

Final workshop within the ERA-NET Bioenergy project "BIOFLEX!"

Technological solutions for the combustion of challenging biomass fuels



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Background and intention (I)



- **Small (<500 kW_{th}) to medium scale (0.5-10 MW_{th}) combustion plants are destined to grow in importance in a future decentralized, sustainable European energy supply scenario**
- **Today, especially small and medium-scale combustion plants show only restricted fuel flexibility**
 - **Large-scale plants:** individually tailored to cheaper, low-grade fuels
 - **Small-scale applications:** rely on chemically untreated stem wood fuels (log wood, wood chips, wood pellets)
 - **Medium-scale applications:** rely on high-quality wood fuels as well as selected cheaper assortments such as forest residues as well as waste wood

Background and intention (II)



- **The flexible utilisation of new, “difficult” biomass fuels in small and medium-scale applications is one major challenge for the coming years**
 - wood from short rotation forestry (SRF – e.g. poplar and willow)
 - herbaceous fuels (e.g. straw)
 - residues from agriculture and industry (shells, sludges etc.)
- **Due to their chemical composition, these fuels are challenging in terms of combustion behaviour and emissions**
 - Elevated ash contents with high levels of e.g. K, Si and P
 - ➔ problems with slagging, deposit formation and fine particulate emissions
 - Increased S, Cl and N contents
 - ➔ increased gaseous HCl, SO_x and NO_x emissions

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Background and intention (III)



- **Small-scale combustion systems:**
Individually tailored solutions and expensive secondary measures for emission reduction are economically not viable
- **Medium-scale plants:**
Limited knowledge regarding the problems associated to the utilisation of such challenging biomass fuels so far held back the development of fuel-flexible combustion systems
- Therefore, the **development of cost efficient primary measures for increased fuel flexibility** is relevant
- **Against this background the overall objective of the project was** to develop technologies, which facilitate an energetically and economically efficient utilisation of, in terms of combustion properties, challenging biomass fuels in small and medium-scale systems

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General project data (I)



- Project title:** Clean and flexible use of new difficult biomass fuels in small to medium-scale combustion
- Acronym:** BIOFLEX!
- Duration:** 36 months
- Partner countries:** Austria, Germany, Poland and Sweden;
6 research institutes and 6 company partners
- Project costs:** 1,660,000 €

The project was carried out in the core of the ERA-NET Bioenergy programme “9th Joint Call for Research and Development Proposals of the ERA-NET Bioenergy”



The project was funded by the national funding organisations of the partner countries involved:



The National Centre for Research and Development








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General project data (II)



Partners from Sweden

-  **RISE – Research Institute of Sweden** (project coordinator)
-  **Umeå University (UmU)**
-  **Luleå University of Technology (LTU)**
-  **Chalmers University of Technology (CTH)**
-  **Opcon AB**

Partners from Austria

-  **BIOS BIOENERGIESYSTEME GmbH**
-  **POLYTECHNIK Luft- und Feuerungstechnik GmbH**
-  **KWB Kraft und Wärme aus Biomasse GmbH**

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General project data (III)



Partners from Germany



TFZ – Technology and Support Centre of Renewable Raw Materials



AMANDUS KAHL GmbH & Co. KG

Partners from Poland



IEn – Institute of Power Engineering



BTI – Office of Technology and Engineering Jan Gumkowski

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Project objectives (I)



- **Improvement of the understanding of ash chemistry with a main focus on ash melting and aerosol formation**
 - by fundamental research
 - accompanied by appropriate experiments
- **Implementation of ash chemistry and ash transformation into combustion-related modelling**
- **Investigation of the application**
 - of additives and
 - fuel blending

in order to improve the combustion quality of challenging feedstocks → **develop fuel design concepts**

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Project objectives (II)



- **Further development of combustion technologies for the**
 - small (<500 kW_{th}) and the
 - medium (0.5 – 10 MW_{th}) capacity range**towards enhanced fuel flexibility by means of primary measures**
- **To perform testing of these measures in appropriately adapted testing plants in cooperation with furnace and boiler manufacturers**
- **Develop guidelines based on the results achieved**
 - for the design of appropriate fuel-flexible low emission combustion technologies and
 - for appropriate fuel design strategies

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Biomass fuels investigated



softwood pellets



poplar chips and pellets (poplar from SRF)



wheat straw pellets



grass pellets



sunflower husk pellets



sewage sludge



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Programme of the final project workshop



Introduction to the ERA-NET project "BIOFLEX"

Ingwald Obernberger, BIOS BIOENERGIESYSTEME, Austria

Fuel design concepts to reduce ash related problems and emissions - Experiences from single pellet combustion tests

Christoffer Boman, Umeå University, Sweden

Combustion tests with kaolin additivated fuels in residential boilers

Robert Mack, Technology and Support Centre (TFZ), Germany

Modeling fixed-bed pellet combustion of fuels of varying ash contents

Henrik Ström, Chalmers University of Technology, Sweden

Use of non-wood pellets in adapted small-scale boilers

Thomas Brunner, BIOS BIOENERGIESYSTEME, Austria

Burner design for difficult pulverised biomass fuels

Pawel Bocian, Institute of Power Engineering, Poland

Guidelines for fuel design, *Christoffer Boman, Umeå University, Sweden*

Guidelines for advanced furnace/boiler design, *Thomas Brunner, BIOS, Austria*

Discussion, conclusions and outlook, *Ingwald Obernberger, BIOS, Austria*

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Thank you for your attention

Project webpage: <https://bioflex-eranet.eu/>



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