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How to Prevent and Remove Mildew[1]

Virginia Peart[2]

Mildew is a persistent problem in warm, humid climates and in many parts of the country where the humidity level is high during summer months. Mildew can also be a problem during the winter months when conditions are just right. To prevent mildew and eliminate it after it has formed, an understanding of what mildew is, what causes it to develop, and how it can be stopped and kept from returning is necessary.

Although there are many varieties of mildew with many variations in growth and appearance, the information that follows is generally true for most mildew types.

Mildew -- the Problem

What is mildew? Mildew is a mold. A mold such as mildew can decompose cellulose and lignin, therefore ruining paper and cellulosic fabrics that are not protected. Wood, paint, glue, and leather may be attacked by mildew also. Mildew mold secretes an enzyme that decomposes organic matter and uses it for growth and reproduction. High humidity is required to hydrate mildew cells and materials on which they can grow. Mildew is unsightly, produces an unpleasant odor, and often acts as an allergen that can create health problems.

What is necessary for mildew to grow? Mildew spores, or seedlike forms of mildew, exist almost everywhere. They will not grow and spread, however, unless certain conditions are met. There are many varieties of mildew, but generally the following conditions contribute to mildew growth:

- Molds thrive on organic materials such as paper, leather, natural fibers or surfaces coated with the slightest amount of organic matter such as food or soil.
- The optimal growth temperature range for molds is 77°F to 88°F (20°C to 30°C), though some growth may occur anywhere between 32°F to 95°F (0°C to 35°C).
- Mildew requires moisture. The optimal growth range for mildew is 70 to 93 percent relative humidity (RH). RH would have to be below 62 percent to stop all chances for mold growth, although RH below 70 percent inhibits most mold growth. A lower RH delays spore germination of molds, reduces the rate of mold growth, and lowers the number of cells produced.
- Molds are aerobic. That is, they require oxygen for growth.

- Light is not required for mold growth. Mold growth can continue indefinitely without light.
- Mold growth is promoted by a slightly acid condition.
- Mold growth is inhibited by a variety of fungicides such as chlorinated phenols, copper napthenate or oleate. Coal tar creosote can be used on wood surfaces where paint is not to be used or where odor or appearance would not be objectionable. Ultra-violet radiation can kill mildew. Exposure to sunlight has been a mildew remedy since pre-air conditioning days.

Mold growth is slow to start and can take several months or seasons to get established. After growth begins, however, it is very rapid.

Identifying Mildew

Mildew on textiles, books, and other household materials will often be recognized by an unpleasant musty odor as well as by discoloration. Dirt on some hard surfaces such as paint, tile, or wood resembles the discoloration caused by mildew. To distinguish between dirt and the discoloration produced by mildew, put a few drops of household chlorine bleaching solution on the discolored surface. Mildew will be bleached within a minute or two, but most dirt will not bleach.

Stains on the exterior surface of buildings that appear below the shade line are usually a type of algae rather than mildew. However, algae often responds to the same types of removal treatment as mildew. In warm, humid environments, treatment of mildew outside a home will need to be repeated from time to time.

Preventing Mildew Growth

Since mildew spores are almost always present, the three best ways to control mildew growth are to eliminate the source of food, deprive the mildew of sufficient moisture, and/or to keep the temperature too low for fast mildew growth.

Keeping things clean. Many materials in homes provide a ready source of nutrients for mildew. Mildew can feed on natural fibers used in clothing and furnishings, paper materials that have not been treated, glues such as those sometimes used in book bindings, and materials in some grout. Some other materials, such as ceramic tile, glossy paint, and glass, do not support mildew growth when they are clean. However, the slightest amount of soil on their surface will supply the necessary nutrients for mildew growth. The organic residue of some soaps left on shower stalls and shower curtains provide the required nutrients for mildew growth. Smoke and volatile cooking oils also settle on walls and furnishings to provide a soil on which mildew will grow. Walls, closets, basements, clothing and other textiles where mildew is likely to grow should be kept clean.

Controlling the temperature. Since mildew thrives at temperatures between 77°F and 86°F, summer conditions will encourage mildew growth. Air conditioning will reduce the interior temperature of homes, but the temperature may not be uniformly low enough to stop mildew growth if the air is fairly humid. Areas within cabinets and closets or behind draperies may be warmer, and humidity will be trapped unless the doors are louvered or left ajar.

Controlling moisture in the air. Since a high relative humidity is required for mildew growth, we need to understand what RH is and how it is related to temperature. Technically, RH is the ratio of the partial pressure of the actual water vapor in the air to the pressure of totally saturated air at the same temperature. Warm air can hold more moisture than cool air. For example, air at 80°F can hold twice as much moisture as air at 60°F. If air in a house at 60°F and saturated with moisture (100 percent RH) is heated to 80°F without a change in moisture, the RH would then be about 50 percent. Both situations would prevent mildew growth:

60°F is too cool for fast mildew growth even at 100 percent RH, and 50 percent RH would be too dry at 80°F.

Managing Moisture in the Home

An ounce of prevention is worth a pound of cure, and with mildew problems, this is especially true. Water vapor moves quickly from a high humidity area to a low humidity area. Think about how rapidly condensation forms on a jar taken from a refrigerator.

Moisture can become trapped in enclosed areas when humidity is sometimes high and sometimes low. In such areas, plastic wrap is not recommended for storing mildew-sensitive materials. Louvered doors and wire closet shelving help promote circulation of air. You may have observed mildew growing behind large pieces of furniture that are placed too close to a wall. Where there is a potential moisture problem, solid closet doors and drawers should be left ajar to encourage air circulation. If a closet, cabinet or drawer space reaches the point of smelling musty, it and its contents should be cleaned and thoroughly dried.

Indoor Moisture Production

Moisture accumulates inside a home from normal household activities: breathing, bathing, cooking and cleaning. A family of four at home for 12 hours a day can produce about 6 pints of water as moisture by respiration. Each shower bath would add another half pint of water directly to the air, and moisture left in the shower stall and on towels would add even more. A bath in a tub would add a little less moisture. Cooking might add another two to three pints. Washing clothes, dishes, and floors would also add more moisture. Ways to reduce some of the moisture from these sources can come from common sense, such as cooking with covers on pans.

Managing Moisture from Outside

The environment in Florida and many coastal areas of the country is nearly always humid and much of the year quite warm. The temperature and humidity levels of outside air are high enough to cause mildew to flourish outside under leaves and in shady places. When this warm, humid air enters a house, it has the capacity to support mildew growth indoors as well. For example, if 85°F air outside with 60 percent or higher RH enters a house and is cooled by walls and furnishings without air conditioning to 80°F, the RH will be 70 percent or higher. These conditions are right for mildew growth indoors, too. Lowering the temperatures only will further increase the relative humidity. Ventilation during warm, humid periods, even at night or early morning when outside temperatures are low, can lead to mildew conditions.

Vapor pressure. Vapor pressure moves moisture through cracks, down the fireplace chimney, and through doors and windows when they are open. Vapor pressure can move moisture through many materials. Once moisture gets into a house, it continues moving into closets, cabinets, and drawers. Once moisture is diffused into wood or other materials, it is very difficult to drive out.

Ventilation. The function of ventilation in inhibiting mildew growth is to replace moist indoor air with dry air. Open windows and doors or exhaust fans can serve this purpose if the outside air holds less moisture than the inside air.

When trying to control moisture during the air conditioning season, windows and doors probably should not be opened at night unless the nighttime low temperature is at least 15°F lower than the air conditioning thermostat setting. The dew point temperature should be below 55°F or 60°F. As much as 7 or 8 pints of excess moisture can be brought into a house every hour. An air conditioner would have to work much harder the following day to remove the moisture.

In a home, moisture also gets into closets, cabinets, and drawers during humid, non-air conditioning periods. The moisture is released very slowly when room air dries out.

Infiltration of air. A new, tightly constructed house can be expected to have some

leaks around windows, doors, vents and other joints that will permit one/half air change per hour. On a humid, summer day as much as 20 gallons of moisture can come into a house through infiltration. Older homes sometimes have as many as 2 air changes per hour. In colder climates, weatherstripping is suggested to reduce the infiltration of cold air. In warm, humid climates, where air conditioning is used much of the year, weatherstripping is suggested to reduce the infiltration of moisture, even more than to keep out heat in the summer or to keep it in during the winter.

Air Treatment

Air Conditioners. Air conditioners remove moisture from the air as the air is cooled. Air is blown over cooling coils, and since cool air can't hold as much moisture, some of this moisture condenses on the coils and runs to a drain. The heat absorbed from the air by the air conditioner is carried by a refrigerant to coils outside the house where the heat is released.

Since moist air conditioners are designed to cool more than to dehumidify, they do not dehumidify effectively enough in Florida during humid periods, which last from May through October.

The longer an air conditioner is operated, the greater the amount of moisture that will be removed. An air conditioner unit too large for the area it cools might not operate long enough to remove enough moisture. Even though the home is cool, enough moisture can remain to produce mildew in areas with little air movement. Unfortunately, energy efficient air conditioners may not reduce humidity effectively enough for homes in warm, humid climates.

When air conditioning during humid weather, do not set the air conditioner fan to run continuously. This will cause moisture just removed by the cooling coils to be put back into the air, therefore, keeping the air more humid.

Dehumidifiers. Where no air conditioning is provided, a dehumidifier can be used if properly sized for the area. When using a dehumidifier, windows and doors must be kept closed. A dehumidifier collects moisture from the air in much the same manner an air conditioner does. However, a dehumidifier has both the heating and cooling coils inside, so there is little temperature change in the air, and moisture removed is either collected in a container that must be emptied periodically or through a hose that runs into a drain. Collector pans can become a place for mold/mildew to grow if not cleaned and cared for properly.

Heating. In some closets or basements that are damp and cool, mildew growth may be inhibited by adding heat. As the air warms, its capacity to hold moisture increases. For example, air at 75°F and 75 percent RH can be heated to 85°F and the humidity will be less than 60 percent, low enough to slow mildew growth. If the problem area is large, such as a basement, an electric space heater can be used. **NOTE: Gas and kerosene heaters add considerable moisture, so cannot be recommended for this purpose.** A low wattage light bulb can do the job in the closet. Place the light bulb away from clothing or anything else that might ignite. Strip heaters designed especially for use in closets are available. For safety purposes, follow instructions very carefully.

Desiccants. In small, enclosed areas, where temperature and humidity cannot be controlled by air conditioning or dehumidification, desiccants can be used. Desiccants are materials such as silica gel or alumina that absorb up to half of their weight in moisture. Place an open container on the floor or a shelf of a closet that can be tightly closed. Once a desiccant becomes saturated it can still feel dry, but will remove no more moisture. To be used again, these desiccants must be heated in a vented oven at 300°F for several hours. They will then be dry and can be cooled and replaced in the closet to continue removing moisture.

Calcium chloride granules are also desiccants and can be used to remove excess moisture from an enclosed area. Granular calcium chloride can absorb and hold moisture equal to several times

its weight. As it absorbs moisture, it liquifies and cannot be reused. The granules should be placed on a screen over a container that can catch the liquid as it forms. Calcium chloride will damage fabrics if it comes in contact with them. Calcium chloride is sometimes combined with other materials to keep it from liquefying as it absorbs moisture. Follow package instructions when using.

Chemical Mildew Inhibitors

There is no true mildewcide -- no product that will kill mildew and guarantee it will not return. Chemical mildew inhibitors should be used with caution, as they are toxic to people and animals.

Cleaning agents that claim to remove mildew most often have a chlorine component. Chlorine both kills mildew and bleaches the darkened mildew filament. However, when such products are used, some scrubbing and rinsing are required to remove the mildew and soil residue. Otherwise, as soon as humidity and temperature conditions are right, mildew will use the residue as a substrate to grow on. A new supply of mildew spores is always floating in the air waiting for the right conditions. Commercial fungicidal products in pressurized cans provide some mildew protection. Check the label on the container to see what it claims to do and for instruction on how to use it safely and effectively.

Protective Sprays

Water-repellent and soil-resistant spray treatments inhibit mildew growth by reducing moisture or food available. Carefully read instructions on the label to understand the claims made and to know how to use the product safely and productively.

Cold Weather Mildew Problems

Areas of Florida that have periods of very cold weather can be exposed to winter conditions that lead to mildew problems. Mildew in moderate climates is usually related to tight construction and indoor moisture production in cold weather. Without an interior vapor seal, moisture produced indoors during cold weather can penetrate walls and condense. Later, when outdoor temperatures are higher, mildew and other organisms can destroy studs in the walls. Occasional ventilation when outside air is cool and dry will protect against this cold weather/high humidity condition.

Basement mildew in moderate climates often starts in the spring when windows in a home are opened to air outside the house. Temperature on the floor and behind books and curtains in basements can still be below the dew point temperature. The relative humidity in these areas becomes high enough for mildew to grow. Apply heat as described earlier to provide protection from this potential mildew problem.

Summary

The two most effective methods of avoiding mildew problems are keeping things CLEAN and DRY. Once mildew appears it should be removed as soon as possible and precautions should be taken to prevent its return by keeping humidity levels low. The following chart contains instructions for dealing with mildew problems on commonly affected surfaces.

October 2001 How to Prevent and Remove Mildew page 6 **Mildew Removal and Prevention**		
Item	**To Remove Mildew**	**To Prevent Mildew Growth**

Clothing and Textiles	Begin as soon as mildew is discovered. Brush off outdoors. Sun and air clothes before laundering or dry cleaning. To remove mildew stains that remain, try one of the following **Test fabrics for color fastness first.** 1. Moisten stain with a mixture of lemon juice and salt. Lay textiles in sun to bleach. Rinse thoroughly. 2. Mix 1 to 2 tablespoons of a powdered non-chlorine bleach containing sodium perborate or potassium monopersulfate with one pint of water. Use the water temperature recommended for the fabric or color. Sponge or soak the stain. Let stand 30 minutes or longer; then rinse well. Old stains may need to soak overnight. 3. Mix 2 tablespoons of liquid chlorine bleach with 1 quart warm water. Sponge or soak stain for 5 to 15 minutes and then rinse. **Do not use chlorine bleach on silk, wool, or spandex fibers.**	Keep fabrics dry. Never let damp or wet clothes lie around. Dry or wash them. Spread out damp towels and washcloths to air dry. Stretch out wet shower curtains. Dry washed clothes quickly. Clean clothing before storing. Soiled clothes are more likely to mildew than clean ones. Do not leave starch in clothes for long storage periods since molds feed on starch. Air the clothes in closets by opening doors and shifting them to provide air space around them. Commercial mildew inhibitors are available in hardware and paint stores. In severe cases, these inhibitors may prove to be effective. Since strong chemicals are used, read the label instructions carefully to see what the inhibitors can do and how they can be used safely.