Section 1 - Masonry Heating

The Birth of the Masonry Stove

From the tenth century onward, homes throughout Europe were predominantly heated with wood. Wood was also in widespread demand as a building material during this era.

By the 15th century, wood shortages had begun to develop and European governments of the day realized an energy crisis was upon them. In the following two hundred years, efforts were made to conserve wood, with little success. However, as the energy crisis worsened into the 17th and 18th centuries, kings in Prussia, Sweden, Norway & Denmark ordered their craftsman and architects to produce better wood stove designs. This concerted effort produced radically new heat-storing masonry stove designs, which showed enormous improvement in efficiency and corresponding wood conservation.

Many of these designs survived and are still in use today in countries such as Sweden, Austria, Finland and Germany. Temp-Cast fireplaces closely follow original Scandinavian designs, which were later refined and used extensively in Finland.

Masonry stoves are still in widespread use throughout northern Europe and are highly regarded for their excellent heating abilities, safety features and environmentally positive aspects.

Notably, the Finnish government encourages the use of masonry heaters through tax incentives, to reduce the use of natural gas, oil and electricity. The result is that 90% of the new homes built each year in Finland are heated with a masonry stove.

An equally long tradition of masonry heating has evolved in Germany, Austria and Switzerland, with the "kachelofen" or tile stove as the predominant style. These heaters are so highly prized that German stove masons custom build thousands of masonry heaters each year, even though customers must often wait a year or more.

In North America, our heating traditions unfolded differently, where an abundance of fossil fuels led to their widespread use in heating. As a result, gas, oil and electricity still have the lions share of the residential heating market and thousands of marketing people spend millions of dollars to keep it that way.

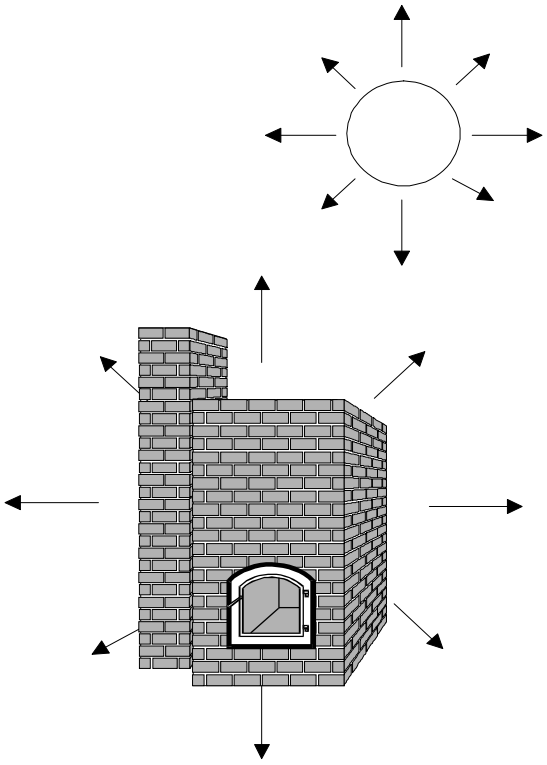
During the North American energy crisis of the '70s, many people turned to metal stoves to cut their heating bills. Environmental and economic concerns of the last decade have forced a critical look at better wood-heating devices.

Radiant Thermal Mass Heating

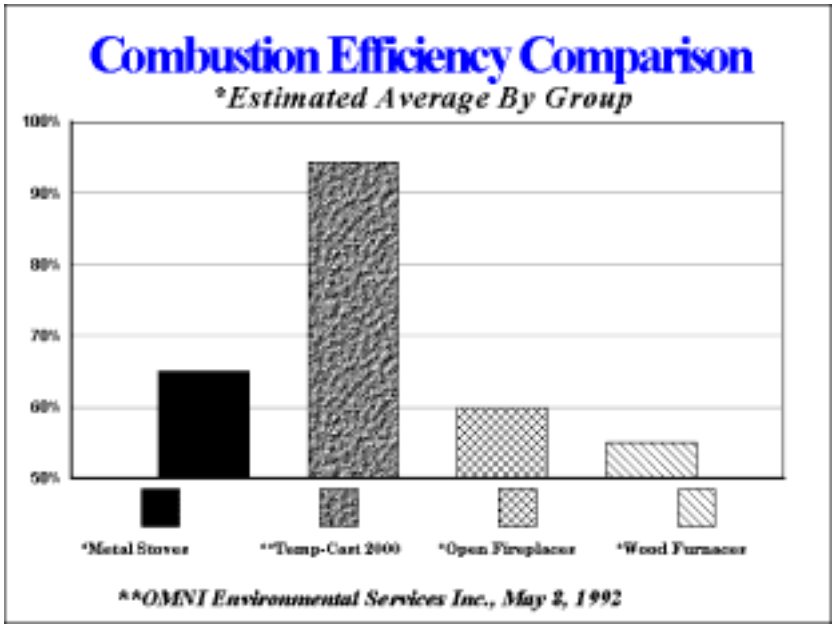
Masonry heaters work by radiating the energy stored in their masonry mass. Heaters like the Temp-Cast 2000 are simply heat storage banks. A short, hot fire heats the masonry mass, which stores and radiates it back to the space slowly and evenly for many hours. This creates a very gentle heater, with almost imperceptible warmth.

Radiant heat from a masonry heater is very similar to the radiant heat from the sun. Just as the sun warms the earth, the masonry stove heats by warming solid objects in the home, such as walls, floors, furniture and people.

And like a miniature sun in the centre of your home, this radiant energy from the heater does not directly heat the air that it travels through, which has some important health benefits, detailed in Section 2.



From the first time the fireplace is fired, the heating cycle is very even, only slightly cooler in the morning than in the previous evening. This is quite unlike traditional wood heating systems, which create a very hot space around them, cool considerably during the night and then super-heat the area when re-loaded in the morning. In addition, radiant masonry heating produces an "all over" warmth, as the solid objects in the area are warmed and then re-radiate the warmth to you.



Combustion and Heating Efficiency

The *combustion efficiency* of a heater measures its ability to burn a given fuel completely and without pollutants, thereby producing heat energy.

When a piece of wood is burned, about 30% of the heat generated is supplied by the solids in the wood and 70% is contained in the gases released as the wood is heated. If the gases are not fully burned, they escape as wasted heat and smoke (air pollution) and often condense on a cold chimney as creosote. Many of these gases do not burn until temperatures reach 1100 degrees F. (593 deg.C)

The requirements for good combustion are a design that allows the firebox temperatures to build sufficiently, and ample oxygen in a turbulent environment.

Heating efficiency shows how rapidly the heat produced by the fire is transferred to the room. It does not, however, measure how comfortable the room will be, only how quickly the heat is delivered. ***A combination of high combustion efficiency and moderate heat transfer efficiency is the ideal in any wood burner.***

Metal stoves and wood furnaces typically have relatively lower combustion efficiencies and relatively higher heat transfer efficiencies than masonry heaters. Metal transmits heat very well, in fact within minutes of the fire being lit. Similarly, the wood furnace heats the air instantly and immediately distributes this hot air to the home. This makes for a very responsive heater, which is able to throw heat into a space very quickly. However, this fast response comes with two critical drawbacks.

Firstly, it becomes very difficult to regulate the heat output so that it is comfortable.

If the heat output (heat transfer) is controlled by restricting the air supply, combustion efficiency drops off drastically, causing a smoky fire, huge amounts of air pollution and probably creosote deposits. If the air supply is not restricted, combustion efficiency improves but the room becomes too hot and dry, which also has an adverse effect on the health of the occupants. This clearly demonstrates that high heat transfer efficiency is not necessarily a desirable quality of a wood heater.

Secondly, combustion efficiencies of metal stoves and furnaces are comparatively low, because the heat is given off too quickly and the temperature of the fire cannot build to the point where the gases are fully burned. Most metal stoves and furnaces cannot be burned safely over 900 degrees F. (482 deg. C) because the metal becomes

too hot and the unit is severely "overfired". They are usually not comfortable to be around when burned at over 400 degrees F. (204 deg. C), due to their high heat transfer efficiency.

Contrast this with masonry heaters, with thick masonry walls, which are slow to release their heat and therefore have *moderate* heat transfer efficiency.

This moderate heat transfer makes the masonry heater cherished for its gentle heating nature. Moderate heat transfer also allows the firebox temperatures to reach 1500 degrees F. (815 deg. C) or higher, creating very high combustion efficiency, while the exterior is still only warm to the touch.

Recent testing in Finland shows that masonry heaters typically attain combustion efficiencies of 88 to 91%. The Temp-Cast 2000 fireplace was tested by an independent lab in April 1992, showing combustion efficiency of 94.4%, and heat transfer efficiency of 65.4%. *(Ref. Omni Environmental Services Inc., "In-Home Evaluation of Emissions from a Temp-Cast 2000 Masonry Heater", May 8, 1992)*

When the principles involved are carefully studied, it becomes clear that ***maximum*** heat storage and ***moderate*** heat transfer produces the optimum in clean burning and gentle heating performance.

Heating Performance

Masonry heaters can serve as the primary heater in a modern home of 1500 to 2000 sq. ft (140 to 185 m^2), particularly when located in the middle of an open plan living space.

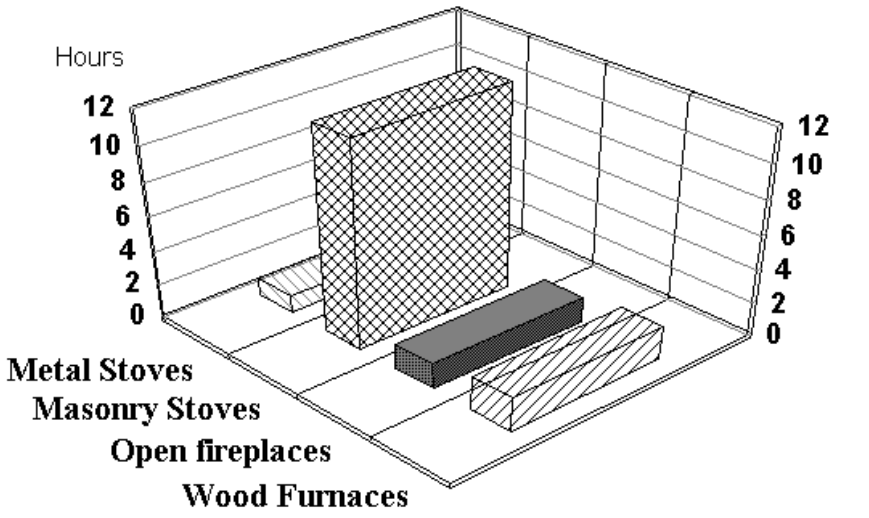
On each firing of 50 lbs (22kg) of wood, a Temp-Cast 2000 fireplace can deliver up to 250,000 BTUs (73.2kw) of radiant heat. Total heat output is controlled by the *amount* of fuel burned, while the rate at which heat is delivered remains relatively constant.

Some exceptions to these guidelines are noteworthy. Thermal mass construction, such as log homes, earth-sheltered homes, sod homes, and even straw-wall homes are perfectly suited to radiant masonry heaters. The structural mass retains a large portion of the heat from the fireplace and radiates it back to the occupants, allowing it to heat more area, or to be burned less often.

By comparison, forced air systems must have a substantially higher BTU rating to heat the same space, due to the "wind chill" effect of moving air.

Solar Compatibility

Masonry heaters are also the ideal complement to passive solar heating, because their energy storage principles are similar. The masonry stove mass can also add to the heat storage total of the building. Both are non-polluting, energy efficient and economical heat systems.



Backup Heating

We suggest that you provide back-up heating for your Temp-Cast fireplace if it used as your primary heater. For those periods when your home is unattended for 3 or more days, a suitable back-up heating system should be considered.

Towards More Independence

Alternate fuels such as solar and wood have always held an appeal for some people, who want to retain a small measure of independence from the gas and electrical utilities and the international oil conglomerates. Peace of mind and satisfaction comes from knowing that you can heat your home with wood, largely unaffected by the boardroom decisions of the giants which control the supply and prices of conventional energy sources.

With escalating costs and uncertain reserves of oil, gas and electricity, this independence has increasing economic and practical benefits for a larger segment of the population as well.

"I am not prejudiced against electricity, but power in my area fails several times each winter. If I were dependent on it for fresh air or heat, I would be out of luck, sometimes for days. To me, one of the main reasons to have solar heat or wood heat is that it lets me, in some small way, function more independently. Then when the power failure occurs, I can still cope. The water arrives by gravity feed. The heat comes from sun and wood. I have no problem with indoor pollution because the fire, that engine of air movement, dries the place out a bit, and keeps fresh air moving. My goal is to use a modest amount of wood each winter - say one to three cords, an amount I could cut with a chain saw if necessary - and let the house breathe. I might have insulated so that a candle and three cats kept the place warm. But I am glad to have a fire, and to know that it is winter. Ideally, I believe the right way to heat such a dwelling is with the sun plus a masonry stove: safe, efficient, attractive, comfortable to live with, and not terribly demanding to operate." (Ref. David Lyle, The Book of Masonry Stoves)