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Study of the fusibility of solid biofuel ashes

Carina Ferrari Braga
Gustavo Vicente Soares
Ligia Antunes Almagro Alves de Souza
Danili Eiji Hirayama
Ricardo Rezende Zucchini
Fabiana Oliviera Alexandre

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Instituto de Pesquisas Tecnológicas do Estado de São Paulo S/A - IPT
Av. Prof. Almeida Prado, 532 | Cidade Universitária ou
Caixa Postal 0141 | CEP 01064-970
São Paulo | SP | Brasil | CEP 05508-901
Tel 11 3767 4374/4000 | Fax 11 3767-4099
www.ipt.br

Figure 1 shows a comparison between the fusibility behavior of the ash in the analyzed samples.

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Figure 1 – Ash fusibility

STUDY OF THE FUSIBILITY OF SOLID BIOFUEL ASHES

Carina Ferrari Braga [a*], Gustavo Vicente Soares [a],
Ligia Antunes Almagro Alves de Souza[a], Danilo Eiji Hirayama [a], Ricardo Rezende Zucchini [b].
carinab@ipt.br
[a]*Bioenergy and Energy Efficiency Laboratory, Institute for Technological Research, São Paulo, Brazil*
[b] *Metrological References Laboratory (LRM), Institute for Technological Research, São Paulo, Brazil*

INTRODUCTION

Energy generation from renewable resources has grown in recent years due to the need to reduce the use of petroleum derivatives for economic and environmental reasons.

Solid biofuels have proven to be an alternative for both electricity production and the transportation sector. To efficiently utilize these materials in their various applications, their characteristics must be understood.

Direct combustion of biomass for energy conversion presents operational problems during combustion, which are generally associated with the fusibility of the ash formed during thermochemical conversion, causing various types of technical problems,

This study aims to map the melting temperature of ash in biomass samples.

MATERIAL AND METHODS

Five different samples of sugarcane bagasse (identified as Samples 1 to 5) and four samples of wood chips (Samples 6 to 9) were collected, supplied by different companies. The samples were obtained on different dates and locations to account for natural variability in the materials, caused by factors such as soil, climate, agricultural management, and storage conditions.

The samples were dried in an oven with air circulation at 105±5°C until a constant mass was obtained, in accordance with ISO 18134-1:2022 The samples were then ground in a Willye knife mill until they reached a particle size of 0.595 mm.

The fusibility assessment was performed based on ISO 21404/2020.

RESULTS AND DISCUSSION

Figure 1 shows a comparison between the fusibility behavior of the ash in the analyzed samples.

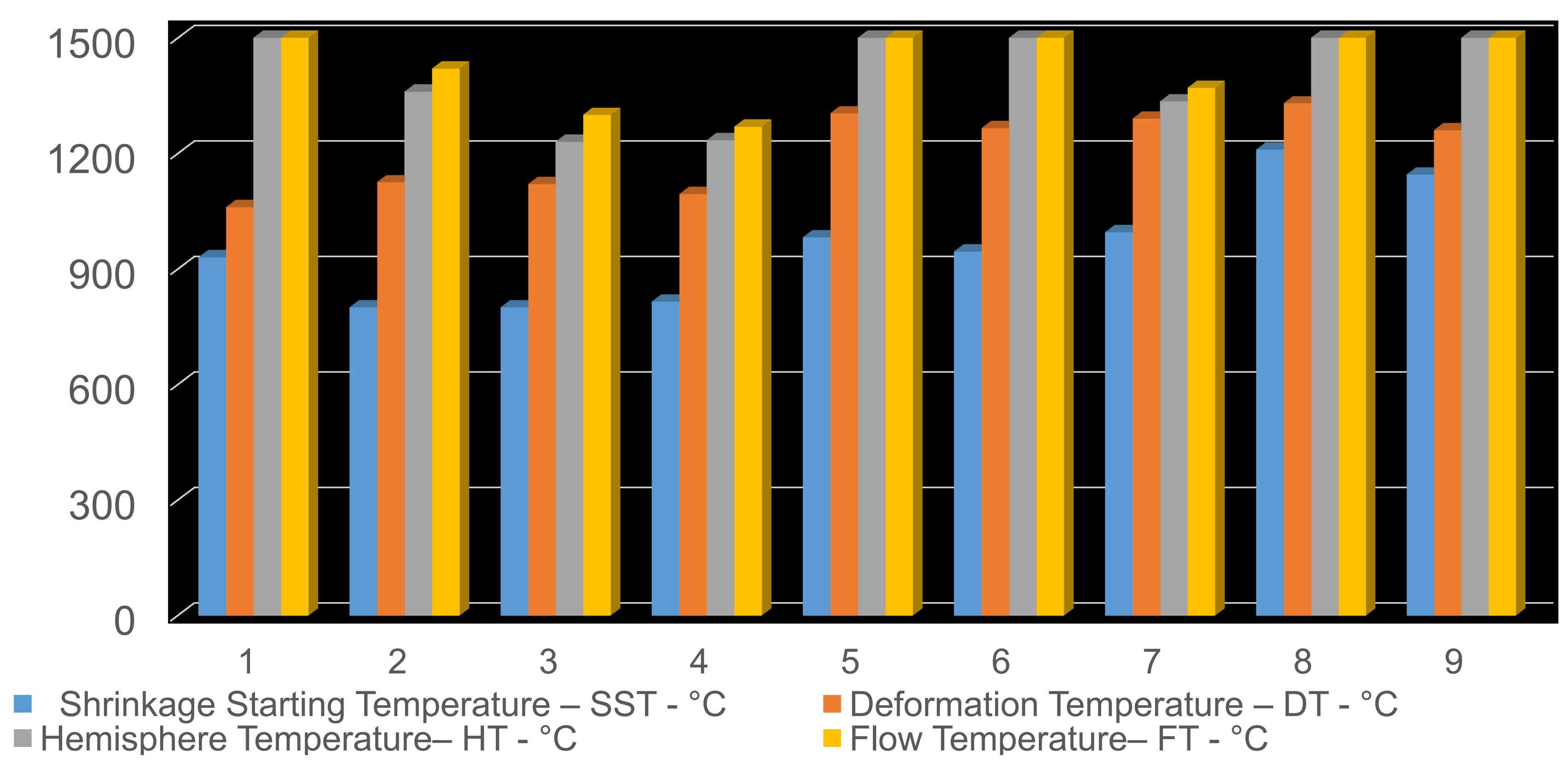

Figure 1 – Ash fusibility

Figure 2 presents the composition of the elements in the samples.

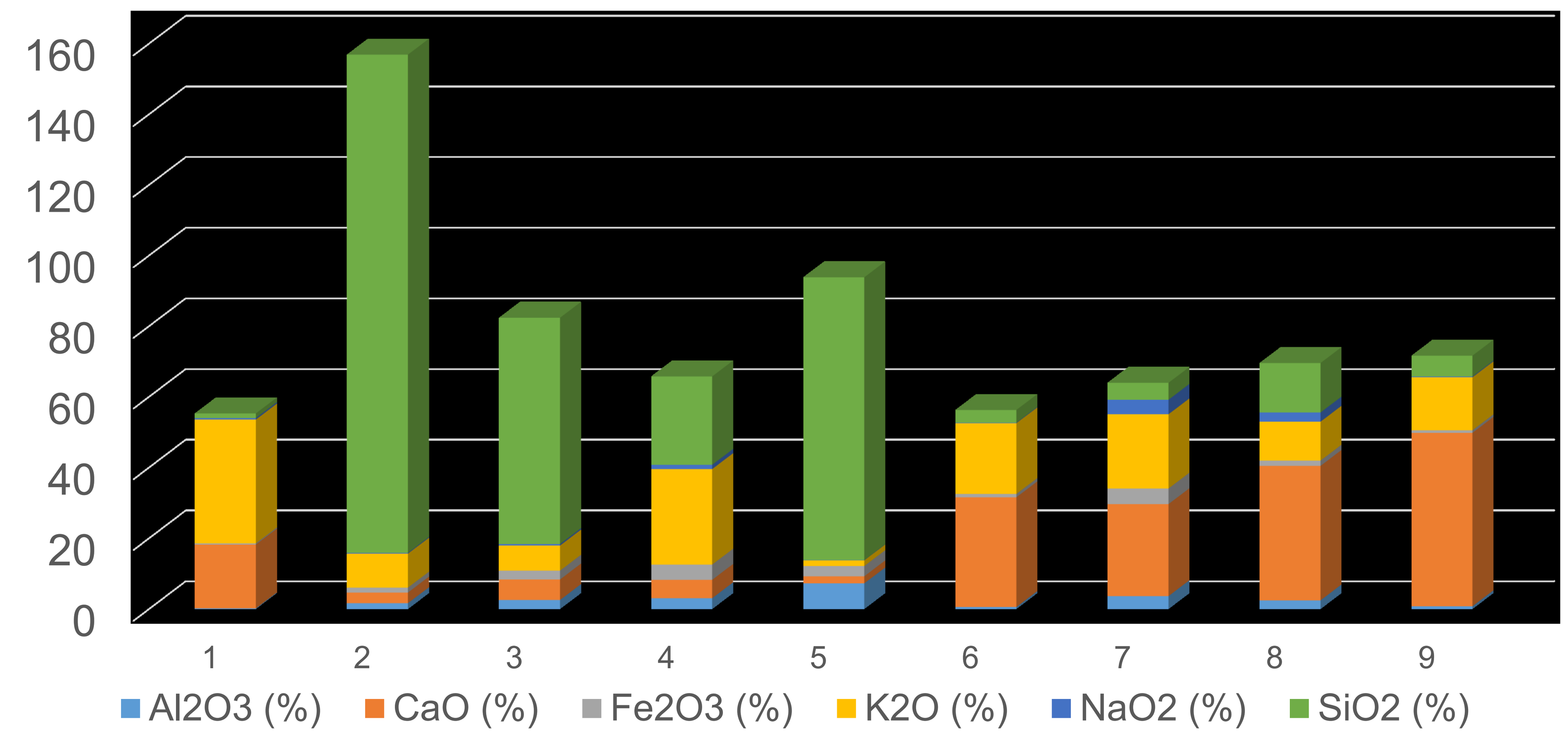

Figure 2 – Chemical Analysis

This study demonstrated the strong correlation between the chemical composition of ash and its melting point, which is essential for the proper management and use of biomass as an energy source. It was observed that refractory oxides, such as silica (SiO_2) and calcium (CaO), significantly increase the melting point of ash, providing greater thermal stability, while alkaline oxides (K_2O, Na_2O) and iron (Fe_2O_3) act as fluxing agents, reducing melting point and increasing the propensity for scale formation and corrosion in equipment.

CONCLUSION

As shown in Figure 1 although some sugarcane bagasse samples (1 to 5) present good thermal performance with deformation temperatures (DT) above 1100°C, the majority present lower hemisphere (HT) and creep (FT) temperatures.

Wood chips (6 to 9), on the other hand, present ash that is more stable and resistant to fusion, with deformation temperatures above 1260°C and, for the most part, presenting hemisphere (HT) and creep (FT) temperatures above 1500°C.

The analysis focused on a limited number of samples and a heating range limited to a maximum of 1500°C, which made it impossible to accurately determine melting temperatures in cases of greater refractoriness. Furthermore, factors such as the specific mineralogy of the silica present, the influence of trace elements (Mg, P, Cl, S), and actual boiler operating conditions were not explored at this stage, which could significantly impact fusible behavior.

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