Research on the possibility of using pyrolysis products from energy willow and waste from MDF fibreboard

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Introduction

With the increase in the number of green energy sources (mainly wind farms using wind turbines and solar power plants using photovoltaic panels), the problem of balancing power lines arises. This is related to the specificity of obtaining energy from renewable sources. The simplest way to say is that at certain times of the day there is too much energy produced, at others there is too little. This can be counteracted by using energy storage.

The authors proposed a non-obvious solution to this problem by using the low-temperature pyrolysis process to transform waste into useful substances. This process can be carried out during periods of excessive electricity production (and its use to heat the pyrolyzer charge). During periods of decline in electricity production, previously obtained pyrolysis gases and pyrolysis oil can be used for its production. This procedure will allow the use of many groups of waste having a certain energy potential. In turn, char produced from wood waste and biomass could play an important role in improving the quality of soil and water. Wood-based waste, such as chipboards, MDF boards, HDF boards, can be a valuable raw material for the production of activated carbon through the pyrolysis process, contributing to the reduction of waste. The obtained product could be used in various fields, including: as an adsorbent or soil fertilizer. The above activities are consistent with the idea of the Circular Economy. However, this approach requires conducting numerous studies that will be able to demonstrate the validity of the adopted assumptions.

Results & Discussion

In this article shows selected test and analysis results for two types of solid substances (waste furniture made of MDF fibreboard, energy willow chips) made mainly of natural materials. To demonstrate the differences between natural and artificial materials, the research was supplemented with waste floor panels made of vinyl board. The research results were presented three products of the pyrolysis process of these substances (char, oil, gas - pyrolysis gases were not subjected to detailed analysis). The pyrolysis process was carried out at a temperature of 425°C.

Table 1. Masses of substrates and products, MDF and EW (g)

Type of Waste	Input	Char	Pyrolytic Oil		Pyrolytic Gas
			Oil-Contaminated Water	Oil	
MDF furniture board	1000.00	418.00	192.14	31.86	358.00
Energy willow	1000.00	360.00	221.12	42.88	376.00

Table 2. Masses of substrates and products, VFP (g)

Type of Waste	Input	Char	Pyrolytic Oil		Pyrolytic Gas
			Paste consistency	Oil	
Vinyl floor panel	1000.00	684.00	98.00	23.76	194.24

As a result of the low-temperature pyrolysis process, 3 products were obtained, their mass balance is presented in Table 1 (MDF; EW) and Table 2 (VFP). The mass of char ranged from 360 g (EW) to 684 g (VFP), pyrolysis gas from 194.24 g (VFP) to 376 g (EW), oil from 121.76 g (VFP) to 264.00 g (EW). After 24 hours, the pyrolysis oil was stratified into an oil fraction (31.86 g – 42.88 g) and water contaminated with an oil fraction (192.14 g - 221.12 g). This phenomenon was observed for the MDF and EW. In the case of VFP, there was a separation into an oil fraction (23.76 g) and a paste fraction (98.00 g).

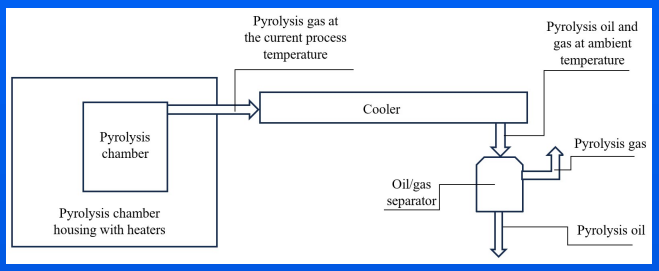

Figure 1. Simplified diagram of the pyrolysis test stand

a b

Figure 2. Pyrolysis chamber: a. before starting the pyrolysis process of the MDF sample, b. after completing the pyrolysis process of the MDF sample

Figure 3. Examples of pyrolysis products obtained from the MDF sample: pyrolytic oil and char

Conclusions

Analysing the obtained results, it can be concluded that both char and pyrolysis oil can be used in thermal processes. This is indicated by high values for flammable parts, carbon, hydrogen content and calorific value. Summarizing the research results, it is possible to propose a direction for further use of the obtained substances.

- Pyrolysis oil can be used as fuel to drive diesel generators, thus producing electricity during periods of energy shortage.
- The char can be used in the production of activated carbon, e.g. by activating it at high temperature. The proposed solutions are consistent with the assumptions of circular economy, both as its closure (electricity production) and the production of a new useful product - activated carbon.
- Oil-contaminated water poses a certain problem when it comes to its management options. The solution may be, for example, the use of a specialized oil separator. This separator will enable the separation of the oil fraction from water. The oil fraction can be treated similarly to pyrolysis oil. The water may be directed either to a sewage treatment plant or used for technological purposes.

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