Adaptation of pelletizing conditions to a set of agricultural waste from Senegal and Côte d'Ivoire

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Purpose

Under-exploited agricultural by-product

- Palm seed shells (a)
- Cashew nut shells (b)
- Peanut shells (c)
- Millet stalks (d)
- Cocoa pods (e)

Raw physical properties not adapted to their final use

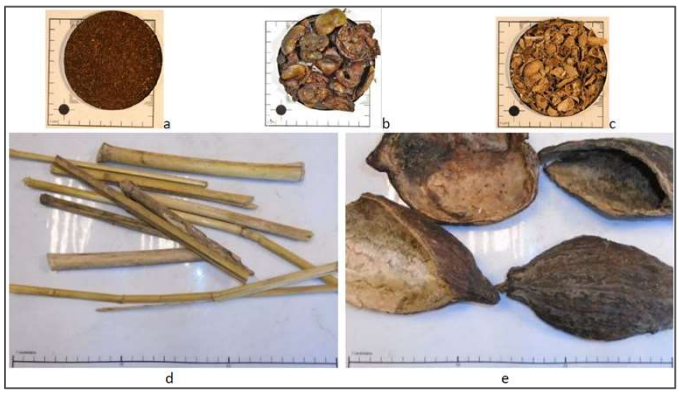
- High moisture content
- Not stabilized
- Low bulk density
- Inadequate particle size
- Not homogenous

Potential applications

- Clean energy production
- Clean cooking
- Animal feeding production
- Soil amendment production

Need to densify/pelletize

What are the best pelletizing conditions and adaptations ?



Biomasses tested during the study

Material and methods

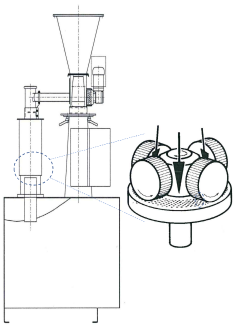
Feedstock selection → Drying at 40°C → Shredding at 10mm → Grinding at 3mm → Mixing during 20min → Pelletizing at 6mm : Moisture content (12-16%) Compression ratio (5-14) → Cooling

Characterisation of biomasses

- ✓ Physical (moisture content, bulk density, particle size distribution)
- ✓ Thermochemical (ash content, heating value, volatile matter)
- ✓ Chemical (fixed carbon, C, H, O, N, S, Cl, metals and macromolecules)

Characterisation of pellets

- ✓ Fines content (%)
- ✓ Mechanical durability (%)
- ✓ Bulk density (kg/m³)
- ✓ Pellet length & diameter (mm)



Flat-die pellet mill used for the trials (3kW-KAHL)

➢ **30 Pelletizing trials : iterative steps in order to optimize pellet quality**

Photos of different pellets produced with **peanut shells**

Moisture content	12%	16%	14%	16%
Compression ratio	5	5	9	8
Fines *(lower is better)*	40%	25%	10%	6%
Mec. dura. *(higher is better)*	43%	83,7%	81,3%	95,5%
Bulk density *(600-750 kg/m³)*	588 kg/m³	675 kg/m³	680 kg/m³	696 kg/m³

Preliminary results

Findings about pelletizing trials

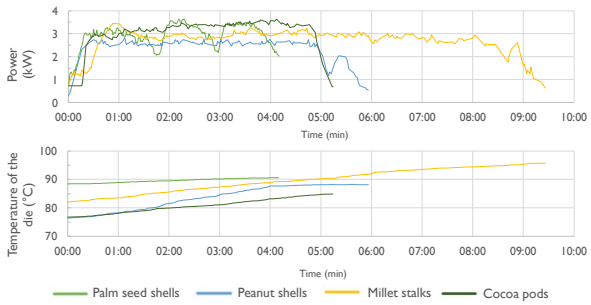
- ➢ **Best pelletizing conditions** can be determined through **iterative pelletizing trials**
- ➢ Adequate **combinations** of moisture content and compression ratio **differ greatly between biomasses** : the quantity of water to add and the pellet mill die have to be **adapted** for each biomass

- × **Cashew nut shells** : pellets with poor physical quality due to its high oil content
- ▪ **Palm seed shells** and **peanut shells** : promising results but can be improved
- ✓ **Millet stalks and cocoa pods** : adequate pellet quality with different pelletizing conditions

Photos of the best pellets obtained for four biomasses

Biomass	Palm seed shells	Peanut shells	Millet stalks	Cocoa pods
Moisture content	12%	16%	13,5%	14%
Compression ratio	12	8	6,5	10
Mec. dura.	88,1%	95,5%	98,8%	99,2%
Bulk density	733 kg/m3	696 kg/m3	703 kg/m3	741 kg/m3

Power curves and die temperature during pelletizing trials of 5kg



Conclusion

Observations :

- ➢ Adequate pellet quality results have been achieved for millet stalks and cocoa pods but it can be improved for the others.

Prospects : potential ways to improve pellet quality in future trials

- ➢ Use of different pelletizing binders
- ➢ Blending of different biomasses together
- ➢ Pelletizing trials on pyrolyzed biomasses

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