Vinyl Siding: A Number of Human Health and Environmental Concerns, But At Least It's Maintenance Free, Isn't It?

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Introduction

You've seen the ads. "Maintenance-free," "virtually maintenance-free," "no hassle," "durable," "never needs painting." These are the words that helped propel vinyl siding to a leading 37 percent share of the U.S. house siding market in 2002. These words have also helped make the case that vinyl siding is a "green" building product and responsible material because it is durable, has a long life span, and doesn't require additional inputs or have the environmental impacts of maintenance. So how accurate is this description of vinyl siding? Is vinyl siding really "maintenance free"?

A recent study of the environmental and health impacts of vinyl products manufacture, use, and disposal was commissioned by the U.S. Green Buildings Council (USGBC). The authors of the final 205-page document (Altshuler et al. 2007) conclude that the health-related impacts of vinyl siding are the worst of all competing products. The same study, however, indicates that environmental impacts of vinyl siding are comparable to or better than potential substitutes. The latter conclusion is interesting since earlier comparative studies of siding products have identified vinyl as clearly among the worst alternatives from an environmental point of view. The difference between earlier studies and the USGBC effort is that maintenance was considered in the latter study, whereas previous work included only product manufacture and installation; in the USGBC study all siding products, *except for vinyl*, were assumed to require maintenance, including periodic painting. The USGBC study specifically assumed that vinyl siding is "maintenance free." Is this an accurate assumption?

An interesting exercise for an otherwise dull evening is to type into a web browser the search string "painting vinyl siding." What comes up are hundreds of pages of information on how to prepare vinyl siding for painting, cleaning products, power washing dos and don'ts, and which paint formulations to use. In addition, searching the web sites of paint manufacturers shows that all brands now include special formulations for painting vinyl siding. For at least one company, vinyl siding paint has been the fastest growing product line over the past decade.

In comparing building products that have a long track record of use with newer products, it has become common to base evaluations of the more recent product introductions on claims made in promotional literature. The problem, of course, is that promotional literature of any product almost always exaggerates positive attributes and downplays or ignores less flattering characteristics. Therefore, due diligence in independently determining attributes of recently-introduced products is essential. In this case, evidence pointing to the need for maintenance of vinyl siding is readily available and should be considered in product evaluation.

Vinyl in the U.S. Siding Market

A 45-Year History of Success

The 1964 Worlds Fair was a landmark event for New York. It was also the venue where vinyl siding was publicly exhibited for the first time. Within 10 years vinyl had grown to a 5 percent share of the U.S. siding market. The remainder of the siding market in 1973 was shared almost equally by hardboard, plywood, brick, and aluminum (about 20 percent of market share each), with small quantities of solid lumber and steel. Over the following decade, penetration of vinyl into the siding market continued, and by 1983, vinyl had increased its market share to 12 percent. Use of hardboard and plywood also grew (to 31 and 24 percent, respectively), while the use of brick and aluminum declined (to 16 and 9 percent). Steel remained a minor player in siding markets at 2.2 percent.

The period 1983-1993 was golden for vinyl siding manufacturers, partly because of well-publicized hardboard siding performance problems and also because of the low cost of vinyl. During that period, the hardboard siding market share decreased from 31 to 16 percent, while the vinyl siding share increased from 12 to 31 percent, an almost complete reversal from only 10 years earlier. Plywood accounted for only 13 percent of siding, down from 24 percent in 1983. Steel remained at 2.2 percent while aluminum regained market share to 12 percent. For the vinyl industry the only clouds on the far horizon of an otherwise clear and seemingly limitless sky were the commercial availability of a new siding product – fiber cement siding – and increasing reports of consumer discontent with the limited color choices in vinyl, a tendency to fade and chalk, and sagging and buckling on southern and western exposures due to heat-induced linear expansion.

The clouds darkened a bit in 1994 when Environmental Building News (EBN 1994) carried an article entitled “Should We Phase Out PVC?” which raised a number of environmental and health concerns linked to vinyl production and use. Nonetheless, by the end of 2000 the vinyl share of the U.S. residential siding market had grown to 36 percent, with vinyl’s market share far above the competition. Slow but steady growth of wood fiber cement continued, though the new product accounted for only 2 percent of U.S. residential siding sales by the end of the year.

By 2005, what had been a small cloud on the far horizon began to look like a developing storm. An explosion of published articles about adverse environmental and health impacts of vinyl products over the previous five years had moved vinyl to the front page and brought scrutiny from a broad spectrum of society (Ackerman 2003; Lent 2003; Steingraber 2004; Thornton 2000, 2002). Meanwhile, over a period of less than five years wood fiber cement siding had increased its share of the U.S. residential siding market more than six-fold, from 2 to 13 percent. In the same timeframe vinyl’s share of the market had begun to decline, accounting for 32 percent of the market, down from a peak of 37 percent in 2002 (Figure 1).

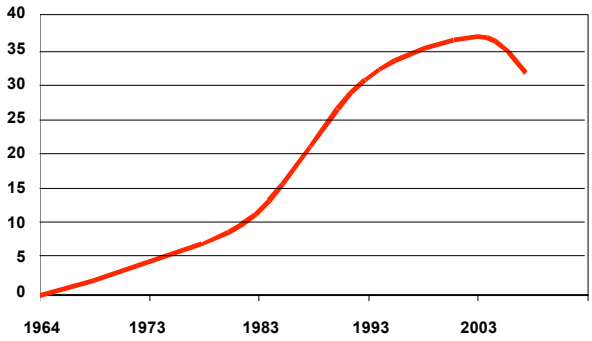
Green Building Movement Brings Questions Regarding Vinyl Products

Health Implications Deemed Serious

Health-related concerns involving vinyl products are many and include risk potential at every point in product life from manufacturing to disposal. Chemicals used or emitted in

the process of manufacturing include diethylhexyl phthalate, dioxin, lead, cadmium, ethylene dichloride, and vinyl chloride monomer. All of these chemicals are classed as hazardous or extremely hazardous to human health and to the environment in general. Health issues following manufacture relate to persistence of emissions in the environment, emissions from PVC in incineration or in building fires, and continued emissions throughout the life of the product. As noted earlier, a large number of reports have focused on vinyl and health issues over the past several decades.

Figure 1
Vinyl Siding Market Share in the United States
(percent), 1964-2005



Vinyl-related health issues regained front page status earlier this year with the late February release of the USGBC Technical and Scientific Advisory Committee Issues Report on PVC (USGBC 2007). The USGBC had referred the PVC issue to its Technical and Scientific Committee in 2002 in response to a proposal to add a LEED credit for avoidance of PVC (Holowka 2007). The report released in February used a combination of life cycle assessment and risk assessment to examine PVC in the context of potential substitutes for a number of different applications. Among four siding alternatives – vinyl (PVC), fiber cement, aluminum, and beveled cedar, vinyl was found to be worse than all alternatives for cancer risk, and tied for worse (with aluminum) with regard to combined human health impacts.

Mixed Environmental Ratings of Vinyl Siding Raise Questions

Product Manufacture to House Construction

Vinyl, a product made from petroleum and salt and a number of additives has long been known as a high embodied energy[1] material. Not surprising, therefore, were results of a recent life cycle inventory (LCI) study comparing fossil energy and global warming potential for various components of exterior walls (Lippke and Edwards 2006). That study found vinyl siding to be the most energy intensive, highest emitting material in a typical wood or steel-framed wall system. For instance, considering a wood-framed (kiln-dried 2x6) wall with ½-inch plywood sheathing, and vinyl siding to the outside, and fibreglass insulation, a 6 mil vapor barrier, and ½-inch gypsum board to the inside, the

[1] Embodied energy refers to the sum of the energy consumed in all steps of manufacture and use of a product, from raw material extraction, through transport, manufacturing, assembly, and installation. The term also sometimes encompasses maintenance cycles, product disassembly and disposal.

vinyl siding layer alone was found to account for over 35 percent of the embodied energy and global warming potential (compared to 15 percent attributed to the wood framing) (See wall section C, Figures 2 and 3).

In a wall framed in steel (with studs 1 $^{5}/_{8}$ x 3 $^{5}/_{8}$) and ½-inch plywood sheathing, expanded polystyrene, and vinyl siding to the outside, and fibreglass insulation, a 6 mil vapor barrier, and ½-inch gypsum board to the inside, vinyl accounts for 26 percent of the embodied energy and global warming potential (compared to 22 and 31 percent, respectively, for the steel framing) (See wall section B, Figures 2 and 3). In other words, vinyl is a very high impact material. Interestingly, if the vinyl siding is replaced with ½-inch plywood siding, the embodied energy in the siding is reduced about 80 percent, with that change alone reducing the total embodied energy of the wall by more than 25 percent.

Consideration of Maintenance and End of Life Disposal

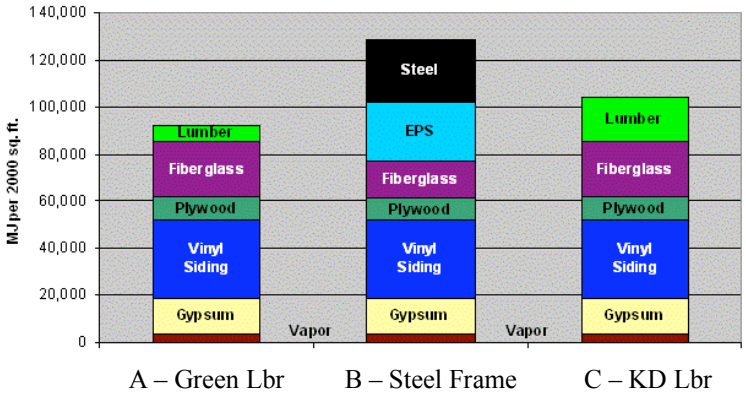
Virtually all life cycle studies of building materials to date have been limited to consideration of the portion occurring from raw material extraction through building construction. That is the case with the Lippke and Edwards study referred to previously. A relevant question then is how, if at all, do product comparisons change if periodic maintenance and disposal at the end of product life are taken into account?

In the case of siding products, the 2007 USGBC Technical and Scientific Committee Issues Report on PVC that was also referenced earlier (Altshuler et al. 2007) seemed to provide the answers. That study found aluminum siding to have the greatest environmental impact, both with and without consideration of end of life disposal issues. However, the study also found overall impacts of vinyl siding to be below those of wood. In view of the very large differences in environmental impact between vinyl and wood, with the difference favoring wood at the building construction stage, these results are surprising.

An examination of project methodology revealed an interesting assumption. Aluminum, wood, and fiber cement siding were each assumed to have a painting cycle of 6 years over a total life span of 50 years. For vinyl, in contrast, it was assumed that there would be no (zero) maintenance of any kind needed.

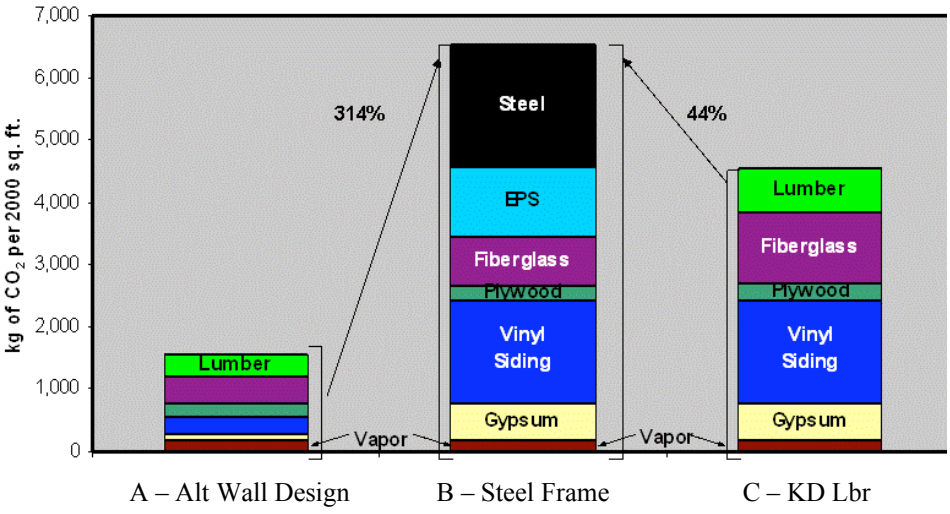
Having an awareness of the prevalence of periodic power washing of vinyl siding in the Minneapolis/St. Paul metropolitan area, and having seen painter's ladders against vinyl-sided houses on many occasions, there appears to be at least anecdotal evidence to question the assumption of "zero maintenance" for vinyl siding. As a journey through any web browser using the search strings "maintenance of vinyl siding," and "painting vinyl siding" quickly reveals, periodic vinyl siding maintenance, including painting, is a common practice. It does not appear that firm research or statistics are available regarding percentages of vinyl homes that are washed, treated, and painted annually; however, a search of websites of a number of paint manufacturers showed special formulations for vinyl siding in every brand examined. One company reported that vinyl siding paint had been their fastest growing product line over the past decade.

Figure 2
Embodied Energy per Component in Various Wall Sections Including Energy Consumed in Raw Material Extraction, Manufacturing, Transportation, and Building Construction



Source: Lippke and Edmonds 2006.

Figure 3
Global Warming Potential per Component in Various Wall Sections Including Energy Consumed in Raw Material Extraction, Manufacturing, Transportation, and Building Construction



Source: Lippke and Edmonds 2006.

Another company, a manufacturer of vinyl siding, indicates that its warranty does not apply if the owner fails to provide necessary maintenance, which is defined as periodic washing and rising.

It appears that a no maintenance assumption for vinyl siding is unrealistic. Therefore, it is likely that the environmental impacts of vinyl siding through its useful life are significantly understated in the USGBC report, Future studies of vinyl siding and building material comparisons will be improved by the completion of additional research that quantifies the maintenance requirements for vinyl siding for which there is currently strong antidotal evidence.

Comparing Real Apples with PR Apples – Diligence Needed

With an increasing rate of innovation in building materials development it is tempting to simply rely on manufacturer's claims regarding product performance. Such claims, however, are commonly overstated – never understated. Because of this, the tendency to use manufacturing claims in environmental assessment of new products must be tempered by a commitment to due diligence in seeking performance data, information regarding consumer experiences, and any other information wherever it may exist. Greater diligence would appear to be needed with maintenance claims regarding vinyl siding before writing the final chapter on product comparisons.

The Bottom Line

The health related impacts of vinyl siding production and use are substantially higher than for other commonly available siding products. Environmental impacts are likewise very high relative to alternatives when tracked through all steps from raw material extraction through installation at a construction site. Recent findings suggesting near-equal performance of vinyl siding to wood when maintenance and disposal are considered are highly suspect, particularly in view of a key, and faulty, assumption that vinyl siding is maintenance free.

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