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.

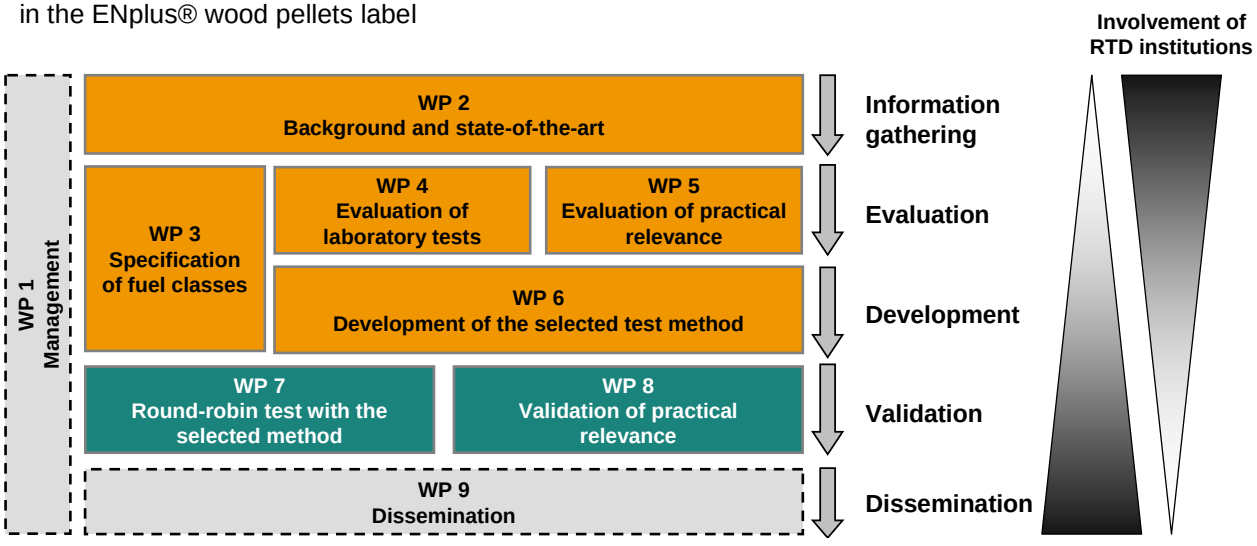

Figure 1: Project structure

Description of the work performed

Currently the project is in the 15th month of overall 36 month project duration. So far the phase of information gathering has been conducted and the evaluation phase is coming to an end.

Pre-selection of laboratory test methods for slagging behaviour

Overall nine different methods for determining the slagging behaviour of biomass fuels in combustion 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. The three most promising methods were preselected for further lab-test evaluation.

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.

CIEMAT ash test: This test method bases on oven tests with ashes from biomass at different temperatures. The testing duration is longer; the differentiation, on the other hand, is ameliorated in comparison to 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.

Fuel classification

The aim of the fuel classification system is to be able to give recommendations of the user friendliness of a certain fuel in a specific combustion appliance. In the first step towards this aim the assessment criteria were defined, how such a classification system should look like. These assessment criteria comprise physical and chemical properties, which are combined in an equation to determine the slagging tendency of a fuel. Furthermore, *15 different wooden and non-wooden biomass fuels* were selected covering a broad range of slagging behaviour, which were further applied for the practical and lab-test evaluation of slagging behaviour.

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. The slagging behaviour and the applicability of the fuel in the combustion system were determined for

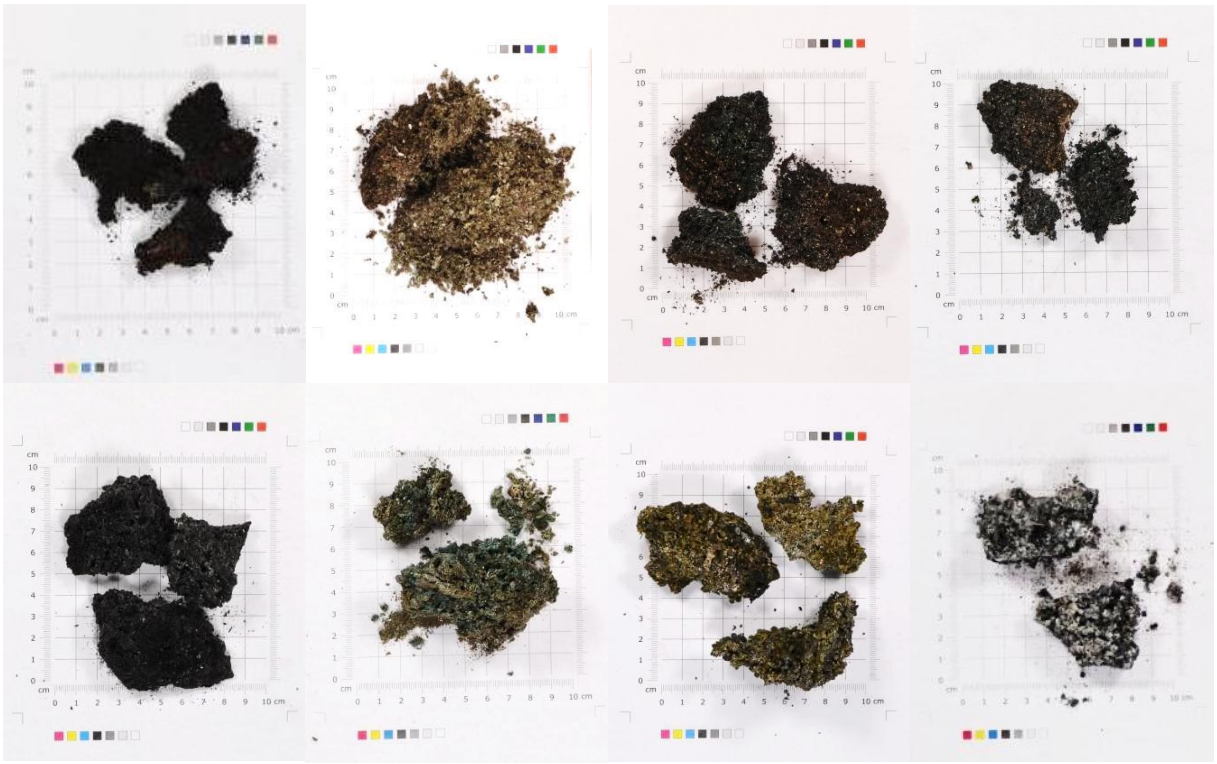

Figure 2: Selected slag samples from practical combustion tests (f.l.t.r: upper row: stem wood spruce, hardwood mixture, short rotation willow/spruce (#1), short rotation willow/spruce (#2), lower row: miscanthus, vineyard prunings, corn cobs, DDGS)

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. 14 fuels were tested in a reference combustion system, and 5 selected fuels were tested in all combustion technologies. This testing matrix allowed a survey of fuel and combustion technology influence on slagging behaviour and applicability. The data acquisition is finished by now, the evaluation process of the data is, however, still on-going.

Evaluation of preselected test methods

The three pre-selected testing methods were evaluated by determining the slagging behaviour of the 14 biofuels. Furthermore the ash fusion temperatures of all fuels were determined accordingly the current standard of AFT. In particular the assessment criteria such as prediction capacity, accuracy and differentiation are inquired in lab tests. By comparison of the testing results with the results from the practical combustion tests the prediction capacity is described. Also other assessment criteria like accuracy and differentiation and ease for standardisation were determined. Currently all lab tests are finished and the basis for the decision on the method selection is being prepared.

Description of the expected final results and their potential impacts

The evaluation process of the three testing methods will last until May 2013. By then the project consortium will decide on the basis of the assessment criteria, which method will be further developed. In the following development process the method parameters and procedures will be enhanced and ameliorated. The development success will be measured by the earlier stated assessment criteria. The resulting final testing method will be documented and prepared for standardisation purposes. In a Round-Robin test the method will validate the applicability of the method in testing institutes all over Europe. Furthermore the practical relevance and prediction potential of the slagging behaviour will be validated by comparing the Round-Robin test results with practical combustion test.

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.

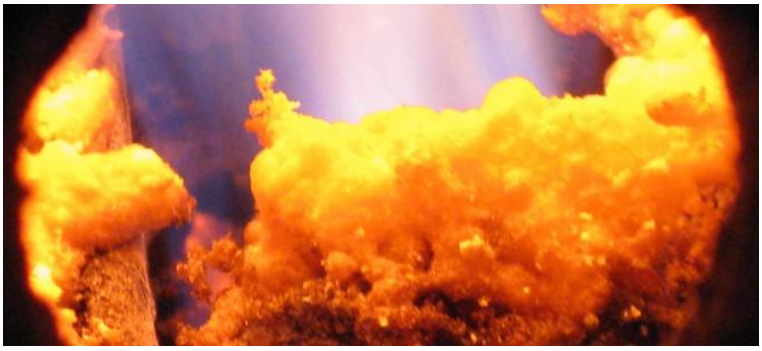

Figure 3: View on slag formation during combustion of corn cobs fuel in a small scale combustion appliance

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.

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.