AshMelT project

Publishable Summary

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Project description and objectives

The utilisation of renewable energy sources is a considerable contribution to the EU 2020 targets, and the utilisation of solid biomass for heat production is of great relevance in this regard. The market for solid biofuels is growing rapidly, and the demand for raw materials is increasing. Consequently it is aimed at extending the raw material basis for biofuel production covering also wooden materials of lower quality as well as agricultural raw materials and residues, which often show unfavourable ash melting properties.

The ash fusion test (AFT) is the only standardised method currently available to assess the ash melting behaviour of solid biomass, but the significance of this test is frequently criticised, in particular the applicability for low-quality wood or non-wooden biomass. Thus a respective normative regulation has not been included in the EN 14961-2, which is considered a major drawback for future development of the high quality end consumer market for wood pellets.

A number of alternative test methods have been developed to predict the ash melting properties of biomass fuels, but predictions and test results have scarcely been evaluated regarding their significance with regard to the practical performance of the fuels during combustion.

The objectives of the AshMelT project are to

- Develop a test method for the assessment of the ash melting characteristics of solid biofuels
- Specify ash melting classes for solid biofuels
- Work out a proposal for a European standard for the developed test method
- Develop a proposal for the implementation of the developed procedure as a testing reference in the ENplus® wood pellets label

3 SME AGs (AEBIOM, PPA, DS-TI), 1 boiler manufacturer (Ligno) and 2 fuel providers (Schellinger, SKELL)) cooperate within the AshMelT project. RTD work is outsourced to a number of RTD institutions in different European countries: Almost all RTD-partners involved have vast experience in the field of slag formation of biomass fuels in terms of fuel and ash analyses, test methods and experimental work in combustion units (BE2020, DTI, FEU, LTU, TFZ, UmU). Moreover, TFZ is versed in development and conduction of evaluation methodologies. FJ-BLT has long-term experience in biofuel characterisation and key personnel involved in the project are members of standardisation groups on a national, European and also international level.

In order to meet the above-described objectives, the project work follows a five-stage approach comprising information gathering, evaluation of methods, method optimisation and validation and dissemination of the project results as shown in Figure 1. The scientific partners contribute with their method know-how, their competences in the field of ash chemistry and their expertise on combustion technology. The associations and the involved industry partners will evaluate the proposed methods regarding their practical applicability.

Description of the work performed

The project has ended on the 31st of December 2015 and the final results are now available. These results comprise in particular following steps:

Selection of AshMelT methods

Overall nine different methods for determining the slagging behaviour of biomass fuels in combustion

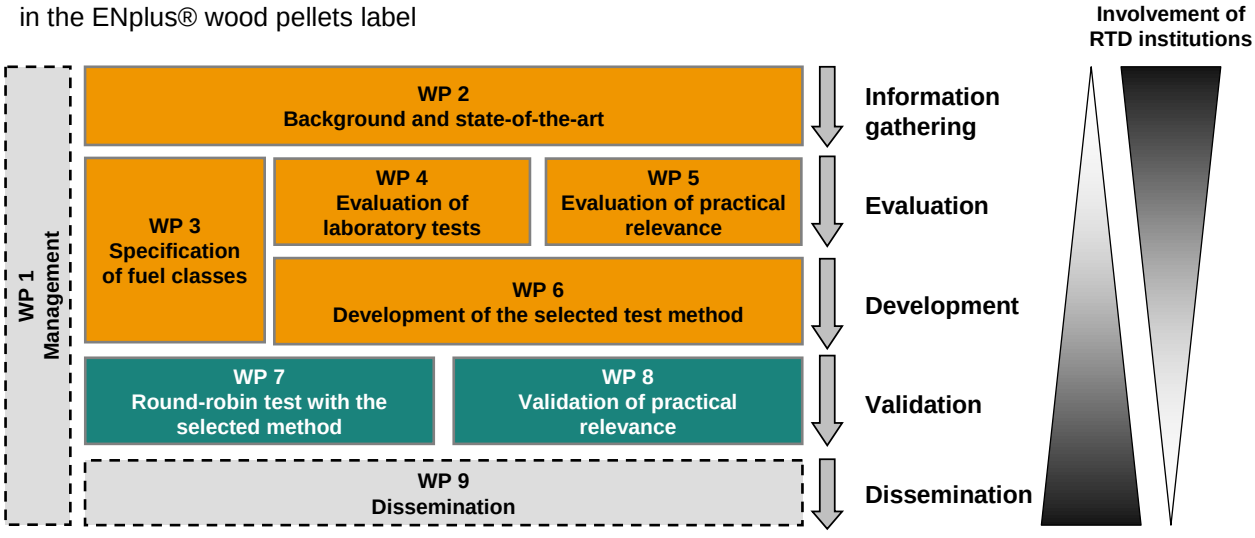


Figure 1: Project structure

systems were reviewed. Each method was assessed for various aspects regarding slag prediction capacity, accuracy and differentiation, ease of implementation, economics, handling and safety issues.

Two methods were selected for further optimisation. Slag Analyser as a robust and highly technologic methodology and an adaption of the rapid slag test.

Slag analyser (DTI): Fuel is combusted in a dedicated furnace and the resulted slag is assessed. This test method showed the highest potential for slag prediction capacity as well as for accuracy and differentiation.

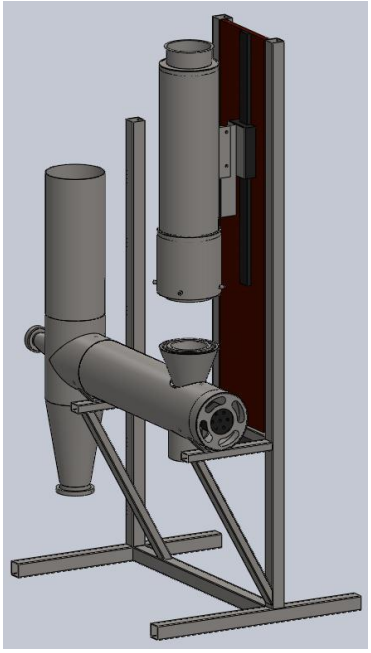


Figure 2: Slag Analyser

Rapid slag test: Based on single fuel particles a simple oven test and consecutive visual characterisation of the residues allows a statement on slagging behaviour within 4 hours. Since this test is conducted with the pure fuel, a high prediction capacity is expected. This method was further developed to allow an increased differentiation between fuels by increasing the fuel mass and add a sieving process.

Fuel classification

Besides the development of a slag assessment methodology, the AshMelT project aimed also for a fuel classification system. This fuel classification system is able to give recommendations of the user friendliness of a certain fuel in a specific combustion appliance. For this reason, dedicated fuel properties (as the content of dedicated chemical elements) and technology assets were combined in an equation, which results in a predicted slag formation propensity of the fuel in a combustion system.

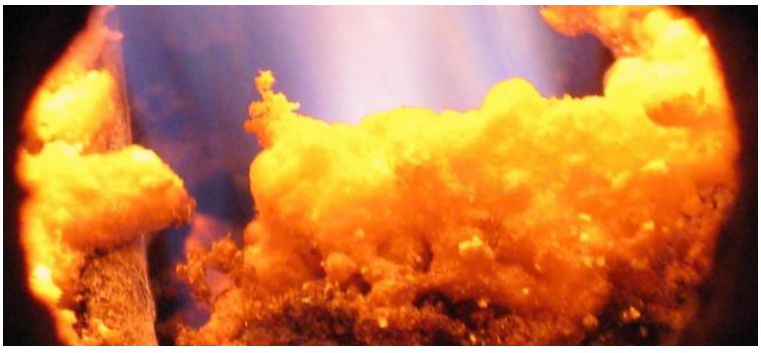


Figure 3: Slag formation in a small scale combustion system

Evaluation of slagging behaviour in small scale combustion appliances

Practical combustion tests in 9 different combustion appliances in a load range of 6-200 kW and different combustion concepts were conducted. Overall 20 different wooden and non-wooden fuels were applied to the combustion appliances. The slagging behaviour and the applicability of the fuel in the combustion system were determined for certain fuel/combustion technology combinations. The slagging behaviour was assessed by visual and physical properties, the applicability by various impact criteria like test duration, necessity of control adaption and emission release. Two parameters were outlined from these tests, which describe on the one hand the residues from the combustion and on the other hand the impact on the combustion system. These two criteria were introduced as

- Severity – How sever is the challenge of the residues from combusting a dedicated fuel to a dedicated combustion appliance. The severity includes only values describing the hardness and amount of the residues.
- Applicability – how is the impact of the residues on a dedicated combustion appliance. The applicability includes combustion test results like, test duration, power output, variance of temperature on the grate,... which describe how the residues affected the performance of the combustion appliance.

It was found, that there is a direct correlation of severity and applicability. The applicability is more dependent on combustion technology, but also the severity shows a distinct variance, when assessing the residues from different combustion appliances.

Round robin testing conducted

Up to now, a round robin test with the PASSA test method was conducted in 12 different laboratories, showing high reproducibility and repeatability. The slag analyser was multiplied allowing also first experience with reproducibility.

Project impact

ISO draft standard

It is therefore the explicit aim of the AshMelT project to develop fuel specifications and classes regarding ash melting properties and to finally propose the AshMelT test to the responsible standardization bodies in Europe and also beyond on ISO level. Therefore two ISO draft standards were prepared, which will be proposed to WG5 in ISO-TC238, who prepare a new work item proposal allowing multiple methods for the determination of slag formation tendency.

Missing link of combustion technology and fuel properties

Originally when developing the project, the applicability of fuels was actually not superficial. During the project elongation, it become evident, that a measurement methodology to assess the impact on the combustion technology is inevitable as soon as a boiler manufacturer wants to allow a dedicated fuel be combusted in the appliance. This methodology was developed in the background of this project, but will state the basis in future to assess the applicability of a fuel in a combustion appliance.

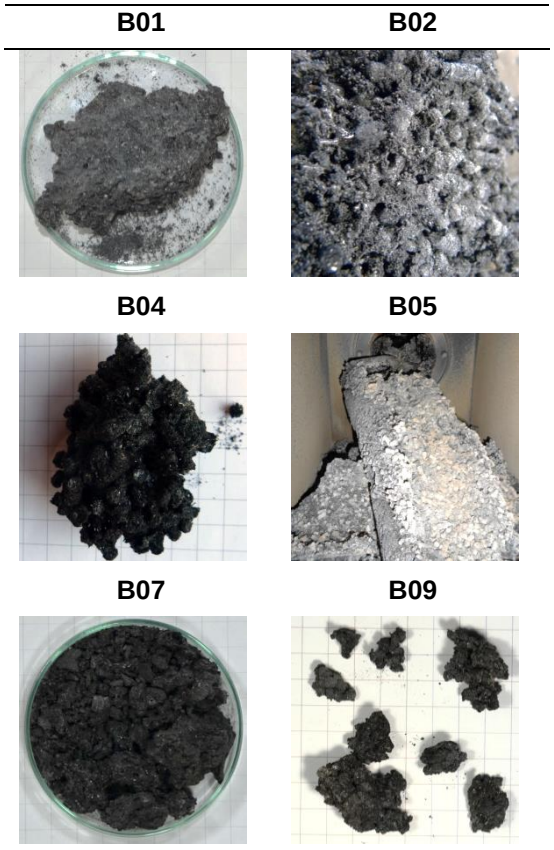
Ash chemistry know-how

Besides the method development, the understanding of the ash-chemistry and the slagging process will be increased. The slag formed in practical combustion tests will be analysed in detail. This will give information on how they were formed and under which conditions. The results of this study will allow the classification of the fuels in terms of slag formation tendency. This information will allow combustion technology providers to improve the fuel specification for their combustion systems.

Conclusions

The AshMelT method will finally have an impact on the utilisation and diversification of pelletized fuels. On the one hand pellets producer can classify their products more specifically and therefore can have a broader range of quality. Combustion system manufacturers on the other hand can choose for which type of fuel the combustion system shall be applicable.

Figure 4: Slag formation of straw in 6 different combustion appliances



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