INDUSTRIAL TESTING OF CENTRIFUGAL DECORTICATOR

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SUMMARY

The centrifugal sunflower decorticator, the capacity of 200 MTPD, has been constructed and industrially tested. The results have shown that the average protein content of 40% for meal and residual oil in the separated hulls lower by 1% were achieved. The dehulling efficiency is adjusted by exchanging frequency and special wear-resistant material ensures a lasting and safe operation.

KEY WORDS: centrifugal decorticator, dehulled sunflower analyses, meal, hulls

INTRODUCTION

It is a normal practice to partly dehull sunflower before its further processing into oil and meal. Very small quantities of sunflower are processed without dehulling. The protein content of the meal obtained by such processing is cca 28%. The meal obtained from partly dehulled sunflower should have the protein content of the minimum of 33.5%, but in practice, 35-37% (1) of protein are achieved. Further increase of the meal protein content can be achieved either by more through dehulling or by screening the finished meal (2). A more through dehulling can result in a meal with the protein content above 40%, and even up to 45%, which can be lysine enriched and thus become even superior to soybean meal (3).

The objective of this work, as well as of further improvements of dehulling procedure, is to achieve as high a protein content as possible (above 40%), with lowering the residual oil content in the hulls by cca 2% efficiency of 200 MTPD per unit of the dehulling system.

Tested in this work was a new sunflower dehulling method, different from all commercially present methods to date.

MATERIALS AND METHODS

The industrial sunflower decorticator, with the capacity of 200 MTPD (Figure 1) (1) has been developed and tested in comparison to the existing "Ripple-flo-mill" decorticators with screening and aspiration (4).

Corresponding analyses were made of the material after dehulling and screening, as well as the hulls and the common material for conditioning/pressing and finished meal after extraction. The dehulling efficiency was controlled by a frequent change of the number of revolutions, and measured by analysis of samples per hour during running-in, and after the operation regime was established, once per shift. The same regime was applied during comparative control of efficiency of operation both of the new and of the existing decorticators. All the results are presented in weighted values.

RESULTS AND DISCUSSION

The structure of dehuuled sunflower is shown in Table 1. The results have shown the total dehulling efficiency higher than 65%, shown as pure kernels and kernels with hull parts, smaller that halves, unseparated from the kernels and hulls.

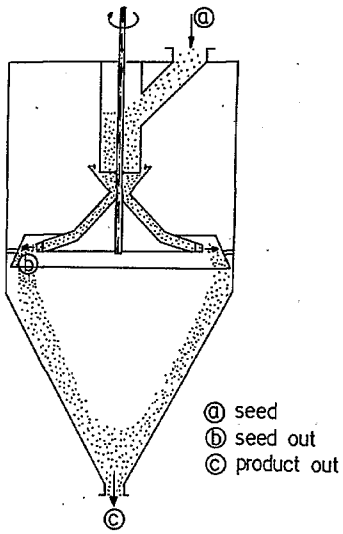

FIG. 1.
Centrifugal Decorticator

TABLE 1.
Composition of Decorticated Sunflower

s e e d	content, % / number of samles				
kernels	total 40.9	< 30 6	30 - 40 18	40 - 50 20	50 - 60 6
kernels with up to 1/2 hulls	total 12.5	< 10 28	10 - 20 21	> 20 1	
undecorticated	total 34.3	< 30 32	30 - 40 9	40 - 50 6	50 - 60 3
hulls	total 12.3	< 5 2	5 - 10 5	10 - 15 43	> 15 -

TABLE 2.

Granulometric Content of Decorticated Kernels

kernels on the sieve	content, % / number of samples					
	total	‹ 20	20-30	30-40	40-50	› 50
⧫ 4.5	45.85	5	6	5	4	28
⧫ 3.5	31.2	‹ 20 19	20-30 8	30-40 8	40-50 10	› 50 5
⧫ 2.5	13.0	‹ 5 3	5-10 14	10-15 13	15-20 12	› 20 8
⧫ 1.0	7.8	‹ 5 14	5-8 9	8-10 8	› 10 19	
⧫ 1.0	2.2	‹ 1 10	1-2 10	2-3 10	› 3 20	

TABLE 3.

Material for Conditioning

1. From New Decorticator, 2. From Existing Decorticators

	content, % / number of samles									
	1	2	1	2	1	2	1	2	1	2
kernels	total 68.8	65.0	‹ 50 3	-	50-60 9	8	60-70 16	26	› 70 22	16
undecorticated	total 15.9	16.2	‹ 10 13	6	10-20 24	25	20-30 11	19	› 30 1	-
partial decorticated	total 7.7	7.5	‹ 5 13	11	5-10 29-34		10-15 8	5	› 15 -	-
hulls	total 7,6	8,8	‹ 5 9	8	5-10 20-27		10-15 15	11	› 15 6	4

In total, up to 35% are unhulled, together with hulls sticking to the kernels but bigger that half hulls. The quantity of completely separated hulls is cca 12%.

After screening of the total separated kernels, granulation is shown in Table 2. The results have shown that 45% of the kernels are mostly whole, 45% are 2 mm to 2/3 of a whole kernel size, 10% are smaller than 2 mm, of which 2% are below 1 mm.

The total screened material, especially from the new decorticator, and especially from the standard dehulling/screening line has been analyzed before milling, the results of which are shown in Table 3. The total hulled material is 76.5% and 72.5% from the new and the existing decorticators, respectively. The unhulled quantity is approximately the same, and the hull quantity is by 1.2% higher with the existing dehulling line.

The results of analysis of the separated hulls are summarized in Table 4. and show that the quantity of residual oil in separated hull is 0.6% higher with the existing dehulling method. The quantity of small hull particles and kernel parts is approximately the same.

The average hull content in the material for conditioning/pressing is 12.3% (Table 5). The average protein content in the meal after extraction is 39.7%, which, compared to the usual protein content of 36% with standard dehulling, is a value higher by about 4%.

The total results presented in the Tables show the following benefits of work with a decorticator of this type:

- One unit of sunflower decorticator system, capacity 200 MTPD, where the degree of dehulling and screening is adjustable during operation.

TABLE 4.
Separated Hulls

characteristics		content, % / number of samples: new dehulling	existing dehulling
1. o i l	total	5.1	5.7
	< 3	3	-
	3 - 4	4	4
	4 - 5	6	5
	5 - 6	27	8
	> 6	10	33
2. small particles through sieve ϕ 2.5 mm	total	4.8	4.5
	< 2	7	10
	2 - 5	27	20
	5 - 7	10	5
	> 7	10	

TABLE 5.
Content of Hulls in Material for Conditioning / Pressing

	content, % / number of samples
hulls total, %	12.3
< 10	13
10 - 12	10
12 - 15	21
> 15	6

TABLE 6.
Protein Content in Meal

	content, % / number of samples
total, %	39.7
< 36	3
36 - 38	8
38 - 40	12
40 - 42	19
> 42	8

- Separation of hulls from kernels by "smashing" on the plate ensures lesser sticking of hulls to kernels than in the case mechanical dehulling.

- Hull screening is more efficient, and unhulled sunflower is returned for dehulling.

- The residual oil quantity in the hulls is lower.

- The meal protein quantity is higher.

- The selected wear-resistant material and the design ensure a lasting, stable and safe operation of the decorticator.

- The space occupied by this line is twice smaller.

- Investment, maintenance and servicing are at a lower level.

- Remote and automatic process are possible.

The principle of sunflower dehulling in this dehulling method is smashing sunflower seeds by means of centrifugal force (Figure 1.)

The seed enters the rotor through the inlet (a) in which it strikes the plate under the effect of the centrifugal force (b), where it breaks and hulls are separated from kernels. A hull and kernel mixture comes out through the outlet (c) for hull and kernel separation by screening and aspiration.

The total energy consumption is below 5 kWh/t of sunflower (5)

CONCLUSION

The set objectives to design a decorticator with a unit dehulling system of the minimum of 200 MTPD of sunflower and with the resulting minimum of 40% of protein in sunflower meal, with the minimum of 2% less oil in the separated hulls, have mostly been achieved. The objective in the forthcoming period is to increase the dehulling efficiency to 44% of protein in sunflower meal with 2% less residual oil in the hulls.

Design improvements made during the experimental work with the decorticator ensure a lasting and stable operation. The wear resistance is now at the level of 3.000 hours without replacement of the parts. The replacement is simple and requires a standstill of not longer than a few hours.

Hull screening can be in rows or parallel, depending on the available space.

REFERENCES

1. Milosavljević, Ž., Puača, V., *Livestock feed*, The Economic Review, Belgrade, 1978.
2. Fetcer, W., *J.Am. Oil Chem. Soc.* 20:203 (1983)
3. Lusas, E.W., Rhee, K.C., Koseoglu, S.S., *Proceedings of the World Congress "Vegetable Protein Utilization in Human Foods and Animal Feedstuffs"*, AOCS, Champaign, IL, 1988, p.p.177
4. Leibowitz, Z., Ruckenstein, C., *Proceedings of the World Conference on Emerging Technologies in the Fats and Oils Industry*, AOCS, Champaign, IL, 1985, p.p.208
5. Simić, D., Pantelić, Z., Milovanović, M., Simposium on Advancement of Oil Industry, Kupari, 1988.