Karlsruhe Institute of Technology

Institute for Technical Chemistry (ITC)
Combustion Technology

APELLO 13 – The Flexible Pellet Boiler

Daniela Baris M. Sc., Dr.-Ing. Hans-Joachim Gehrmann, Prof. Dr.-Ing. Dieter Stapf

Development of the energy market

The introduction of the Renewable Energy sources Act (EEG) and the start of the energy transition led to an increasing public awareness of energy and climate change issues.

The increase in environmental awareness and the targeted interventions in the energy market with funding instruments by the government led to a continuously increasing number of pellet boilers and modern fireplaces.

The combustion of wood pellets is low in pollutants – with exception of the shutdown and startup phases, when significantly higher emissions may occur.

Due to the slow mass transfer compared to gas and oil firings, short-term fluctuations in heat demand need to be buffered with an adequately dimensioned heat storage.

This means, the whole system and especially the buffer tank must be able to cope with the maximum heat load, although this demand only occurs on a few hours per year (figure 1).

As a result the boiler is turned on and off frequently and often operates in partial load mode, which makes the installation of a buffer tank unavoidable.

Due to the dimensioning with respect to the maximum heat load, the buffer tank has to be chosen sufficiently large.

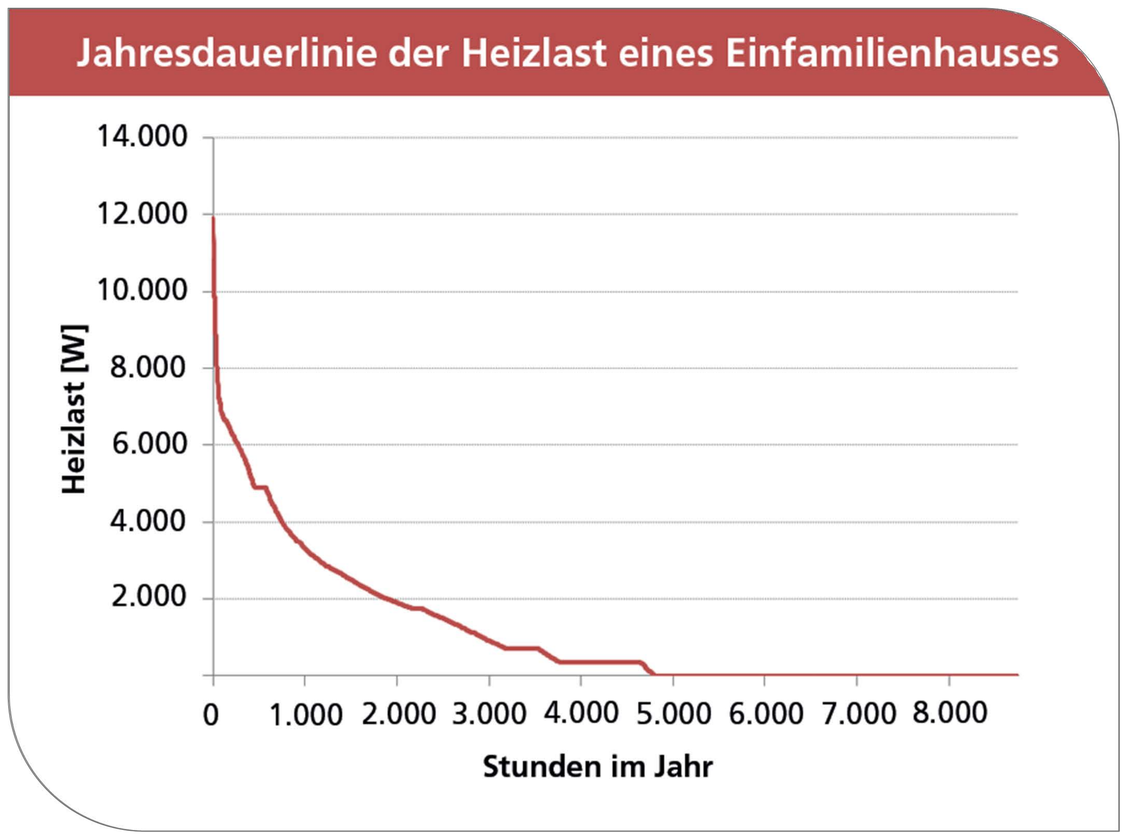

Figure 1: Heat demand of a single-family house per Year
Source: Fachgebiet Bauphysik & Technischer Ausbau (fbta), KIT

This leads to heat losses and therefore to a decrease in efficiency.
During the shutdown and startup phases, higher emissions of pollutants and greenhouse gases occur due to the poor fuel utilization.

The special feature of APELLO 13

APELLO 13 has a secondary stage to meet an increased heat demand more efficiently.
A mill is used to grind wood pellets into smaller pieces. The dusty material is then fed directly into the flame of the primary burner.
Due to the grinding, the specific surface area of the fuel is increased. This further improves the mass and heat transfer and results in a faster heat release.

Upgrading of APELLO 13

The secondary stage not only increases the heat supply and therefore the flexibility of the system but also improves the control characteristics of the boiler.

Through appropriate dimensioning of the boiler, the heating system can be realised without buffer tank. For the first time, a heating system for solid fuels can be designed as an instant-on water heater.

At the same time, emissions are reduced and the energetic, ecological and economic balance of pellet boiler is improved significantly.

Karlsruhe Institute of Technology

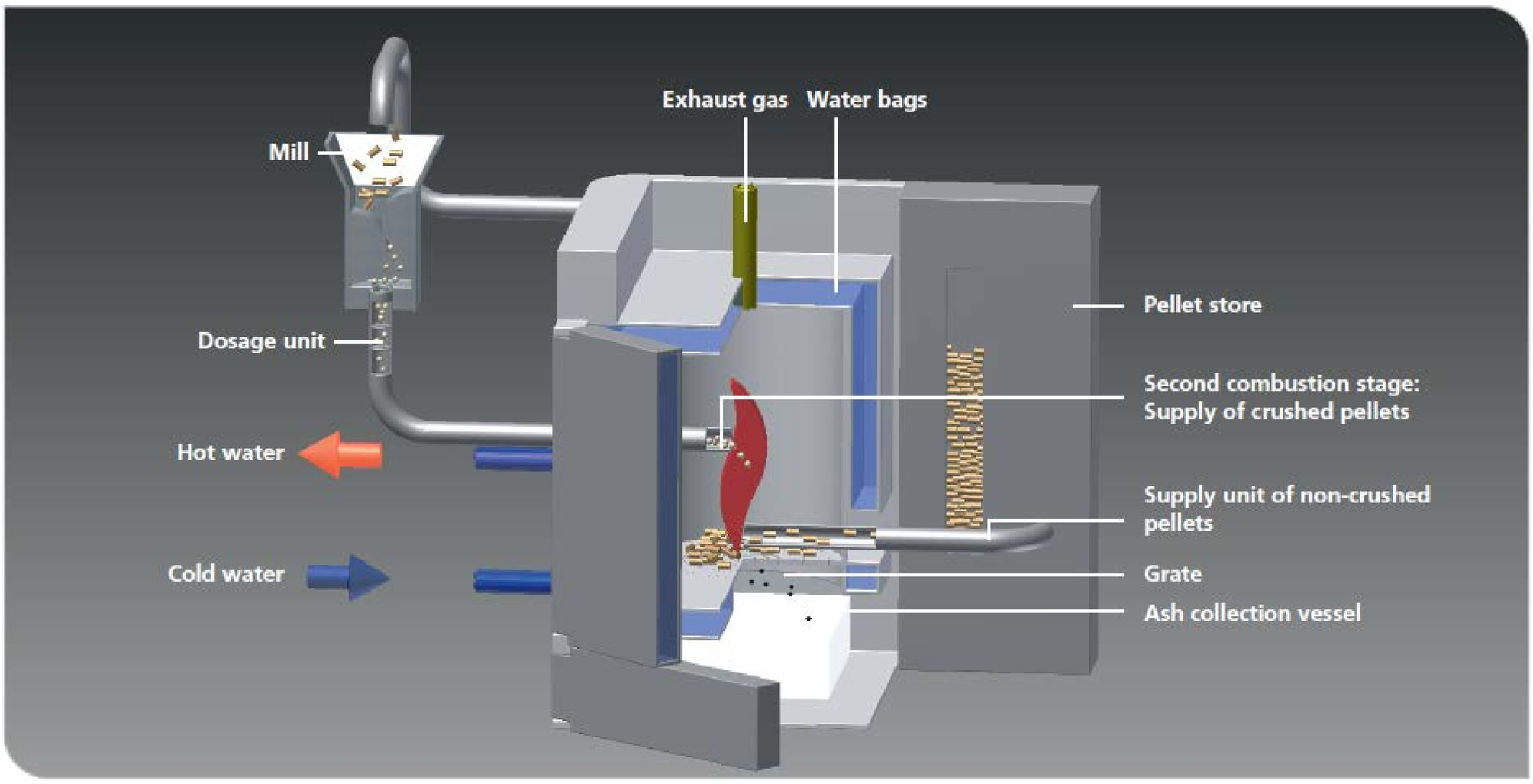

Figure 2: Schematic Representation of APELLO 13
Source: KIT

During base load operation unground wood pellets are burned. During partial load operation and the shutdown and startup phases, crushed pellets are fed additionally, which burn faster, more regular and with lower emissions (Figure 2). The pellet boiler can thus be adapted to fluctuations of heat consumption. This reduces the volume of the buffer tank on the one hand and the emissions on the other hand. The boiler is more environmentally friendly und saves valuable resources

Performance data APELLO 13	
Nominal heat output	12 kW
Volume of burner pot	0,5 l
Height of solid bed	2 cm
Diameter of burner pot	10 cm
Weight of sample taken	250 g
Characterisation of the burned material via load cell. Measuring of temperatures, gas- and dust concentration	

Advantages:

- improved burnout
- reduced heat losses
- Reduced fuel consumption with the same performance→ resource-saving and environmental friendly
  → less space required for fuel storage → long-term cost savings
- Emission reduction
- Higher flexibility
- Further applications for domestic and industrial biomass furnaces

For further Information go to:
https://www.itc.kit.edu/

Daniela Baris M. Sc.
Tel.: +49 721 608-24134
E-Mail: daniela.baris@kit.edu

Karlsruhe Institute of Technology
Campus Nord
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen

Dr.- Ing. Hans-Joachim Gehrmann
Tel.: +49 721 608-23342
E-Mail: hans-joachin.gehrmann@kit.edu