

Chimney filters can save billions



Photo: Torben Skøtt/BioPress

According to a recent survey carried out by the National Environmental Research Institute of Denmark and the Danish Environmental Protection Agency, chimney filters are able to remove 96% of all particles stemming from wood firing. This solution would cost the consumers a total of DKK 4.5 billion; however, our society would save more than DKK 16 billion by reducing particle pollution significantly.

By Torben Skøtt

Just a few years ago, research into air pollution was mainly about traffic issues, but ever since a survey on air quality in a residential area close to Roskilde was published by the National Environmental Research Institute of Denmark in 2004, the interest in pollution stemming from wood firing has increased considerably. The survey, carried out in an area, where half of the households were using a wood-burning stove or a wood-fired boiler, showed that the level of particle pollution was similar to that of one of the busiest roads at rush hour; H. C. Andersens Boulevard in central Copenhagen.

Later, the National Environmental Research Institute of Denmark pub-

lished a series of reports and articles on this topic, concluding, amongst other things, that around half of the particle pollution in Denmark can be assigned to the use of wood firing.

The wood fuels cannot be blamed for this problem; the big sinners are the individual installations, in particular older boilers and wood-burning stoves, causing problems and creating a bad image for the idea behind wood firing.

It is not completely clear just how dangerous the smoke particles stemming from wood-firing stoves are, but based on quite an extensive knowledge on health risks related to particles stemming from traffic, there is no reason to

believe that particles from wood-firing stoves are less dangerous than traffic particles.

Apart from particles, certain contents of dioxin and PAH are found in wood smoke. Both substances are carcinogenic and emerge, amongst other reasons, from incomplete incineration and burning of waste that contains chlorine combinations.

Solutions

Recently, the Danish Environmental Protection Agency completed a large project involving an overview of the problems as well as some of the technical solutions needed in order to reduce pollution to an acceptable level. At the same time, a new declaration on wood-firing stoves is in the making and DKK 10 million have been earmarked for the years 2008 and 2009 to be used for testing a range of technologies believed to be able to reduce pollution stemming from wood-firing stoves and boilers. Wood firing pollution is caused by a complicated interaction between a variety of factors such as fuel, firing technique, the individual stove or boiler, the chimney, as well as the location of the chimney in relation to its surroundings. Consumers are able to do quite a lot to reduce pollution by using their wood firing equipment sensibly and by following the advice published, amongst other places, at www.fyrfornuftigt.dk.



Photo: Torben Skøtt/BioPress

The masonry stove is a low-tech but effective method of reducing particle emission.

Just applying a better firing technique will not do the job, though. In order to create a significant reduction of particle emission deriving from wood firing, we need to improve the stoves and boilers. As many solutions still only exist on the drawing board or as prototypes, this is yet another obvious task for researchers and developers alike.

Chimney filters

Norway is one of the countries at the forefront of developments within the area of electrostatic filters that are fitted onto chimney tops. According to the National Environmental Research Institute of Denmark, if all wood firing installations in Denmark were fitted with such filters, the particle emission level would be reduced by no less than 96%.

The price of a filter for a household is expected to be around DKK 4,000 - 5,000. Furthermore, the filter will require a bit of electricity and cause a certain level of expenses for installation and maintenance. During a period of ten years, each household will face a total cost of around DKK 10,000.

Previously, the Danish Institute of Agricultural Sciences have carried out trials involving electrostatic filters for straw and wood chip-fired plants within the agricultural industry. These trials showed that such filters are able to reduce particle emission by 97% - 99% and furthermore, they are able to retain those alkali metals released during straw burning procedures. The price of such a filter is expected to be around DKK 60,000.



Photo: Torben Skott/BioPress

Installing an automatic stoker for wood pellets is one of the cheapest methods of reducing particle emission.

	Reduction TSP/GJ	Investment DKK	Cost DKK/kg TSP
Masonry stove	900	35,000	78.41
Modern stove	460	12,000	52.17
Wood pellets stove	1,040	20,000	51.70
Electrostatic filter	1,045	10,000	38.59
Afterburner in an old stove	770	2,000	20.78
New wood boiler with storage tank	1,850	60,000	10.81
New wood pellets boiler	1,965	50,000	8.48
Wood pellets burner fitted	1,900	20,000	4.68

Table 2. Shows the reduction potential of various technologies in relation to a reference scenario. Furthermore, the expected price for each investment, as well as the cost in comparison to the potential particle emission (TSP) reduction, is included. Source: "Wood-burning stoves and small boilers - particle emission and reduction initiatives", the Danish Environmental Protection Agency, 2007.

Afterburner

Another way of reducing particles, released from older stoves, is to establish a type of extra fire chamber within the stove, in which the gasses are burned by means of adding pre-heated air from the fire chamber.

Several foreign producers offer afterburning technologies, but it is still unsure whether or not these technologies would fit to Danish stoves. Additionally, the cost difference between applying afterburning technologies and investing in a new stove is still to be defined.

One unit, developed at Norway's University of Technology and Science, has been tested in cooperation with the municipality of Trondheim, Norway, by installing 100 units into old stoves and open fireplaces. The participating families reported a higher heat utilisation efficiency, a better chimney draught, as well as less soot and ashes.

The Danish Environmental Protection Agency is hoping to be able to carry out a range of field experiments during the heating season 2008/2009, using different types of filters and afterburners. The agency does highlight the fact, however, that none of the technologies available today can be considered complete.

The simple solutions

Finally, a variety of simple and tested solutions are available, which would be able to reduce particle emission considerably. It is well-known that wood pellets create a much lower emission than

firewood and that particle emission from a masonry stove is significantly lower than that of a wood-burning stove (see table 2).

In its most recent project, the Danish Environmental Protection Agency analysed three scenarios, each reducing particle emission levels by means of different initiatives (table 3); one scenario involving a declaration listing certain requirements with regards to particle emission and two scenarios involving the fitting of filters on all or a demarcated part of the chimneys, respectively. All three scenarios lead to a socio-economic profit; however, the scenario involving filters on all chimneys is clearly the economically best option, featuring a socio-economic profit of almost DKK 12 billion.

The report "Wood-burning stoves and small boilers - particle emission and reduction initiatives" can be downloaded at www.mst.dk. ■

Scenario	Cost	Net saving
Declaration	384 mio.	2,989 mio.
Partial filters	1,364 mio.	6,399 mio.
100 % filters	4,538 mio.	11,857 mio.

Table 3. Costs (covered by the consumers) and net savings induced by each of the three scenarios. Source: "Wood-burning stoves and small boilers - particle emission and reduction initiatives", the Danish Environmental Research Institute, 2007.