# Mildew and Mildew Control for Wood Surfaces

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## WHAT IS MILDEW?

### Definition

The term "mildew" is a common term in the paint and coatings industry and is used to describe an unsightly discoloration of a paint film. Mildew is a general term for growth produced by mold fungi. This growth can occur on a variety of surfaces both of organic and inorganic origins. Surfaces can be inanimate, such as wood, vinyl, and aluminum; or living materials such as plants. Mildew can also grow on superficial surfaces such as dirt, grease, and other industrial pollutants, provided the appropriate nutrients are present to facilitate such growth.[1]

Moisture is the primary environmental component necessary for mildew growth, followed in lesser degree by temperature. Consequently, tropical areas that have high moisture (humidity) and high temperature profiles provide the greatest geographic challenges to mildew growth prevention. Hot, dry climates, as one would suspect, see much less mildew growth. Fungal spores are present in air at counts of 100 to over 1000 per $m^3$ of air, depending on geographic location.[2] Even freshly milled wood is immediately exposed to mildew regardless of location. Appmximately 100,00 species of mildew exist? many of which affect the appearance and performance of finishes. Mildew can be transported from one surface to another by insects, animals, or air.

### Effect on Appearance and Performance

Mildew affects finishes in both appearance and performance. Mildew generally appears in two forms, a spore type, which resembles caviar in appearance, or a mycelium or filament type. Mildew generally appears as an unsightly discoloration on a finish, thereby making the appearance unacceptable. The performance of a finish may be compromised either by mildew growth on the coating surface, or by the application of a coating to a mildewed surface. The presence of mildew can have a detrimental effect on dirt pickup, cracking, flaking, and adhesion properties of the finish. When an appropriate finish is applied to a mildewed surface, the adhesion of that finish to the substrate will be reduced due to the physical interference of the mildew. When an infected finish is applied to a substrate, the above failures can occur even more rapidly.

**INTERFERENCE WITH ADHESION:** Paints are designed to have excellent adhesion to a variety of surfaces. Depending on the paint manufacturer's intentions, a particular paint may be designed to adhere to wood, masonry, vinyl, aluminum and/or other substrates. The presence of mildew or other foreign matters such as oil, grease, dirt, tree pollens, and/or other substances on a substrate interferes with the adhesion characteristics of the paint' It is in the homeowners best interest to ensure that the substrate to be painted is properly cleaned and prepared prior to painting.

**INTERCOAT ADHESION OF PAINTS:** When mildew has grown on as surface, a home owner may think he can improve the appearance by applying a coat of finish directly over the mildewed surface. This approach is not a desirable cure. Instead, this new coat of finish provides protection for the existing mildew, preventing its removal and can actually provide a nutrient source to facilitate new mildew growth. Because of the infestation below the newly finished surface, mildew will certainly appear again on the new surface.[4] In addition to the poor appearance of the mildew, a greater problem now exists with the adhesion of then new finish to the old finish, a property commonly referred to as intercoat adhesion, By not following good surface preparation procedures, the homeowner has allowed the mildew to exist between the old and new coals of finish. Intuitively and quantitatively, we know that this mildew interferes with the new finish's ability to adhere to the old finish. Early failures such as cracking, flaking, and blistering can be expected. To insure the best intercoat adhesion, an appropriate method of surface preparation must be followed. This is described in the following.

**EFFECT OF MILDEW ON WOOD:** We have discussed some of the harmful effects that mildew can have on wood finishes. Mildew can also effect unfinished wood. In fact, it is often more of a problem with unfinished wood. The colored residue that mildew can deposit on a wood surface can cause severe discoloration; this discoloration can be a variety of colors but is most often gray or black. However. this mildew growth does not degrade the wood; mildew fungi are not capable of using lignin, cellulose, or hemicellulose for food. Therefore, mildew does not decrease the structural integrity of the wood. They can, however, use the nonpolymeric materials in wood, such as the extractives and natural oils for food. Wood species that are rich in natural extractives may be more prone to mildew growth than wood speccies with lower extractive content. Since mildew spores infect all surfaces, their growth can be limited only by controlling moistures temperature, or using paint film mildewcides.

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If the surface is infected with mildew, it can be removed using a mildew cleaner, but will return if the growth conditions remain the same. If wood is to be painted it is beneficial to remove mildew before painting. This increases effectiveness of the paint film mildewcide.

### Common Species

There are a variety of common mold species known to effect coatings performance. A list of 19 of the most common species appears below:

*Alternaria sp.*
*Aspergillus flavum*
*Aspergillus niger*
*Aureobasidium pullulans*
*Botryodiplodia sp.*
*Cephalosporium sp.*
*Cladopsorium sp.*
*Fusarium sp.*
*Helminthsporium sp.*
*Monilia sp.*
*Mucor sp.*
*Pacacilomyces sp.*
*Penicilium sp.*
*Pestalotia sp.*
*Phoma sp.*
*Pleospora sp.*
*Rhizopus sp.*
*Stemphylium sp.*
*Trichoderma sp.*

Of these species, *Aureobasidium pullulans* and *Aspergillus niger* are the most common mold species encountered.

### Nescessarry Contributing Factors

**SUBSTRATE AND ENVIRONMENT:** -Regardless of specific species, all mildew require oxygen, water, a food source and a narrow temperature range to metabolize and reproduce. Typically, mildew causes problems with the finish after it has been applied and dried, and does no taffect the product in the can as there is usually insufficient oxygen present for metabolism. Mildew needs water to grow. Consequently, as the humidity of the environment continues to rise, the mildew flourishes. For food, mildew generally metabolize organic food sources like starches, sugars, proteins, and some oils found in paint systems. Specifically, mildew can also feed on pollens, bacteria, or many other organic contaminants on the finished surface. Temperatures from ~70° to 90°F (~20° to 30°C) are ideal for mildew growth. Below freezing mildew fungi become dormant, however, they do not die.

**PAINT FILM:** Other factors that can also contribute to mildew growth include the type of finish and its surface characteristics. Generally, top quality paints offer the best protection from mildew. As the quality of the paint decreases, the chance for mildew growth typically increases (a further discussion will follow under Mildew Control). Generally, latex finishes are more mildew resistant than alkyd paints.

### Geographically Prone Areas

Mildew growth can occur anywhere in the world. Climates that supply more of the contribution factors previously discussed will promote greater mildew growth. For example, hot, tropical regions often have the greatest mildew growth. Coastal regions generally grow more mildew than dry in land areas. however, inland areas are near lakes, rivers, or heavy vegetation can experience heavy mildew growth.

## MILDEW CONTROL

### Surface Preparation

If mildew is already present on a substrate, the mildew must be killed and removed before the substrate is repainted, or else the mildew will grow through the new finish, as previously discussed. To kill mildew and remove mildew from a surface, follow the steps outline in the following:

(1) Using a spray canister (one designed for insecticide application will do) available at most local hardware stores, apply the following solution liberally to the substrate and allow to set for about 10-15 min:

a. three quarts of water
b. one quart common household bleach
c. ¼ cup maximum of liquid dishwasher detergent (ammonia free)

NOTES:
1. Do not mix bleach and ammonia. This mixture can result in hazardous, toxic vapors.
2. Precautions should be taken to protect shrubs and other areas that may be adversely affected by bleach.
3. Protect eyes and skin from contact with bleach solution.

The bleach is the key component that actually kills the mildew. Allowing this solution to set for 10-15 min gives the bleach time to settle into any crevice and hard to reach places to kill all of the mildew present. Skipping this 10-15 min set time may result in a inadequate job. The detergent is added in a small amount to help emulsify any mildew or dirt to aid in its removal. Liquid dishwasher detergent is the best choice because it will not foam like dry dish or laundry detergent. Most dry detergents are not easily washed off with cold water. Use of trisodiumphosphate (TSP) detergents is cautioned since the phosphate may actually serve as a food source for mil dew and may actually promote future mildew growth.

(2) Wash the substrate clean using a power washer. A second choice, if a power washer is unavailable, is to scrub the surface. For masonry substrate use a wire brush. For wood, use a softer bristle brush. For substrate sensitive to abrasive damage like aluminum and vinyl siding use a sponge.

(3) Use a garden hose to wash off any excess dirt, mildew, and loose substrate residue from the surface. Residue left behind can cause adhesion failures of the finish.

If mildew was present on the original substrate or previous coats, and a new finish coat is already applied, the mildew will grow through the new finish. It is usually impossible to stop mildew growth at this point. All the finishes must be stripped down to the original sub strate and then cleaned as previously described before applying a new finish coat.[5]

### Mildewcides

Mildewcides are chemicals added to paints and other finishes to help stop mildew growth on the finish. There are a wide variety of mildewcides used in the paint and coatings industry. Identifications of these chemicals are usually listed on the container label, although exact amounts are not usually revealed. For the consumer, attempting to study can label analysis to determine mildew resistance of a finish would be tedious and nonproductive. A majority of the mildewcide names are extremely long, complex, and meaningless to the consumer. The best way for the consumer to gauge mildew performance is by the overall quality of the finish. Top quality finish will offer the best mildew protection in nearly all cases.

Certain pigments offer mildewstatic protection and. when used in combination with certain mildewcides, offer superior mildew protection. One commonly used mildewstatic pigment is zinc oxide.

### Pretreatment and Preservatives

We previously discussed surface preparation before coating a substrate. After proper surface preparation has been done, one may choose to apply a special coating before applying the finish coats. Types of special coatings in-

clude primers, wood preservatives, and sometimes semitransparent stains. Primers are used when the finish coats are opaque. Paints, opaque stains, and timber finishes are examples of opaque finishes. Clear wood preservatives can be used under opaque finishes, and under semitransparent stains. Transparent stains themselves can be considered a pretreatment when used under a clear finish. This is popular in cases where one wants the natural look of a semitransparent stain, but desires the added protection of a clearcoat. Each type of pretreatment has its own requirements for application to obtain optimum performance, so following the label instructions necessity. Regardless of the type of pretreatment, proper surface preparation is essential to assure adequate performance.

Besides pretreatment approaches with finishes, installation of galvanized zinc oxide metal fIashing either to roofs or siding is sometimes used. When exposed to rainwater, some zinc oxide is solubilized and will wash down over the finished surface, helping to prevent mildew growth.

## ADVANTAGES OF MILDEWCIDES

Any particular finish could contain one or more types of mildewcides. For the consumer, it is not important to be know exactly how a particular mildewcide works, only whether one is present in the finish they have purchased. Depending upon the application conditions and environment, the present and level of mildewcide can have greater or less significance. For exampie, bathrooms and exterior siding need more mildew protection than a living room wall. There are several advantages to having mildewcide in a finish:

(1) The appearance of the finish is enhanced, not by immediate results of the mildewcide itself, but the long-term protection from unsightly mildew growth.

(2) The useful life of a finish will be extended by improving resistance tering, cracking, and so forth.

(3) When a surface does need to be refinished, surface preparation is easier, since mildew does not have to be removed.

(4) For interior applications, the environment is healthier since mildew is not present on the walls.

## DISADVANTAGES OF "POINT-OF PURCHASE" MILDEWCIDES

Finishes that already have mildewcides included in the container do not bring any disadvantages to the consumer. Since they have already been sucecessfully formulated into the paint or stain there are typically no further concerns. Only in rare cases are people sensitized to finishes as a result of the mildewcide. Mildewcides that were commonly used in the past, namely mercurial mildewcides, posed environmental threats since they did not break down over time. However, nearly all of the mildewcides used today eventually break down into nonhazardous molecules that are reabsorbed into the environment.

"Point-of-Purchase" mildewcides (POPs) are rarely used, but can be purchased from many professional paint stores. These mildewcides are used by consumers when the application requires an extra measure of mildew protection. These mildewcides are post-added to the finish either at the store or at home. POPs vary in chemistry. One new approach is to add a zinc oxide dispersion to either water, or solvent-based paints for extra mildew protection. This approach is effective, however, the paint must be used within 90 days of the treatment to assure paint stability.

Since the original finish was not formated by the manufacturer with this mildewcide, some disadvantages can arise:

(1) POP's are expensive and add significant cost to the finish.

(2) The POP's may be unstable with a particular finish. Fortunately, instability in finishes is not dangerous; instead the finish can lose viscosity (thickness), show color problems, become offensively odorous, turn solid. and for solvent-based system may even slow or prevent curing.

(3) Depending on the chemical structure of the particular mildewcide, the user may have dispose of any unused portions by special, and costly, means.

(4) Performance lifetime is typically much shorter than mildewcides formulated into a finish. Other failures like chalking, color or tint loss, and yellowing can be accelerated.

## SUMMARY

Mildew growth is an ongoing problem. Fungal spores land on surface and, under the environmental conditions, grow. Ideal conditions are warm, moist climates, oxygen, and a substrate that serves as a nutrient source for mildew.

Mildew growth on finishes cause discoloration and premature failure of the finish. Prevention of mildew can be done by pretreating the wood with a preservative that contains a mildewcide. Removal of mildew is achieved by using appropriate cleaning solutions. Finishes that contain synthetic mildewcides, with or without zinc oxide, help the finish resist mildew growth.

### Bibliography


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