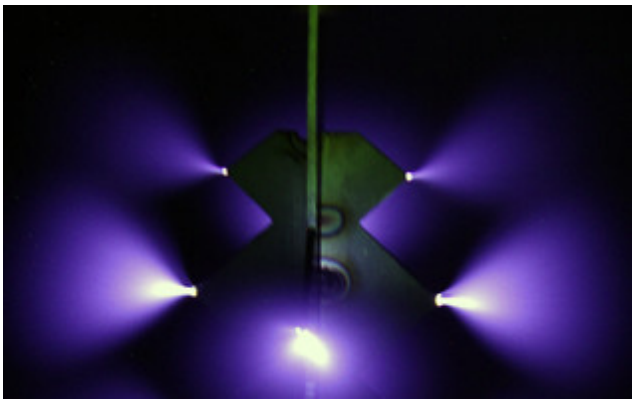

Corona deployed on the discharge electrode
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Biomass heating 25.10.2018

Electrostatic precipitator reduces emissions

Boilers powered by biogenic fuels emit more particulate matter than oil and gas boilers. In order to safely undercut the stricter limit values in all operating states, which have been in place since the beginning of 2015, researchers and plant manufacturers are working together to achieve the emission-reduced operation of biomass heating systems by means of secondary emission reduction measures.

EFC203 electrostatic precipitator system with small precipitator box
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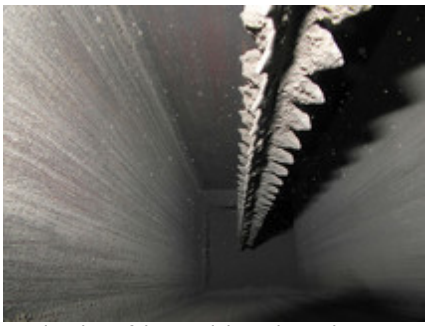
For this purpose, researchers from IZES gGmbH (Institute for Future Energy and Material Flow Systems) and the Hoval boiler manufacturer have developed an electrostatic precipitator for smaller biomass boilers. This new precipitator is also suitable for retrofitting existing biomass boilers and can be specially adapted to the requirements of the systems.

The simple and robust system is suitable for different boiler types. Depending on the system, the precipitator system can be integrated into the biomass boiler or, by means of a specially developed precipitator box, mounted directly on the boiler body, irrespective of the manufacturer and boiler type.



Interior view of the precipitator box: The deposited particulate matter can be seen at the electrodes.
© IZES

The new electrostatic precipitator is the result of the “IntEleKt – integrated electrostatic precipitator in small-scale production testing” project, which started in 2015. The precipitator system was tested in extensive field trials with a total of 16 boiler configurations. The developers used woodchip-, pellet-, energy grain- and log-fired boilers for the investigations, with nominal heat outputs of up to 160 kWth. They tested the electrostatic precipitator on plants from different boiler manufacturers for about 20,000 operating hours. The system, which can be used for every type of boiler, can now be further developed with other partners until it is granted approval.

The electrostatic precipitator system

The modularly constructed electrostatic precipitator works with high voltages. It consists of the precipitator system and the high-voltage control and regulation unit.

Electrostatic precipitators work according to the physical principle of electrostatic field charging. This enables solid, liquid and gaseous components to be ionised and deposited, whereby deposition rates of up to 99% can be achieved. It can be used for cleaning product or exhaust gases from technical processes, in particular combustion processes. The electro-physical processes in an electrostatic precipitator can essentially be subdivided into four sub-processes: gas discharge or corona formation, particle ionisation, particle transport and particle deposition. A corona discharge on a high-voltage discharge electrode ensures that the particles are electrically charged in the flue gas. The flue gas then passes the collecting electrode, on which the ionised particles are deposited. The deposited particles are usually removed mechanically.

The researchers together developed an improved precipitator line with optimised flow characteristics, a more powerful discharge electrode and optimised operational management for the precipitator system. In order to achieve permanently high degrees of deposition, cleaning devices at the discharge and collecting electrodes are required. These were installed and tested as manual and automated variants during the 2017/18 heating season in various field test facilities. It was shown that the necessary cleaning effort differs considerably depending on the installation system and boiler type.

Low-emission pellet boiler with greater capacity

In addition, in the EmiLy project IZES and Hoval are working on further developing and testing a biomass boiler for larger thermal output ratings greater than 150 kW as a clean and sustainable alternative for the heating market. This low-emission pellet boiler is intended to be suitable for all pellet qualities.

The use of pellet heating systems offers considerable potential for replacing heating oil-fired systems, particularly in the larger output range. Here it is important to minimise dust, CO and NO_x emissions. Other requirements include compact boiler dimensions and competitive costs relative to fossil fuel-fired systems. This project is focussing on primary measures to reduce emissions. However, the electrostatic precipitator can also be integrated in this pellet boiler in order, for example, to comply with the particulate matter limit values in the case of particularly poor fuel quality.

Minimising particulate matter emissions

Since the legal limit values for particulate matter emissions were tightened in the 1st Federal Immission Control Ordinance (1. BimSchV) at the beginning of 2015, electrostatic precipitators are also being increasingly used for emission control on a smaller scale. This is particularly relevant for small- to medium-sized biomass boilers with nominal thermal outputs less than 1,000 kWth, for example pellet or log-fired heating systems in detached and semi-detached houses, apartment buildings and districts. Specifically, dust emission limit values of 0.02 g/Nm^3 (CO: 0.4 g/Nm^3) apply for newly installed biomass boilers, based on 13% residual oxygen in the exhaust gas. The systems are checked by conducting measurements every two years. If the limits are not met, the boilers must be optimised or retrofitted accordingly.

High dust emissions are very likely to occur if alternative and non-woody biogenic fuels are increasingly utilised in future, such as pellets from waste wood, bark-rich forest residue wood, halm-like materials, dried or torrefied biomass and biochar from hydrothermal carbonation (HTC) plants. The use of electrostatic precipitators here makes it possible to undercut the applicable limit values.

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