Thermal degradation of RDF obtained from landfill

Justas Eimontas[1] and Nerijus Striūgas[1]

[1]Laboratory of Combustion processes, Lithuanian energy institute, Kaunas, LT-44403, LITHUANIA

1. Introduction

Every type of material has different composition and behaves differently at high temperature setting. Therefore, it is necessary to perform tests and determine thermal degradation parameters of feedstock, to run the gasification process at optimal conditions. Pyrolysis of waste is one of the most promising processes of waste disposal [1]. Also, volatile matter composition is important factor for gasification processes, to predict what organic derivatives has possibility to form, and avoid hardware interference.

2. TGA of RDF, Wood and Straw

All three materials were placed in thermogravimetric analyser, to determine how it behaves at the same temperatures. The same methods have being used with all samples.

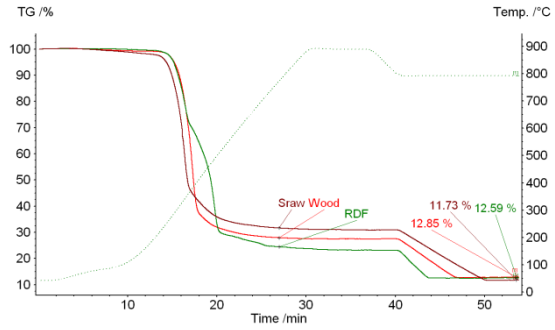

Figure 1. TGA curves of Wood, Straw and RDF samples

3. FTIR analysis

Thermogravimetric analyser is combined with Fourier – transform infrared spectrometer, which can determine the functional groups of volatile matter. After identification of functional groups, depending on our feedstock, we can predict, what kind of derivatives it is

4. Ultimate and proximate analysis

Ultimate analysis shows most representative parameters, such as percentages of C, H, N, S and O. Also, proximate analysis can expose composition of the feedstock in terms of gross components, such as moisture, volatile matter, fixed carbon and ash.

5. Results

The study shows that all selected feedstock has similar residual masses, which is about 12%. The highest rate of volatile matter releases shows Gram Schmidt curve, which has extremum points at different temperatures. These temperatures are placed in Table 1.

Table 1. Feedstock volatile matter temperatures

	Temperature, °C
Straw	338.2
Wood	379.4
RDF	342.6 / 487.7

According to FTIR spectra, we are able to identify the functional groups, which are in volatile matter. In RDF feedstock, we can identify some alcohols, primary or secondary amines, methane and CH_2 groups, which belongs to polyethylene, carbon dioxide, carbon monoxide, aldehydes, ketones and esters. Also, there

is a lot of metals (like aluminium or iron), but FTIR are not able to detect them.

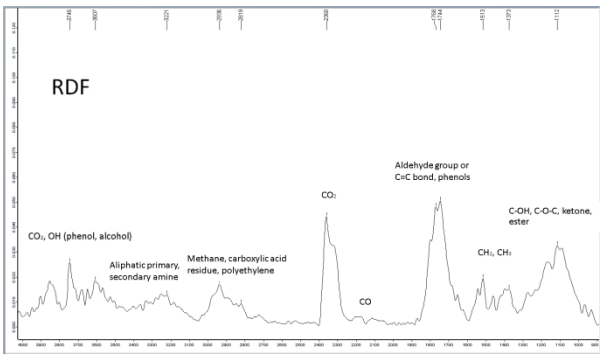

Figure 2. Identified functional groups of RDF pellets feedstock

The spectrum was taken from the spectra cube at a certain temperature.

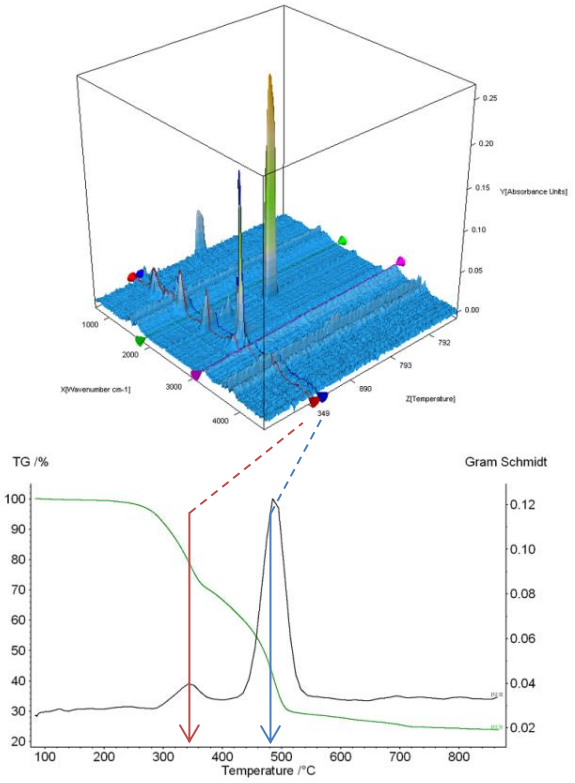

Figure 3. RDF spectra and TGA-Gram Schmidt correlation

Table 2. Proximate analysis results

Proximate analysis			
	Wood	Straw	RDF
Moisture	1,03	7,6	1,8
Volatile matter	71,43	75,7	84,4
Fixed carbon	14,7	19,7	4,8
Ash	13,10	4,7	10,8

Table 3. Ultimate analysis results

Ultimate analysis			
	Wood, %	Straw, %	RDF, %
C	50,76	47,2	67,6
H	2,6	5,8	10,0
N	5,62	0,3	0,7
O	29,44	42,0	10,9
S	-	-	-

6. Conclusions

Based on the observations in this study, it is clear, that highest thermal degradation rate of all three feedstock are different, so it behaves differently in gasifier. According to FTIR impressions, we can identify some functional groups, which belong to various derivatives. Ultimate and proximate analysis shows most representative parameters, like main elements percentages and feedstock gross components, which is quite different for every feedstock.

7. References

[1] J. Wang et al. Investigate the interactions between biomass components during pyrolysis using in-situ DRIFTS and TGA. Chemical Engineering science, Volume 195, Pages 767-776, February 2019.