DOI: http://doi.org/10.21698/simi.2023.ab18

PHYSICAL-CHEMICAL AND ENERGETIC CHARACTERISTICS OF THREE FUELS RECOVERED FROM MUNICIPAL WASTE

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Keywords*: alternative solid fuels, physico-chemicals parameters, municipal solid waste, sewage sludge, solid recovered fuels*

Introduction

Circular Economy Action Plan underlines that separate collection of waste is a prerequisite for high-quality recycling and for keeping valuable materials and products in the recycling loop. This leads to the optimization of waste management by increasing the degree of recovery of useful components and their transformation into secondary raw materials such as alternative fuels. Using an alternative fuel which meets the quality parameters well defined for the purpose of energy production in combustion installations, represents one of the possible solutions for reducing the impact of waste on the environment. Their use as substitutes for fossil fuels in combustion installations requires high-quality standards, in order not to cause operational and technical problems. The aim of the present work is to evaluate from a technical and energetic point of view, 3 solid alternative fuels produced from sewage sludge taken from a city treatment plant (SS), which was later mixed with plastic (SS+PLW), wood chips (SS+WCW) and cardboard (SS +CBW), each of them being separated from municipal solid waste (MSW). The classifications for the alternative fuel classes mostly depend on physico-chemical parameters such as the net calorific value, chlorine and mercury concentrations. Thus, the determination of these three major characteristics, allowed the studied fuels to be classified in the SRF class, according to the requirements of EN ISO 21640:2021.

Materials and methods

The alternative solid fuels evaluated in this paper were prepared in a ratio of 3:1, dewatered municipal sludge: MSW fractions (plastic, wood chips and cardboard). Acting as a binder in the waste mixture, the dried sewage sludge was preliminarily rehydrated to a final moisture content of 75%. In order to improve the calorific value and density per unit volume, the obtained mixtures were briquetted to dimensions of about 3.5/10 cm. The need to obtain good and reliable laboratory results, requires representative and homogeneous fuel samples. Thus, the briquettes under analysis, were crushed through laboratory mills equipped with 2mm and 0.5mm sieves. In accordance with the standardized methods in force, the physico-chemical composition of the fuels was established, by determining the following parameters: moisture (W), ash (A), carbon (C), hydrogen (H), nitrogen (N), lower calorific power (LHV), sulfur (S), chlorine (Cl) and mercury (Hg)

Results and conclusions

Analytical results obtained from the analysis of the 3 alternative fuels are presented in Table 1 and Figure 1.

Table 1. Physico-chemicals characteristics of alternative compared with an inferior coal

Parameters	Units	Lignite	SS+PLW	SS+WCW	SS+CBW
W	[%]	40-43	6.30	33.7	37.1
A		18-25	33.3	15.7	18.6
N		0.6-0.8	2.51	2.62	1.06
C		18-25	33.5	25.9	22.0
H		1.7-2.2	4.44	2.99	2.55
S		0.5-1.9	0.64	0.31	0.31
Cl		<0.03	0.05	0.09	0.04
Hg	Mg/Mj	-	≤0.01	≤0.01	≤0.01
LHV	MJ/kg	(7.5 – 14.0)	13.9	8.2	7.6

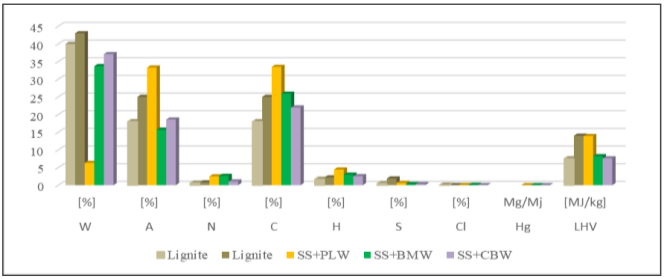

Fig.1. Characteristics of the alternative fuels obtained from municipal solid waste

From the results presented above, it is observed that the specific values of LHV for all three studied solid fuels are higher than 6 MJ/kg, which is the minimum condition for placing a combustible material in the fuels category. By similarity with the solid fossil fuels, the values for the lower heating value, ash and carbon content of the solid combustibles are comparable to those of the lignite, which is an inferior coal. A calorific value higher than 10MJ/Kg, (SS+PLW) is assigned to the IV class of SRF. With values greater than 3 MJ/kg, the alternative fuels (SS+WCW and SS+CBW), are assigned to the V class of SRF. The values for chlorine content was lower than 0.2%, while the content of mercury was lower than the quantification, thus, placing the 3 alternative fuels to the class I of SRF.

Acknowledgments. This work was carried out through the Nucleu Programme of the National Research, Development and Innovation Plan 2022-2027, supported by MCID, project no. PN 23 22 04 01.