



## Influences of Pectin on the Water Resistance Index of Orange Waste Charcoal Briquettes.

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### Abstract

Brazil's significant agriculture makes it capable of taking advantage of its residues in the thermochemical conversion process, such as carbonizing orange solid waste in order to obtain fuel briquettes. The charcoal must undergo an energy densification process, and a binder is required on this stage. The aim of this study was to verify the influence of the binder pectin on orange bagasse charcoal briquette's water resistance. The results showed that pectin improved the briquettes water resistance, however the WRI of all the samples were still considered low, once the best briquette WRI obtained was 67% when 15% of pectin was applied.

### Key words:

Orange bagasse, water resistance index, charcoal briquette.

### Introduction

The need for renewable energy resources has increased the interest in biomass waste. Brazil has high potential to use biomass in the thermochemical conversion process. Brazil also stands out as a major orange producer, which makes orange bagasse a viable alternative through the application of carbonization on orange solid waste<sup>1</sup>.

Charcoal particles themselves do not possess an effective binding mechanism. Therefore, a binder is required to provide the characteristics a briquette requires<sup>2</sup>. Aiming an improvement on briquettes properties, different binders have been tested, such as pectin. There are some tests that measure the quality of the briquette. The water resistance index (WRI) is one of them. The WRI test simulates severe storage conditions, where the briquette would be subjected to rain, evaluating its absorption of water. A high absorption makes the WRI lower.

The aim of this study is to identify the effects of different percentage of pectin on the WRI of orange bagasse charcoal briquette.

### Results and Discussion

The briquettes were made from a mixture of charcoal, pectin and water. The mixture was produced in two different ways. The first method (Mix 1) consists in mixing the pectin and the charcoal, and after that adding the water. In the second method (Mix 2), the pectin was added to the water, acquiring a gel like texture, and then the charcoal particles were put together. These mixtures were submitted to a cylindrical mold and a force of 5 tons was applied for 1 minute.

The WRI was determined by submerging the briquette in distillate water for 30 minutes. The briquette was weighted before and after the submersion. The WRI is given by Eq. 1. Similar methods can be found on the literature<sup>3</sup>.

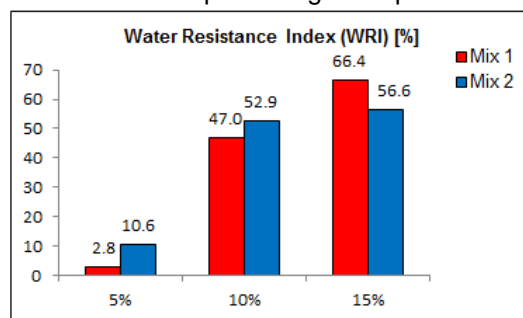
$$WRI [\%] = \left(1 - \frac{Final\ mass - Initial\ mass}{Initial\ mass}\right) \times 100 \quad (1)$$

A duplicate for each of the three different percentage of pectin was made, the results are shown below

Table 1. Initial mass and absorption

Charcoal Briquette	Mix 1		Mix 2	
	I. Mass [g]	Absorption [%]	I. Mass [g]	Absorption [%]
5%	4,3176 ± 1,5548	97,20	4,9529 ± 0,8782	89,45
10%	3,8677 ± 0,4230	53,01	5,4374 ± 0,0512	47,14
15%	3,2963 ± 0,4316	33,55	4,4841 ± 0,3701	43,39

Chart 1. WRI for each percentage composition of binder



As the percentage of binder increases, the WRI also increases, indicating that pectin is a good binder to this characteristic. The results show that there is no tendency in the WRI value regarding the type of mixture. All briquettes presented WRI lower than 95%, which is considered a low index according to Richards (1991). This may have happened due to the high porosity of the charcoal particles. Further studies on this must be done.

### Conclusions

Increasing the percentage of the binder had a positive effect on the WRI. Even though, the tests demonstrated that severe humidity conditions are detrimental even to briquettes made with 15% pectin. Orange waste charcoal briquettes with pectin as binder require over caution on storage conditions.

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<sup>1</sup>Tienne, L.; Deschamps, M.; Andrade, A. Biomassa & Energia, 2004, v. 1, n.2.

<sup>2</sup>Teixeira, R., S.; Souza, A. E.; Peña, A. F. V.; Lima, R. G.; Miguel, A. G. In:

Manzanera, M. Alternative Fuel, 2011, cap. 8, p.179-200.

<sup>3</sup>Richards S. R. Physical testing of fuel briquettes. Fuel Process Technol 1990, v.25, p.89-100.