



the influence of the
parameters of
charcoal pellets and relative humidity
on compressive strength and
moisture adsorption

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Material and method

Resultss

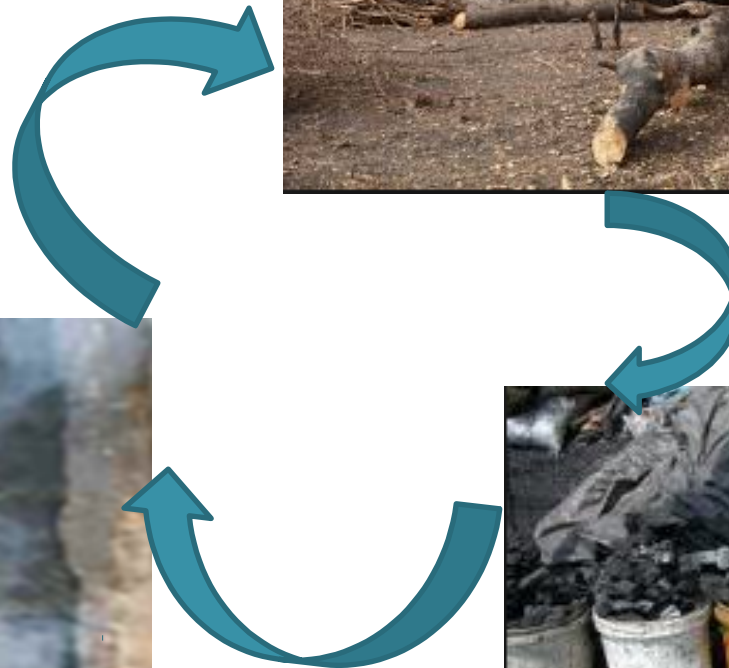
Conclusion and prospects

Context

and

problematic

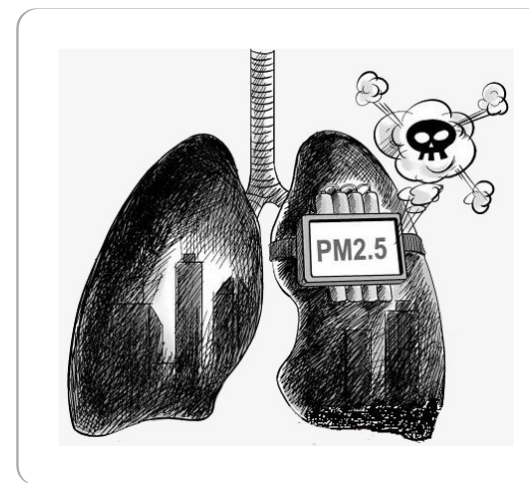
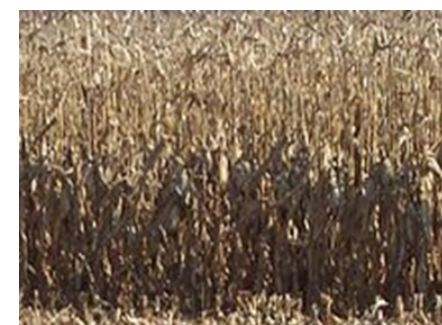
In the World, some where in Senegal



Context and

problematic

- Over 40% of our agricultural and forestry crops are wastes
- This amount of agriculture and forestry wastes could be used to make coal briquettes
- 7904 deaths in Senegal in 2016 were attributed to household air pollution (WHO, 2018) by use of biomass cooking fuel



Context and problematic	Material and methods	Results and Discussions	Conclusion & prospects
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We need alternative cooking fuels like **coal** **briquette** to satisfy our daily **needs**!



Solution: Valorization of agricultures and forestry waste



Agricultur
e waste



Coal
briquett
es



Clean and
efficient
cooking

Purpose of the study

- Examines the influence of operating variables of charcoal pellets production on compressive strength and moisture adsorption by statistical analysis.

Context and problematic	Material and methods	Results and Discussions	Conclusion & prospects
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Production of charcoal pellets

1. Preparation of binder solutions



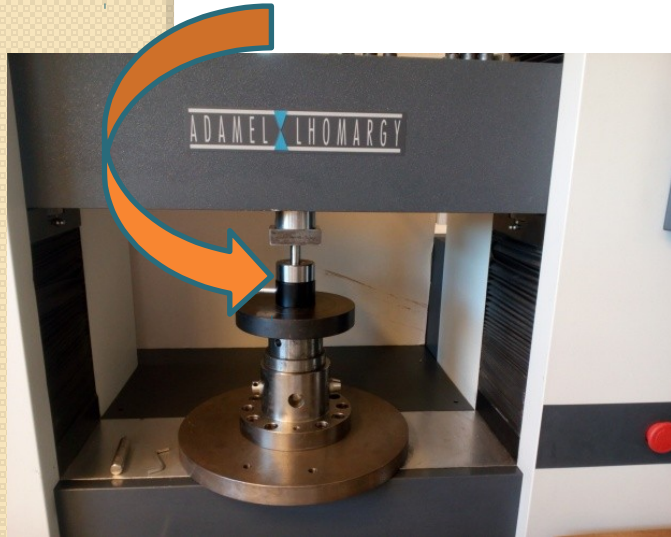
2. Mixing of fine coal with binder solution



Blend product

Production of charcoal pellets

2 g of the mixing



3. Compaction

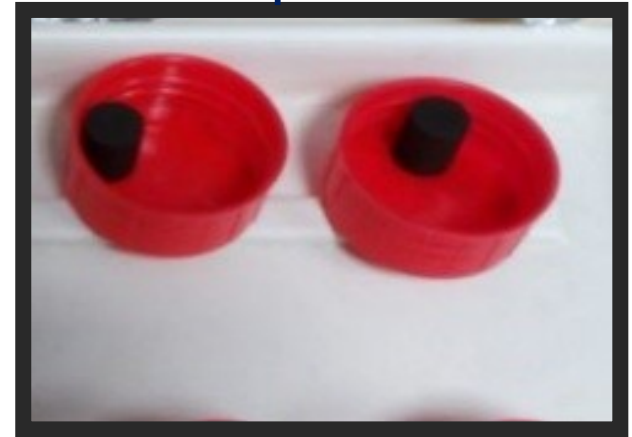
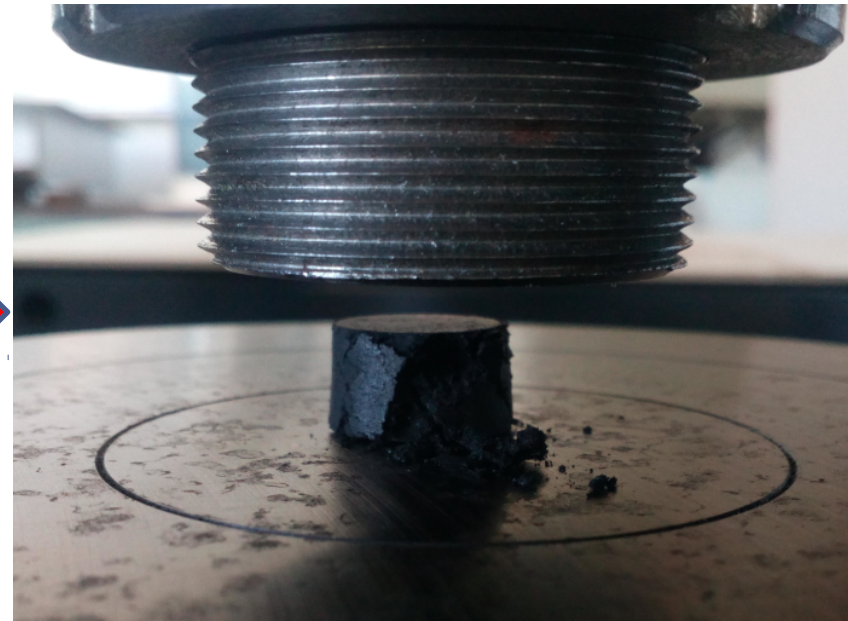
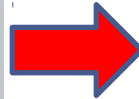
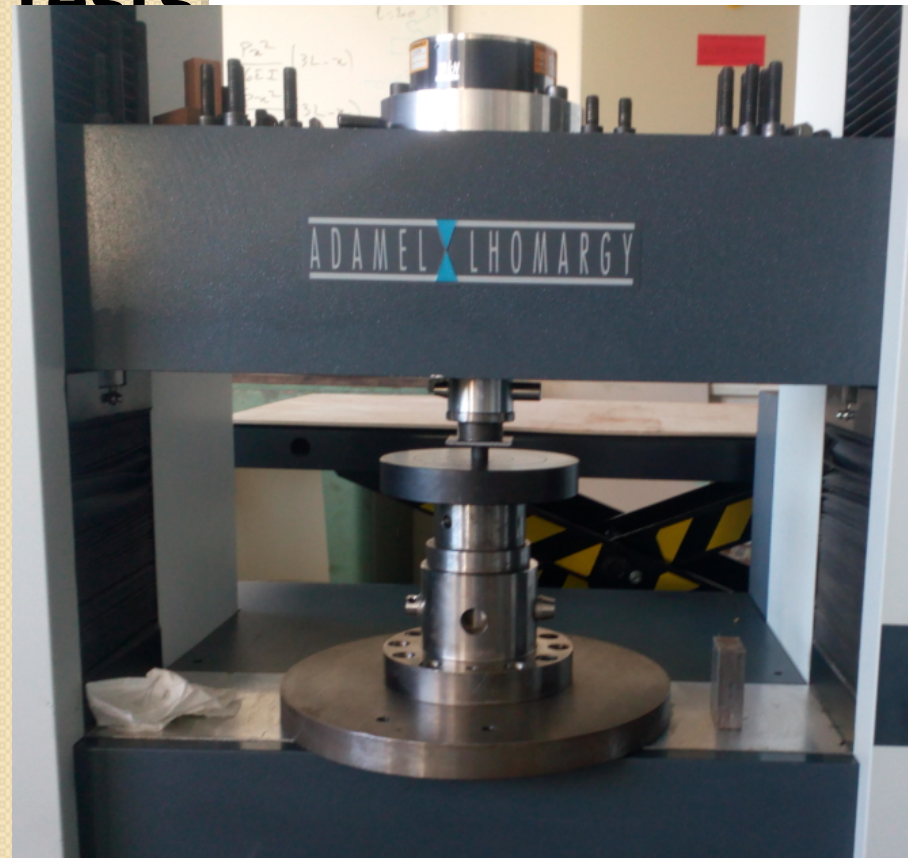


Table of control of pressure and displacement

- ✓ Compaction pressure: 20, 30 & 50 MPa
- ✓ Displacement velocity: 0.05 mm/s

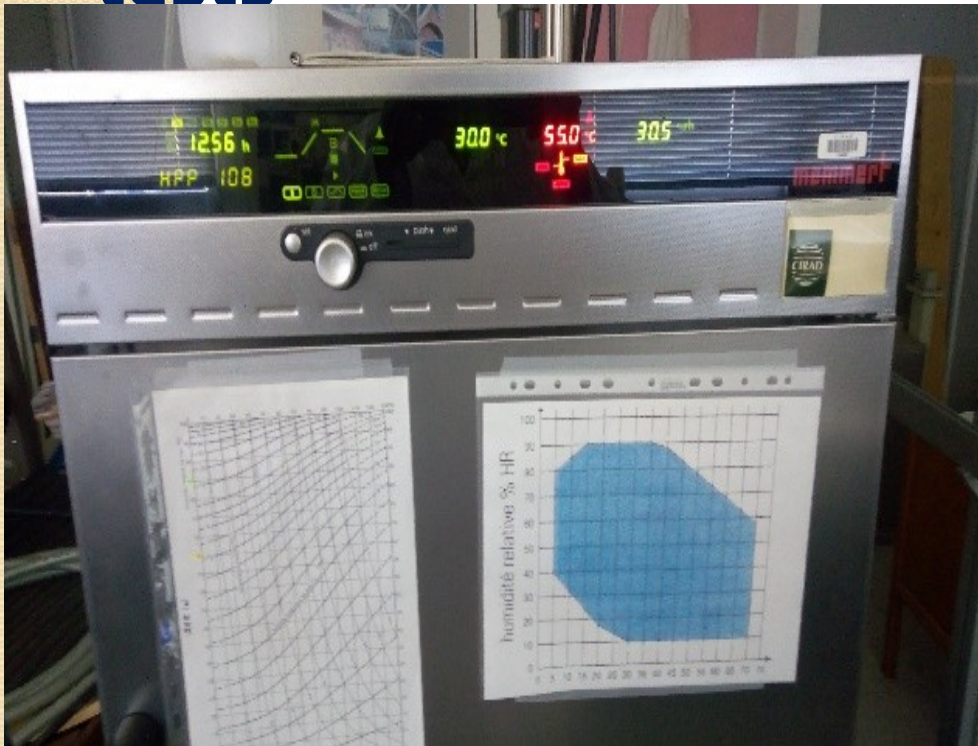
Compressive strength tests

strength



- ✓ Apply load until structure of pellet failed

Moisture adsorption tests



✓ Test conditions: relative humidity (30 %, 65 % et 80 %), temperature (30 °C)

Memmert oven for moisture adsorption tests

Axial compressive strength results

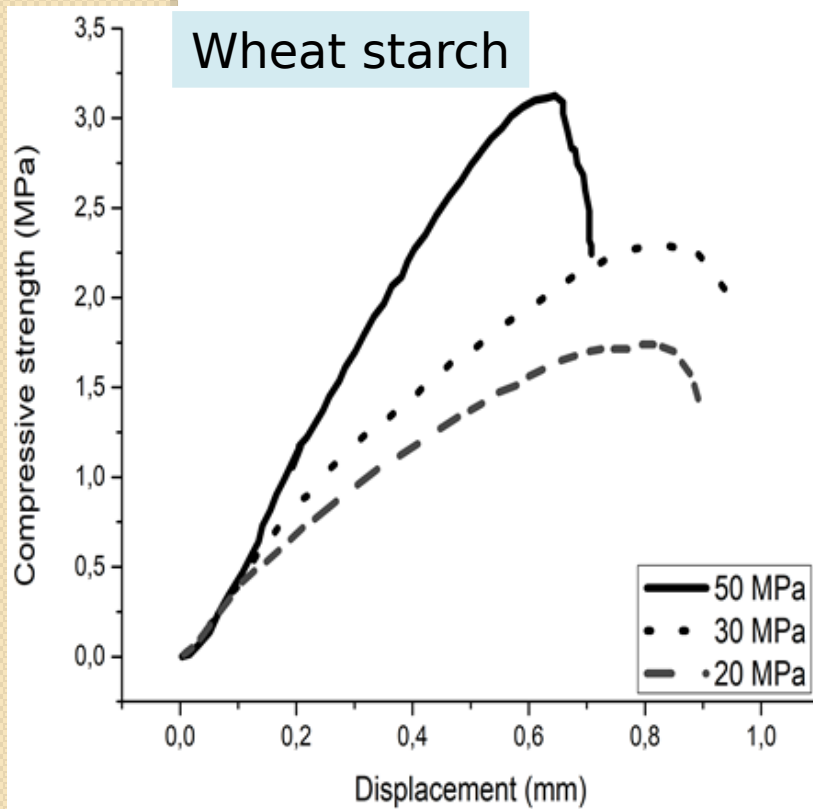


Fig.1: Compressive strength of charcoal pellets with 10% of wheat starch

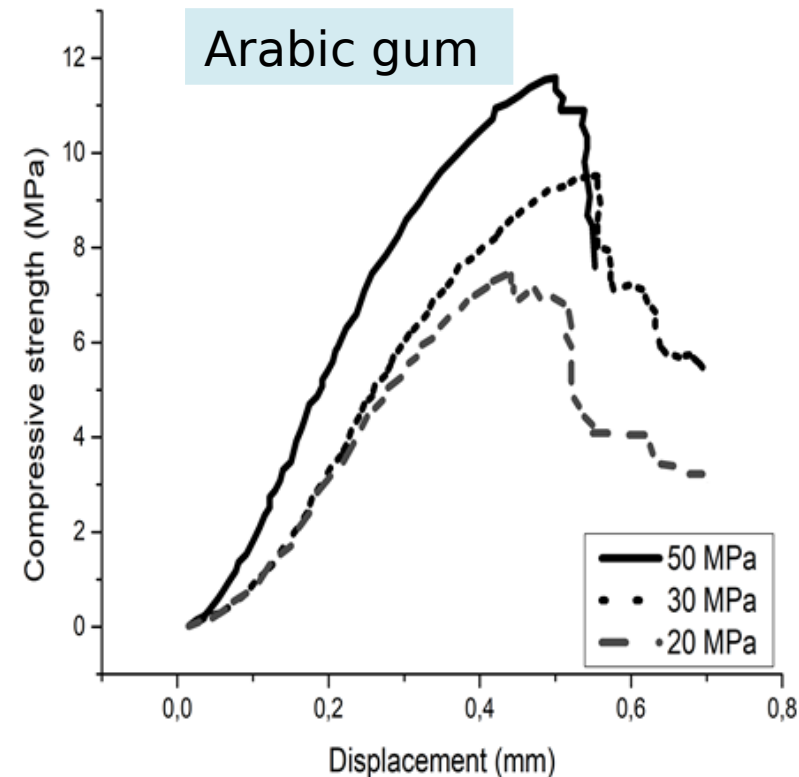


Fig.2: Compressive strength of charcoal pellets with 10% of arabic gum



Better compressive strength of charcoal with arabic gum

Axial compressive strength results

Table 1: Compressive strength of charcoal pellets for different conditions of briquetting

Independent variables			Dependent variable
Binder type	Binder rate (%)	Compaction pressure (MPa)	Compressive strength (MPa)
Arabic gum	6	20	2.70
Arabic gum	6	30	3.18
Arabic gum	6	50	4.04
Arabic gum	10	20	7.14
Arabic gum	10	30	9.55
Arabic gum	10	50	11.56
Wheat starch	6	20	1.23
Wheat starch	6	30	1.55
Wheat starch	6	50	1.78
Wheat starch	10	20	1.79
Wheat starch	10	30	2.33
Wheat starch	10	50	3.14

- 👉 Binder rate & Compaction pressure → Compressive strength
- 👉 More compressive strength of charcoal with arabic gum

Results of moisture adsorption test

Wheat starch

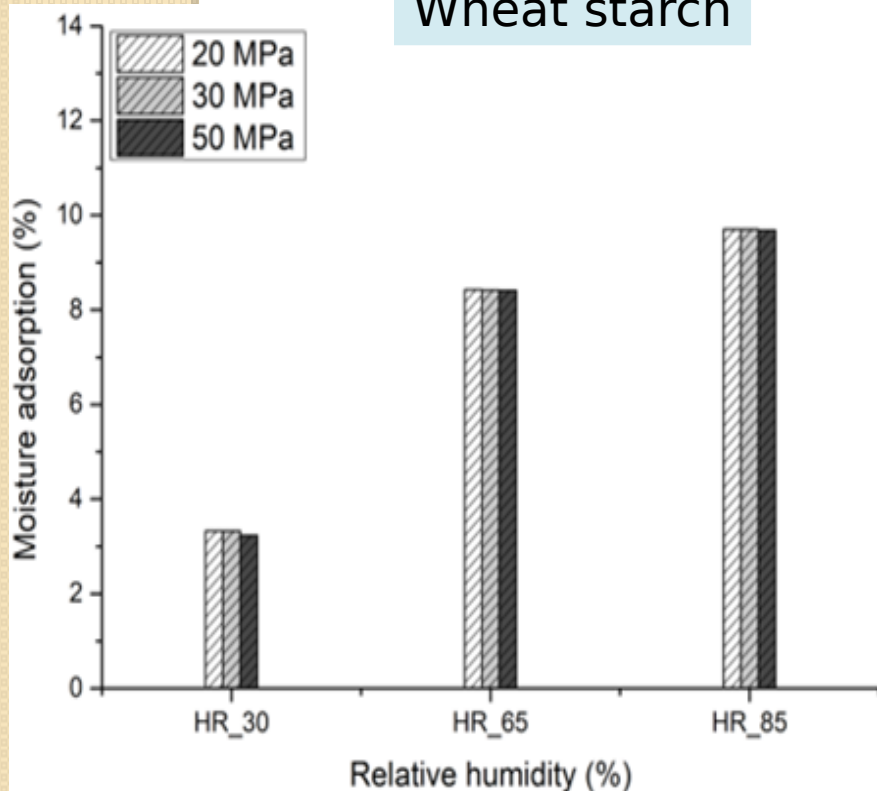


Fig.3: Moisture adsorption of charcoal pellets with 10% of wheat starch

Arabic gum

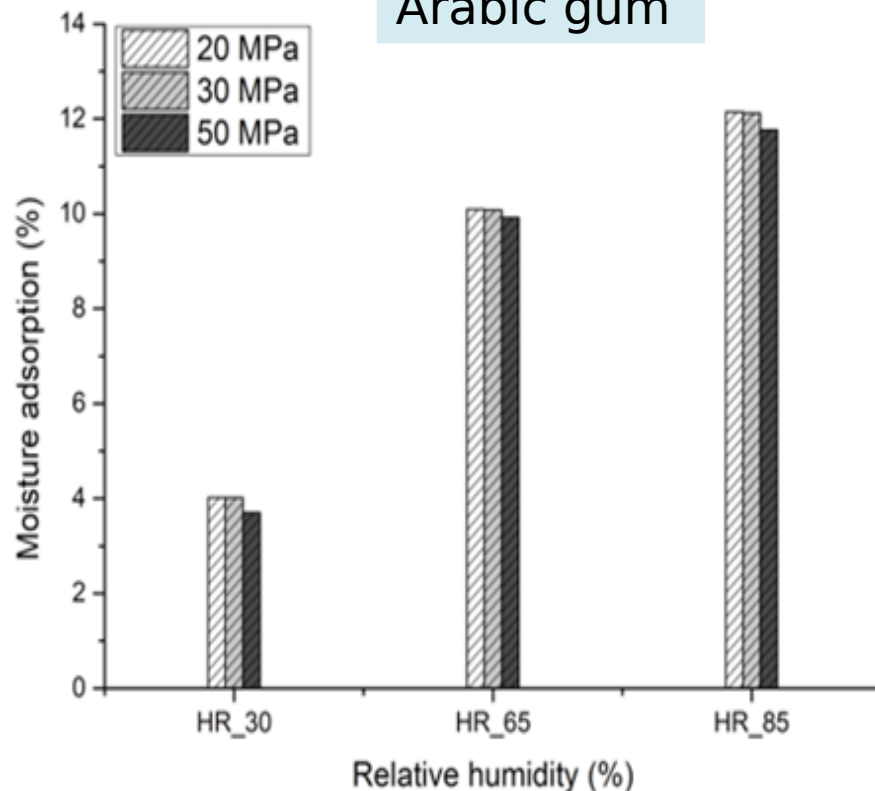


Fig.4: Moisture adsorption of charcoal pellets with 10% of arabic gum



More adsorption with charcoal with arabic gum

Results of moisture adsorption test

Table 2: Moisture adsorption tests
results

Binder type	Binder rate (%)	Compaction pressure (MPa)	Relative humidity (%)	Moisture adsorption (%)
Wheat starch	6	20	30	3.63
Wheat starch	6	20	65	8.70
Wheat starch	6	20	85	10.00
Wheat starch	6	30	30	3.73
Wheat starch	6	30	65	8.89
Wheat starch	6	30	85	10.12
Wheat starch	6	50	30	3.67
Wheat starch	6	50	65	8.97
Wheat starch	6	50	85	10.12
Wheat starch	10	20	30	3.33
Wheat starch	10	20	65	8.43
Wheat starch	10	20	85	9.70
Wheat starch	10	30	30	3.33
Wheat starch	10	30	65	8.42
Wheat starch	10	30	85	9.70
Wheat starch	10	50	30	3.23
Wheat starch	10	50	65	8.42
Wheat starch	10	50	85	9.68
Arabic gum	6	20	30	3.05
Arabic gum	6	20	65	8.70
Arabic gum	6	20	85	10.25
Arabic gum	6	30	30	4.10
Arabic gum	6	30	65	9.90
Arabic gum	6	30	85	11.47
Arabic gum	6	50	30	4.02
Arabic gum	6	50	65	9.84
Arabic gum	6	50	85	11.40
Arabic gum	10	20	30	4.02
Arabic gum	10	20	65	10.09
Arabic gum	10	20	85	12.14
Arabic gum	10	30	30	4.02
Arabic gum	10	30	65	10.08
Arabic gum	10	30	85	12.12
Arabic gum	10	50	30	3.70
Arabic gum	10	50	65	9.94
Arabic gum	10	50	85	11.97



Great effect of
relative humidity

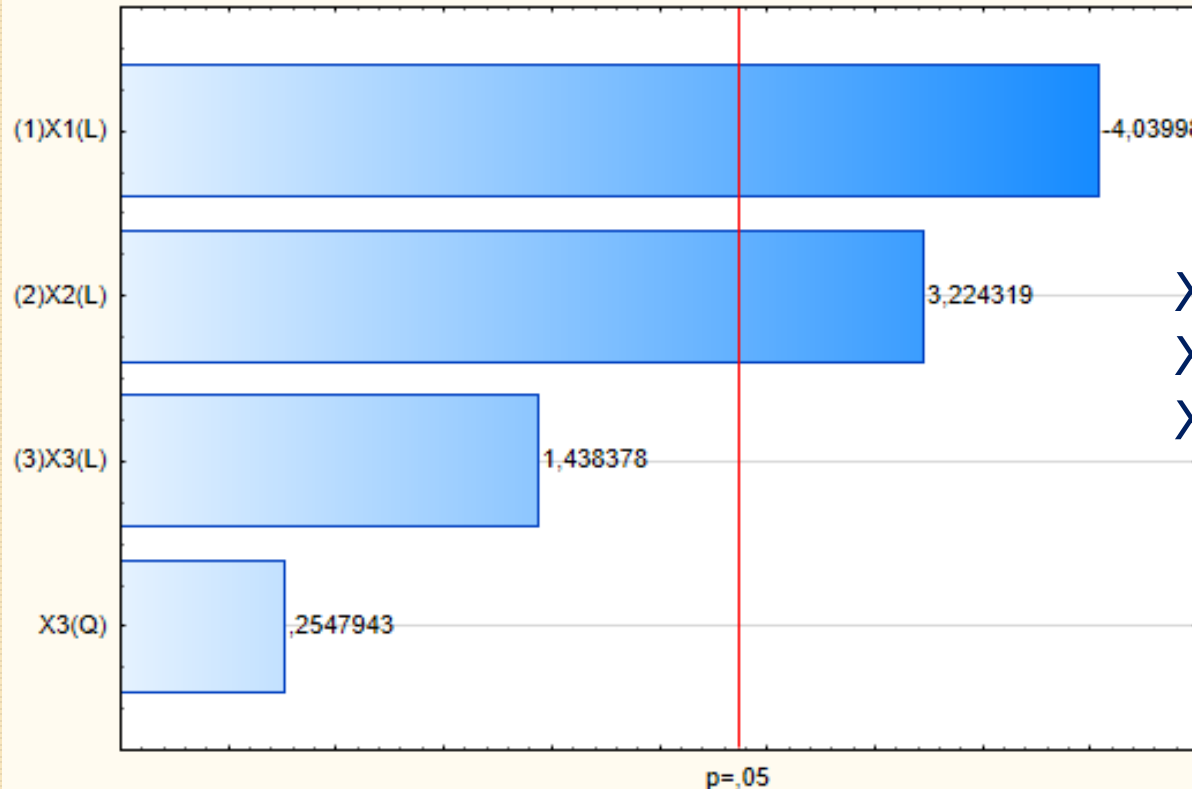


Influence of binder
type

Statistical analysis

Compressive strength

Pareto diagram



X1: Binder type

X2: Binder rate

X3: Compaction pressure

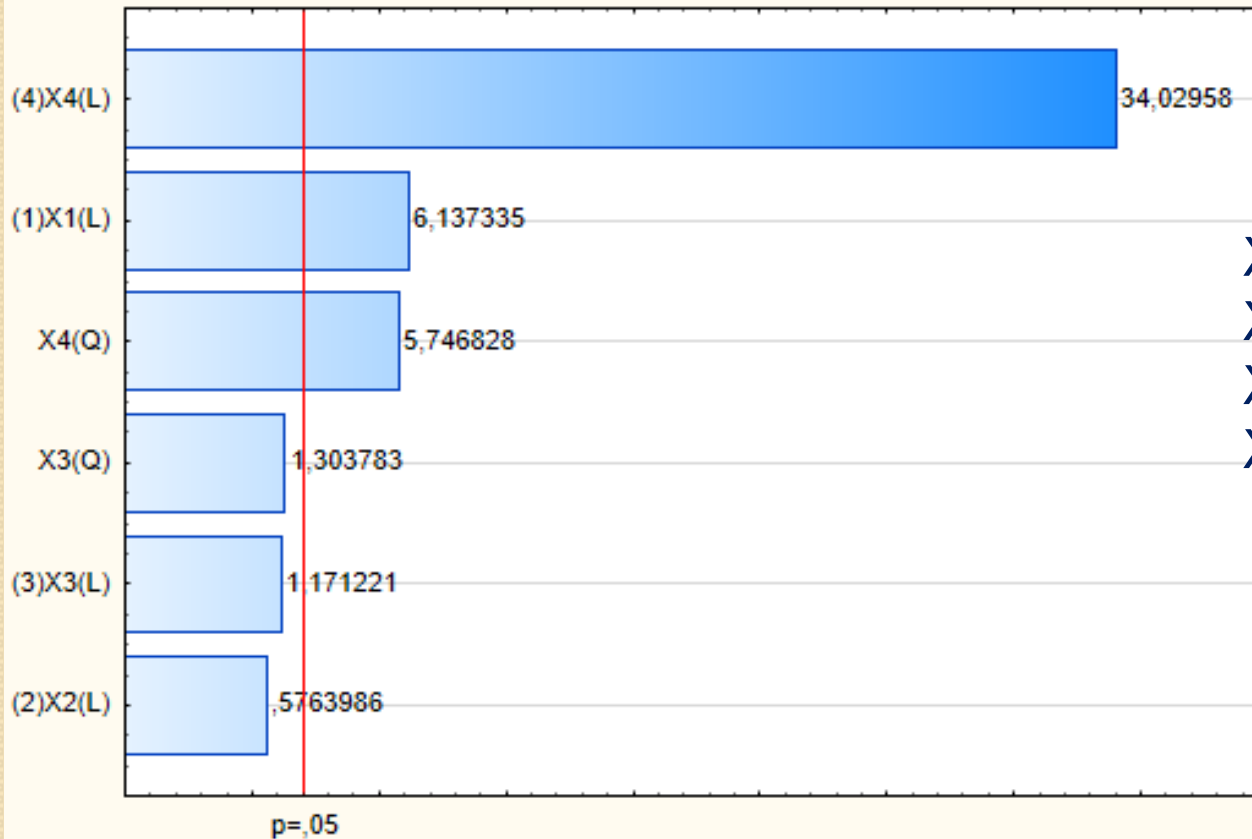


Significant effects of binder rate & binder type

Statistical analysis

Moisture adsorption

Pareto Diagram



X1: Binder type

X2: Binder rate

X3: Compaction pressure

X4: Relative humidity



Significant effects of binder rate & compaction pressure

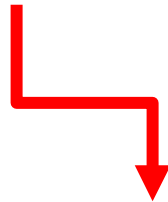
Conclusio

- n ☐ Wheat starch and arabic gum can be use as binders source to produce adequate compressive strength charcoal pellets (above 1.0 MPa)
- ☐ When charcoal pellets are stored in atmosphere of 65 % of relative humidity, their moisture content can be reach 10 %
- ☐ Statistical analysis showed that compressive strength can be more improve by increasing the rate of binder or choosing a good binder. To improve moisture adsorption, attention will be pay in the choice of the binder

Prospects

Used the same parameters of production:

- ✓ Binder type: arabic gum and wheat starch,
- ✓ Binder rate: (between 6 % and 10 %)
- ✓ Compaction pressure (between 20 MPa et 30 MPa)



To produce briquette from agriculture waste in order to fight against deforestation and to promote new combustibles for cooking or heating

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Thank You for your attention!!!