Fire Engineering®

Construction Concerns: Misleading Marketing

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By Gregory Havel

"Let the buyer beware" is a legal principle brought to America in English Common Law. This principle implies that it is up to the buyer to decide whether an item is appropriate for the purpose for which it is purchased, to evaluate its quality, and to judge whether the price is fair.

This same principle applies to our understanding of marketing literature and broadcast advertising regarding building materials and products. You need to be cautious and evaluate what is said about a product before you decide that what is said is true.

If a building material is advertised as "fire rated" or "fire retardant," you should be shown the standard to which it was tested and the name of the independent laboratory that performed the tests. These standards and laboratories can guide us in making decisions that balance tested performance against marketing claims. If test standards and laboratory information are not shown, you must verify the truth of the statement before approving the material for use in code compliance. If this information is included in the advertising, it is simple to verify whether the listing is legitimate.

Recently, some manufacturers and association Web sites have claimed that vinyl siding is fire resistive and flame retardant.

One marketing brochure states, "*Vinyl's chemical makeup makes it inherently flame resistant. Rigid vinyl building products are slow to ignite, their flame spread is slow and they cease to burn after the flame source is removed. The products of vinyl combustion are no more hazardous than those produced by burning many other common materials, both natural and synthetic."*

Another marketing brochure, incorporated into advertising on a fire service Web site, states, "*Vinyl siding is inherently flame retardant. It is composed mostly of polyvinyl chloride, more commonly known as vinyl or PVC. Due to its chlorine base, it is harder to ignite and easier to extinguish. It doesn't release much energy when it burns and will not readily spread flames on its own. Vinyl siding will not ignite even from another flame until it reaches 730^{O}F (387^{O}C). Common framing lumber ignites from a flame at 500 ^{O}F*

(260^{O}C). Siding rarely plays a role in residential fires. Only 4% of house fires start on the outside of the structure. Vinyl siding does not exhibit sustained flaming. UL fire-rated assemblies specify vinyl siding as a cladding option. Safety first! Vinyl siding complies with building codes throughout the country."

Photo 1 shows a photo of a wall test at Underwriters Laboratories (UL) Firefighter Safety Research Institute with vinyl siding over plywood sheathing, two minutes after ignition. Photo 2 shows a photo of a wall test at UL Firefighter Safety Research Institute (FSRI) with cedar siding over plywood sheathing, two minutes after ignition. These photos appear to contradict the above marketing statement.

(1, 2) Photos courtesy of UL Firefighter Safety Research Institute.

According to material safety data sheets (MSDS) from lumber manufacturers, the auto-ignition temperature of wood dust (saw dust) ranges from 400^{O}F to 500^{O} F (204^{O}C to 260^{O}C), depending on the species of wood and its moisture content. According to MSDS and marketing materials from vinyl siding manufacturers, the auto-ignition temperature of rigid vinyl is 730^{O}F (387^{O}C). According to the marketing materials, this temperature is the result of replacing a hydrogen atom in the monomer molecule with a chlorine atom.

Research into the properties of ethylene monomer (the precursor to polyethylene plastic and vinyl chlorides) shows the following results of replacing a hydrogen atom with a chlorine atom:

- Ethylene (C_2H_4, with no chlorine) has a boiling point of -154^{O}F (-104^{O}C), lower explosive limit to upper explosive limit (LEL—UEL) range of 2.7–36 percent, and an auto-ignition temperature of 842^{O}F (449^{O}C).
- Vinyl chloride (C_2H_3Cl; ethylene with one chlorine atom replacing one hydrogen) has a boiling point of 7^{O}F (-13.9^{O}C), LEL—UEL range of 3.6–33 percent, and an auto-ignition temperature of 881^{O}F (472^{O}C).
- Vinylidene chloride ($C_2H_2Cl_2$; ethylene with two chlorine atoms replacing two hydrogen) has a boiling point of 86^{O}F (30^{O}C); a LEL—UEL range of 5.6–11.4 percent, and an auto-ignition temperature of 855^{O}F (457^{O}C).

The higher auto-ignition temperature of vinyl chloride and PVC when compared to wood is more due to the properties of ethylene than it is to the single chlorine atom in the vinyl chloride molecule. Replacing more of the hydrogen atoms with chlorine or other halogens like fluorine and bromine, will further increase the boiling point and the auto-ignition temperature, and narrow the LEL—UEL range.

When a hydrogen atom in a hydrocarbon is replaced with a chlorine (or other halogen) atom, it raises the auto-ignition temperature and narrows the LEL—UEL range. At the same time that combustion is inhibited, the amount of smoke produced during combustion increases.

[According to a technical data sheet from one vinyl siding manufacturer, the flame spread rating using ASTM E84/UL 723 testing (using a horizontal test specimen) is 20, and the smoke developed is 390. Flame spread is faster when using a vertical sample, as in the tests conducted by UL FSRI.]

The MSDS from lumber manufactures state that firefighting procedures should use water to thoroughly wet the wood and reminds firefighters to remove any charred material to an open secure area to ensure that all fire is extinguished and to avoid breathing the smoke.

The MSDS from a vinyl siding manufacturer states the following:

"The decomposition products from this material are those that would be expected from any organic (carbon-containing) material, and are mainly derived from pyrolysis, or burning, of the polymer. These decomposition products may include carbon dioxide, carbon monoxide, carbon particles, hydrocarbons, chlorine, hydrogen chloride, phosgene, and formaldehyde. This product should not be burned as construction waste.

"Use any extinguishing media suitable for the surrounding fires. Water spray, fog, carbon dioxide (CO_2), dry chemical, foam.

"Firefighters should wear full-face, self-contained breathing apparatus and impervious protective clothing. Firefighters should avoid inhaling any combustion products. Do not release chemically contaminated water into drains, soil or surface water."

Is it true then, that the combustion products of vinyl are no more hazardous than those of many other common products, including wood? What will these decomposition products and products of combustion do to an unprotected individual, or one who is protected only by firefighter's personal protective equipment (PPE)? What effect will the acidic condensation from the products of combustion have on the materials that make up firefighters' PPE?

The statement from the marketing brochure, "*UL fire-rated assemblies specify vinyl siding as a cladding option"* isn't exactly true. Report ESR-1066, issued by the ICC Evaluation Service (a subsidiary of the International Code Council) and dated March 2014, obtained from a vinyl siding manufacturer Web site, states, *"**4.6.2 Fire-Resistance-Rated Walls on Buildings of Type V Construction under the IBC** (International Building Code): The vinyl siding may be installed over code-complying, exterior, fire-resistance-rated bearing or non-bearing walls required to be of Type V*

construction under the IBC without affecting the hourly rating of the walls." The UL and other fire resistance directories have similar wording. These simply state that vinyl siding can be used on fire-resistance-rated Type V walls without affecting the wall's fire resistance rating. The vinyl siding is not part of the specification for the fire-resistive wall assembly.

UL FRSI has recently completed a series of tests that evaluated the properties of burning 28 varieties of exterior wall assemblies after ignition from the exterior. An online course describing these tests can be found at http://www.firecompanies.com/modernfirebehavior/AtticFiresOnlineCourse/story.html. At the left part of the screen, look for Module 2: Wall and Eave Experiments.

The summary of the heat release rates from some of the FSRI tests include the following:

- Eight-inch (20.3 cm) wood lap siding on plywood sheathing with fiberglass insulation: heat release rates as high as 200 kilowatts (kW).
- Four-inch (10.15 cm) vinyl siding on plywood sheathing with fiberglass insulation: heat release rates from 300kW to 500kW
- Four-inch (10.15 cm) vinyl siding on one-inch (2.54 cm) polystyrene sheathing with fiberglass insulation: heat release rates from 500kW to 1300kW.

Although vinyl siding has an auto-ignition temperature of 730^{O}F (387^{O}C), like many other materials, it can ignite at a lower temperature with flame impingement. It begins to soften and melt at even lower temperatures (photo 3), exposing the sheathing that supports it.

(3) Photo by author.

View, at minimum, Module 2 from the FSRI online course and the course introduction and form your own conclusions concerning the properties of vinyl siding under fire conditions.

National Fire Protection Association (NFPA) Codes and Standards are published by the NFPA (www.nfpa.org) and can be purchased on CD, as an online resource, or on paper. Your local Fire Prevention Bureau may allow you to use its copy for reference. Technical college and fire training school libraries often have these codes and standards available online or on paper for use by instructors and students.

The UL Fire Protection Directory is available online at http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/fireressrch.html or at www.ul.com

The Factory Mutual Approval Guide is available on-line at www.fmglobal.com or www.approvalguide.com There is no charge for its use after free registration and log-in with password.

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