Water from private supplies can be tested by water treatment companies.

Hard water is undesirable for washing clothes with soap because the hardness minerals react to form insoluble, sticky soap curd, which adheres to fabrics and other surfaces. Hard water also decreases the cleaning ability of both soaps and anionic detergents. In addition, hard water makes some soils more difficult to remove.

Water hardness can be controlled by the builders in built detergents. Sodium citrate holds water hardness in solution, but less well than phosphates. Sodium aluminosilicate provides incomplete control of hardness, but does not add any negative effects. The carbonate ion, however, causes insoluble compounds to form; the insoluble material adheres to fabrics and appears as a white film that dulls colors or as white streaks. Usually, sufficient builder is present in detergents to handle hardness levels up to about 15 grains per gallon.

Water softeners other than the builders in detergents can also be used. In general, three means of softening water are used: (1) tank softeners, (2) packaged water softeners that do not form a precipitate with the hardness ions, and (3) packaged softeners that do form precipitates. The packaged softeners are available in grocery stores.

Tank type softeners are also called zeolite or ion-exchange softeners. They are connected to water supply lines. As water passes through them, sodium ions from the zeolite or resin within the tank are exchanged for calcium and magnesium ions. All the water passing through the tank is softened. These softeners must be regenerated at intervals with salt (sodium chloride) to replace the sodium ions that have been used up and to get rid of the accumulated calcium and magnesium ions.

Tank-type softeners are the most convenient and least expensive to use, but require the largest capital investment.

To use either of the types of packaged water softener most effectively, the softener should be added to both the wash and rinse water; furthermore, the operator should add just enough softener to equal the amount of hardness. Adding too little does an incomplete job of softening the water; using too much is wasteful. To determine how much softener to add, the operator should know how hard the water is and what quantity of water is used. Most operators find that using packaged softeners is inconvenient.

The two types of packaged softeners are similar to the builders in detergents. In Virginia, *nonprecipitating softeners* containing sodium citrate soften the water by preventing the hardness ions from reacting with other ions. No precipitate is formed. A common example is *Calgon* . *Precipitating softeners*, usually based on carbonates, cause the calcium and magnesium to form insoluble compounds. Particles can adhere to the fabrics and may deposit on washing machine parts. Washing soda is a common example of a precipitating softener.

The nonprecipitating softeners bind calcium and magnesium strongly enough to dissolve soap curd. Soaking clothes in a solution of nonprecipitating softener is often recommended as the first step in cleaning up discolored clothes.

Turbidity in water often results from finely divided particles or mud suspended in the water. During the washing process, the particles are trapped in the fabric and discolor it. Turbid water should not be used for washing.

Colored water may result from the decay of vegetable matter (i.e., leaves) or from the presence of iron or manganese in the water. Continued use of colored water for laundering may, in effect, dye the fabrics. Usually the color from decaying organic matter can be removed by laundry bleach.

Iron is a troublesome impurity in water. The iron may be either dissolved or suspended in the water. Even at low concentrations, 0.2 parts per million or higher, it causes an orange stain on fabrics. Chlorine bleaches make dissolved iron insoluble and leave particles of iron oxide suspended in the water. The suspended iron oxide particles then attach to the fabrics and discolor them.

Nonprecipitating softeners can be used to tie up soluble iron and prevent bleach from reacting with it. If the iron content is very low, tank-type water softeners may also be able to handle the problem. For high concentrations of iron, iron removal filters should be used.

Manganese is rarely found in water used for laundering. If it is present, it can be removed by filters similar to one used for removing iron.

In addition to water quality characteristics, the *quantity of water* used in laundering also requires attention. A sufficient volume of water should be used to allow the fabric to move freely in the washer. For washers that allow a choice of water levels, the level selected should match the size of the clothes load. If too little water, in relation to the wash load, is used, the clothes will not receive the proper agitation. If more water is used than needed, not only is water wasted, but in extreme cases, the clothes may not rub against each other and against the surfaces of the washer enough to loosen the soil.

The quantity of water used is also one of the determinants of the proper amount of detergent to use. Therefore, to conserve detergent and yet have an adequate concentration of detergent, use no more water than is needed.

Water Temperature

The water temperature selected influences the amount of cleaning accomplished, the energy used, and, in some cases, the extent of wrinkling and the fading of colors. Higher temperatures generally remove more soil, require more energy to heat the water, may leave more wrinkles, and may remove more dye.

The maximum temperature of a hot wash is limited by the temperature of water in the water heater; in fact, because of heat transfer to the pipe, the washer, and the clothes, the temperature of the water in the washer is likely to be at least 10 degrees F below the temperature in the water heater. Temperature of a cold water wash varies with the season and the geographic location; it may be as low as 40 degrees F in the winter or as high as 80 degrees F in the summer. On the warm setting, the actual temperature of water delivered to the washer depends not only on the temperature of the hot and cold water supplies but also on the mixing ratio of hot and cold water. The mixing ratio is usually either 50/50 or 40/60 (hot/cold). Therefore, the temperature of water at the warm water setting may vary from 70 degrees F to 110 degrees F, depending on the season, the geographic location, the thermostat setting on the water heater, and the mixing ratio.

Washing in warm or cold water is recommended as a means of conserving energy. Cold water is not recommended, however, for white fabrics or heavily soiled items.

Temperature of the rinse water has little effect on the cleaning. To conserve energy, however, cold rinse water is recommended. Although slightly more energy is required by a dryer to dry clothes that have been rinsed in cold water, the increase in energy for drying is small compared with the savings from using cold rinse water.

Man-made fibers become softer at higher temperatures. If the clothes are spun to extract water while the fibers are soft, wrinkling will occur. On the permanent press cycle of washers, the clothes are cooled by the addition of cold water before they are spun to minimize wrinkling.

Wash Cycle and Time

Mechanical energy is contributed to the system through agitation or stirring of the fabrics in the detergent solution. Vigorous movement over an extended time is needed to remove tenaciously bound soil.

To allow for adequate agitation, the clothes should move freely during agitation. They should be unfolded and loaded loosely, not packed in. If a choice of water level is possible, select the right amount for the size of the load. Overloading a washer leads to poor cleaning, production of excessive lint, and wear damage to the fabric.

Some washers allow choice in selection of the washing action. The regular setting should be chosen for most loads of clothes. Delicate fabrics and knits, however, may need more gentle action. Less vigorous washing action can be obtained by a shorter "stroke" of the agitator as it oscillates or by slower oscillation. Gentle washing can also be obtained by alternating wash and soak cycles.

Bleaches

Bleach is required to remove some stains. When bleach is used, it should be a supplement to good laundry procedures, not a substitute for them. All bleaches, including sunlight, may damage fabrics. To minimize the damage, bleach should be accurately measured and used with care, the directions on the package being followed exactly. For some fabrics and (or) dyes, the type of bleach chosen, as well as the way it is used, determines whether damage will occur.

Laundry bleaches are oxidizing agents that remove the stain or make it colorless. Two types of bleach are available: chlorine and oxygen. Bleaches can be purchased in both liquid and dry forms.

Chlorine bleach. Liquid chlorine bleach is the most popular of all bleaches because of its powerful effect and low cost. The problems associated with liquid chlorine bleach are usually the result of improper use. Because all the bleaching action is available as soon as the bleach is added to the wash load, the addition of undiluted bleach is likely to cause weakening of the fabric and (or) fading of colors. The bleach should be diluted before it is added to the clothes. Soaking clothes in bleach solution for periods longer than 15 minutes is not recommended because of potential damage to the fabric.

Chlorine bleach should not be used on silk, wool, or spandex fibers or on fabrics treated with certain resin finishes; check the care label for restrictions on use of chlorine bleach.

If iron is present in the water, chlorine bleach increases the problem of discoloration of the fabric. Chlorine bleaches also decompose some of the fluorescent whitening agents (FWA) used in soaps and detergents while the FWA is in the wash water. Delayed bleaching--that is, adding the bleach to the wash water several minutes after the detergent and clothes have been in contact--allows time for the FWA to become attached to the fabric, thus avoiding decomposition of the whitening agent.

To determine whether liquid chlorine bleach can be used on colored fabrics, test the bleach in an inconspicuous place on the garment. Mix one tablespoon of bleach in one-fourth cup of water; add a drop or two of the diluted bleach to the fabric. After a couple of minutes, blot the fabric and inspect it for change in color. If there is no color change, it is probably safe to bleach the fabric.

Oxygen bleach. Sodium perborate and persulfate are oxygen bleaches. Because perborates are most effective in water above 140 degrees F, they do not exhibit their maximum bleaching ability in the wash and, therefore, are less effective than chlorine bleach. The effectiveness of persulfate bleaches is intermediate between that of the chlorine and the perborate bleaches. Perborates and persulfates can be used on all fibers and finishes, and they are relatively safe for all colors. They do not decompose the fluorescent whiteners or increase problems of rust.Dry oxygen bleach should not come in contact with wet fabric. The advantage of liquid all- fabric bleach over dry all-fabric bleach is that it is already in solution.

Special Laundry Aids

Prewash agents. Removal of oily soil has become more difficult with the shift from cotton to synthetic fibers, blends of man-made fibers with cotton, and durable-press finishes. The problem of oily soil removal is further aggravated by the increased practice of using cooler wash water.

To aid in removing oily soils, a new category of laundry product, referred to as a prewash agent or a prewash stain remover, has been introduced. Because these products are designed to remove oily soils they are likely to contain both an organic solvent similar to a dry- cleaning solvent and a surfactant. The surfactant is usually a nonionic type; its function is not only to solubilize oily soil but also to disperse the solvent and oily soil mixture in the wash water.

As the name implies, these agents are used before the clothes are put into the washer. The product is applied directly on the spot to be treated. For many products, the directions indicate that the fabric should be washed while it is still wet with the prewash agent.

Presoak agents. Another category of special laundry aids is the presoak agent. These laundry products contain enzymes and are particularly useful in removing protein stains from fabric. Other components include a surfactant to help the solution penetrate the fabric and remove soil, and a builder to provide the proper alkalinity for the enzyme action. An oxygen-type bleach and a fluorescent whitening agent may also be included.

Protein soils that have become "set" are very difficult to remove. The enzymes assist in breaking up the insoluble protein molecules, making them more soluble. Because the enzymes act relatively slowly in decomposing protein stains, they are used in a soak step before the regular wash. Follow directions on the package.

Laundry sanitizers. The least commonly used laundry aid is a sanitizing agent. To prevent the spread of bacterial infections by clothing or household textiles, however, families may on some occasions wish to use a disinfecting or sanitizing agent. Bacteria may be removed and rinsed away from fabrics by the

general laundry procedures, but the washing temperature and the laundry detergents do not kill bacteria.

Bacteria can be transferred from one fabric to another during washing or from fabric in one wash load via the washer tub to the fabric in the next load. Prevention of transfer of the bacteria is especially important when there has been an infection or other sickness in the family. When used according to directions, laundry sanitizers can reduce the number of bacteria on fabrics to a safe level.

Four classes of materials are used as sanitizing agents.

Liquid chlorine bleaches, when used in a concentration recommended for bleaching, are effective sanitizers in hot, warm, or cold water. They are limited in use to fabrics and colors that can be treated with chlorine bleach. In general, they are used in the wash step of laundering.

Quarternary disinfectants usually contain quaternary ammonium chloride compounds. These odorless, colorless compounds are effective in hot, warm, or cold water. Because they react with anionic surfactants, they are not used in the wash step; instead, they are used in the rinse water.

Two other sanitizing agents are pine oil and phenolic compounds. Each of these has a characteristic odor, but the odor does not remain on the fabrics. These products should be used in hot or warm water to be effective. Pine oil should be used in the wash water, but the phenolic disinfectants can be used in either the wash or rinse water.

Some sanitizing agents can be purchased in grocery stores in the same area as other laundry supplies. Or they can be bought in drugstores or in janitor or hospital supply outlets.

Fabric softeners. Fabric softeners make fabrics feel softer by increasing the flexibility of the fabric. They act as lubricants to allow easier movement of fibers and yarns within the fabric. Besides feeling softer, bath towels, napped fabrics such as corduroy, shag rugs, and bath mats are made fluffy, and the nap stands up. Woven or knitted fabrics have fewer wrinkles; wash and wear garments look better; and items that require ironing will iron more easily. Fabric softeners also act as antistatic agents, preventing or decreasing static cling.

Most liquid fabric softeners are added to the rinse water. Several detergents contain a fabric softener. Follow the directions on the container.

The inconvenience of returning to the washer to add fabric softener to the rinse water has encouraged the addition of fabric softener dispensers to some washing machines. At the time that the washer is loaded with clothes, detergent, and other supplies, the fabric softener is placed in the dispenser, where it stays during the wash. When the rinse step begins, the fabric softener is dispensed into the load of clothes.

Dryer-added fabric softeners also eliminate the need for the operator to return to the washer. Instead, a sheet of nonwoven or foam material containing the fabric softener is added to the dryer along with the clothes. As the dryer drum rotates, the clothes rub against the sheet containing the fabric softener, and it is transferred to the clothes. Less fabric softener is added to the fabrics in the dryer, but the amount is sufficient to prevent static cling.

Liquid fabric softeners should be diluted before they contact the clothes because there is a chance that the dye in the fabric softener could discolor the clothes or that direct application of softener could make an oily stain on the fabric. Staining may also occur if the fabric softener sheet in the dryer is in direct contact with the fabric for a period of time. If a fabric softener leaves patches or splotches of discoloration, wet the fabric, rub the spot with bar soap or liquid detergent, and rewash the fabric.

If excessive amounts of fabric softener are used, the fabric may develop a greasy feel and become somewhat discolored and less absorbent. To correct that condition, wash the fabric once or twice without further addition of fabric softener. From then on, adjust the amount of fabric softener used to avoid a build-up.

Fluorescent whitening agents. Fluorescent whitening agents (FWA) are one of the components in laundry detergents. They are also likely to be present in many other laundry supplies such as presoak and prewash agents and fabric softeners used in the washer. They may also have been added to fabrics during the manufacturing process.

These materials are complex organic molecules that have the ability to absorb ultraviolet light (which is not visible) and convert it to visible light, usually in the blue range of color. By this process the appearance of the fabric is improved in two ways: an increased amount of light is reflected making the fabric look brighter, and the blue tint of the reflected light helps to cover up any yellowing of white fabric and make it look whiter.

FWAs are absorbed strongly onto textile fibers. Therefore, only a small amount is needed in the laundry aid to produce the desired results. During the wash some of the FWA added in previous washes is removed and is replaced with FWA from the laundry supplies used.

Tips For Improving the Appearance of Discolored Fabrics

Overall gray discoloration--the result of unremoved or redeposited soil or of dye transfer

1. If the water used for washing clothes is hard, soak clothes in an excess of nonprecipitating softener. Use two or three times as much water softener as recommended on the package. Use the hottest water available and appropriate for the fabric. Agitate the clothes at intervals during the soak period.
2. Wash the clothes in hot water using ample detergent and agitation. Hot water and extra detergent will loosen and remove oily soil that has accumulated. When the oily soil is removed, other types of soil can be washed away.
3. If concentrations of oily soil remain, use a prewash spray product or liquid detergent on the soiled area, or treat the area with a drycleaning fluid before washing.
4. If discoloration remains on white or bleachable items, treat them with a bleach.
5. If discoloration from dye transfer remains on white items after bleaching, use a color remover such as *Rit* color remover.

Yellow discoloration--the result of unremoved oily soil; yellow is concentrated in use areas. Use steps 2, 3, and 4 above.

Yellow discoloration--iron rust stain; yellow is either in distinct rust spots or is evenly distributed over the entire fabric. Use a rust remover. If the discoloration is a large area or an entire garment, soak or wash the clothes using a commercial rust remover, such as *RoVer* or *Rit* rust remover. Follow the instructions on the container. Do not use chlorine bleach on rust.

Energy Considerations

Three forms of energy are involved in washing clothes:

- thermal energy from the hot or warm water
- chemical energy from the detergent, pretreatment products,and bleach
- mechanical energy from the agitation provided by the washer.

To some extent these three forms of energy are interchangeable. That is, if less of one is used, more of another can be substituted.

With the national emphasis on saving energy, many families have lowered the thermostat setting on their water heaters. In addition, many have chosen lower temperature settings on their washers. Both of these actions decrease the thermal energy available for cleaning. Within limits, more detergent or greater agitation can be used to compensate for lower wash temperatures. Alternatively, a soak step before the wash can be used to increase the time available for the detergent to act.

Revised with permission by Janice Woodard, Extension Specialist, Home Management and Equipment, Virginia Tech, from Cornell Extension Information Bulletin 17.