

Experimentation and combustion properties of Patagonian Andean forest (Argentina)

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Summary: The information on the combustible properties of native species of the Andean Patagonian Forest is scarce. In research paper we present the results of eight experimental fires, with their analysis and interpretation of shrinkage cracks produced in the wood of two conifers of the southern hemisphere: *Austrocedrus chilensis* and *Fitzroya cupressoides*.

Key words: experimentation, Andean Patagonian Forest, Argentina

INTRODUCTION

With experimentation, is possible to describe the quality that the woody species have as fuel (combustible), and to understand their behavior during combustion (Bazile-Robert, 1982; Théry-Pariset, 2001; Théry-Pariset and Costamagno, 2005). The experimental design, allows the investigator to have a more precise knowledge on the studied phenomenon. Nevertheless, the experiment has certain limitations regarding the difficulty of reproducing the past situations in an identical way

The information about combustible properties of the native species of the Patagonian forests is scarce. The objective of this research paper is expanding our knowledge about the combustible properties of four native species of the Andean Patagonian Forest: *Austrocedrus chilensis* ("Ciprés de la cordillera"), *Fitzroya cupressoides* ("Alerce"), *Nothofagus antarctica* ("Ñire") and *Nothofagus dombeyi* ("Coihue"). The method used in this investigation is as follows: The combustion was made with green and dry wood of each one of the species and the study and interpretation of shrinkage cracks of the remaining charcoal.

Later one we will develop the experimentations, analysis and interpretation of shrinkage cracks produced on the wood from two species mentioned before: *Austrocedrus chilensis* and *Fitzroya cupressoides*. The *Nothofagus* species are on the final process of experimentation.

DATA AND RESULTS

We realized a total of eight controlled combustions, half of them with wood of *F. cupressoides* and the remaining ones with *A. chilensis*. Each group of each species bonfires was divided in half and made with dry wood and fresh cut wood (green).

The eight combustions were realized under controlled laboratory conditions. All fires were made following a strict protocol. The tree branches were measured and weighed before and after combustion. Temperature, duration of flame and time of the total combustion were registered during the whole process for each one of the controlled combustion (Table 1).

The scars in the remaining charcoal that characterize the kind wood used for the combustion were analyzed using "Image pro-plus" image analyzer software. Over the transverse plane of the charcoal we quantified shrinkage cracks on 25 charcoals extracted from each of the eight fires, therefore a total of 200 charcoals were analyzed.

Experimental fires	Max T°	Combustion duration	Flame duration	Ashes (in g)
<i>F. cupressoides</i> (DW) 1	583°	1.47hs.	45 min.	37,56
<i>F. cupressoides</i> (GW) 2	522°	1.30hs.	12 min.	15,86
<i>A. chilensis</i> (DW) 1	497°	1.14hs.	25 min.	18,67
<i>A. chilensis</i> (DW) 2	488°	1.20hs.	28 min.	15,26
<i>A. chilensis</i> (GW) 2	464°	1.26hs.	13 min.	19,68
<i>F. cupressoides</i> (DW) 2	459°	1.38hs.	31 min.	18,21
<i>F. cupressoides</i> (GW) 1	441°	1.20hs.	13 min.	55,7
<i>A. chilensis</i> (GW) 1	426°	1.58hs.	12 min.	18,14
(DW) Dry wood (GW) Green wood			1-2: replicate	

TABLE 1. Data obtained from our combustion experiments.

The total combustion time reached by the fires was 1.30 to 2 hours (approximately). Dry wood of *F. cupressoides* reached the highest temperatures (583°C), while the lowest was registered using green wood of *A. chilensis* (426°C). The flame length was higher when dry wood was used, opposite to the fires with green wood (see Table 1).

All the charcoal obtained shown contraction cracks. The variable humidity becomes evident in the charcoal

resulting from the eight bonfires. The green wood combustions delivered charcoals with more contraction cracks than the ones made with dry wood. The highest temperature reached during the combustion does not infer to have direct relationship to the amount of contraction cracks observed in the charcoals obtained from the wood of both Patagonian conifers.

CONCLUSION

This stage of development of the experimentation allowed us to know the some properties of native Andean coniferous of the Patagonian Andean Forest used on combustions.

The combustion length, does not infer to have a relationship with the different species used in the experimental bonfires.

All combustions made with fresh cut wood had coals with a higher number of shrinkage cracks compared to the ones from dry wood. As an example an *A. chilensis* green wood bonfires generated 17 % shrinkage cracks opposite to the 6 to 9 % obtained from dry wood.

A relationship between the shrinkage cracks and the highest temperature reached during the combustions was not achieved during the analysis of the obtained coals from *A. chilensis* as well from *F. cupressoides*. However the deeply development of this topic will be restarted, once we conclude the experimental analysis of *Nothofagus antarctica* and *Nothofagus dombreyi* wood.

We will deepen in our knowledge working with more dry and green *Nothofagus* wood combustions.

These experiments will allow us to finally found and interpret charcoal indicators of combustible properties on these four native species of the Andean Patagonian Forest - *Austrocedrus chilensis*, *Fitzroya cupressoides*, *Nothofagus Antarctica* and *Nothofagus dombreyi*.

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FIGURE 2. From left to right, the different stages of the combustion experiment