Assessment of Energetic Potential from Automobile Industry Textile Wastes – Potential for RDF Production

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ABSTRACT
The purpose of this study was to evaluate the energetic potential of the Refuse Derive Fuel (RDF) obtained from automobile industry textile wastes (TW). Additionally, it was assessed the influence of their mix with a rejected fraction from undifferentiated urban wastes (UW). The work started with the physical characterization of the 6 collected textile samples. From these wastes, 8 RDF pellets were produced: 6 with TW alone, 1 only with UW, and 1 with a mix of the 6 TW and UW (ratio 1:1). These RDF pellets were characterized in terms of lower heating value (LHV) and chlorine content according to the related normative documents. Overall, the TW have in their composition a white textile fiber, a foam, and a black textile fiber. All wastes had low moisture content (<3%). The LHV ranged between 23 and 30 MJ/Kg. The RDF with a higher foam quantity in their composition had a higher LHV. For all RDF pellets, the chlorine content was lower than 1% and is not expected to cause any significant technical or environmental problems. Overall, it seems that the TW from the automobile industry have potential to be used for the RDF production, moreover, their mix with UW will not negatively influence their energetic potential.

Keywords: Automobile Industry; Circular Economy; Heating Value; Refuse Derive Fuel; Textile wastes; Urban Wastes

INTRODUCTION

Textile materials are used in automobiles for interior trim and for ensuring comfort (e.g. seat covers, carpets, roof liners, and door liners) as well as for reinforcement (e.g. tyre) and filters. The automobile industry sector generates annually significant textile wastes (TW) quantity, mainly from the automobiles seats. A circular automobiles economy is achieved with the increasing of wastes valorization, including the textile wastes stream. Moreover, fossil fuel reserves depletion, and costly and problematic wastes recycling call for renewable resources of energy and consumer products. As an alternative to the 100% petrol economy, production processes based on Refuse Derive Fuel (RDF) are developed. RDF is the solid fuel prepared from non-hazardous waste, the use of which aims to recover energy in incineration or co-incineration units, in strict compliance with the legislation (NP 4886:2008, 2008). In this work, it was intendent to study the potential of the RDF obtained of textile wastes from automobile seats to be an alternative fuel and the influence of their mix with undifferentiated urban wastes (UW).

MATERIALS AND METHODS

Six different types of TW automobile seats and 1 sample of UW were used. The TW were collected from an automobile industry sector located in the center of Portugal. Firstly, the physical characterization of TW samples (composition and moisture content) was performed. Then, 8 types of RDF pellets: 6 with only TW (TW1-6), 1 with UW and 1 with a mix of the 6 TW and UW, within a ratio of 1:1 (TW:UW) were produced. Their characterization was done according with the solid recovered fuels European standards: Lower Heating Value (LHV) and chlorine content.

RESULTS AND DISCUSSION

The wastes physical characterization showed differences between the 6 TW samples collected from automobile seats. The TW are composite materials constituted by textile fibers and foams. Textile fibers are essentially polyester and foams, organic materials based on polyol and isocyanate (polyurethane). The samples TW1 – 3 have a white textile fiber, a foam, and a black textile fiber; TW4 is a black textile homogenous material without foam and TW5-6 are a composite of a white textile fiber and a foam. These industrial wastes are classified as 040222 code (European List of Waste) and are non dangerous wastes. TW6 have a higher foam layer comparing with the other samples. The UW composition is: 29% paper/cardboard, 6% plastic and 59% textile, wood and other

energetic materials useful for RDF production (Brás et al., 2020). All the wastes had low moisture content, ranged from 0.23 to 3.24%. After the RDF pellets production, it was made their characterization (Table 1). The LHV values ranged between 23 and 30 MJ/Kg. The RDF pellets with higher foam layer registered highest heating values, despite the fact that they are both organic materials (textile fibers and foam).

Table 1. RDF Pellets Characterization

	TW1	TW 2	TW 3	TW 4	TW 5	TW 6	UW	TW:UW (1:1)
LHV (MJ/kg)	24.4±0.04	24.4±0.06	23.4±0.02	23.5±0.01	29.9±0.02	27.4±0.1	23.6±0.1	24.2±0.1
Cl content (%, db)	0.41±0.07	0.31±0.01	0.29±0.05	0.07±0.001	0.17±0.03	0.98±0.01	0.78±0.07	0.52±0.03

db – dry basis

The LHV are in accordance with values obtained for polyurethane foams with a heating value of 26-32 MJ/Kg. Comparing with the fossil fuels, that is, coal, oil and natural gas, the obtained LHV for the RDF pellets is close to coal and higher than those for biomass briquettes, wood chips, wheat straw, or barley straw (Forest Research, 2021). The mix of textile wastes with rejected fractions from urban wastes (TW:UW) do not influence the heating value of RDF, however, it would improve slightly the LHV of UW RDF. These values are in accordance with values obtained by Dong et al. (2009) in their studies of the heating values of RDF from urban and industrial wastes. Moreover, chlorine is a factor that may affect the long-term boiler availability due to its extremely corrosive behavior, thus its concentration must be constantly monitored when biogenic fuels are used.

The chlorine content was lower than 1% and lower than the obtained by other authors and not expected to cause any significant technical or environmental problems (Ma et al., 2014). The highest chlorine content value was obtained for the RDF with a higher foam layer in their composition.

CONCLUSION

The analysis of potential RDF resources from textile wastes of automobile industry showed that this type of wastes has potential to produce RDF. Moreover, their mix with rejected fractions from undifferentiated urban wastes will improve their energetic potential.

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