WOOD HEATING MISCELLANY
– Ceramic stoves, two measures of 'efficiency', and wood heating in SAP

Ceramic stoves

When I wrote about log burners for the July edition of the magazine, I thought that ceramic stoves were too exotic to mention, that they came from another time and another place, irrelevant to a modern house in the UK. So they didn't get a mention. However, I went on a tour of eco-renovations at the recent AECB conference, and a ceramic stove was due to be installed in one of the renovations. That prompted a re-think on my part. A ceramic stove acts as a heat store, giving out its heat slowly over a long time (typically a day). The low heat output makes it very suitable for an ultra insulated home.

A ceramic stove also suits modern living in that it requires less attention than a conventional wood stove. And for people who think a lounge is not complete without some sort of fireplace as a focus – well, a ceramic stove certainly fulfils that function. Ceramic stoves are big!

So what are ceramic stoves?

Typically, they are about two metres high, have a diameter of about 80 cm, and weigh about a tonne. They are built in situ from masonry or refractory concrete components, and they are usually faced with tiles. The firebox is at the bottom, and within the upper section of the stove are flues which heat up the considerable mass of the stove. The stored heat is slowly released to the room.

They are not a new idea.

Osier untiled, octagonal ceramic stove

In the nineteenth century, an American writer, Samuel Clemens, while travelling in Europe came across a ceramic stove, and under the nom de plume, Mark Twain, he wrote:

> *"At half-past seven on a cold morning the servant brings a small basketful of slender pine sticks and puts half of these in, lights them with a match and closes the door. They burn out in ten or twelve minutes. He then puts in the rest and locks the door. The work is done. All day long and until past midnight all parts of the room will be delightfully warm and comfortable ... The stove's surface is not hot; you can put your hand on it anywhere and not get burnt."*

Ceramic stoves have evolved out of masonry stoves that date back to Roman times. Present designs owe much to two Swedish barons who were commissioned by the King of Sweden in 1767 to improve the design of stoves. The result was the Swedish 'kakkelovn' (tiled oven).

Features of a Swedish kakkelovn:

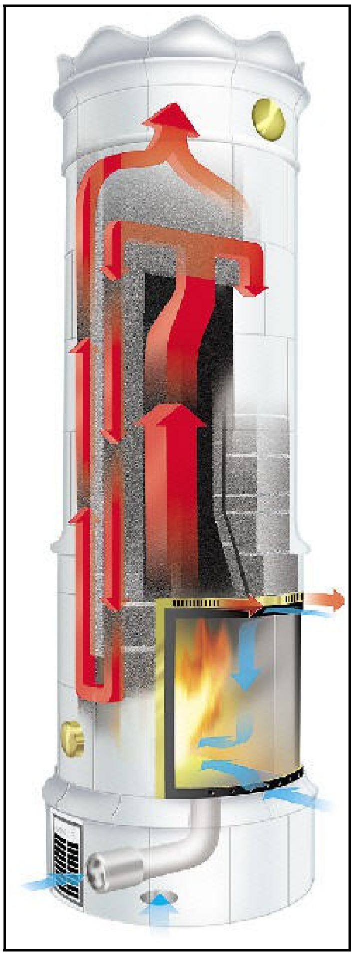
- *A firebox of masonry (or refractory concrete)*

  A masonry firebox (or nowadays, refractory concrete) allows the fire to be very hot, over 1,000ºC – much hotter than is possible in an iron stove. (At these temperatures iron would be white hot and close to melting.) Efficiency is improved, and emissions are cleaner.

- *Multiple flues inside the stove*

  The flue from the firebox rises through the upper section of the stove. Near the top it splits to the left and right and these two flues pass downwards, back towards the firebox. At the bottom, the direction of each flue is reversed 180º in a turning chamber, and the flues pass back up again.

  At the top, the two flues join together to form a single flue passing into the chimney. So there are five vertical lengths of flue in the upper section of the stove. Nearly all the heat in the flue gases is absorbed into the body of the stove, and the gases entering the chimney are relatively cool – below 200ºC.



Official tests in Sweden have shown that the stoves have an efficiency of about 90% – presumably the 'net' efficiency (see below). In the USA, where the stoves are called 'masonry heaters', they don't need certification from the Environmental Protection Agency. But in smokeless zones in the UK, they do need exemption, as do other wood burners. (See Further Info for the few exempted ceramic stoves – most have not been tested.)

Construction

A ceramic stove is built in situ, usually from a kit. The firebox and flues are fixed in place with a clay/sand mortar. The outside is generally clad with tiles, though in North America brickwork is popular. The air supply is best taken through a pipe from the outside.

In Sweden, ceramic stoves more than a century old have been taken apart and rebuilt in new homes – the clay/sand mortar can be softened with water.

Usage

The fire is lit and allowed to burn fiercely for an hour or two. (The fire is always burnt 'flat out'.) The high thermal mass of the stove absorbs the heat, and then it gradually gives out the heat to the room over many hours.

After the fire has gone out, a damper plate is used to check the air flow through the stove – an airflow would cool the stove down, wasting heat up the chimney. In

Scandinavia, the damper plate completely stops the airflow. In the UK, the building regulations unfortunately require that the flow is only partially blocked. (I suspect that the Scandinavians are even more safety conscious than the British. If they consider themselves safe with a totally blocked flue, is it not time for our regulations to be updated?)

Last words on efficiency

In the July edition of the magazine I wrote about the muddle concerning the way that the efficiency of wood burners is measured.

There are two different measures in use:

- 'Net' efficiency
  – based on the net calorific value of wood. This measure is used in European standards.

- 'Gross' efficiency
  – based on the gross calorific value, which includes the heat that is released when steam in the exhaust gases condenses to water. This measure is used for the building regulations.

It's easy to show the relationship between 'net' and 'gross' efficiency. Using the figures supplied by Gastec for the July article, we have:

Net Calorific Value of wood = 14.8 MJ/kg (approx).
Gross Calorific Value of wood = 15.8 MJ/kg (approx).

Heat is a form or energy, and I prefer to express the figures using kiloWatt.hours rather than MegaJoules.
Using the conversion 1 MJ = 0.278 kWh:

Net Calorific Value of wood = 4.11 kWh/kg.
Gross Calorific Value of wood = 4.39 kWh/kg.

Imagine that in burning 1 kg of wood in some particular stove, we obtain, say, 3 kWh of heat. For that stove we would have:

'Net' efficiency = (3 ÷ 4.11) x 100
= 72%.

'Gross' efficiency = (3 ÷ 4.39) x 100
= 68%.

There is a simple way to convert from 'net' to 'gross' efficiency:

'Gross' efficiency = 0.936 x 'net' efficiency
(where 0.936 = 4.11 / 4.39).

Recently the draft specification for SAP2009 was published, to replace SAP2005. For the first time, SAP gives a factor to convert from 'net' to 'gross' efficiency: 0.91 for logs, chips and pellets. (There is a small discrepancy between the two figures, our 0.936 and SAP's 0.91. Presumably, the SAP figure is based on different figures for the gross and net calorific values – which for a substance like wood must be somewhat variable.)

A couple of months ago I mentioned a German-made stove, the Xeoos Twinfire. ('Xeoos' alludes to the Greek god whose name we spell as 'Zeus'). An amazing efficiency is claimed for the Twinfire: 93%. But what sort of 'efficiency' is this? The HETAS list gives the stove a 'gross' efficiency of 76%. Using the SAP2009 conversion factor would give it a 'net' efficiency of 83.5% (76 / 0.91) – excellent, but well down from the 93% claim! The importers, Anglia Fireplaces, tell me that the 93% figure is the efficiency measured under a German DIN standard. This adds to the muddle in the measuring of the 'efficiency' of wood burners – a muddle which reflects disagreements at a theoretical level amongst the Standards bodies in Europe.

SAP and wood heating

When the Standard Assessment Procedure (SAP) is applied to the design of a new house, the calculations yield the Dwelling Emissions Rate (DER) and the Target Emissions Rate (TER) – in kilograms of carbon dioxide per year per unit floor area. The building regulations require that the DER is less than the TER.

Wood heating is nearly carbon neutral, so using woodfuel is a simple way of reducing the DER of a house – it can make it possible for a not-so-well-insulated house to reach the emissions target. (But the house cannot be too poorly insulated as there are limits on the U values of the roof, walls, floors and windows.)

However, wood is not completely carbon neutral – usually fossil fuels are used for processing and transporting it. Unlike SAP2005, the draft version of SAP2009 gives different emission figures for the three wood fuels:

	Kg of CO_2 per kWh
Chips	0.015
Logs	0.018
Pellets	0.037
For comparison:	
Mains gas	0.206
Oil	0.284
Mains electricity	0.591

Emission figures for heating fuels

Because of the greater processing in their production, pellets are associated with more carbon emissions than logs or chips. But all three wood fuels result in much lower emissions than fossil fuels or mains electricity.

FURTHER INFO:

Ceramic Stove Company
Swedish stoves cost about £9,000 installed, and some untiled stoves about half of that.
www.ceramicstove.com.

Feature Stoves
www.featurestoves.co.uk.

Ceramic stoves for smokeless zones:
Osier, Cronspisen, Jansen Design.
– email from 'UK Smoke Control Areas'.

Masonry Heater Association of North America
www.mha-net.org.

Biomass Energy Centre
New database of woodfuel suppliers.
www.biomassenergycentre.org.uk.

Ecofan
Ingenious heat-powered fan that stands on a conventional wood stove. It blows heat from the stove around the room.
www.ecofan.co.uk.

Words: 1608.