Economic feasibility of a 2 steps ethanol extraction

FINANCING

Picardie Innovations Végétales, Enseignements et Recherches Technologiques

P. Carré[1], A. Quinsac[2] (1) OLEAD, (2) Terres Inovia - 11 rue Monge, Parc Industriel, F-33600, Pessac, France

Aqueous ethanol at 5% of water cannot dissolve much oil. Oil solubility is temperature dependent (fig. 1).

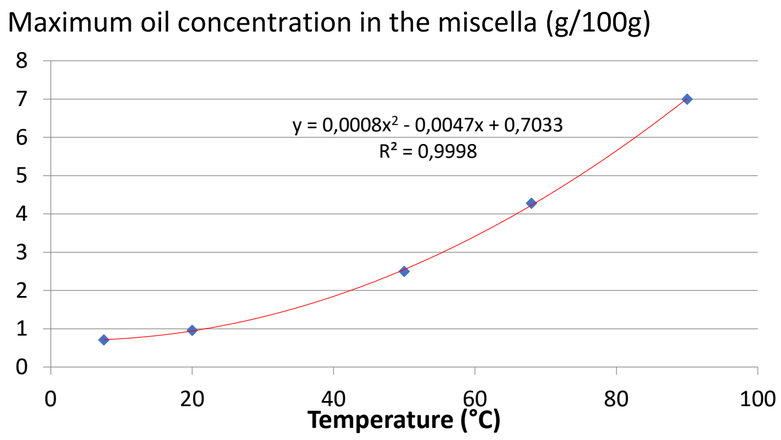

Figure 1: Saturating concentration of oil at different temperatures

This property can be used to extract oil at high temperature and separate it by cooling the miscella. The dry matter trapped in the lean miscella is removed by distillation of a small part (20%) of the lean miscella.

In consequence, the extraction of oil from a press cake requires much more solvent than with conventional extraction. But, since it is not required to evaporate this solvent to recover the oil, the energy cost can remain acceptable. According to our simulation, thanks to the low oil content of the miscella, only 2 stages of counterflow extraction would be required to obtain a meal with 1.8% of oil residues from a press-cake at 15% provided that an efficient solid-liquid separation could be carried out between the steps. With centrifuge horizontal decanters it is possible to satisfy this condition.

This study aimed at assessing the economic feasibility of such a new processing scheme for dehulled rapeseed cake with a mild desolventization under vacuum to preserve the proteins quality.

Fig. 3: Decomposition of processing cost for 1 t of seeds (Total: 46.85 €)

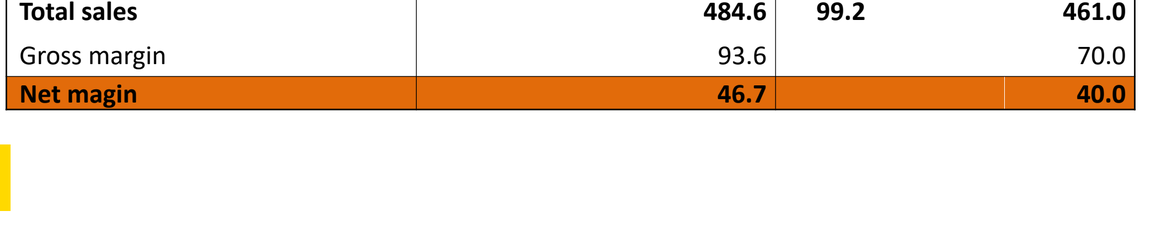

Table 1: Sales / costs balance of the new process compared to the conventional process

Item	New ethanol process			Conventional process		
	Balance	Value of products (€/t)	Per ton of seed (€)	Balance	Value of products (€/t)	Per ton of seed (€)
Seeds	100	391	391.0	100	391	391.0
Oil	42.3	809	342.2	42.8	800	342.4
Meal (dehulled/non dehulled)	36.8	340	125.1	55.7	213	118.6
Hulls	18	85	15.3	0	0	0.0
Molasse	2.4	81	1.9			
Total sales			**484.6**	**99.2**		**461.0**
Gross margin			93.6			70.0
Net magin			**46.7**			**40.0**

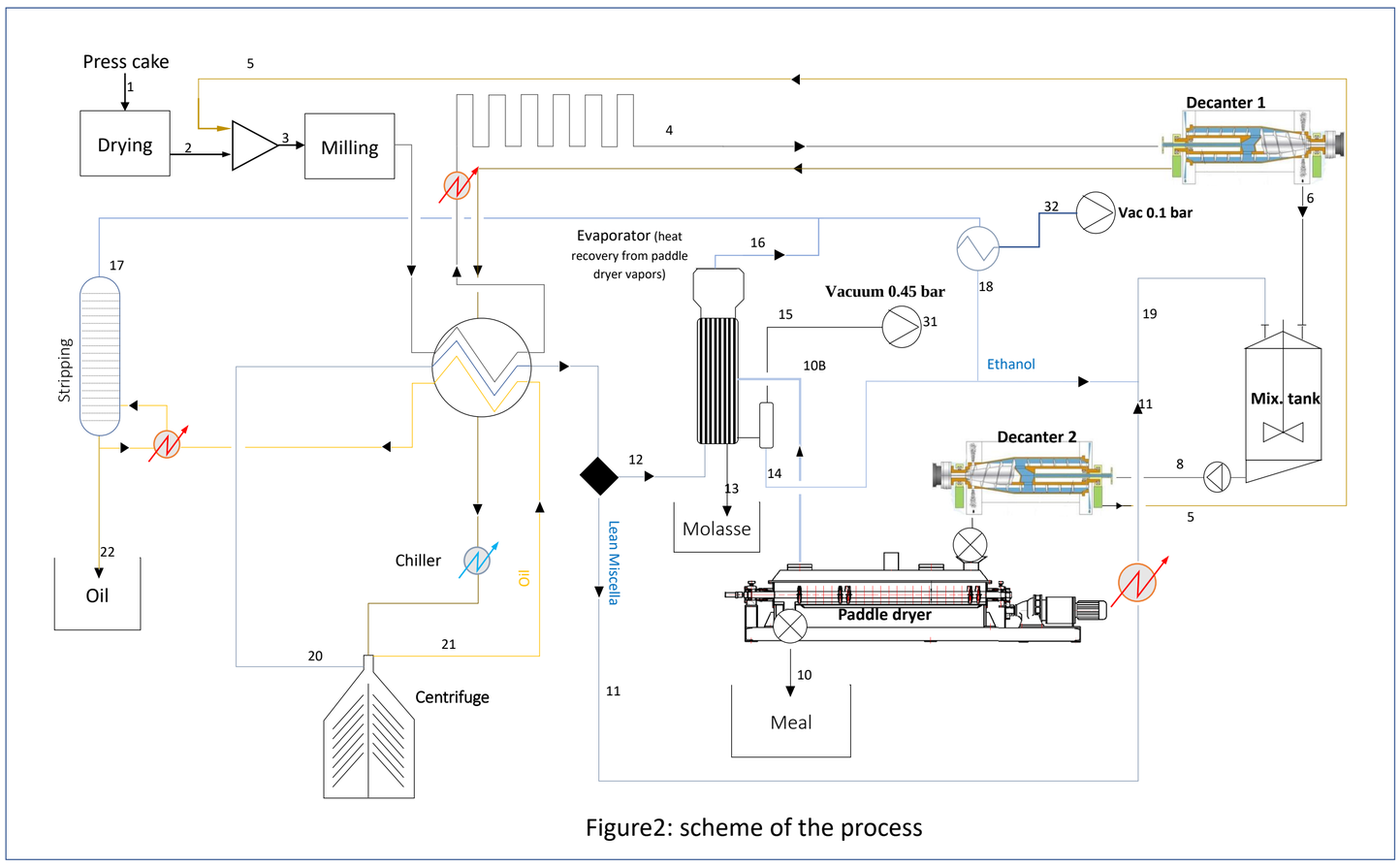

Figure2: scheme of the process

The simulation was taking in account the oil solubility in the miscella in function of the temperature. The volume of solvent required was adjusted accordingly. We simulated a processing unit with a 100 kt/year capacity. Before the solvent extraction, the seeds are dehulled and cold pressed, then the press-cake is submitted to the diagram of the fig.2. The calculation of the CAPEX was made by estimation of the cost of each important operation units and the rest of the cost by application of Lang's factors according to the characteristics of each technology. Energy consumption was assessed according to matter and thermal balance of each operation. Heat recovery is taken in account at the level of the liquids entering and outing the system and for the partial distillation of the lean miscella using the latent heat of vaporization of the vapors of the desolventizer (paddle-dryer). Other OPEX (wages, maintenance and other services) were also estimated.

Improved value of oil and meal: The ethanol process reduces the oil acidity and refining costs resulting in a slightly better oil value (+1.1%). Dehulling and ethanol extraction are contributing to increase the proteins concentration of the meal, dehulling by removing fibers, ethanol by extracting sugars and phenolic compounds. Mild desolventization preserves the proteins digestibility and gives a pale yellow color to the meal (fig. 4). These better characteristics and an "hexane-free" claim will strongly improve the value of the meal (+ 60%). Hulls contain fibers and 15% of proteins that could be used as feed for cattle (value ~10% above wheat straw).

Figure 4 : Meal aspect

Comparison of meals	Residual oil (g/100g)	Proteins (g/100g)	NDF (g/100g)	Glucosinolates (µMol/g)	Proteins solubility (KOH)
Conventional non dehulled	2.9	32.7	24.0	10	50
Conventional dehulled mild*	1.8	42.1	9.4	25	87
Ethanol dehulled mild*	2.1	45.4	?	19	77

* Mild desolventized: low temperature impact

Conclusion: The economic equilibrium of the new process is based on a premium that is hypothetical but not out of touch with the growing concerns surrounding the hexane processed meals and GM soybean meals.

Terres Inovia OLEAD