The Use of Primers and Sealers After Fire and Smoke Damage

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Over the past several years, the introduction of primers and sealers in the fire and smoke damage restoration market has provided restorers a supplemental method to address stubborn and lingering smoke stains and odors, a process described here as "contamination isolation." This paper examines the use of contanimation isolation in lieu of the traditional contamination removal processes used to remove combustion residues.

Contamination isolation embeds residues under an impervious coating. This coating — commonly called a *sealer* — is said to permanently block fire products and odors, thereby restoring surfaces to their pre-fire state. The enticement to replace traditional contamination removal may be fueled by an exaggerated belief in the ability of sealers to address all aspects of smoke contamination. Intentional or unintentional disregard of sealer specifications might be another factor. While post-repair smoke odor problems are one potential result, the long-term collateral effects of sealer may prove even more significant.

The Fire Scenario

In addition to heat, uncontrolled combustion produces a mix of partially oxidized particles, gases, liquids and aerosols, some of which settle or adhere to surfaces. Some combustion residues corrode metals or produce other undesirable outcomes. Volatile emissions from fire residues may continue after the fire has been extinguished, accompanied by odors that range from barely noticeable to extremely pungent. The toxicity of fire-generated Volatile Organic Compounds (VOCs) has long been recognized, even though their presence at any specific fire site can vary widely.

A long-established principle of fire damage repair has been the objective of restoring damaged property to its predamage condition and value. This is consistent with principles of indemnification inherent in property insurance. Another basic assumption has been that loss-related combustion residues are undesirable and should be removed as part of the repair process. One might say that its emphasis on the removal of fire residues and odors has been a principle element distinguishing fire damage repair from traditional building repair or remodeling.

Primers and Sealers

Paint primers are coatings formulated to adhere to a substrate and create a uniform surface for the finish coat. Primers are designed for specific surfaces: latex primers for unfinished drywall and exterior use, oil-based primers for raw wood. Many primers have specialized ingredients such

as stain-inhibiting tannin blockers, preservatives, or corrosion inhibiters.

Sealers are designed to be used before or in place of a primer. A key role for sealers has traditionally been to bind porous surfaces such as crumbly concrete or plaster. Sealers are specifically designed to seal off surface porosity and block stains. Because they share many characteristics, the terms primer and sealer are sometimes used interchangeably. In this paper the term sealer will be used for interior coatings applied after fire damage.

In building construction sealers have long been employed as moisture barriers or to prevent the migration of wood resins and stains. Shellac, a natural polymer, has traditionally served painters as a stain blocker. Sealer producers have brought synthetic polymers to market to serve the same function. Some popular sealer brands include Kilz© (Masterchem Industries LLC), B-I-N (Wm. Zinsser), and Recon© (Fiberlock Technologies, Inc.). Their shellac-based products were not designed for fire damage, but having proved effective, the designation often appears in their list of uses.

In current fire repair practice, sealers are applied to isolate and bond settled combustion particles, hide heat and smoke discoloration, and prevent transmission of smoke odors. A white pigment (titanium dioxide) is typically added to enhance stain-hiding. It has now become a routine procedure to apply pigmented sealer to smoked building surfaces for "odor control."

However, dependence on primers and sealers to permanently block smoke odors should be discouraged. It is well established, due to the hygroscopic nature of wood and variations in atmospheric humidity, the dimensional stability of wood is dynamic in the built environment. As wood seeks out equaliberium, the material will shrink and swell in different directions and planes, with changes in atmospheric moisture. While the application of a good quality primer or sealer may slow

Synopsis

The introduction of primers and sealers in the fire and smoke damage restoration market has provided a supplemental method to address stubborn and lingering smoke stains and odors, a process described as "contamination isolation." Contamination isolation embeds residues under an impervious coating. This coating — commonly called a *sealer* — is said to permanently block fire residues and odors, thereby restoring surfaces to their pre-fire state. This paper examines contamination isolation both in lieu of and in contrast to traditional contamination removal.

Fire produces a mix of partially oxidized particles, gases, liquids and aerosols. Some residues corrode metals or produce other undesirable outcomes. Emissions from residues may continue after the fire has been extinguished, accompanied by odors that range from mild to pungent. A long-established principle of fire damage repair has been that loss-related combustion residues should be removed as part of the repair process.

Paint primers are formulated to adhere to a substrate and create a uniform surface for the finish coat. Sealers are designed to be used before or in place of a primer. Sealers eliminate surface porosity and block stains. In containment isolation, sealers are applied to isolate and bond settled combustion particles, hide heat and smoke discoloration, and prevent transmission of smoke odors.

Major sealer brands carry detailed use instructions that typically start with surface preparation. These instructions demonstrate that a clean, particle-free surface is a near-universal requirement for application of sealers.

Combustion particles settle and adhere to surfaces through a variety of mechanisms. In the aftermath of a fire they are principally surface contaminants. Gross accumulations can be removed by HEPA vacuuming, and cellular rubber sponges capture additional particles. Some fine particles are protected by surface texture and escape dry wiping. Liquid and gaseous products may have been absorbed. Remaining combustion residues are largely water soluble. Wet washing neutralizes electrostatic bonding of particles and introduces moisture, which conveys volatile components back to the surface with drying. When absorbed residues, intractable staining, or charring of wood are present, abrasive techniques are available.

Intensive cleaning is unlikely if sealer has been specified.

To block odors, sealer should form an unbroken membrane over the surface. Viewing typical sealer coatings under 8–10X magnification shows that a certain amount of the surface area remains unsealed. Coverage becomes even less certain if combustion particles remain.

Smoke odor complaints after fire damage repairs are not uncommon. By blocking the release of volatile emissions, sealer drives them more deeply into the substrate. In some cases a persistent smoke odor requires physical removal of the sealer prior to abating the odor.

The side effects of contamination isolation include:

Moisture blockage. The transmission of water vapor through exterior walls is an important consideration in building design. Sealing the inner surface of an exterior wall hinders its ability to transmit water vapor.

Corrosion. The corrosiveness of fire residues varies, but corrosion can progress undetected beneath sealer. Metal ceilings, joists, ducts and support hardware are candidates for hidden corrosion.

Property value. Pigmented sealers are usually white. A white coating on trusses, roof sheathing, ceiling joists or other normally bare surfaces might raise questions in the mind of a prospective property buyer. Property insurance is designed to make the owner "whole." Does applying a sealer to block combustion residues or odors meet that obligation? The sealer, in effect, preserves damaging residues while potentially altering the performance of some building components.

Sealer failure may be rare, but it tends to be troublesome and expensive. It is the opinion of the authors that a modification of current practice to emphasize removal of fire residues instead of sealing them would benefit all parties.

this process, no known product on the market can permanently prevent the inevitable movement of moisture and, therefore, the odor molecules of smoke, as the impervious coating will eventually crack under the stress of the wood's dimensional instability.

Surface Preparation

Major sealer brands carry detailed use instructions that typically start with surface preparation. For example, Kilz Max® Clear Primer specifies "the surface must be clean, free of dust, grease, wax, peeling paint, mold, mildew and wallpaper paste. If washing is necessary, use a non-soapy detergent or TSP (Tri-Sodium Phosphate) substitute. Rinse well and allow to dry completely."

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B-I-N Shellac-based Primer Sealer states: "Surfaces should be clean, dry, sound and free of dust, dirt, excessive chalky material, grime, grease, oil, wax, mildew, wallpaper adhesive, or any contamination that may interfere with adhesion…. Remove existing stains by washing, sanding, scraping, etc."

Valspar Paints' instructions: "Clean and dry surface thoroughly. Scrub stained areas with an all-purpose cleaner to remove any residual stains. Remove all surface dirt, chalk and mildew…. For fire damaged areas, remove burned or severely charred areas to sound wood surface."

These and other product specifications suggest that a clean, particle-free surface is a near-universal requirement for application of primer-sealers. Apparently coating manufacturers consider surface condition to be an important element in their products' performance and they avoid uncertainty by stating specific procedures rather than relying on variable interpretations of clean.

Combustion particles settle and adhere to surfaces through a variety of mechanisms. In the immediate aftermath of a fire they exist principally as surface contaminants. Gross accumulations can be removed by HEPA vacuuming with brush attachment or wiping. Cellular rubber sponges (commonly but inaccurately called chem sponges) capture additional settled fire particles. However, some fine particles are protected by surface texture and escape dry wiping. Liquid and gaseous products may have been absorbed. As a result, effective removal of combustion residues is rarely a one-step process.

Settled combustion residues are largely water soluble. A range of methods exist to facilitate wet washing, such as vigorous scrubbing, brushing, and power washing. Wet washing neutralizes electrostatic bonding of particles. It introduces moisture, which conveys volatile components back to the surface with drying. When absorbed residues, intractable staining, or charring of wood are present, abrasive techniques such as scraping, power sanding and grit blasting are available. In brief, there is no shortage of procedures and equipment to remove combustion residues and provide a clean, uncontaminated surface.

In actual practice intensive cleaning is less likely to be performed if sealer has been specified. Adjusters may omit it from their specifications in the belief that sealer is a cure-all. In other situations contractors may bypass aggressive cleaning to cut costs. (One of the authors has encountered burned framing specified for replacement that remained untouched under a coating of sealer.) When cleaning is performed, wiping down smoked surfaces with dry cellular sponges is thought to fulfill the requirement. This can provide an illusion of adequate preparation if fire residues and odor are moderate.

Sealer Application

To fully block odors, sealer should form an unbroken membrane over the target surface. Spray application is the most frequent method, sometimes by airless sprayer, other times with individual spray cans. Viewing typical sealer coatings under relatively low magnification (8–10X) has shown that a surprising percentage of the surface area remains unsealed. This could be the result of insufficient material or improper spray technique. Proper spray application requires skill and experience. Every surface has some degree of irregularity; if the sprayer is not held perpendicular across the surface, a shadowing effect is inevitable. Coverage becomes even less certain if particulate material remains in place. An overall appearance of whiteness does not assure complete sealer coverage.

Smoke odor complaints after fire damage repairs are not uncommon. If a sealer application has failed to entirely isolate smoke odors, the problem becomes more complex. By blocking the release of volatile emissions, sealer drives them more deeply into a wood or drywall substrate. In some cases a persistent smoke odor requires dismantling the job for physical removal

of the sealer (occasionally the entire substrate) preliminary to abating the odor. When discovery occurs after the property has been reoccupied, the disruption and expense of odor remediation may exceed tolerable limits.

Side Effects

Moisture blockage. The transmission of water vapor through exterior walls is an important consideration in building design, and involves careful sequencing of materials. Local climate determines the appropriate direction and rate of vapor flow. However, to block the transmission of odors a sealer must form an impermeable air and moisture barrier. Thus, sealing the inner surface of an exterior wall alters its ability to transmit water vapor in either direction. Exterior wall framing will have the studs sealed on three sides but not where they abut the sheathing, with the result that moisture entering the sheathing/stud interface will not be able to exit. While the specific effects of an unplanned vapor barrier hinge on a list of variables, it is safe to say that indiscriminate application of sealer to the inner surface of exterior walls carries a potential for long-term moisture damage in some climates.

Corrosion. The corrosive nature of combustion residues has been well documented. After a fire, what effect might the application of sealer have on metal components?

Several years ago one of the authors was asked to investigate a replacement air handler that had punctured a warehouse roof. The crane operator insisted that the unit was lowered gently. Examination of the corrugated metal roof from within revealed that a section of ceiling had been painted white. The manager said the coating was applied after a fire eight years earlier. Examination from a scaffold revealed that the metal was perforated to a brittle lace. Fragments of the white-coated ceiling could be pulled out by hand, whereas the surrounding unpainted ceiling remained intact.

The corrosivity of fire residues varies, but corrosion can progress undetected beneath a coating of paint or sealer. Metal ceilings, joists, ducts and support hardware are candidates for hidden corrosion. Prompt and aggressive removal of combustion residues from metal components is essential after smoke exposure. Sealer has no useful role to play.

Property value. Pigmented sealers are usually white. In addition to hiding smoke stains and char, pigmentation has the advantage of showing the applicator what areas have been coated, and to a degree, the density of the coating. However, visible sealer may also have a negative impact. A white coating on trusses, roof sheathing, ceiling joists or other normally bare surfaces might raise questions in a prospective buyer, such as "Why the white paint?" The explanation that it was applied to block odors after a fire might not be comforting.

Many state codes require home sellers to disclose significant building damage. The occurrence of past flooding is a fact sellers may be expected to reveal. Similarly, a fire at the property, even if fully repaired, may require disclosure. Under these circumstances, an unwarranted white coating would take on greater significance. If material were flaked off (a not unlikely consequence) the appearance of untreated combustion products would have an immediate impact. Some realtors refuse to show homes with prior fire damage because of potential liability.

Since property insurance is designed to make the owner "whole" after covered damage (within policy limits) there is a question of whether applying a sealer to block combustion residues or odors fulfills that obligation. The sealer, in effect, preserves damaging residues while potentially altering the appearance and performance of some building components. This differs from the property's predamage state, which included neither fire residues nor sealer to cover them.

By blocking the release of volatile emissions, sealer drives them more deeply into a wood or drywall substrate. In some cases a persistent smoke odor requires dismantling the job for physical removal of the sealer (occasionally the entire substrate) preliminary to abating the odor.

Conclusion

The occasions when sealer fails may be rare, but they tend to be troublesome and expensive. A larger issue may be the unintended consequences of sealer application. When the full effect of sealing fire residues is considered, the cost benefits may be less attractive. It is the opinion of the authors that a modification of current practice to emphasize removal of fire residues instead of sealing them would work to the advantage of all parties involved. In addition, the authors recommend that alternative smoke deodorization procedures — such as the use of ozone, hydroxyl, or thermal fogging, which have proved effective in recreating

the same conditions of permeation and deactivating the odor-producing molecules — be explored before attempting to seal impacted surfaces.

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