The importance of the physical and energetic properties of straw briquettes

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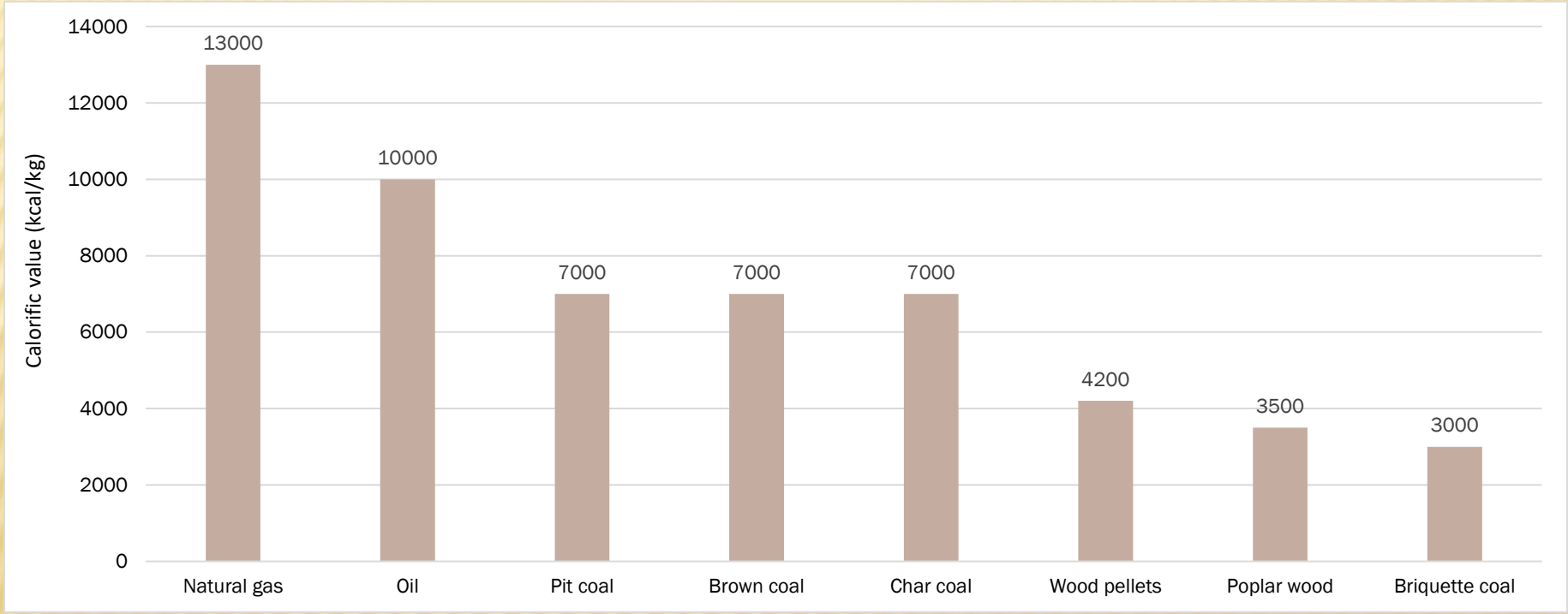
1. INTRODUCTION

Biomass is a renewable energetic source, and represents the vegetal component of the nature. As a way of keeping the sun's energy under a chemical form, the biomass is one of the most popular and universal energetic resources on Earth. It assures not only food, but also energy, construction materials, paper, homespun, medicines and chemical substances. Reducing pollutant emissions is one of the main objectives of international environmental policy. According to the New Energy Policy of the European Union, the European Commission aims to increase the share of energy sources from 7% in 2005 to 20% in 2020.

Romania, in the given conditions of the actual geographic space, is appreciated as a country with a high energetic potential derived from vegetable biomass, of almost 8000 tep/year which represents approximately 19% from the total consume of primary resources for the year 2000, with the following categories of fuels: wood waste from forest exploitation and firewood, wood remains (sawdust and other wood residues), agricultural residues (cereal straws, corn waste, vegetable waste from grape, rape stems), biogas.

FIG. 1 CALORIFIC VALUE OF SOME FUELS



OBJECTIVE

The paper aims to make a comparative analysis of two types of straw briquettes batch 2018 and 2019, in order to observe the influence of soil, air humidity and vegetation conditions on the properties of briquettes obtained from these types of wheat straw. To solve this general objective some briquette proprieties such as density, calorific value and ash content of the straw briquettes were intended to be investigated.

2. MATERIALS AND METHODS

Two types of briquettes were realized and analysed straw briquettes of year 2018 and straw briquettes of year 2019, to observe which have better density and energy efficiency. A study about climatic condition where the straws were collected shows that the months March-June of year 2018 was much moist than year 2019 with an average of 51.3 l/m^2 precipitations, comparison with an average of about 40 l/m^2 in year 2019.

The briquettes were weighted using an electronic balance TP KERN EW 1500-24 with a precision of 0.1 grams. The density determination relationship took into consideration mass of briquettes and their volume as cylindrical one:

$$\rho = \frac{4 \cdot m}{\pi \cdot d^2 \cdot l} \cdot 10^6 \quad [kg / m^3]$$

where: m is mass of briquette, in g; d- diameter of briquette, in mm; l- length of briquette, in mm.

Ten determination of gross calorific value and net calorific value have been done accordingly to German norm DIN 51900-1 The net calorific value is the difference between gross calorific value and the amount of heat released for evaporate water from the combustion gases. The equipment used to determine the calorific value is the calorimetric apparatus with explosive bomb.

For determining the ash content of briquettes the general method of standard determination was used accordingly to European Norm EN 14775 [33]. With respect to this method, the small and dry material up to 0% moisture content is calcinated at 750 ºC in a laboratory oven, for three hour. The advanced combustion operation is carried out in a high temperature resistant metal crucible and weight was carried out on an analytical balance with an accuracy of three decimal. When determining the ash content, it shall be taken into account that the sample is completely dried and the mass of the clean and empty crucible was obtained (Eq.3):

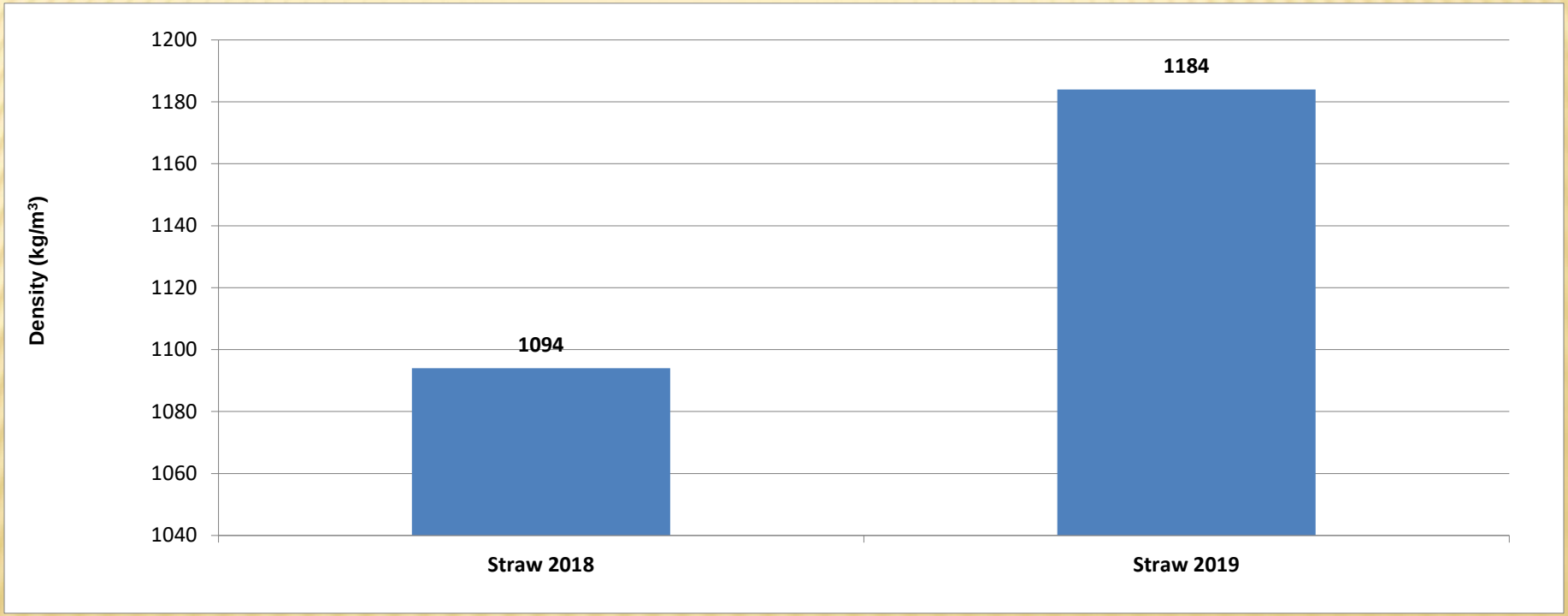
$$A_c = \frac{m_{a+c} - m_c}{m_{s+c} - m_c} \cdot 100 \quad [\%]$$

where: m_{a+c}-mass of calcinated ash, considering also the crucible mass, in g; m_{s+c}- mass of sample considering also the crucible mass, in g; m_c- mass of empty crucible, in g.

3. RESULTS AND DISCUSSIONS

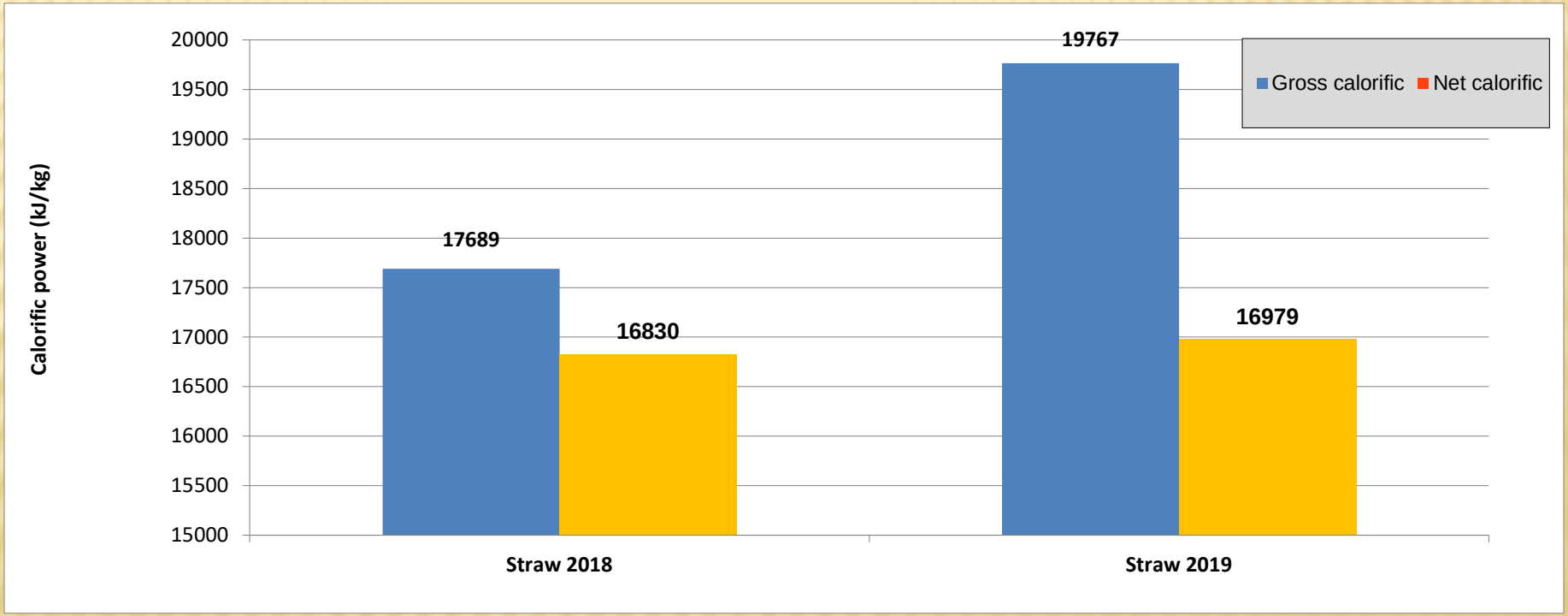
The moisture content the two types of briquettes was about 10% and was in concordance with EN 14774-1. The density values for the two types of briquettes are 1094 kg/m^3 for straw briquettes for production year 2018 and 1184 kg/m^3 for straw briquettes of production year 2019.

FIG. 2 THE VALUE OF DENSITY FOR TWO TYPES OF BRIQUETTES



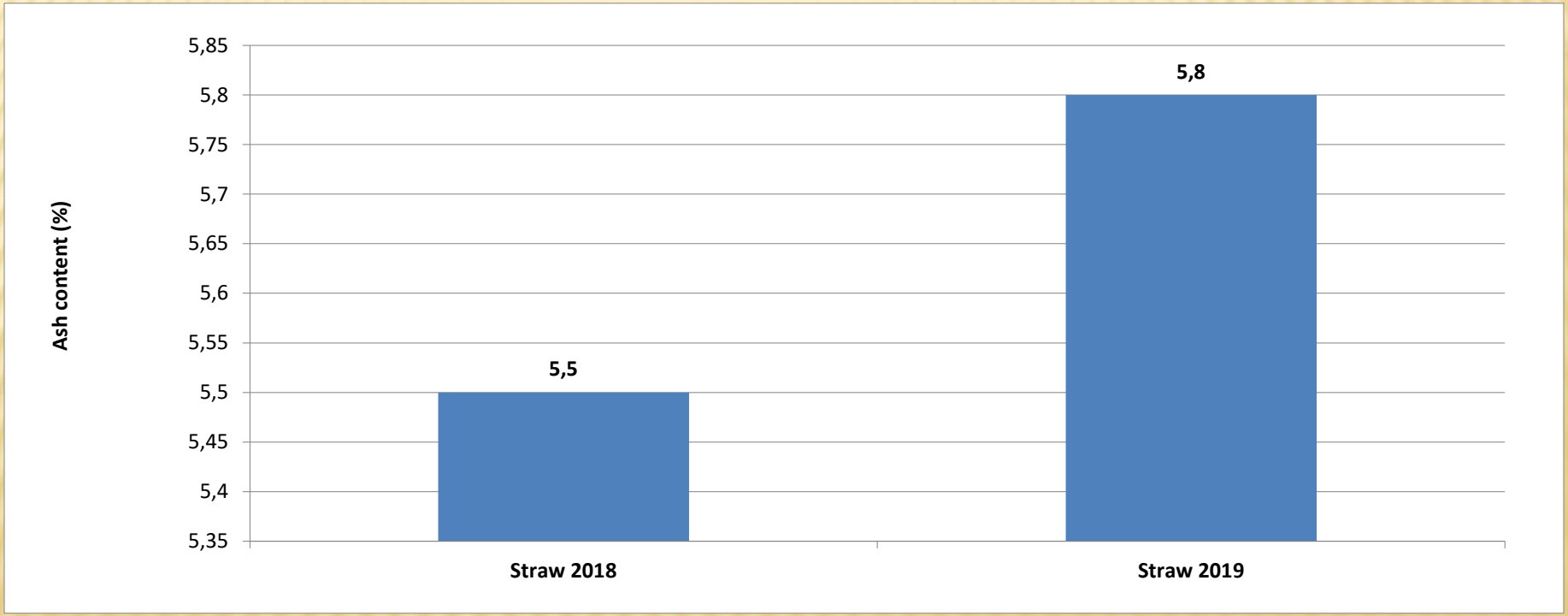
The gross calorific value for the two types of briquettes are 17689 kJ/kg for straw briquettes production year 2018 and 19767 kJ/kg for straw briquettes production year 2019. The net calorific value for the two types of briquettes are 16830 kJ/kg for straw briquettes production year 2018 and 16979 kJ/kg for straw briquettes production year 2019. Calorific power for straw briquettes production year 2019 is higher than straw briquettes year 2018. As in the case of densities, if we correlate calorific value with the amount of precipitation in 2018 and 2019, it is clear that the straw from the rainier year had a lower calorific value.

FIG. 3 THE CALORIFIC VALUE FOR THE TWO TYPES OF BRIQUETTES



The ash content value for the two types of briquettes are 5.5% for straw briquettes of production year 2018 and 5.8% for straw briquettes of production year 2019. Fig. 8 shows the value of the ash content for the two types of briquettes.

FIG. 4. THE VALUE OF THE ASH CONTENT FOR THE TWO TYPES OF BRIQUETTES



4. CONCLUSIONS

Following this study, it was observed as a first conclusion that the straw can be used in the briquetting process as well as any other biomass category. This is highlighted by the fact that the briquettes obtained have a good density and calorific value, similar to other materials.

Regarding the use of straw from dried year (2019) related to moist year (2018), it can be stated that although they are weaker in quantity, in terms of density, calorific value and ash content are better.

Therefore an increase with 8.2 for density, 11.7% for gross calorific power, and 5.4% for ash content was highlighted for briquettes obtained in 2019. It makes possible the classification of this vegetal fuel in the category of high-performance solid fuels.

All briquette features were within European Norm EN plus or other regional norm, exception from this rule being ash content. Beyond this fact, the ash content is in the area of other categories of plant biomass and even wooden biomass such as bark. Transforming wheat biomass in briquettes by grinding and pressing can be a good solution and possibly mixed of it with wood sawdust would be a good solution to improve the weakness.

THANK YOU FOR YOUR THE ATTENTION!