The Environmental Impact Of Building Materials: A First Look

by

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Globalization has resulted in obvious changes in the North American brick industry – in management practices, in operating philosophy, and in renewed attention to the bottom line. Globalization has also affected public perception of environmental matters, in part, due to the continuing political influence of environmental or "green" parties in Europe.

One example of this is global warming attributed to the "greenhouse effect", i.e. the adsorption in infrared radiation by the earth and the re-radiation of energy toward space with entrapment of energy by an increasing presence of carbon dioxide and other greenhouse gases in the atmosphere. Global warming has become a preeminent issue with different groups *"marketing"* their side of the issue through the Internet. One organization promoting their views on global warming is the United Nations Framework Convention on Climate Change via www.unfccc.de. At the UNFCCC site, one can produce charts of sources of CO_2 emissions from various developed countries.

You can find just as many scientists who say global warming is a "hoax" or minor effect as you can find scientists dedicated to saving future generations from inundation by the sea. Since water vapor is an infrared absorber, it is surprising that H_2O emissions are not charted by the UNFCCC. Obviously regulators have not decided how to restrict evaporation from the oceans.

In domestic matters, a number of groups are articulating their environmental agenda. The largest such effort may be by the Environmental Protection Agency at www.epa.gov. Information on emissions from a number of brick manufacturers is available on EPA's "Envirofacts" pages at www.epa.gov/enviro/html/qmr.html. Environmental interest groups have sites such as those at www.rtk.net and www.scorecard.org. The latter site, a presentation of the Environmental Defense League, is particularly offensive to knowledgeable people because it categorically states that every emission is harmful to human health. This is in opposition to the body of human health knowledge accumulated throughout the history of the world that indicates that some chemicals are helpful in low doses while harmful in high doses (where prolonged exposure occurs). Otherwise many municipalities wouldn't fluoridate their drinking water.

If environmental interest groups are promoting their side of their agenda using the Internet, it means that they are reaching down to young people to affect eventual change in society. Industry, on the other hand, has only modestly countered these tactics with their own web sites. Just in the last two months,

utilities started advertising their own site possibly in response to the EPA lawsuit over older coal burning power plants.

European brick makers have been dealing with the potential impact of environmental emissions because of the *intrinsic energy requirements* to manufacture brick. This has resulted in "fast firing" research and some developments in kiln energy efficiency. Interest in energy efficiency has resulted in "life cycle" analysis for cladding materials for buildings. A developing British site at www.bre.co.uk offers information for different wall systems with a detailed life cycle analysis that includes mining, manufacturing, transport, construction, and disposal. It is obvious that distributing the effect of manufacturing over the life of a product like brick is advantageous due to the long life of brick buildings.

Because Europeans build durable buildings to last in excess of 100 years, products like vinyl siding and EFIS have not become significant factors in the European market. This makes the "BRE" web site of limited use for purposes in North America. A need thus exists for a similar analysis for materials used in North America.

This method of this paper considered only air pollution *as a first approximation* of the effect of manufacturing on the environment. The air pollution data used was from the U.S. EPA AP-42 compilation for each product or its major components. For example, the analysis for brick masonry included the air pollution impacts for both the brick and the mortar. In a like manner, the analysis for EFIS used data for the supporting lath, the organic component, and the cement used in this "composite" system.

The logic of the method was to add all of the major air pollutants producing a sum of pollution per unit area of cladding (lb./ft^2). This was subsequently adjusted by dividing the sum of air pollutants by the expected service life of the cladding (providing lb./ft^2/year). Finally, credit was given for the recycling potential of the material by dividing the adjusted potential emission per unit area per year of service by the fraction of recyclable material in the cladding. The minimum recyclable cladding fraction was assumed as 20%.

The results of this simplified analysis are shown in Table 1. It is obvious that materials can be placed into either of two groups from the aspect of their environmental impact:

1. *Brick, aluminum siding, and vinyl siding* all exhibit about the same environmental impact in the area of about 10^{-5} lb./ft^2/year (0.00001 lb./ft^2/year).

2. *Fiber-cement board and EFIS* both exhibit significantly higher environmental impact in the area of 10^{-3} to 10^{-2} lb./ft^2/year (0.001 to 0.01 lb./ft^2/year or 100 to 1000 times that of brick, aluminum siding, or vinyl siding).

It is obvious that the *new convenience* cladding products have a significantly higher impact of the environment than the older products. For example, fiber-cement board products have an effect some 20 times greater than that of brick masonry while EFIS has an effect some 400 times that of brick masonry.

The basic assumptions in this analysis are subject to scrutiny by manufacturers of competitive materials. For example, the assumption of a 1000-year life is an easy target. But 1000-year-old load bearing brick building built by the Romans in both Italy and Germany are in excellent condition. It is the wooden frame used in veneer construction that limits the life of the building. In addition, if the life chosen is 100 years for brick masonry, it does not affect the gap between EFIS and brick very much.

Given this information on environmental impact, is there a story to tell to the consumer in North America? The idea is that tomorrow's customer will likely be very interested in environmental impact. "Green marketing" in England has not been very successful to date, but the English are still building durable buildings. In North America, where everybody else is using the Internet to present their agenda, the story on brick should be available.

We are promoting brick based on classic beauty, strength, lasting value, energy efficiency, and low maintenance. This marketing approach is working for today's consumer. But tomorrow's consumer may be less knowledgeable and more Internet dependent. It makes sense that the brick industry should tell their story using a forum where the story can be most effective.

Global warming may be real or it may not be significant. The point is that the UNFCCC is advertising it anyway. Plastic producers and steel makers are advertising their generic materials. For brick companies wanting a robust market in North America beyond 2010 (when today's graduates are buying houses), new approaches to promotion seem to be a good investment in the future.

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Table 1: Life Cycle Analysis of Cladding Systems for Buildings

	Brick		**Vinyl**	**EFIS**	**Aluminum Siding**	**Fiber Cement Board**
	Brick	Mortar				
Weight per ft^2 of surface	29.1	6.4	1.04	0.303	0.378	2.3
Total Pollutants/ft^2						
Criteria Pollutants Lb/ton Lb/ft^2	 0.67 9.75e-3	 8.2 4.14e-3	 4.0 2.08e-3	 NA	 NA	 8.2 4.14e-3
Acid Gas HF+HCl+ NOx Lb/ton Lb/ft^2	 0.89 12.95e-3	 7.47 3.773-3	 NA	 7.63e-3	 3.0 0.567e-3	 15.72 18.08e-3
PM Stack Lb/t Lb/ft^2	 0.37 5.38e-3	 0.46 0.23e-3	 0.37 0.19e-3	 72.4e-3	 11.77 2.22e-3	 1.0 1.15e-3
Major VOC Lb/t Lb/ft^2	 0.0053 0.077e-3	 0.0187 0.009e-3	 3.184 1.656e-3	 11.3e-3	 4.7 0.889e-3	 0.028 0.032e-3
Major metals Lb/t Lb/ft^2	 0.0011 0.016e-3	 0.0429 0.022e-3	 0.0006 0.003e-3	 99.2e-3	 0.05 0.009e-3	 NA
Total Lb/ft^2	28.12e-3	8.17e-3	3.929e-3	190e-3	7.53e-3	23.40e-3
Service Life, years	1000		50	40	50	50
Total Per Yr. of Service Life						
Criteria lb/ft^2/yr	0.975e-5	0.414e-5	4.16e-5	NA	NA	8.28e-5
Acid lb/ft^2/yr	1.295e-5	0.747e-5	NA	19.08e-5	1.13e-5	36.16
PM lb/ft^2/yr	0.538e-5	0.023e-5	0.38e-5	181.0e-5	4.44e-5	2.30e-5
VOC lb/ft^2/yr	0.0077e-5	0.0009e-5	3.312e-5	28.2e-5	1.78e-5	0.06e-5
Metal lb/ft^2/yr	0.0016e-5	0.0022e-5	0.005e-5	248.5e-5	0.018e-5	NA
Recycle %	100	40	100	20	100	40
Total Per Yr. Adjusted for Recycling						
Criteria lb/ft^2/yr	0.975e-5	1.035e-5	4.16e-5	NA	NA	20.7e-5
Acid lb/ft^2/yr	1.295e-5	1.868e-5	NA	95.4e-5	1.13e-5	90.4e-5
PM lb/ft^2	0.538e-5	0.058e-5	0.38e-5	905e-5	4.44e-5	5.75e-5
VOC lb/ft^2/yr	0.0077e-5	0.0022e-5	3.312e-5	141e-5	1.78e-5	0.15e-5
Metal lb/ft^2/yr	0.0016e-5	0.0055e-5	0.005e-5	1242e-5	0.018e-5	NA
Grand Total of Pollutants; adjusted lb./ft^2/year	5.786e-5 (0.00005786)		8.157e-5 (0.00008)	2383e-5 (0.024)	7.37e-5 (0.00007)	117e-5 (0.00117)
Column/Brick	1		1.409	412	1.273	20.2

Exponential Notation: e-3=10^{-3}=0.001 and e-5=10^{-5} =0.00001