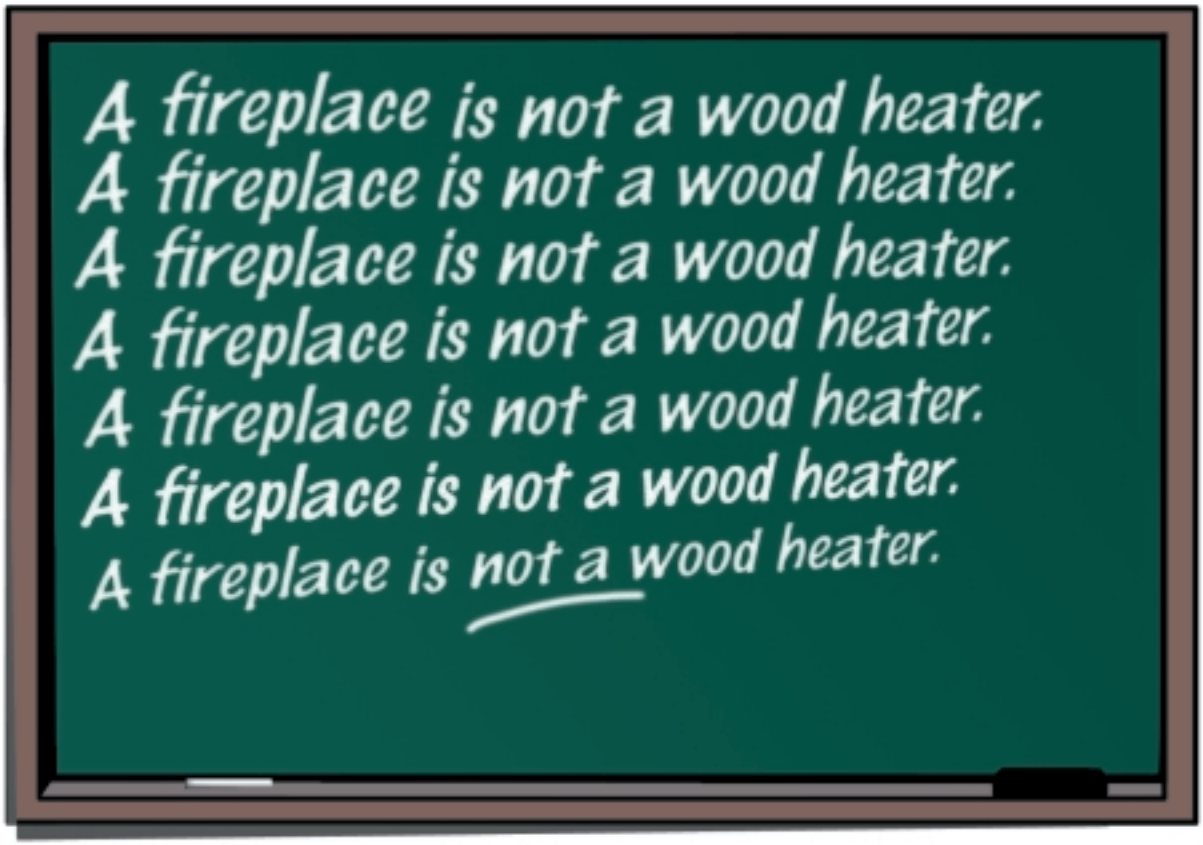
by James E. Houck, Paul Tiegs and Richard Sparwasser

It is in everyone's interest to make a low-emission fireplace. Can it be done? The answer is yes, no and maybe.



Straight Talk

Woodburning fireplaces are unquestionably very popular, almost ubiquitous, and the foundation of a large hearth products business.

• They are the most popular household amenities after two-car garages and air conditioning.

• About 65 percent of new houses have one or more wood- or gas-fired fireplaces.

• There are approximately 400,000 woodburning fireplaces installed into new houses each year in the U.S.

• There are about 30 million woodburning fireplaces in homes in the U.S. and three million in Canada.

• More than 4.4 million cords of wood and 270,000 tons of wax/sawdust firelogs are burned in them each year.

• Beyond businesses associated directly with factory-built fireplaces, site-built fireplaces and their fuels, the manufacture and sale of chimney materials and miscellaneous accessories, as well as chimney sweeping services all add significantly to the hearth products industry's coffers.

(The fact that many fireplaces contain wood stove inserts complicates the statistics of fireplaces and their fuel usage. The 30 million U.S. and three million Canadian fireplace numbers quoted above include both woodburning fireplaces with and without inserts. The four million wood cords and 270,000 wax/sawdust firelog fuel values quoted are for fuel burned only in true fireplaces without inserts. It also should be noted that surveys have shown

that about 30 to 40 percent of fireplaces are not used in any given year.)

Existing woodburning fireplace models pollute the air, their efficiency is low, and they are not considered serious wood heaters. They cannot be certified for emissions by EPA, as wood stoves are, due to their fundamental design and operating characteristics. Technically, they are little more than a hole in the wall with a vent.

While not trying to be negative, the true bottom line is that they waste fuel and pollute the air, and the only reason to have them is for aesthetics, ambiance and enjoyment, i.e., to see the flames, to hear the burning wood crackle and to feel the radiant heat.

These inherent issues have not been lost on energy policy makers, air quality regulators or most members of the hearth products industry. Restrictions on the installation of new fireplaces are already part of the picture or are being considered in a growing number of western air quality jurisdictions. The Hearth, Patio & Barbecue Association (HPBA) has developed a fireplace option document and, along with the Canadian Standards Association (CSA), recently contracted OMNI to host a workshop for industry representatives primarily to discuss these issues.

All this being said, most of us will agree there is nothing wrong and a lot right about aesthetics, ambiance and enjoyment. The point to be made is that the arguments for fireplace usage should be de-coupled from hard, cold energy efficiency levels and the concept of woodburning stoves and fireplaces being the same animals to be treated equally. Each regulator, policy maker and hearth product industry member should be forced to write on the blackboard 100 times: "A fireplace is not a wood heater."

Clearly, it is in everyone's interest to make a low-emission fireplace. Can it be done? The answer is yes, no and maybe.

The Pseudo-Fireplace

A fireplace can be made efficient and can be EPA certified to have low emissions if it is really a wood stove made to look like a fireplace. Similarly, a masonry heater, while it can't be certified, also has low emissions and can look like a fireplace. Both of these approaches raise some serious issues. The most significant is cost.

A wood stove-fireplace costs about five times more than a simple "builder's box" fireplace. A masonry heater can cost on the order of 30 to 40 times more than a simple factory-built fireplace, and perhaps five times more than a simple site-built fireplace. In addition, both a wood stove-fireplace and a masonry heater are operated differently than a true fireplace and may not give the home occupant his or her "fireplace fix."

The Low-Emission Fireplace Legend

Low emissions have been achieved with wood stoves primarily through the introduction of secondary combustion air, heat management (e.g., with insulation), small fireboxes, or through the use of catalysts. With adequate heat (i.e., temperature), secondary air causes unburned organic vapors above the fuel to be combusted by providing enough oxygen to complete the combustion process.

Secondary air, which needs to be

preheated and properly directed to be effective, is not a good candidate for fireplace emission control due to the typical box-like firebox geometry, high flue gas flow rates, and commensurate dilute emissions characteristic of fireplaces. It must be remembered that the flow rate of a fireplace is typically a few hundred cubic feet per minute, compared to the 10, 20 or 30 cubic feet per minute of a wood stove.

The higher fireplace flow rates are the result of higher fireplace burn rates and the fact that fireplaces have limited or no combustion air control, which allows lots of excess air to come along for the ride up the chimney. It is more difficult to burn off organic vapors when they are diluted in a large volume of air and, as noted, it is very difficult to properly heat and direct high volumes of secondary air to the needed locations with the box-like geometry of a fireplace firebox.

One would think that a strategy to reduce emissions might be to control air through the use of an airtight door and an air-control regulator. The problem is that, when the excess air is reduced to a point where it starts to make a difference, the air-to-fuel ratio drops below 35:1, which makes the appliance legally a wood stove and hence a wood stove-fireplace, as previously discussed. This wood stove-fireplace now has to pass EPA certification with its very low burn rate requirements.

Catalytic control also does not appear to be a good option for fireplaces due to their high flow/dilute flue gas and non-airtight design. Catalysts unavoidably cause resistance to flue gas flow (particularly to high flows), greatly increasing the potential for spillage of smoke into living areas. In addition, a catalyst, like secondary air, works best when organic vapors are concentrated, not diluted as typical of a fireplace.

Catalysts have been successfully employed in wood stove-fireplaces to control emissions because these appliances have much higher concentrations of burnable gases then do fireplaces. Catalyst emission control works better in larger fireboxes than emission control by secondary air, and larger fireboxes are, of course, desirable when the objective is to simulate fireplace ambience.

Rumors that a low-emission, true fireplace has been, or can be, made have permeated the industry. If it has been made, where is it? The authors remain skeptical.

Documented Real Mitigation Measures

There have been mitigation measures documented to reduce fireplace air emissions. They are: 1) The use of wax/sawdust firelogs as fuel, 2) Forced air grates, 3) Gas or firelog firestarters designed to reduce the impact of high emissions generated during kindling conditions, 4) Gas-fired conversion/replacement of woodburning fireplaces, and 5) Afterburners.

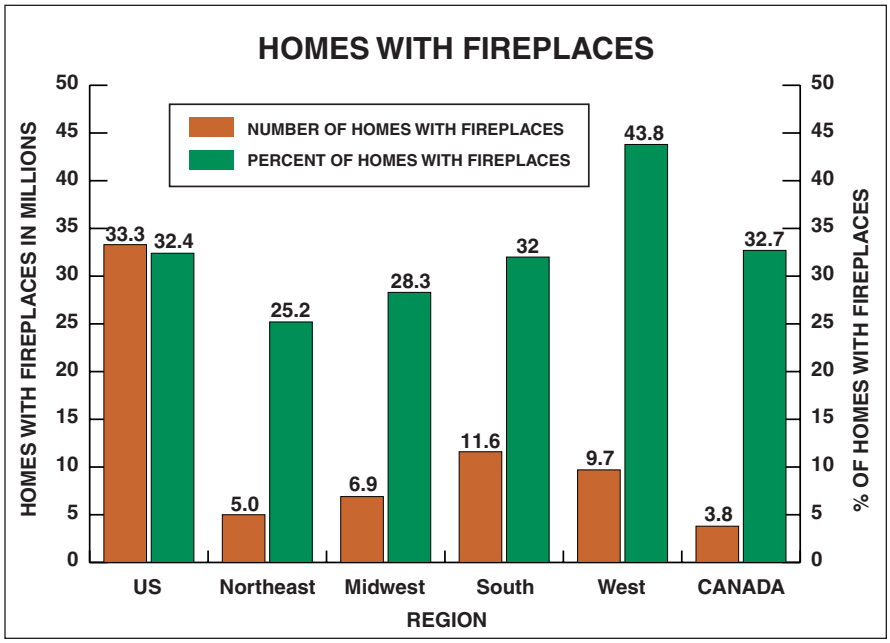
Reasonable reductions in air emissions have been documented for wax/sawdust fireplace logs, forced air grates and firestarters. However, the reductions they offer are not as dramatic as offered by natural gas (and to a lesser extent for LPG where natural gas is not available). Rightly or wrongly, because of this some regulators have

continued to feel that only gas fireplaces are acceptable.

This opinion is somewhat myopic, in that all issues associated with using a non-renewable fossil fuel (e.g., global warming and energy economy) come into play with gas-fueled fireplaces. In addition, some regulators and policy makers are nervous about the use of wax/sawdust firelogs, forced air grates and firestarters as control options because their use would be difficult to enforce.

As for afterburners, either electric or gas can work and can probably work well, but would be very expensive to purchase, install and operate. The fundamental problem with afterburner application to fireplaces is again the high volume/dilute flue gas exiting the fireplace that necessitates a very large amount of energy to make the afterburner effective.

The bottom line? There are mitigation measures that work for fireplaces, all have pros and cons associated with them but, very significantly, they do not follow the same approach that has been established for wood stoves.



Data Courtesy Duraflame, Inc. Source: Vista Marketing Research, March 1995

Test Methods, the Passing Grade and the Equivalency Fallacy

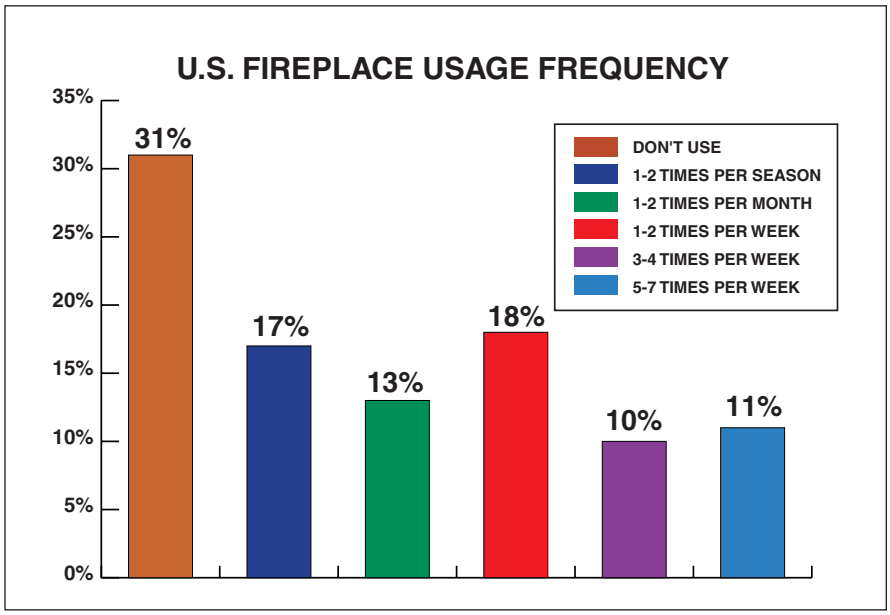
Three test methods have been developed to document particulate emissions from fireplaces. While all are technically sound, each has issues associated with it. The methods are as follows:

The Wood Heating Alliance (WHA) test method, which was prepared for

the WHA more than a decade ago. The WHA method was intentionally never officially released by the WHA nor its successor organization, the HPA (now HPBA), hence it is essentially unknown, except to some HPBA members, and it is not in consideration for use by any regulatory jurisdiction.

The Washington State method promulgated by the State of Washington in 1995. OMNI has submitted 36 tests for fireplaces to the State of Washington for certification. A major criticism has been that the "passing grade" is too lenient and none of the fireplaces tested have failed. For this reason other jurisdictions have viewed it with caution. Rumors have it that an aggressive and nervous industry lobby was in part responsible for the lenient passing grade and may have been too successful for its own good. (For the record, there have been failures, but for obvious reasons they have not been publicized.)

The Northern Sonoma County (NSC) test method. This method is similar to the Washington State method with improvements incorporated into it based on experience with the Washington method. The NSC test method was assessed by OMNI three years ago in a project funded by the Northern Sonoma County Air Quality Management District (NSCAQMD), the Bay Area Air Quality Management District (BAAQMD), and several hearth industry members. The method is still under review by the NSCAQMD. The key concern with the NSC method is that the NSCAQMD is a small local jurisdiction and, even after the method is adopted by



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it, there is no guarantee that method will become widely accepted. In addition, since the method has not yet been officially promulgated, there is no passing grade associated with it.

The bottom line? There are sound test methods, with lots of backup data, for testing fireplaces. The problems are more political. There seems to be little motivation, resources or interest among public agencies to become a leader in establishing a fireplace test method with its attendant passing grade. To date, only the State of Washington and NSCAQMD have been actively involved, and even their involvement has been limited due to internal staff and budget restrictions, as well as other more pressing air quality issues facing them. Similarly, there has not been a concerted effort by the HPBA to formalize/accredit/publicize a fireplace test method that could be adopted with relative ease by regulatory agencies.

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The development of a credible "passing grade" or standard is pivotal. A standard that is technology forcing is needed for public agency acceptance. Documentation of the emission levels characteristic of a clean fireplace versus a dirty one is also needed. This is very fundamental; all fireplaces cannot pass nor can all fireplaces fail, otherwise the testing exercise is worthless. Only the best should be allowed to pass. The key question is what emission level defines the best.

One shortcoming that applies to all three test methods should be noted. None currently have the flexibility to fully evaluate the emission reductions offered by such post-manufacture options as the use of wax/sawdust firelogs, forced air grates or firestarters. The methods could and should be modified to handle these scenarios rigorously.

Finally, the record needs to be set straight on the concept of wood stove equivalency. It makes absolutely no sense. It is an apples and oranges comparison. It defies logic on so many levels that it is difficult to explain.

For example, the 7.5 grams/hr EPA standard for non-catalytic wood stoves is based on a weighted calculation of emissions measured from a number of burn rates, most of which are impossibly low for fireplaces. Even if a fireplace burns wood as cleanly as a wood stove, i.e, the grams of particles per kilogram of dry fuel burned (g/kg) is the same, if the fireplace burns wood four times faster than the wood stove (which is about typical), the fireplace emissions rate (gram particles per hour -g/hr) will be four times higher.

Further, EPA Method 28, which details the operation of the woodburning appliance during certification testing, was designed for the operation of a wood stove, not a fireplace. A fireplace physically cannot be operated as specified in Method 28. For example, OMNI recently evaluated loading a small 36-inch fireplace with fuel as specified by Method 28. The fuel load weighed an unrealistic 42 pounds. Similarly, the sampling methods (Methods 5G and 5H) used for wood stove certification cannot, without modification, be used for fireplaces.

When a report or publication notes that Method 5G or 5H was used to determine emissions from a fireplace, it is a misnomer. The sampling equipment associated with the methods, as well as the calculation procedures, can be modified for use with a fireplace, but the 5G and

5H methods as written in the Code of Federal Regulations (40 CFR, Part 60) for wood heater certification cannot be strictly followed due to the high and dilute fireplace flows.

Even the term "5H equivalent" that has been associated with testing reports and is used in emission factor compilations (e.g., EPA's AP-42) is a paper correlation and is used in an attempt to convert data from different studies to a common basis for making comparisons. A true Method 5H value for a fireplace is impossible.

Prudence might suggest that a well-established test protocol, a rational, well-documented passing standard, and the development of lower emission fireplace models (if possible) by manufacturers are important to the industry in the long run.

The Future

With all the concern and technical discussions that have gone on for over a decade, what does the future hold for fireplaces? The authors' conclusion is anticlimactic: Most likely there will be little change in total numbers installed in the near future.

While it is true that some western air quality jurisdictions have or are considering restrictions on new woodburning fireplace installations, the total population in those jurisdictions represents only a small fraction of the total combined populations of the U.S. and Canada, and gas-burning units can be installed there anyhow.

Furthermore, even though it is assumed that other jurisdictions will follow suit, there appears to be no "bandwagon" to do it yet. Perhaps the wise business strategy for the fireplace industry is to simply do nothing in the near term and wait it out.

On the other hand, while the population in the jurisdictions with woodburning fireplace controls is currently small as compared to national levels, it is still large and represents a lot of business potential, particularly to fuel suppliers, the manufacturers of retrofit devices and chimney sweeps. Further, the slow but steady implementation of policy to comply with the national PM2.5 air quality standard, and increasing concern over air toxics such as dioxin in the Bay Area of California and benzo(a)pyrene in the Great Lakes region will continue to put pressure on woodburning.

Prudence might suggest that a well-established test protocol, a rational, well-documented passing standard, and the development of lower emission fireplace models (if possible) by manufacturers are important to the industry in the long run. Certainly having lower emission models of some kind, whether they are true fireplaces or not, available as options may be a wise business strategy, considering that environmentally influenced consumer purchase decisions of products and energy are on the rise.

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