

OUT SPOT, DARN SPOT

PRE LAB DISCUSSION

We usually don't think about doing laundry as a scientific endeavor. Most people would be amazed at the number of chemists involved in developing better chemicals to clean clothes. Every year new fabrics, dyes, sizing chemicals, wrinkle resistant chemicals, etc. are developed, so the cleaning agents need to be constantly altered to be compatible and effective with the other changes in the clothing industry.

Cleaning clothes is applied solubility chemistry. We try to dissolve dirt, oil, etc. out of our clothes, but we do not want to remove any of the bright colorful dyes and anti-wrinkle agents or damage the fabric.

Spot removal is the most difficult part of clothes cleaning. To be successful in removing a spot or stain we must approach the problem as a scientist. The first and most important step is to try to determine what caused the spot or stain.

Knowing the type of stain allows us to narrow the list of solvents that will effectively dissolve and thus remove the spot. Remember that there are two basic types of solvents, polar [water] and non polar [oil].

For water-soluble stains, soaps and detergents increase the solubility of water. Dish washing liquid is especially good since it contains ingredients designed to break up oil.

There are many types of oils that may be used to dissolve non polar stains. These include paint thinner, waterless hand cleaner, cooking oil, kerosene, and lighter fluid. Waterless hand cleaner works well because it can be worked into the fabric and is designed to be removed with warm water.

There are stains that are not readily soluble in either type of solvent [i.e. rust]. This type of stain may be removed by oxidation or reduction of the substance that caused the spot. These procedures should be the "last resort" since they may react with the dye or even the fabric. It is best to test the reactive agents on an inconspicuous area of the garment before attempting to remove the spot.

It is important to remove spots before normal laundering. **Heating and drying** may make a stain almost impossible to remove. The fresher the stain, the easier it is to remove. When possible, it is best to try to remove a stain before it dries. One trick used for oil stains is to put some white shortening on the stain immediately to prevent the oil from drying. Sometimes the oil will dissolve in the shortening and then the shortening [and stain] can be removed by dish washing liquid and warm water.

Once a stain has been dissolved, the next step is to remove the solvent-stain mixture from the fabric. With a water-soluble stain, the next step is obvious, just rinse with a large amount of water.

In the case of a nonpolar solvent-stain mixture, there can be more of a problem. Sometimes a heavy oil and stain mixture must be removed by using a lighter oil, and then the light oil can be removed by soap and warm water.

Another method that is very useful in removing the solvent-stain mixture is to use capillary action to move the mixture into another material. This method is often used in carpet cleaning where rinsing out the solvent-stain mixture is not practical. Carpet cleaners use foam or insoluble powder for the *other* material. The solvent stain mixture travels by capillary action to the surface of foam or powder where the liquid evaporates leaving the stain on the upper surface. When the surface is covered with a powder such as cornstarch, the stain is in the powder rather than the rug. The powder, dirt, and stains are then picked up by a vacuum cleaner.

The same process can be done by using an absorbent paper towel or cornstarch on a stained piece of clothing. The solvent-stain mixture will travel into the cover material. Often, more solvent may be needed and the procedure repeated several times to completely remove a spot. This works

most effectively with solvents that evaporate quickly such as alcohol, acetone, and lighter fluid.

Bleaches cause a chemical change in the substance, which caused the stain. Bleaches are oxidizing agents. Substances such as sodium bisulfite and oxalic acid are reducing agents. Both oxidizing and reducing agents also react with the dyes in the cloth. They should not be used on anything except white colors. In a more concentrated form, they may also damage the fabric of the garment. There are also several other chemicals that may be used to remove stains.

The chart below is meant to give guidance for trying to remove some common spots.

Blood	If wet, rinse with lukewarm water. If dry, soak in ammonia solution, then treat with dilute [2-5%] oxalic acid [found in auto radiator cleaner and in bar tenders cleanser]
Coffee	Wash in concentrated salt water
Grass	Fresh stains may be removed using alcohol; older stains try sodium perborate solution [drug store]. On white clothing, bleach followed by sodium thiosulfate solution.
Ink	Dissolve in alcohol or acetone [dissolves acetate fabrics] and cover solvent-stain solution with cornstarch or paper towel. Usually needs to be repeated several times.
Iodine	Chemically react with a solution of sodium hyposulfite [hypo or photographer's fixer]
Rust	Try citric acid [Tang, Gator Aid, or Crystal Light drink powder] or 5% oxalic acid with 5% glycerin.

CHEMICALS/EQUIPMENT:

Students are to bring in fabric with a variety of stains and the teacher will provide fabric stained with iodine, rust, and unknown spots.

The chemicals listed below may not all be needed and other organic solvents may be included by the instructor based on availability:

acetone, alcohol, ammonia water, bleach [sodium hypochlorite and/or hydrogen peroxide], citric acid, corn starch, glycerin, baby oil or lighter fluid, oxalic acid, sodium bisulfite, sodium thiosulfate, waterless hand cleaner.

PROCEDURE:

This laboratory exercise is different in that students will not be given a set procedure to follow to remove a spot. Instead they will need to use the information above to develop a procedure to remove a spot. The students will do a complete written report for each type of spot that they attempted to remove.

RESULTS AND CONCLUSION

Each student will be assigned to remove a number of spots. The student will write a report on EACH spot. The report will include the following:

1. The type of stain on the fabric
2. The procedure used to attempt to remove the spot.
3. The rationale behind choosing this procedure.
4. The success of the procedure.
5. If the procedure was not successful, then parts 2, 3, & 4 will be repeated

The fabric will be attached to the report to show the final success.

THINKING SCIENTIFICALLY

1. List the things in your kitchen that could be used for spot removal.

2. List the things in your bathroom that could be used for spot removal.
3. List the things in your workshop, garage, or basement storage area that may be used for spot removal.
4. Record the ingredients from the label in several commercial spot removers and tell why these chemicals are included in the solution or mixture.