Improved Rapeseed Crushing Process by Means of Extrusion

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Context

The implementation of the Blair House agreement in the European Union in 1993 has led to put set aside in practice and to identify potential markets for specialty oils for non-food utilization : oils from new seeds or commodity oils with tailored fatty acid profiles. In many cases, the identified potential markets for these specialty oils or other new products are limited (niche markets) and the seed volumes to process are too low for traditional crushing capacities (1000 to 2000 T per day at minimum). Moreover, the development of these new applications requires an identity preservation of oil and meal all along the process chain. More generally, the use of solvent in oilmeal plants could be forbidden in the future for a better respect of the environment.

Alternative to the traditional crushing system

The present trends in crushing industry are :

- increases in outputs
- energy savings
- decrease in wastes
- reduction of investment costs
- stability of the process vs seeds quality variability
- research of a better quality of oil and meal

Alternative solutions to the traditional crushing system have been proposed over the last years :

- The VPEX process developed by Krupp Company, which cuts out flaking and cooking before pressing.
- The Hivex expander with draining cage developed by Anderson International Corporation.

Both systems have been tested on industrial scales without a real success.

Conventional	Alternative
Seed cleaning	Seed cleaning
Flaking	-
Cooking	-
Pressing	Pressing
Solvent extraction	Solvent extraction

The twin-screw extruder with draining barrels

In this context, the utilization of a twin-screw extruder fitted with a deoiler barrel appears as an interesting alternative technology. This system was developed by Clextral Company (Firminy, France) in connection with the Technology University of Compiègne (France) and was the subject of a Ph.D in 1994. The technical feasibility of this extruder has been demonstrated on rapeseed and sunflower (dehulled and non-dehulled) and castor. These studies showed the possibility to process dehulled rapeseed meal with 8 to 10% of residual oil. This new process allows a good flexibility : the unit processes of the traditional pressing, which are flaking, cooking and pressing are made by this single machine. This technology should also improve meal and oil quality. The process is done within 3 to 5 minutes (vs 45 to 60 minutes in the traditional process). The machine can be heated by heating bands, or cooled by water circulation in sleeves. In these conditions, an added value for meal could be obtained by the extrusion technology in preserving the protein functionalities during the oil extraction process and the reduction of non hydratable phospholipids in crude oil should allow the water demucilagination and reduce phosphorus wastes during refining.

Experimental procedures

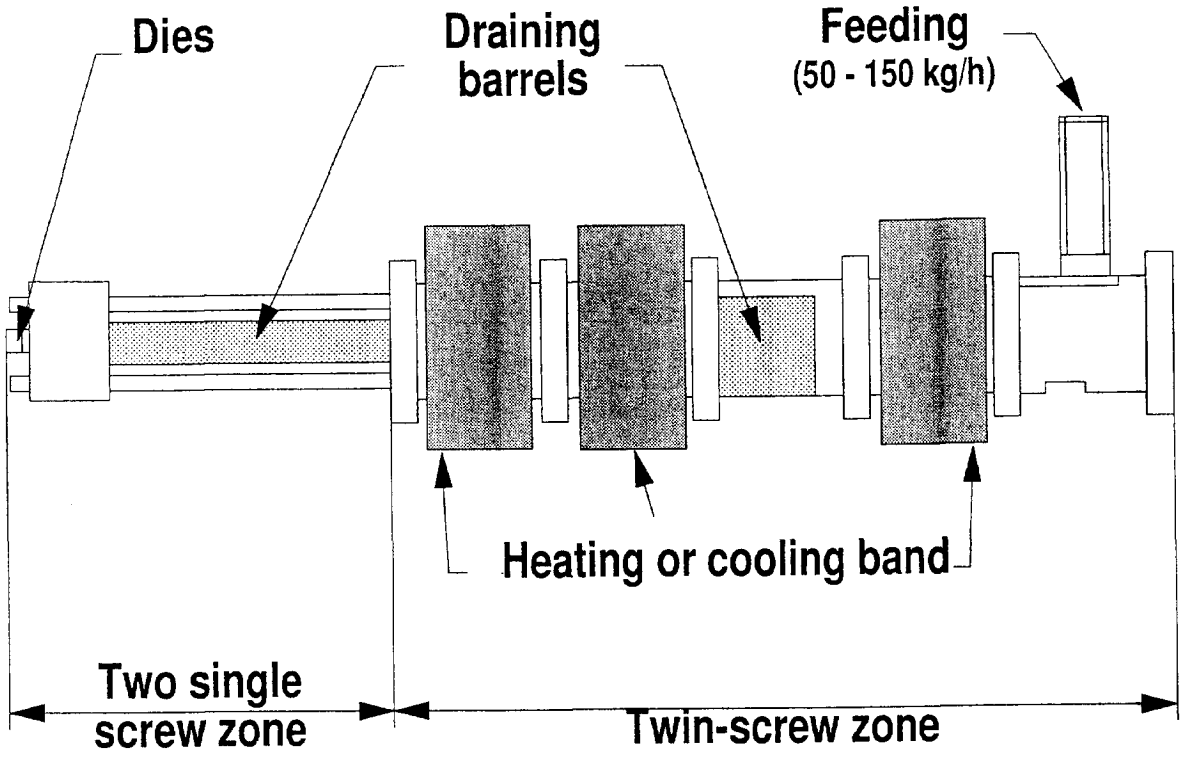
A pilot extruder (50 to 150 Kg/h) is presently operating at CETIOM, in the CREOL oil mill pilot plant[1], with a grant of AGRICE (the French Agency for Environment and Energy Management). The research mainly includes the optimization of deoiling with different oilseeds and the examination of oil and meal quality.

Operating conditions :

- optimal screw configuration
- seed input flow rate
- screw rotation speed
- temperature
- seed moisture

1 CREOL is the oil mill pilot plant of the French oilseed organisation. In addition to the twin screw extruder, the plant is equipped to reproduce the main process options of industrial oil plant : pressing, hexane extraction of oil, processing of protein concentrates by ethanol extraction. Trials can be achieved in batch or continuous mode, from dozen kg to dozen tons.

The twin-screw extruder BC45 design



Preliminary results on rapeseed

The first results show that it is possible to obtain a residual oil content in rapemeal in the range of 12% (oil yield 85%) with an input flow rate of 100 kg/h and a temperature in die of 130°C. Nevertheless, large variations are observed.

Parameters	Variations
Input flow rate	50 - 150 kg/h
Screw rotation speed	50 - 130 rpm
Temperature in die	80 - 130°C
Pressure in die	60 - 140 bars
Oil yield	70 - 85%
Residual oil in meal	12 - 30%

Conclusions

The twin-screw extruder with draining barrels could provide a new option to traditional crushing process and preliminary results confirm previous data. Nevertheless, many studies have to be carried out :

- oil and meal quality gains
- research of optimal screw profile
- specific role of each parameter