USE OF A SCREW-FEEDER FOR BIOMASS FEEDING IN COMBUSTION PROCESSES IN A DTF AND COMPARISON TO THE GASEOUS EMISSIONS

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INTRODUCTION

➢ An important parameter when solid fuels are feeding in a thermochemical system is the homogeneous mass flow. The performance of the feeding mechanical conveying have been widely studied. However, several types of feeding systems are used and have shown high fluctuations of the flow mass. Therefore, such inconvenient should be reduced and studies that evaluate both the feeding system and different types of fuels need to be performed [1, 2]. For this reason, this study deals with experiments performed in a DTF (Drop Tube Furnace) using a particular feeding system specially designed by our research group.

OBJECTIVES

➢ This study evaluates 5 rotation velocities (30, 35, 40, 45 and 50%) of a screw-feeder, which maximum rotation is 15.0 rpm obtained by PWM (Pulse-Wide Modulation) for the biomasses feeding into a DTF.

➢ This study also evaluates emission gases (SO_2, CO, CO_2 and NO) from the combustion process.

MATERIALS AND METHODS

Figure 2. (a) *Tucumã's* fruits, (b) *tucumã* seed *in natura* after preparation and (c) SEM image of *tucumã* seed.

A) SAMPLES PREPARATION FOR FEEDING

- Washed, dried at 80 °C for 24 h, grinded and sieved.
- Average particle size of ≈ 460 μm.

B) THERMAL ANALYSIS OF THE RESIDUES

- TGA/ DTG (Shimadzu TGA-50);
- Atmosphere: synthetic air (100 mL min^{-1});
- Heating rate: 10 °C min^{-1} from room temperature to 700 °C;
- Sample mass: (10.0 ± 0.5) mg;

C) COMBUSTION PROCESS AND GASEOUS EMISSIONS

- Drop Tube Furnace (DTF);
- Furnace temperature: 1000 °C;
- Experimental time ± 10 minutes;
- Flow mass 0.3 g min^{-1};
- Primary air flow: 1 L min^{-1};
- Gases analyzer (SICK GMS 810) - SO_2, CO, CO_2 and NO.

RESULTS

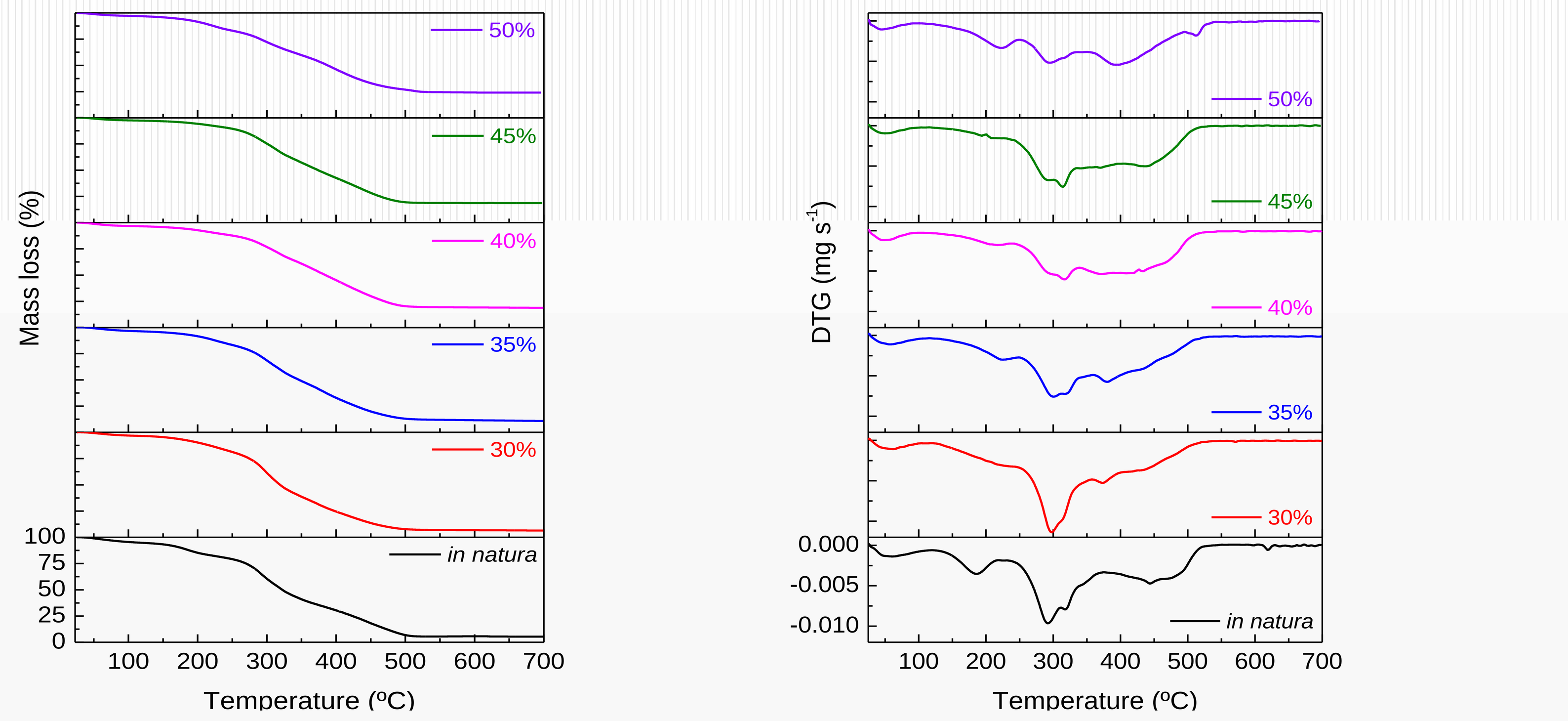

Figure 3. (a) TG and (b) DTG curves of *tucumã* seed *in natura* and ashes from the combustion obtained under 5 rotation velocities

Table 1. Mass loss percentage (%) for the *tucumã* seed *in natura* and after combustion process in a DTF at 5 rotation velocities

samples	moisture	Hemicellulose + cellulose + residual lignin	ash
in natura	5.3 ± 0.3	89.4 ± 1.3	5.3 ± 0.4
30%	3.7 ± 0.1	89.4 ± 0.6	6.9 ± 0.5
35%	4.8 ± 0.1	83.3 ± 0.7	11.9 ± 0.1
40%	4.4 ± 0.8	81.0 ± 1.4	13.8 ± 4.9
45%	3.4 ± 0.1	77.8 ± 0.2	18.8 ± 0.1
50%	3.3 ± 0.0	72.2 ± 0.5	24.5 ± 0.1

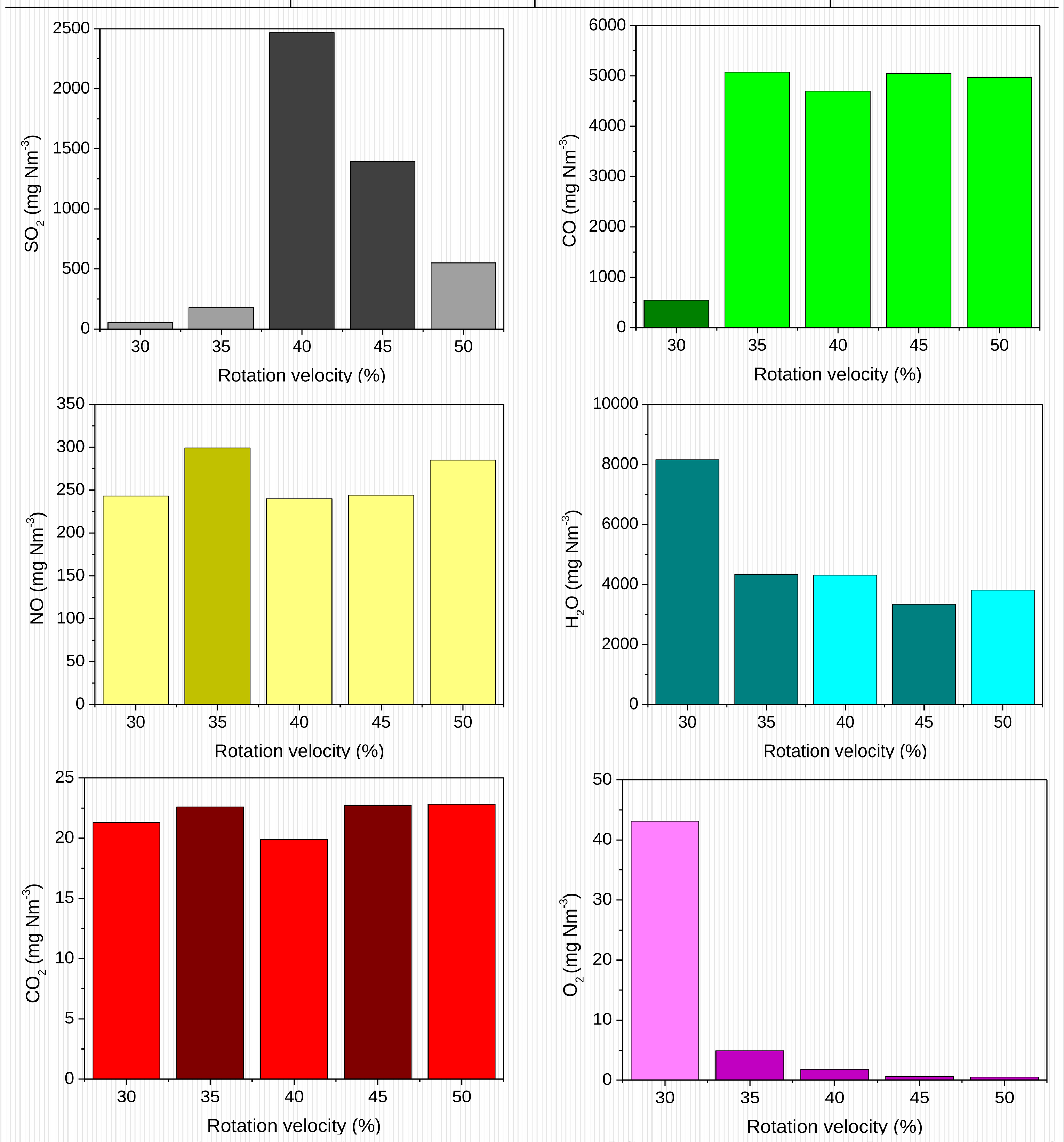

Figure 4. Main atmospheric pollutants generated by *tucumã* seed samples after combustion process in a DTF under N_2/O_2 (80/20) atmosphere at 5 rotation velocities.

CONCLUSIONS

➢ TG/DTG curves for the residues of *tucumã* seed samples after combustion process in a DTF at 5 rotation velocities, showed that 50% of motor total rotation was the best feeding velocity, which presented high loss of moisture, residual lignocellulosic material and ash formation, indicating a good efficiency of thermal conversion system;

➢ In the DTF, 40% was the optimal rotation velocity for the biomass feeding, which showed a more continuum and homogeneous mass flow;

➢ Gaseous emissions for these samples under combustion atmosphere in a DTF, presented at 30% rotation velocity the lower limits for SO_2 and CO. However, for NO and CO_2, 40%. The emission limits found in this study are in agreement with Brazilian environmental legislation.

REFERENCES

[1] Joppich, A. and Salman, H. **Biomass & Bioenergy**, v. 16, n. 3, p. 191-198, 1999.

[2] Gabra *et al.* **Biomass & Bioenergy**, v. 15, n. 2, p. 143-153, 1998.

ACKNOWLEDGEMENTS

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