Briquettes from Sugarcane Crop Residue as potential fuel for co-firing biomass-coal at the South West Colombian Region

DANIELA LOPEZ

BY JESUS AGUALIMPIA

JUAN BARRAZA

UNIVERSIDAD DEL VALLE

FACULTAD DE INGENIERIA

ESCUELA DE INGENIERIA QUIMICA

Universidad del Valle
Facultad de Ingeniería

Saccharum officinarum – SUGAR CANE

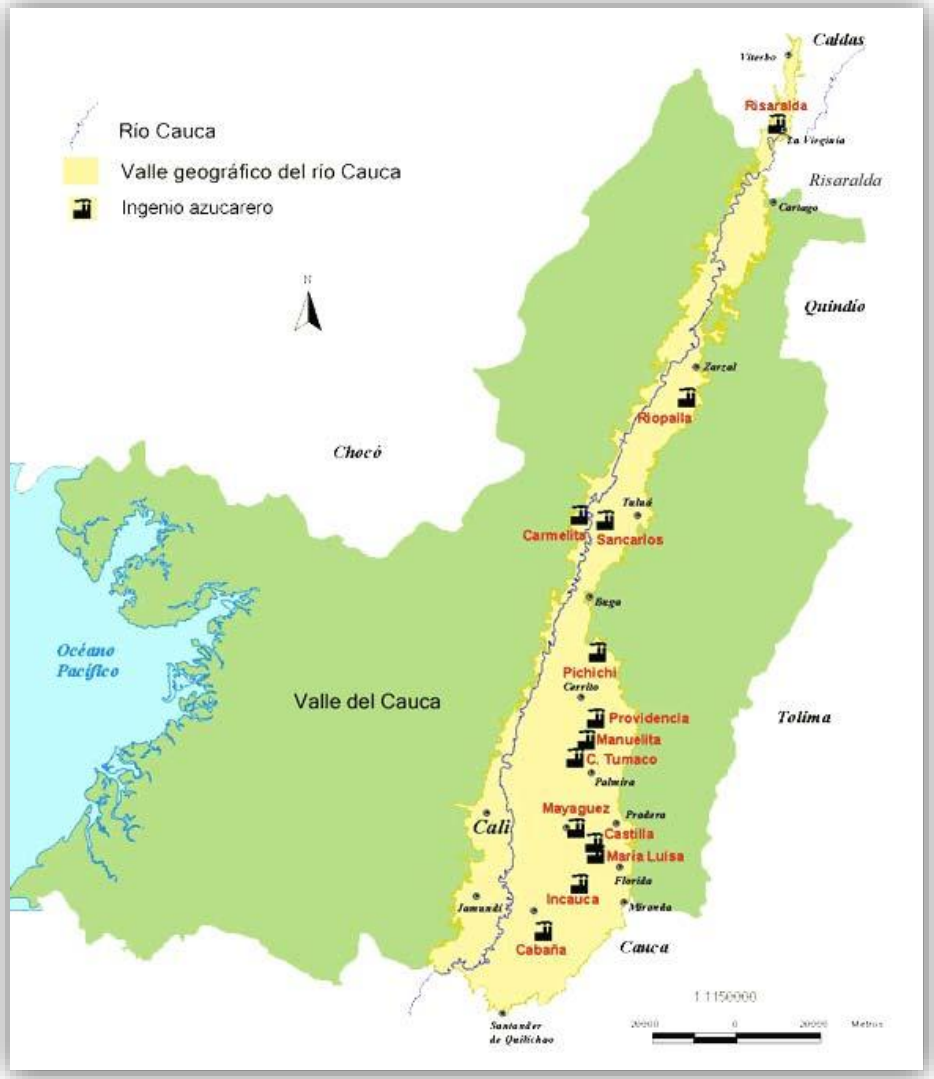
1

- Most used for sugar
- HARVEST EVERY 12 - 14 MONTHS
- SOWING CONTINUES ALL YEAR

2

- 125 tons/hectare per year
- 80 tons/hectare of residue per year
- 225.650 hectares in Colombia

South west of Colombia



Sugarmills

13 sugarmills in 273,4 miles

Use of sugar cane:

- Juice extracted from the stem for the production of sugar
- Residue of sugar production – Bagasse is used for the production of energy in steam boilers
- Molasses is used for the production of bioethanol

75%

PROBLEM WITH THE RESIDUE

RESIDUE DENSITY
25 – 30 kg/m3

- Expensive transportation
- poor combustion efficiency in boilers – unburned material
- MANUAL HANDLING DIFFICULT AND DANGEROUS

Objetives

- To evaluate the influence of the composition of the residue (leaves and stems) in the preparation of briquettes of sugar cane residue.

- Analysis the effect of compaction pressure and particle size on the characteristics of the briquette as mechanical strength and density.

Particule size
Size of the sieve hole

The particle diameter ranges selected by preliminary briquetting tests were: 0.31 - 0.59 mm (ret 60) and 0.59 - 0.97 mm (ret 35).

Variables to test results

For the analysis of briquettes were used as response variables:

- Impact resistance index
- Compressive strength
- Density
- % Of conversation

Pressure to compact

For the process of analysis on the compression pressure and the density of the resulting briquettes, sugar cane leaf samples were used in the analysis pressure ranges of 16, 24, 32, 40 Mpa

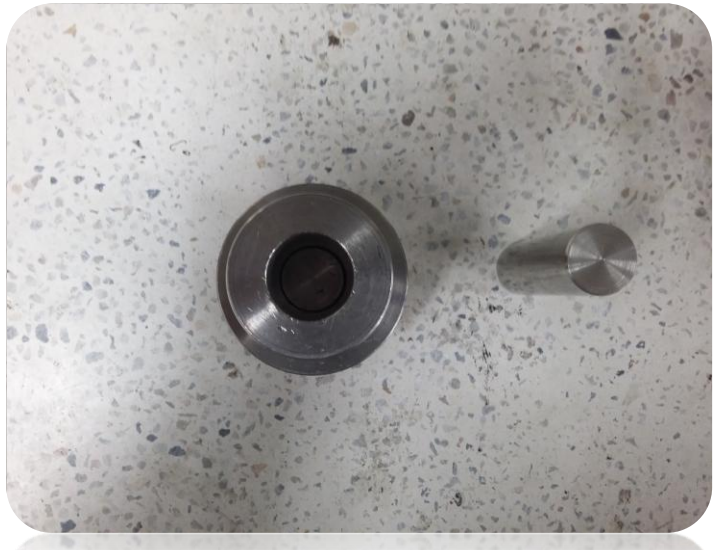
MIX

While for the analysis of the effect of dense material (stem) on the qualities of the briquette blends of leaf and stem were used in concentrations of 0, 33, 66 and 100% (% stem)

Briquetting process

BRIQUETTE

1¨ X 1¨



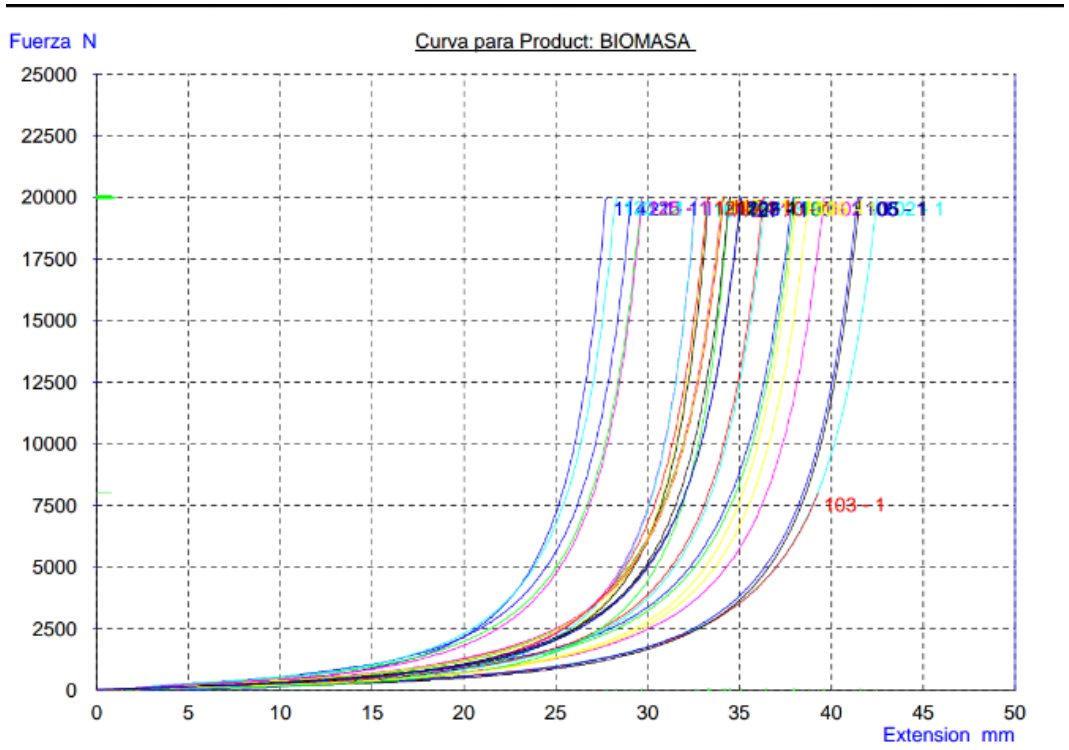
MOLD

Tinius Olsen

Briquetting process

6 grams of each sample was weighed and added to the mold without binder, applying the following strength levels: 8, 12, 16 and 20 kN, and holding the force on the piston for 1 second.

The conversion to Mpa is performed with the cross-sectional area to the applied force which in this case would be 2.54 cm of the piston of the mold.

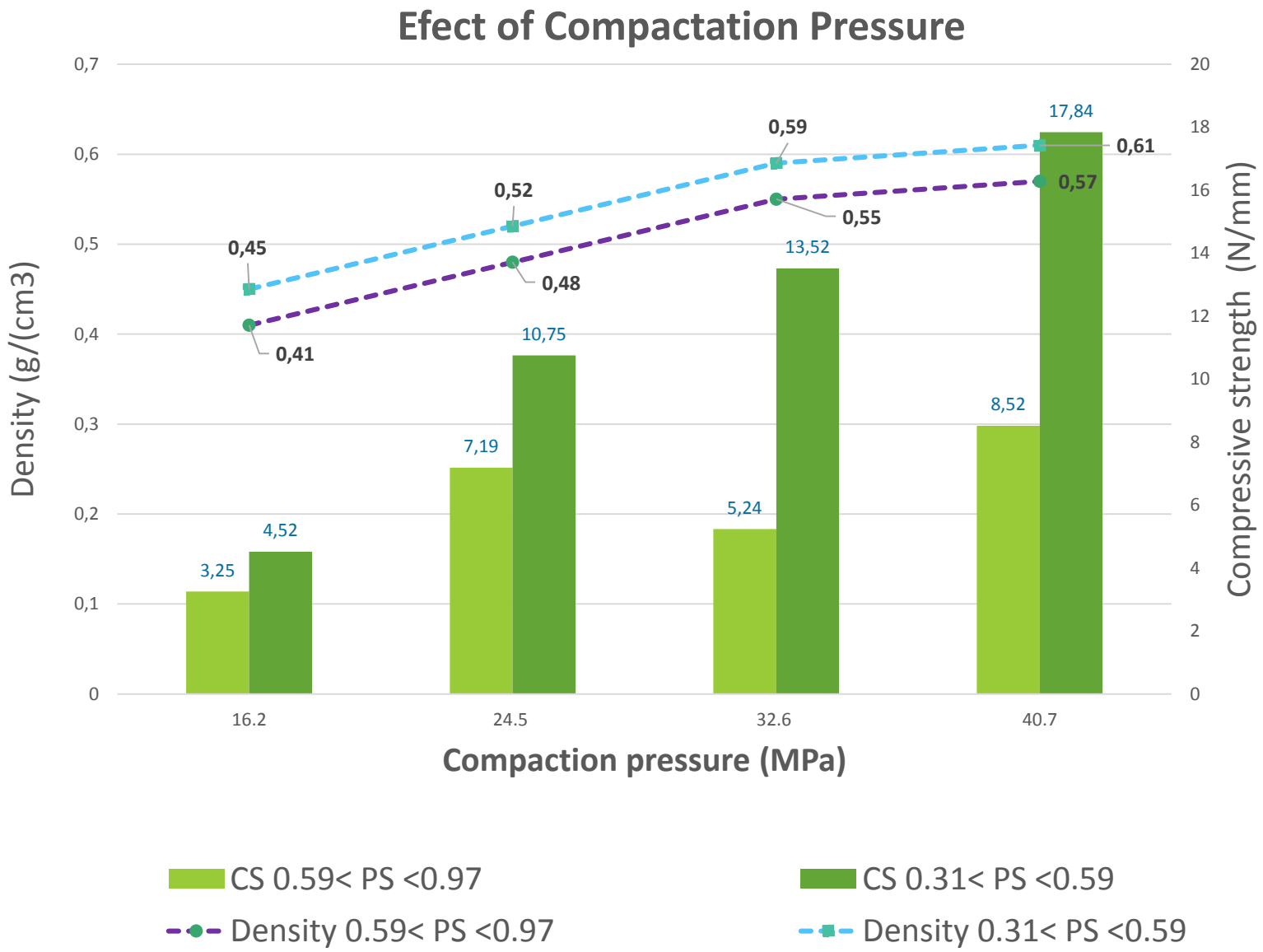


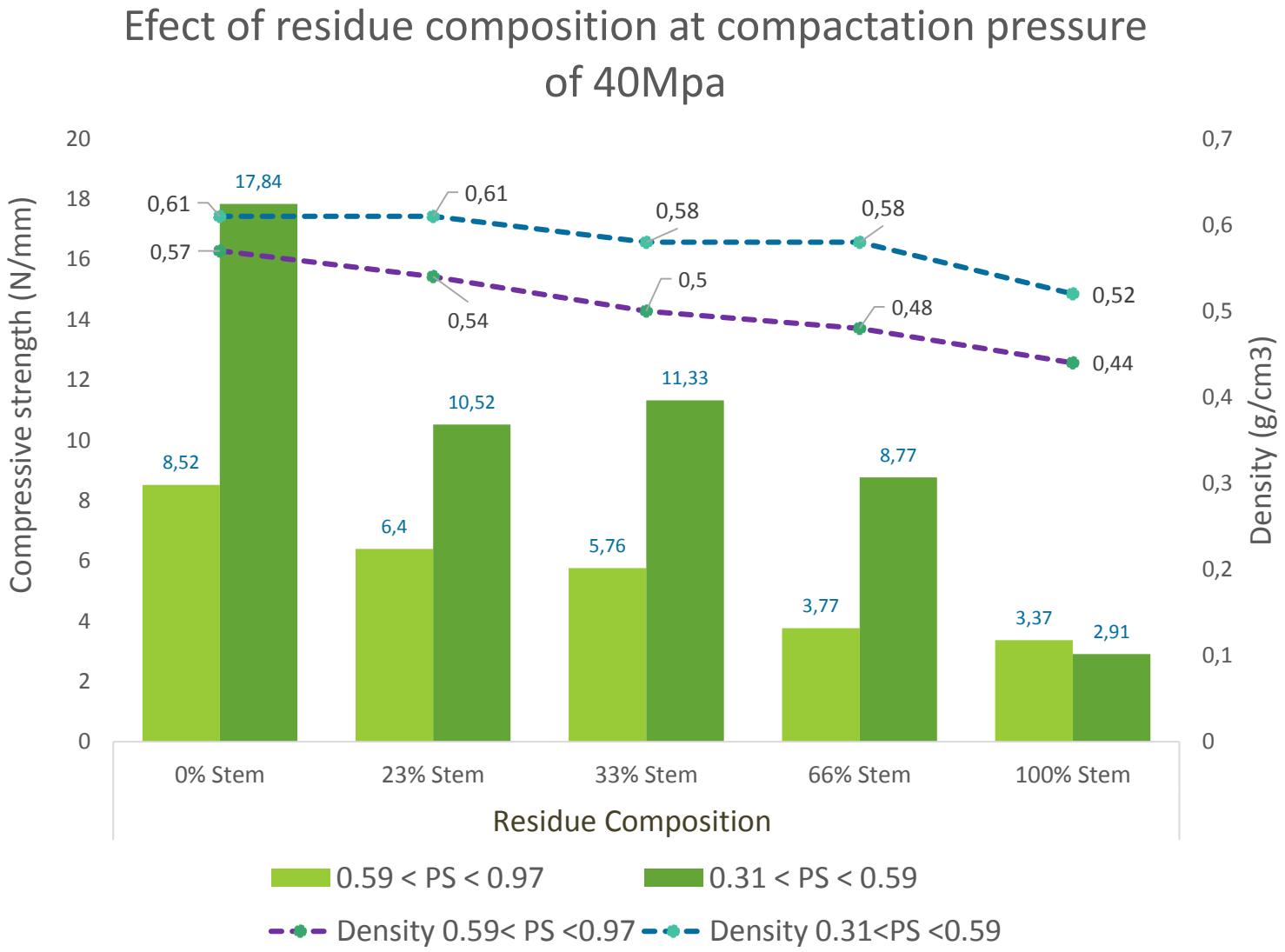
Speed of compaction: 30 mm/min

Leaves

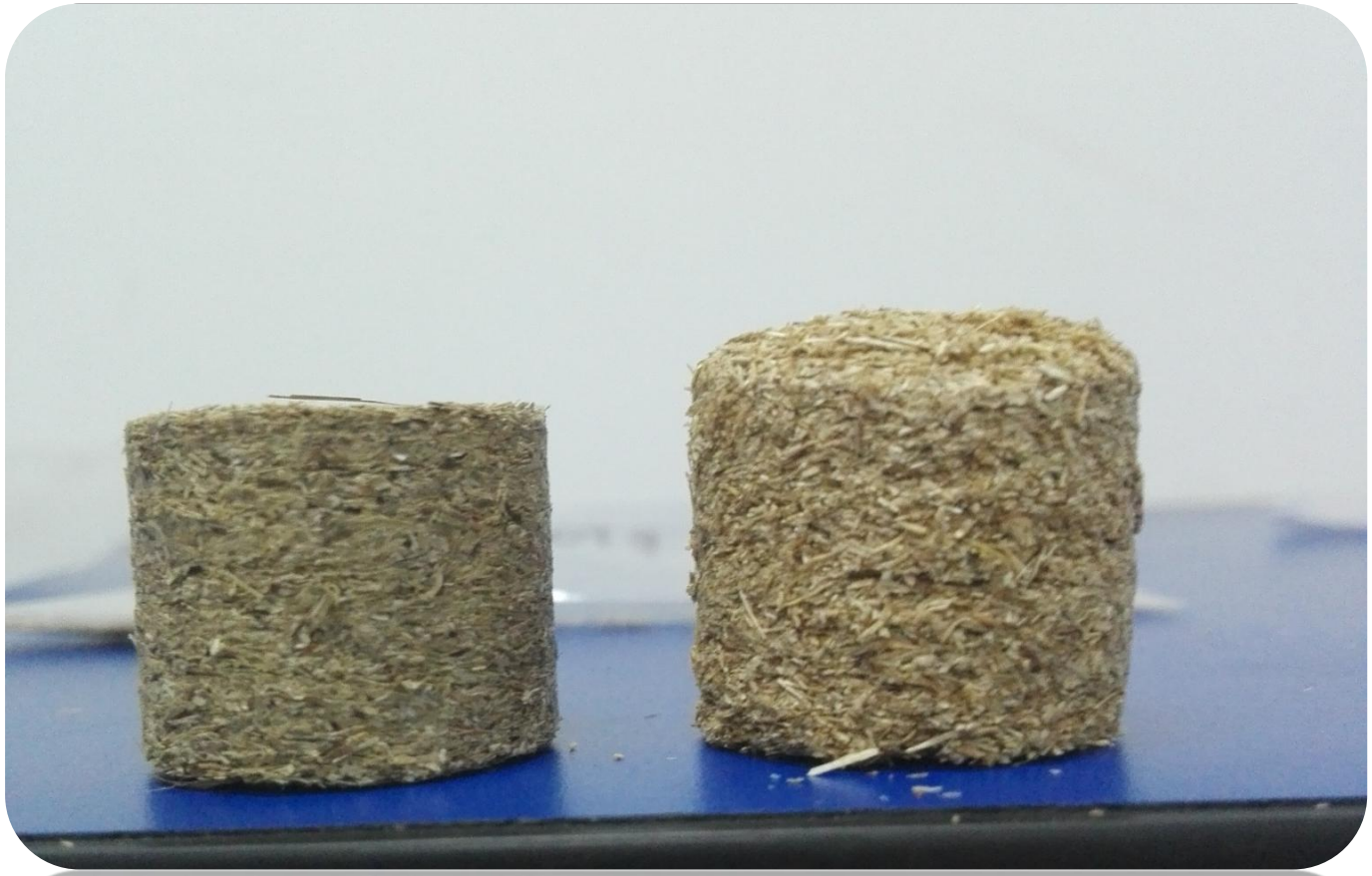
Moisture (%w)	
6,7	7,3
Ash (%w)	
14,9	5,7

Stem and bud


Efect of Compactation Pressure
Density (g/(cm3)
Compressive strength (N/mm)
Compaction pressure (MPa)
16.2
24.5
32.6
40.7
0,45
0,52
0,59
0,61
0,41
0,48
0,55
0,57
3,25
4,52
7,19
10,75
5,24
13,52
8,52
17,84
CS 0.59< PS <0.97
CS 0.31< PS <0.59
Density 0.59< PS <0.97
Density 0.31< PS <0.59


Efect of residue composition at compactation pressure of 40Mpa
Compressive strength (N/mm)
Density (g/cm3)
20
18
16
14
12
10
8
6
4
2
0
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
17,84
8,52
10,52
6,4
11,33
5,76
8,77
3,77
3,37
2,91
0,61
0,61
0,58
0,58
0,52
0,57
0,54
0,5
0,48
0,44
0% Stem
23% Stem
33% Stem
66% Stem
100% Stem
Residue Composition
0.59 < PS < 0.97
0.31 < PS < 0.59
Density 0.59< PS <0.97
Density 0.31<PS <0.59

VISUAL MIXTURE EFFECTS



0%

66%

Strength Compression

The compressive strength test was performed with the Tinius Olsen H50ks universal test machine from the physical tests laboratory of the Universidad del Valle, with a compression stroke speed of 0.035 mm / min, and Entering the values of length and diameter of the briquettes to the software connected to the test machine that attends the next equation

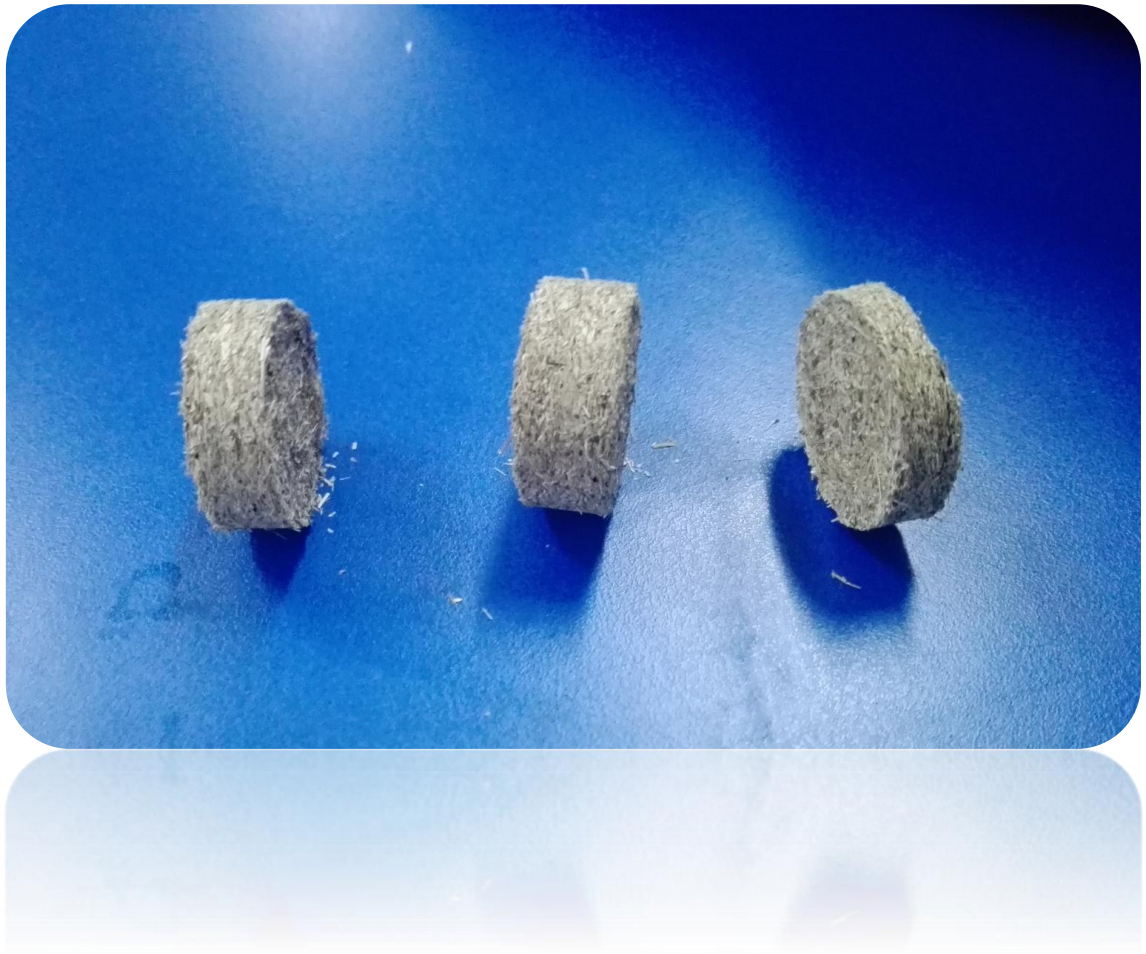
$$\text{Compressive strength in cleft } (N/mm) = \frac{3 \times \textit{The load at fracture point } (N)}{[l_1(mm) + l_2(mm) + l_3(mm)]}$$

INDEX OF IMPACT STRENGTH (IRI)

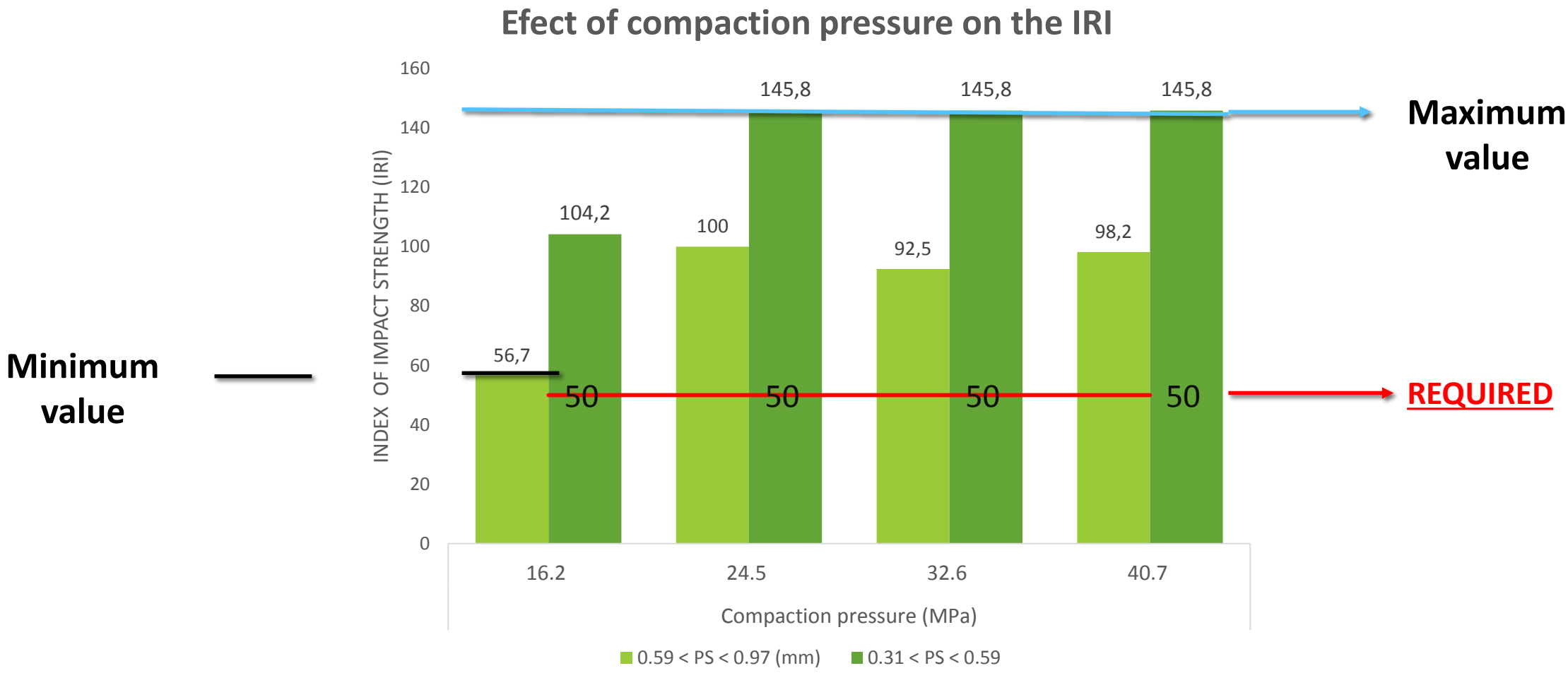
Throw the briquette 5 times from 1.80 meters on a glass plate, weighing the briquette between each impact, counting the amount of pieces detached as long as they weigh more than 5% of the initial weight of the briquette.*

$$IRI = \frac{100N}{n}$$

N: number of throws
N: number of pieces formed.



*The A-STM method D440-86

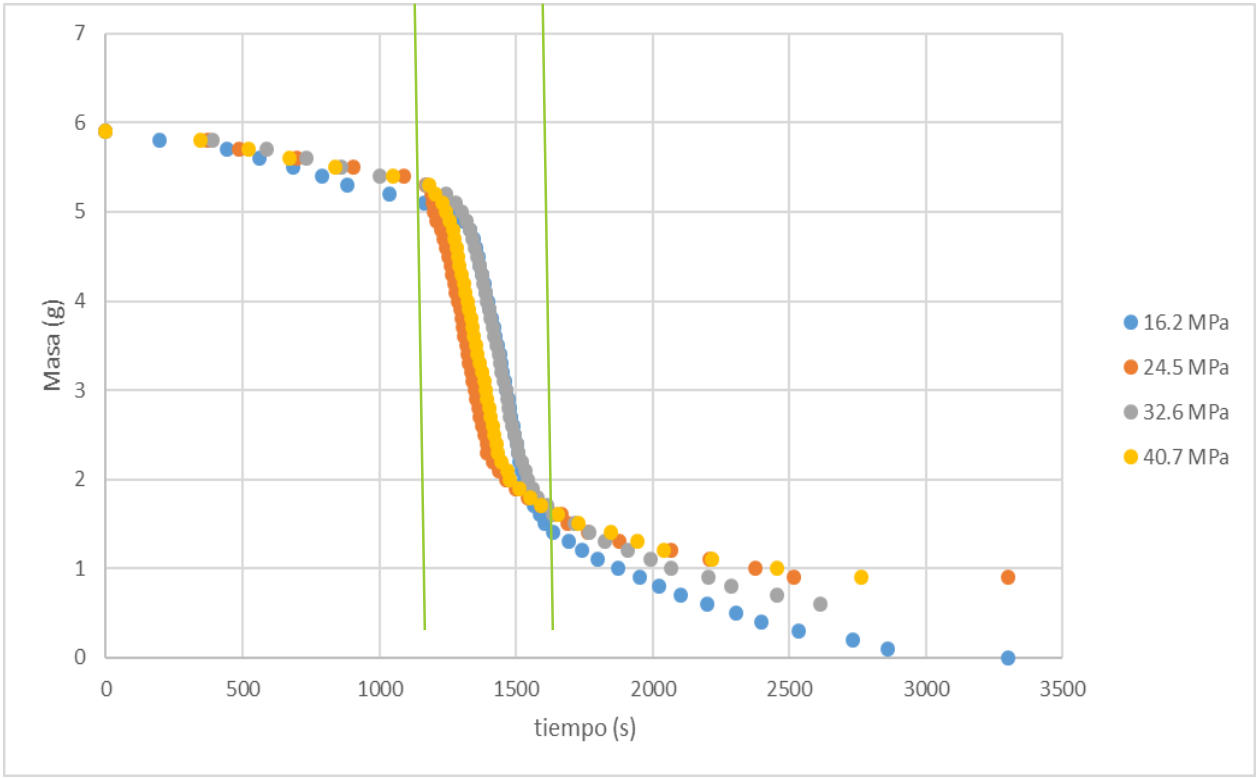


Factors affecting strength and durability of densified biomass products by Nalladurai Kaliyan, R. Vance Morey - 2008

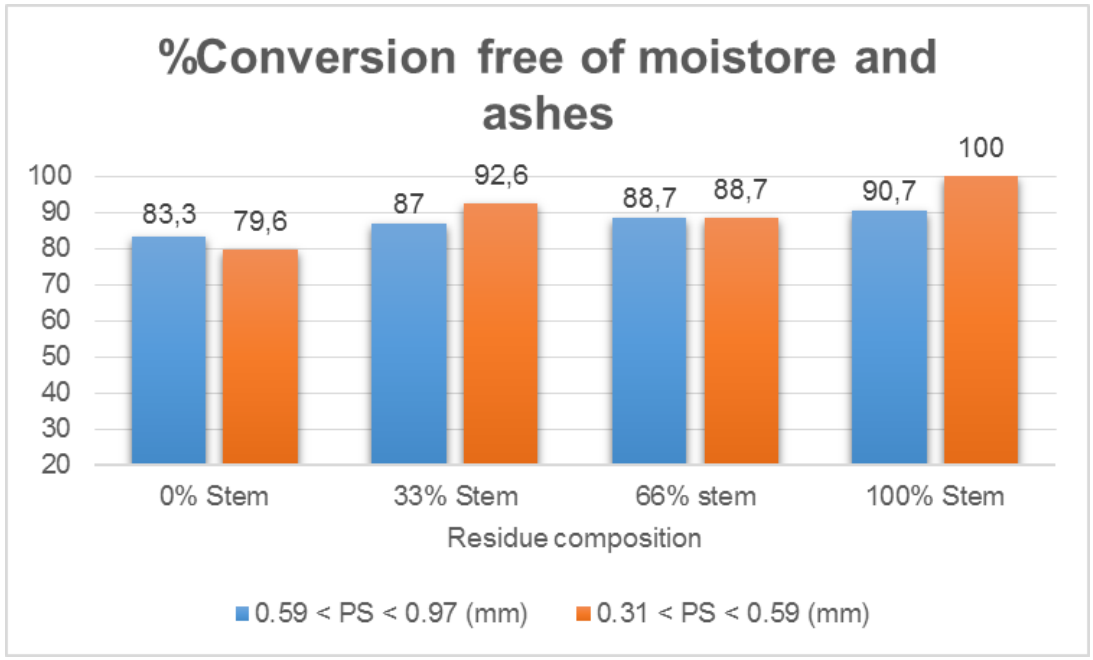
REACTIVITY TESTS

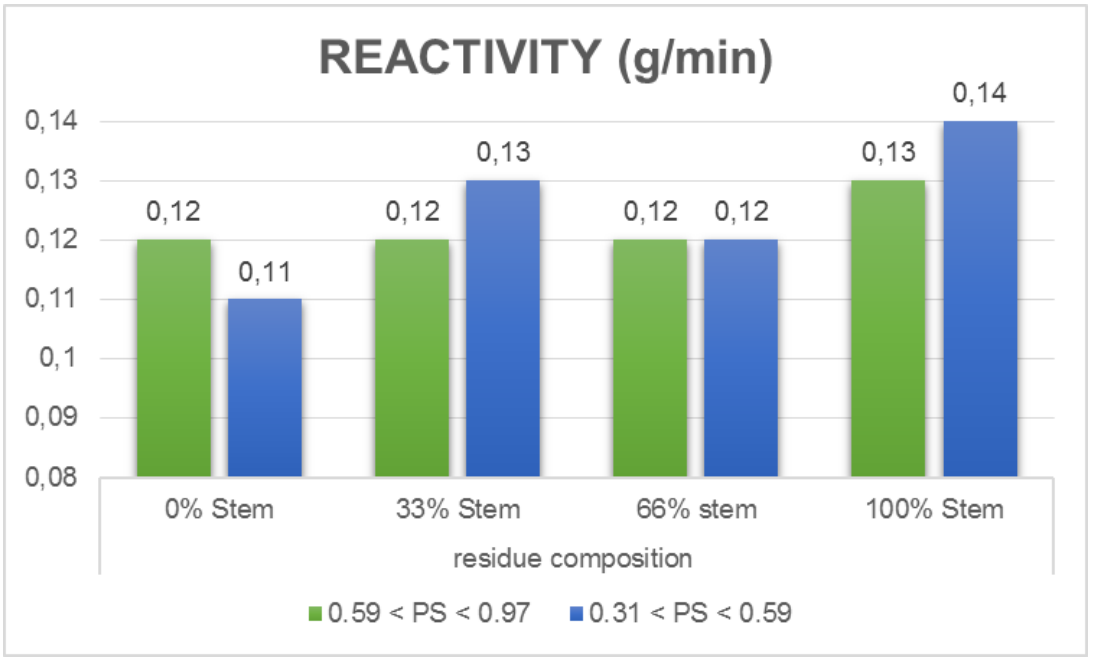
A mufla with gramera and a ramp of 600 degrees, with a delta of 10 degrees per minute, and continuously measuring weight, temperature and time.

Plus percentage of moisture and ash

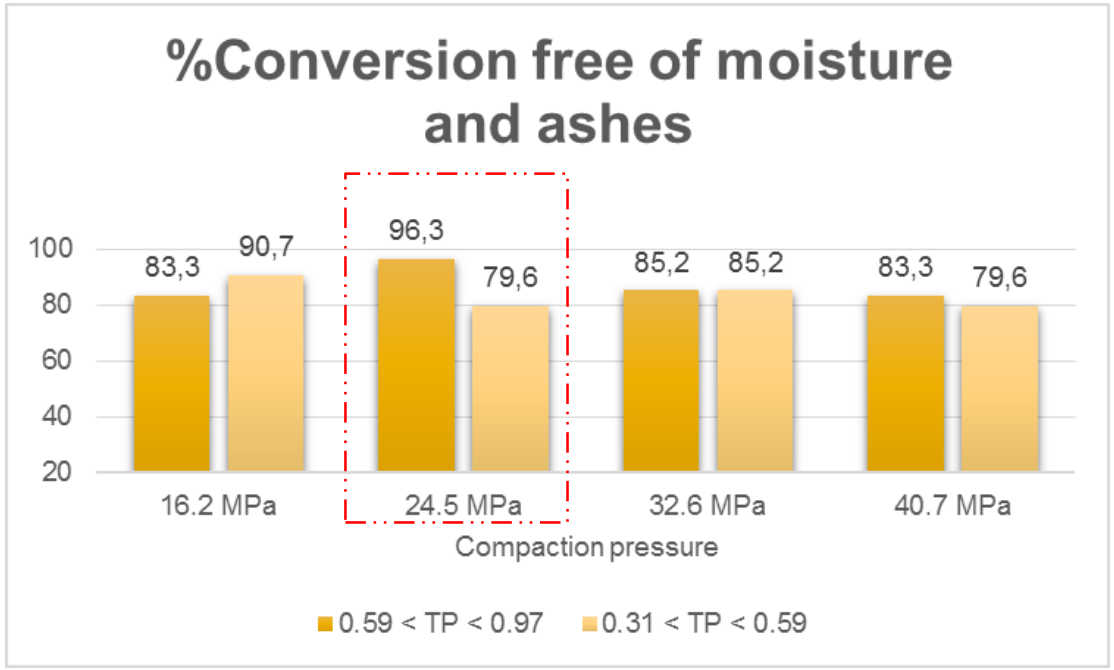


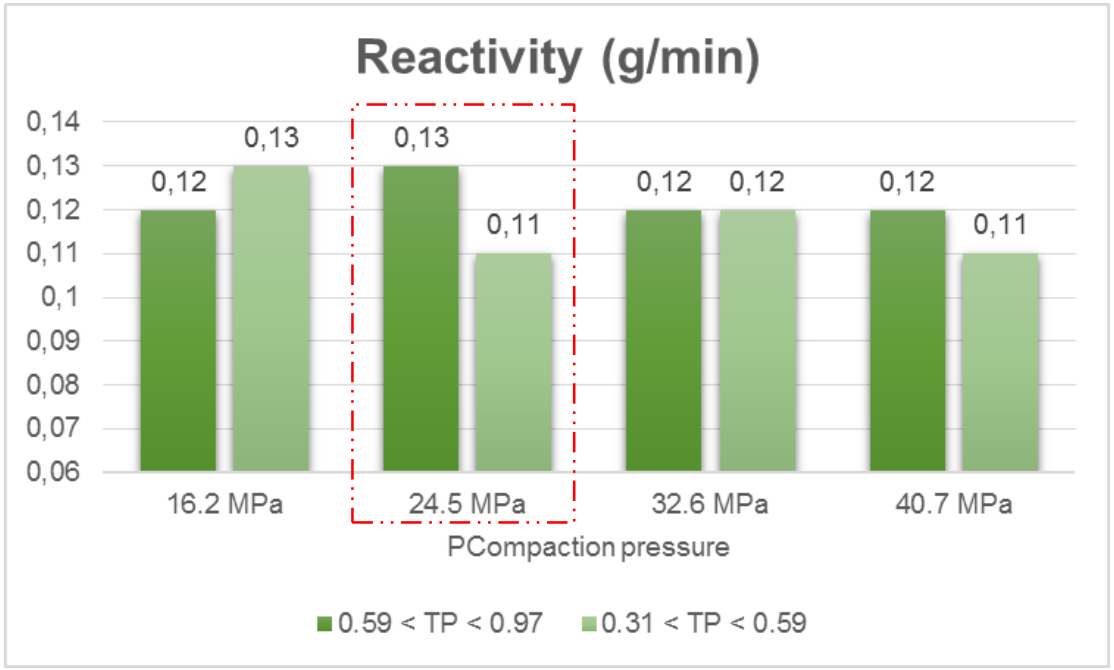
Residue composition





Compaction pressure





THANKS FOR YOUR ATTENTION