PYROLYSIS OF KLASON LIGNINS EXTRACTED FROM FORESTRY RESIDUES

Marta Martins[1], M. Amélia Lemos[1], Francisco Lemos[1], Helena Pereira[2]
[1]CERENA, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal
[2] Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal

MOTIVATION

Biomass as an energy source is known to have many advantages such as being a renewable resource, low cost, being carbon dioxide neutral, reducing the dependence on fossil fuels, and having high availability. It is usually described in terms of three major constituents: hemicellulose, cellulose, and lignin.

Klason lignin constitutes the major mass proportion of the lignin content for most lignocellulosic materials. Understanding the pyrolysis kinetics of lignin is important to better understand woody biomass thermal degradation and provide useful information for rational design and scaling-up of pyrolysis reactors [1]. Pyrolysis is defined as thermal degradation under an inert atmosphere. Lignin decomposes at a much slower rate than other components of lignocellulosic materials, not only in the torrefaction (slow pyrolysis) temperature regime but also over a much wider range [2].

This study investigates the differences in thermal degradation behaviour of two Klason lignins obtained from two common shrub species present in the Portuguese Forest, ***rock rose***(Esteva) and ***white broom*** (Giesta) This behaviour was compared with a commercial Kraft lignin.

EXPERIMENTAL SETUP

Soxhlet Extraction

Acid hydrolysis with 72% of H_2SO_4
using 0,35g of each sample

Samples Extracted

Washing in H_2O distilled

Vaccum filtration

Klason lignin
- **TG/DSC**
  - TA Instruments SDT 2960 device
  - **Experimental conditions:**
    - N_2
    - 40 to 800ºC
    - 10ºC/min

Soluble lignin and carbohydrates
- **UV at 206nm**
- **HPLC / IC-PAD**

RESULTS

➢ BIOCHEMICAL COMPOSITION

Table 1 : Chemical composition of *white broom* and *rock rose* branches.

	Giesta branches	Esteva branches
Ash %	0.57	2.22
Total extractives%	34.50	18.20
Lignin total %	16.08	21.49
Klason lignin %	13.47	19.11
Solube lignin %	2.61	2.37
Polysaccharides %	32.77	36.61

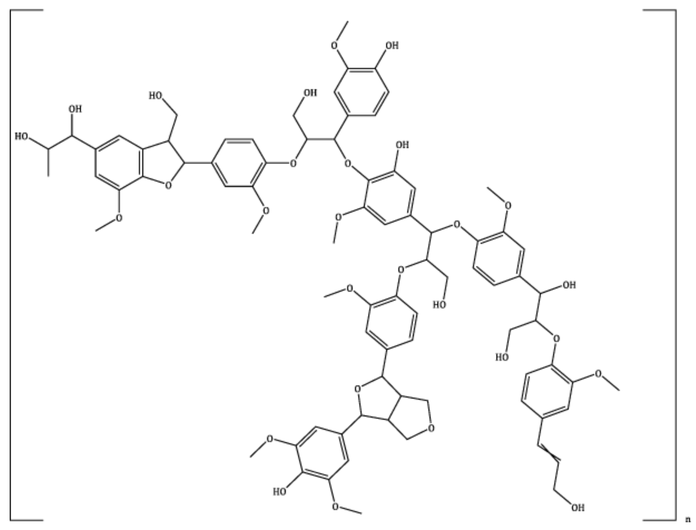

Fig. 1: Klason Lignin strucuture

➢ THERMAL ANALYSIS (TG/DSC) USING PYROLYSIS EXPERIMENTS

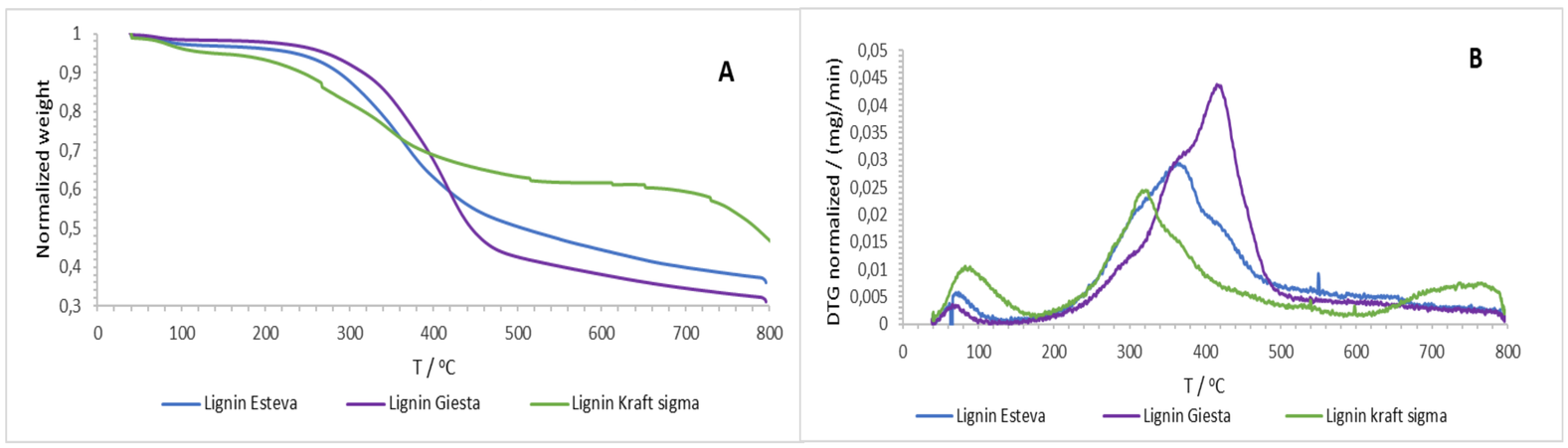

Fig. 2: TG (A) and DTG (B) profile for pyrolysis of two Klason lignins and Kraft lignin at 800ºC with heating rate of 10ºC/min.

CONCLUSIONS

- The lignin percentage of these samples was coherent with those reported for common lignocellulosic biomass (10-25% lignin).
- Klason lignins showed a faster degradation process than Kraft lignin.
- Apart from the moisture peak, the second DTG broad peak occurs at 360 and 420°C for Klason lignins extracted showing a more complex pattern with a wider temperature range than the commercial Kraft lignin used as reference.
- For Kraft lignin, the peak appeared at 325ºC. These peaks could be attributed to the primary lignin pyrolysis.

REFERENCES

1. Jiang G., Nowakowski, D. J., Bridgwater, A.V. A systematic study of the kinetics of lignin pyrolysis. Thermochimica Acta 2010; 498; 61-66.
2. Polleto M. Assessment of the thermal behaviour of lignins from softwood and hardwood species. Maderas. Ciencia y tecnologia 2017; 19, 63-74.

ACKNOWLEDGEMENTS

The author would like to thank the College of Chemistry of the University of Lisbon (CQUL) for the Ph.D. grant (Ref.14/BD/2017) and the FCT financial support through projects PTDC/EQU-EQU/29614/2017 and UID/ECI/04028/2020 (CERENA).