Evidence of a Speed Dependent Critical Pressure for the Mechanical Extraction for High-oil and Low-fiber Matrices

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- It’s very difficult to extract oil from a low fibers matrices on a continuous press
- Many phenomenons appears decreasing the oil extraction efficiency
  - Feets
  - Backflow[1]
  - High oil content in the pressure cake
- To increase the oil yield and minimise the losses, it’s important to caracterise and understand this phenomenons, we will focus on the **extrusion**

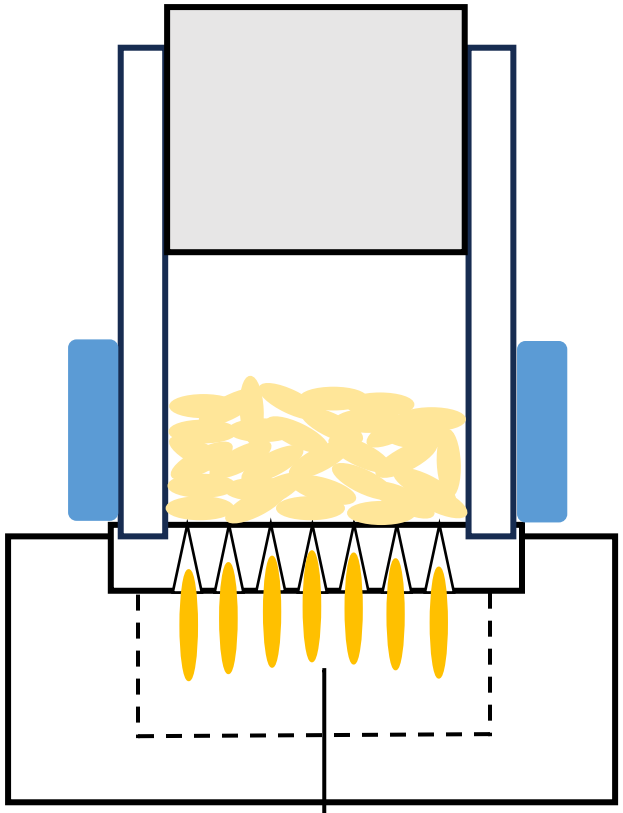
[1] BOGAERT, L., *Étude et modélisation du pressage continu des graines oléagineuses*, Thèse UTC, **2017**

- In 2001, Raβ saw this phenomenon and linked it with the plasticity or elasticity of the matrice[2]

- Also seen by several observers until recently by DEMIREL *et al.*[3], which showed this phenomenon and called it « Serration effect »

[2] RAβ, M., *Über die rheologie fester biomatrizen unter kompression fall von geschältem raps,* Essen Universität, **2001**
[3] DEMIREL, C. *et al., Numerical estimation of deformation energy of selected bulk oilseeds in compression loading,* IOP Conf. Series : Materials Science and Engineering, **2017**

- Look after the phenomenon of extrusion and watch what are the factors which influence it
- Make hypothesis on the behaviour of the matrice during the compression
- Etablish a predictive model that permit to predict the extrusion in a continuous press



Solid output

Example of a test of extrusion points

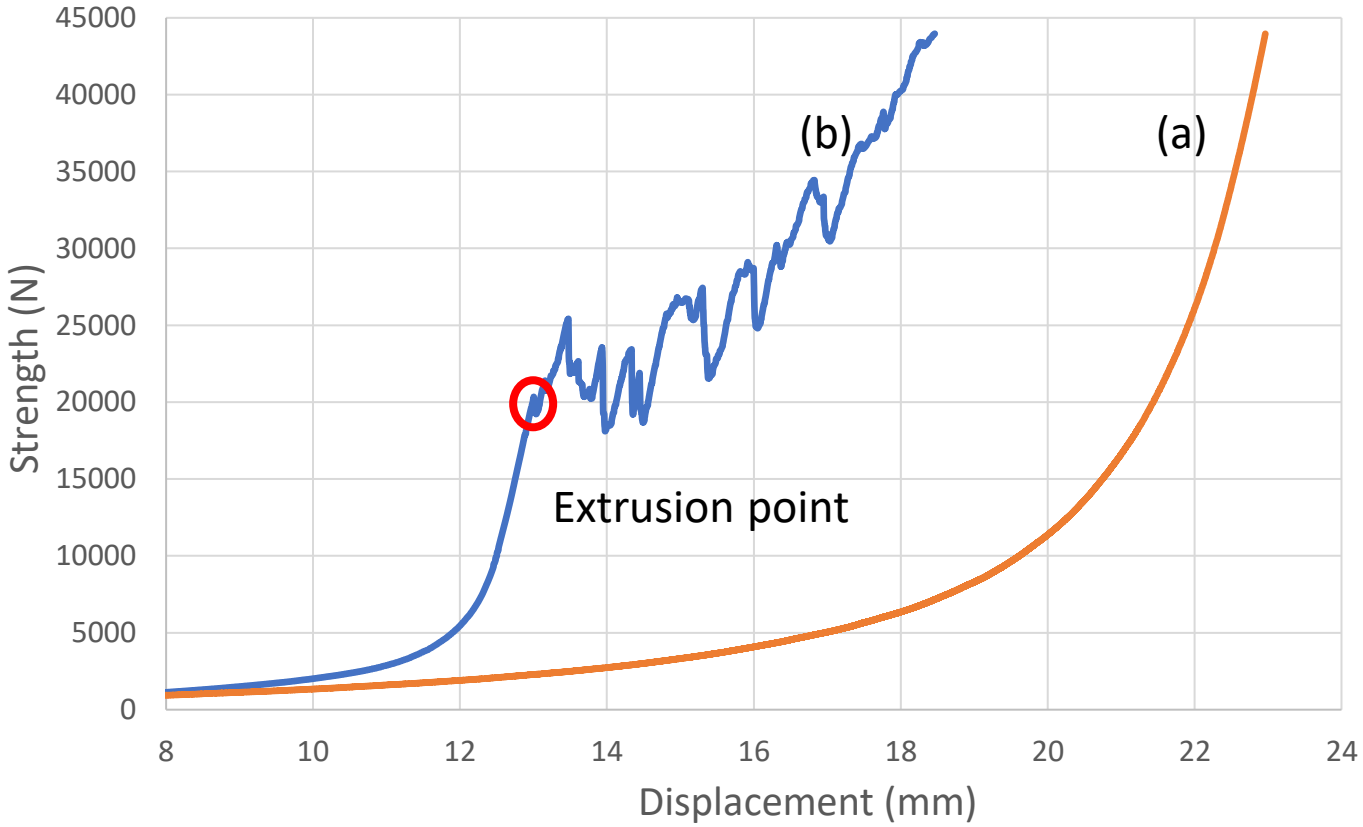
- Unidirectionnal compression with a constant speed (v), recording strength (F) and displacement (d) function of the time
- Using a specific modulus to work on the compression of different seeds

With the 50 kN strength of the Omnitest, it could reach a pressure up to 350 bar

- Matrice : Dehulled Sunflower
  - Moisture : 4.7%/6%
  - Oil content : 51.6%

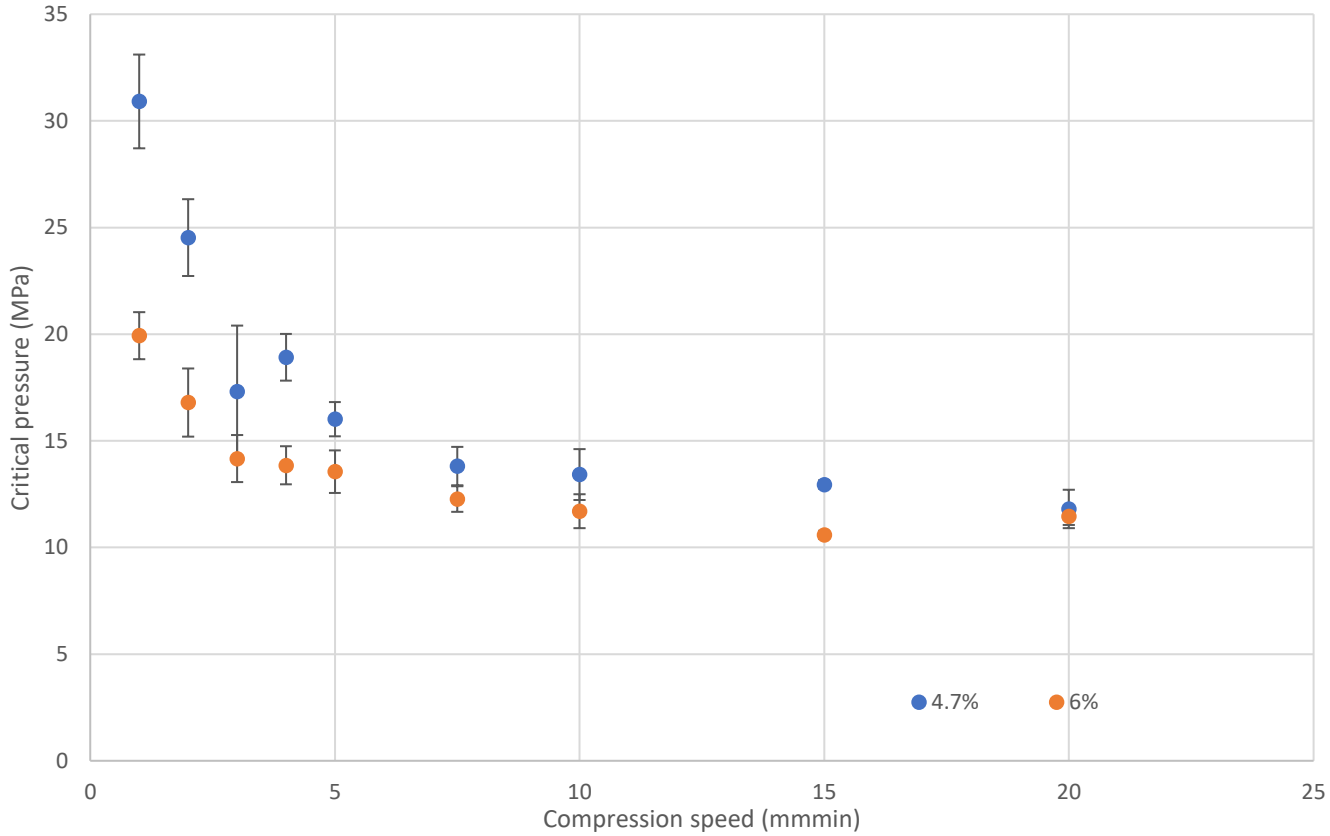
Dehulled sunflower use for the test

- 15 g of dehulled sunflower
- Range of speed from 0.1 mm/min to 20 mm/min



Example of curves obtained with unidirectionnal compression; (a) Curve without extrusion ; (b) Curve with extrusion

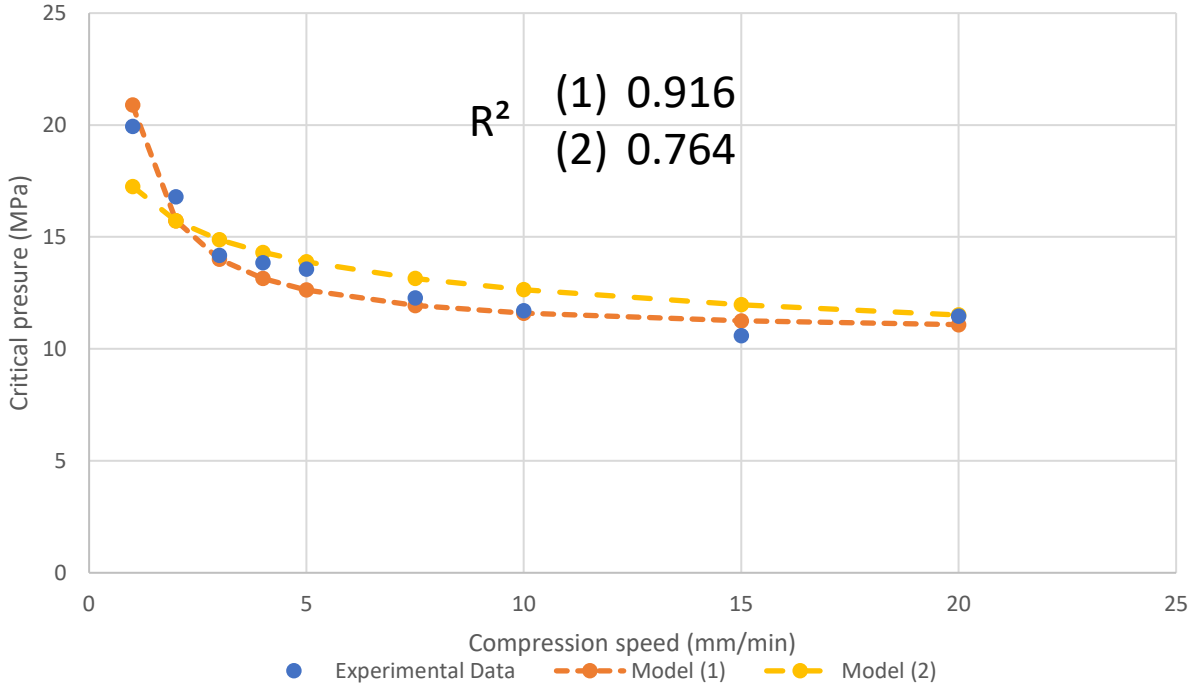
- The critical pressure is speed dependant
- No extrusion with a speed under 1 mm/min
- The water content influence the pressure value of the extrusion



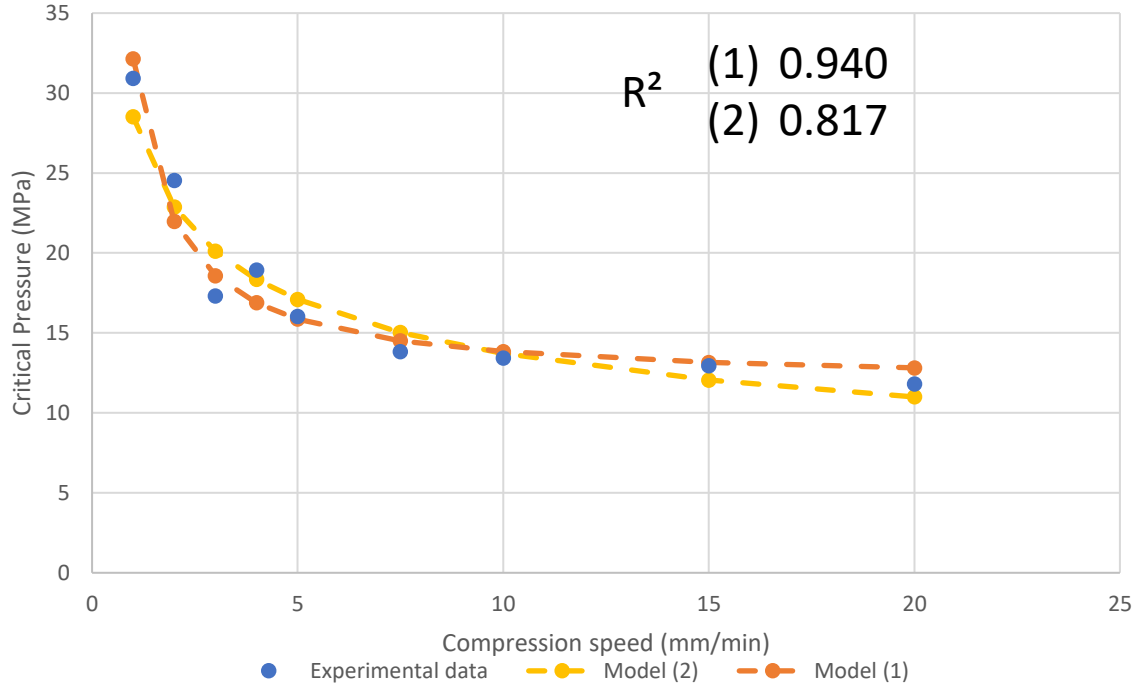
- Predicting the critical pressure, 2 models were compared (1) (2)

$$F = \frac{\ln(2)}{Av} + B \quad (1)$$

$$F = Av^B \quad (2)$$



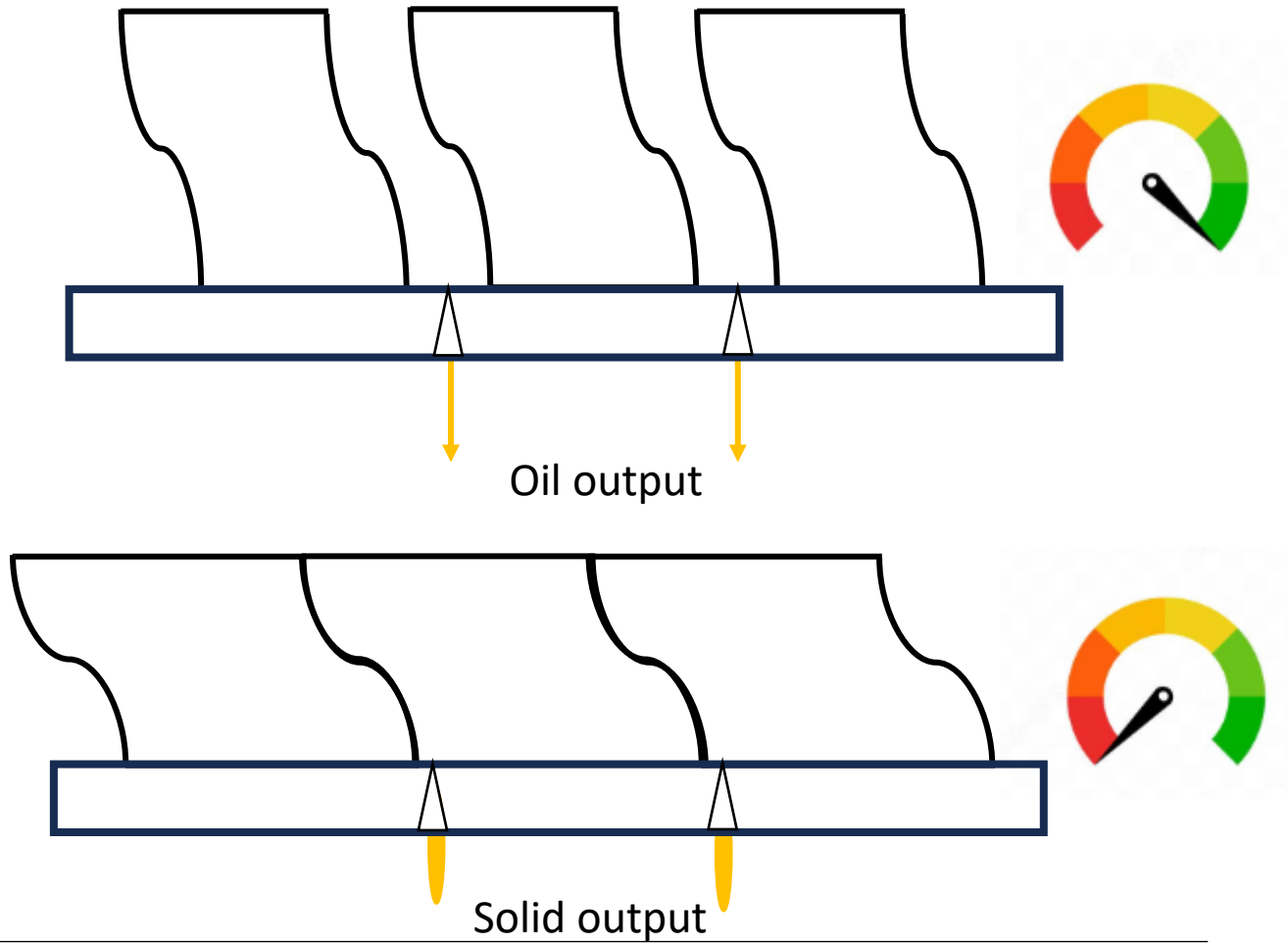
Extrusion points at 4,7% moisture and the 2 differents models



Extrusion points at 6% moisture and the 2 differents models

- May due to the liquide pressure reaching the solid pressure and force the solide to pass threw the holes[4]

- When the fluide can escape, the liquid pressure is lower than solid pressure. With a high speed, the liquid couldnt escape and the liquid pressure increase too quick



[4] SHIRATO, M., *et al., Slurry Deliquoring by expression,* Dechema Monogram, **1974**

- Find a physical sens of the constant A, B and see if it's an available prediction in the continuous press
- See if the value that was found are corresponding to a continuous extraction press
- We have an instrumentate press with pressure captors all along the process to see if the phenomenon appears at the pressure found

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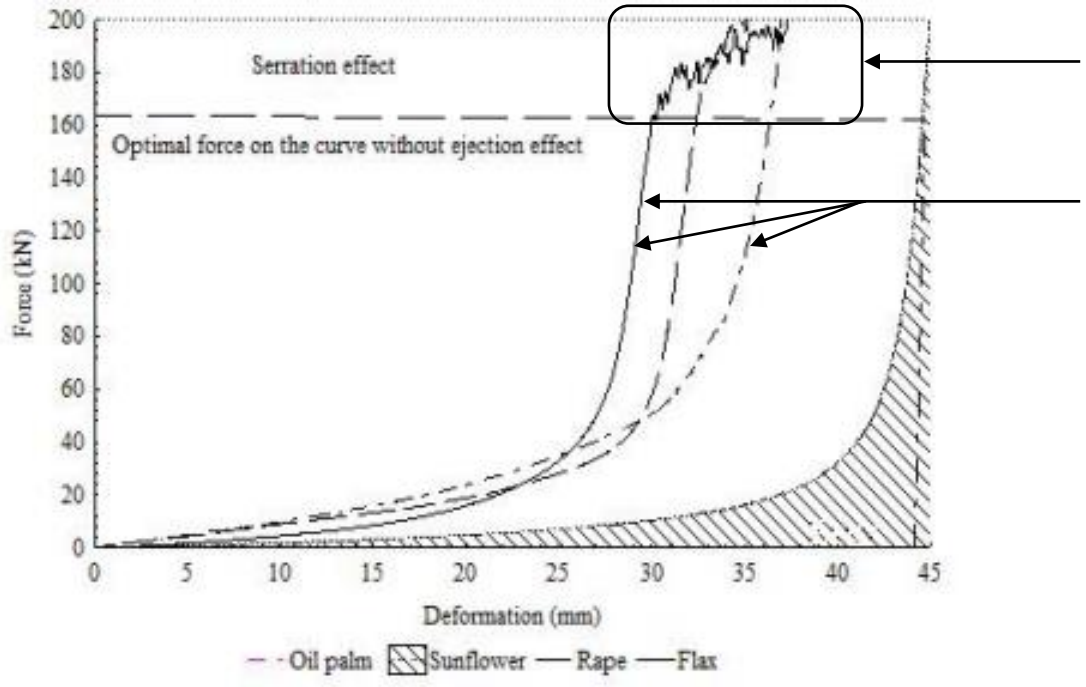

Example of compression curve under regular speed[3]

Serration effect zone

Classic compression curve shape

- This is notable by the classic exponential shape breakup of the compression curve

- The serration effect is dependant of the compressive forces[4] inherent of the vessel diameter[5]

- Dependant of mutliple parameters as matrice[6], moisture[4]

[4] KABUTEY, A., *et al., Behaviour of different moisture contents of Jatropha curcas L. seeds under compression loading,* Resarch in Agricultural Engineering, **2011**
[5] KABUTEY, A., *et al., Deformation energy of Jatropha curcas L. seeds under compression loading,* Resarch in Agricultural Engineering, **2014**
[6] DIVIŠOVÁ, M., *et al., Deformation curve characteristics of rapeseeds and sunflower seeds under compression loading,* Scientia Agriculturae Bohemica, **2014**