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OIL SEED PROCESSING TECHNOLOGY IN PAKISTAN
Part -VII. Operational Parameters of Expeller Model-2 (16") Under Field Trials

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Processing parameters of expeller Model-2 (16") on both soft and hard oil seeds have been studied under field testing/operation conditions. It has been found that the expeller performs satisfactorily on all types of seeds and maintains its claimed enhanced processing capacity and extraction efficiency under these conditions.

Key words: Expeller, Parameters, Conventional, Un-conventional.

Introduction

The modified Expeller Model-2 (16") described in the previous report [1], was tested at the village/town level oil seed processing technology after dissemination in collaboration with the manufactures [2] and processors. The processing parameters studied during these trials included seed preparation, capacity, extraction efficiency and energy consumption.

The performance evaluation, as carried-out by the processors, indicates that the system is trouble free and effective both for the traditional (rape/mustard, cotton, groundnut, sesame and linseed) and the non-traditional (sunflower, safflower and soybeans) oil seeds. Further the expeller is being adopted as a commercially better alternative to the existing standard as well as the modified Lahore Expeller (4") because of its increased capacity, lower energy consumption, reduced maintenance cost and free from jamming problem.

The results described here were obtained on the expellers manufactured and operated respectively according to the design specifications and operation manuals provided to the manufacturers and the processors by the PCSIR - IDRC project managers. The disseminated technology has yielded essentially the same performance in the field as was obtained during its trials in the laboratories.

Materials and Methods

The expeller Model-2 (16"), manufactured as per the design specification [1] and equipped with an electric motor (10 H.P.), was used for all the experiments at five different places in the vicinity of Lahore. The experiments were conducted on rape/mustard, sunflower, safflower, soybean, linseed, groundnut and cotton seeds. The seeds were procured from the local market as well as from the Seed Division of the Ghee Corporation of Pakistan. The seeds were properly cleaned and were free from sand, dirt, leaves, stems and any other foreign material before processing.

A batch of 20 kg seeds (sun dried) was processed in each case and recycled till the oil recovery stopped. The oil expressed in each cycle was weighed and time was recorded for calculating the processing capacity for each oilseed processed. The energy consumption was also recorded by means of an electric meter. The residual oil in the cake was determined by solvent extraction according to standard methods [3]. The extraction efficiency was calculated by the equation

$$\text{Extraction efficiency} = \frac{\text{Recovered oil}}{\text{Total oil in seeds}}$$

The oil yields and energy consumption per processing cycle alongwith processing capacity on each type of oil seed processed are provided in Table 1 experiment-wise.

The experimental results on rape/mustard, sunflower, safflower, soybean, linseed, groundnut and cotton seeds are summarized under experiment nos. 1,2,4,5,6,7 and 9 respectively in Table 2. The data on decorticated sunflower, safflower and cotton seeds are also enlisted in Table1 and 2 under experiment nos.3,8 and 10 respectively. The given values are a mean value of five experiments in each case. Extraction efficiency and energy consumption for successive pass (1-3) through the expeller during processing of all oilseeds discussed here are presented in Figs. 1-10.

(Note: The amount of water, added at the time of processing the seeds, as mentioned in Table 1, is determined by the processors through processing experience.)

Results and Discussion

The performance evaluation of modified expeller Model-2 (16") has been carried out both on the traditional and non-traditional (as well as "soft" and "hard") oilseeds. It was desirable as with the introduction of sunflower, safflower and soybean in the country, these seeds are also available to the processors at the village/town level. For example the production of sunflower seeds has increased almost 10 folds in the past 10 years [5]. However, the whole oil seeds processed for the studies included rape/mustard (Experiment no.1.) sunflower, (Experiment no.2.), safflower (Experiment no.4), soybean (Experiment no.5), linseed (Experiment no.6), ground-

TABLE 1. CAPACITY, EXTRACTION EFFICIENCY AND ENERGY CONSUMPTION FOR THE PROCESSING OF DIFFERENT TYPES OF OILSEEDS.

Exp. No.	Water added (ml)	Oil yield kg/extraction efficiency pressing cycles			Energy consumption wh/kg seed; wh/kg oil pressing cycles		
		1	2	3	1	2	3
1.	100	5.0/56.4	2.33/82.7	0.6/89.5	33/130	65/177	100/252
2.	400	3.8/51.4	1.9/77.1	0.6/85.3	35/184	75/263	115/365
3.	400	4.2/47.01	3.3/82.4	0.8/88.2	23/107	48/127	73/181
4.	800	3.1/47.5	1.4/68.9	0.5/82.7	65/419	100/444	170/630
5.	600	0.9/19.9	1.4/50.8	0.8/68.4	105/2333	165/1435	265/1710
6.	300	4.4/57.6	1.73/80.2	0.66/88.8	40/182	83/271	138/405
7.	600	3.4/55.7	0.8/68.9	0.6/78.7	70/412	110/524	150/625
8.	400	4.33/49.3	2.66/79.5	0.83/89.0	28/138	58/173	98/260
9.	nil	2.23/58.0	-	-	100/897	-	-
10.	nil	2.2/40.5	1.4/66.3	0.6/77.3	20/222	40/258	68/321

TABLE 2. RESULTS AFTER LAST PRESSING CYCLES.

Exp. No.	Cycles	Res.oil in cake (%)	Total oil yield (kg)	Extraction efficiency (%)	Capacity kg/hr	Total energy consumption wh/kg seed; wh/kg oil
1	3	7.4	7.93	89.5	70	100/252
2	3	8.0	6.3	85.3	70	115/365
3	3	8.0	8.0	88.2	71	73/181
4	3	7.9	5.4	82.7	50	170/630
5	3	8.6	2.1	68.4	40	265/1710
6	3	6.6	6.8	88.8	103	138/405
7	3	8.7	4.8	78.7	40	150/625
8	3	8.0	7.8	89.0	70	144/368
9	1	7.8	2.23	58	72	68/321
10	3	9.0	4.2	77.3	75	100/897

nut (Experiment no.7) and cotton seed (Experiment no.9), and decorticated sunflower (Experiment no.3), groundnut (Experiment no.8) and cotton seeds (Experiment no.10). The processing data, as given in Table 1, suggests that the expeller Model-2 performs efficiently with all these seeds. It was observed during processing, that sun drying of seeds (2-3 days) to bring the moisture content of 4-5% level and addition of extra water (Table 1) to act as a lubricant to discharge the material through the cage, were useful hints for effective processing. The results of all experiments are briefly discussed in the following lines:

Experiment No.1. The processed seeds (20 kg). Yielded 5.0, 2.33 and 0.6 kg oil in the Ist, 2nd and 3rd cycles respectively (total 7.93 kg oil). The energy consumption wt/kg seeds processed and wt/kg oil recovered during successive cycles were 33/130, 65/ 177 and 100/ 252. For the three pressing cycles the capacity and extraction efficiency were observed to be 70 kg/hr and 89.5 % respectively.

Experiment Nos.2 and 3: Sunflower seeds. Sunflower seeds, both undecorticated and decorticated, were processed efficiently by the expeller. In both cases the processing capacity was 70-71 kg/hr and extraction efficiency ranged between 85.3 - 88.5 %.

Experiment No. 4: Safflower seeds. For processing safflower seeds (20 kg), the expeller required a 15 HP motor and addition of 800 ml water (lower volumes of water resulted in jamming of screw assembly). With these seeds although a low processing capacity (50 kg/hr) because of highly fibrous material on seeds was observed yet the extraction efficiency was good (83 %).

Experiment No.5: Soybean. Because of high starchy material and poor oil content in soybean the processing capacity (40 kg/hr) as well as extraction efficiency (68.4%) were observed to be low. However, the working of the expeller was observed to be smooth.

Experiment No.6: Linseed. Both the processing capacity (103 kg/hr) and the extraction efficiency (88.8%) were very high for linseed's processing by expeller Model-2. This can perhaps be attributed to the higher oil contents and soft nature of linseeds.

Experiment Nos. 7 and 8: Groundnut. The processing capacity on the whole groundnut without decortication (40 kg/hr) and extraction efficiency (78.7%) were observed to be higher (70 kg/hr) and (89%) respectively when decorticated kernels were processed. The lower levels may be due to the higher fibrous content of the pods covering the kernels.

Experiment Nos.9 and 10: Cotton seeds. The values for processing capacity and extraction efficiency, on uncorticated cotton seeds increased from 58 kg/hr and 58% to 77 kg/hr and 77.3% respectively when decorticated seeds were processed. This trend is also understandable for reasons mentioned under experiments on groundnut and sunflower seed's processing.

During these studies it was observed that extraction efficiency was greatly influenced by three factors namely; (a) seed preparation, (b) expeller setting for cake thickness, and (c) re-

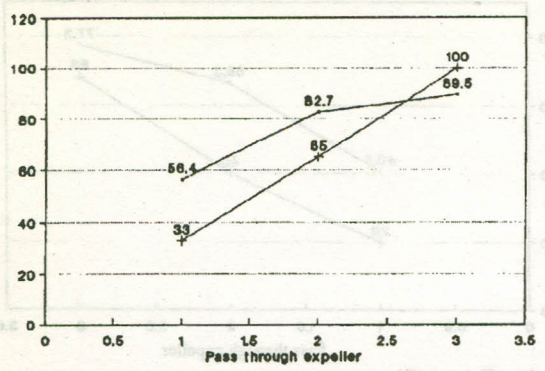


Fig. 1. Rape seed.

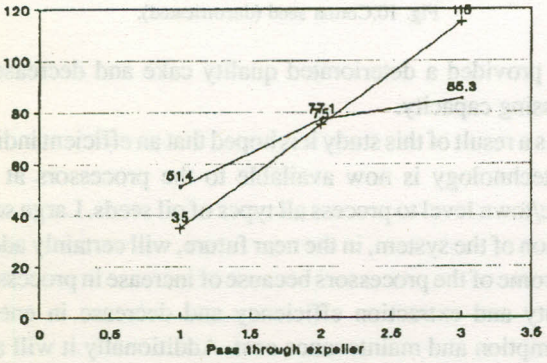


Fig. 2. Sun flower seed.

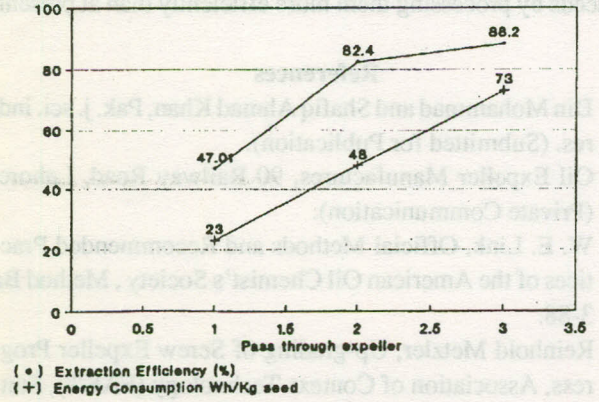


Fig. 3. Sunflower seed (Decorticated).

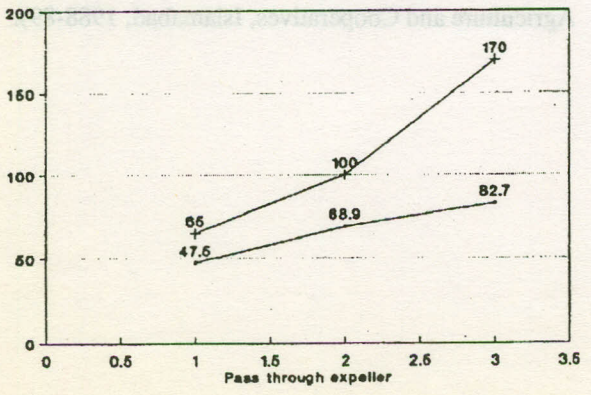


Fig. 4. Safflower seed.

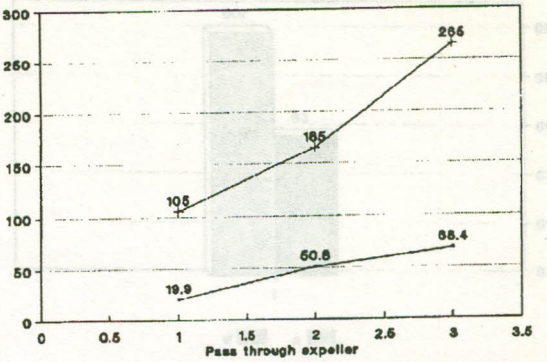


Fig. 5. Soybean

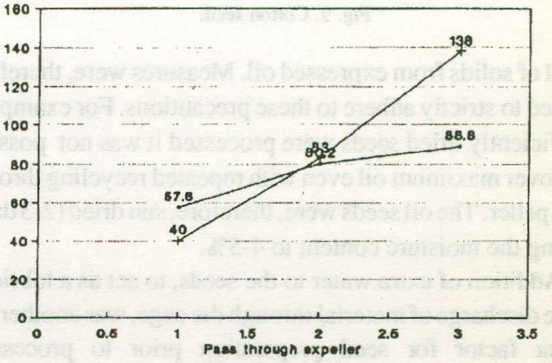


Fig. 6. Linseed.

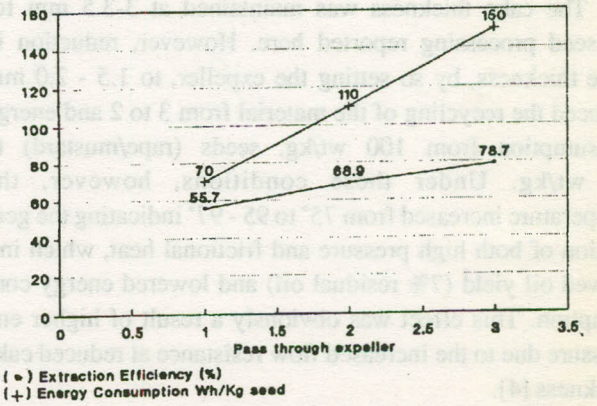


Fig.7. Groundnut.

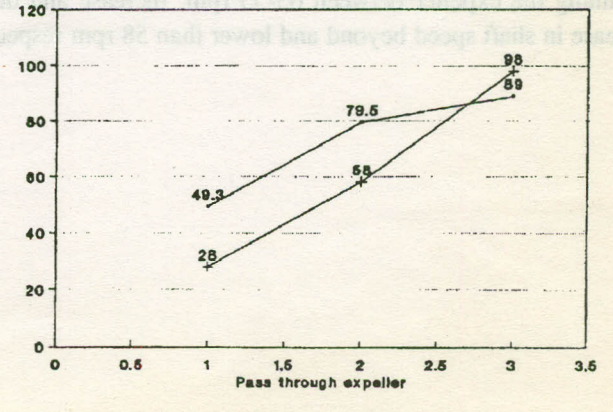
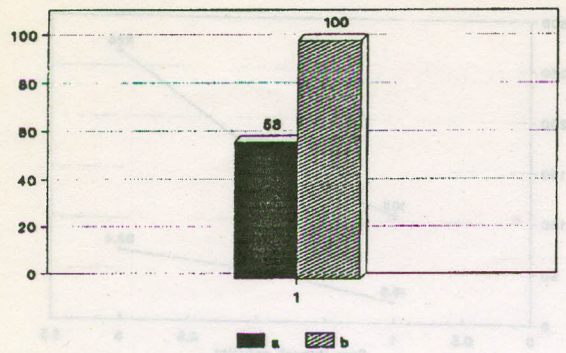
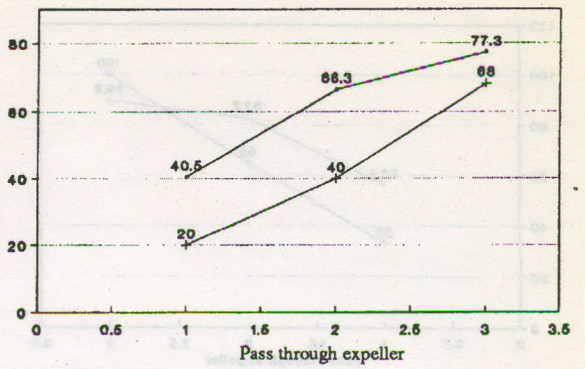


Fig. 8. Groundnut (Decorticated).



(.) Extraction efficiency (%)
(+) Energy consumption wh/kg seed

Fig. 9. Cotton seed.



(.) Extraction efficiency (%)
(+) Energy consumption wh/kg seed

Fig. 10.Cotton seed (decorticated).

moval of solids from expressed oil. Measures were, therefore, adopted to strictly adhere to these precautions. For example if insufficiently dried seeds were processed it was not possible to recover maximum oil even with repeated recycling through the expeller. The oil seeds were, therefore, sun dried (2-3 days) to bring the moisture content to 4-5%.

Addition of extra water to the seeds, to act as a lubricant for the discharge of material through the cage, was another important factor for seed preparation prior to processing (Table 1).

The cake thickness was maintained at 3-3.5 mm for all seed processing reported here. However, reduction in cake thickness, by so setting the expeller, to 1.5 - 2.0 mm reduced the recycling of the material from 3 to 2 and energy consumption from 100 wt/kg. seeds (rape/mustard) to 75 wt/kg. Under these conditions, however, the temperature increased from 75° to 95 - 97° indicating the generation of both high pressure and frictional heat, which improved oil yield (7% residual oil) and lowered energy consumption. This effect was obviously a result of higher end pressure due to the increased flow resistance at reduced cake thickness [4].

The optimum shaft speed (58 rpm.) was determined by running the expeller between 65-55 rpm. Increase and decrease in shaft speed beyond and lower than 58 rpm respectively provided a deteriorated quality cake and decrease in processing capacity.

As a result of this study it is hoped that an efficient indigenous technology is now available to the processors at the village/town level to process all types of oil seeds. Large scale adoption of the system, in the near future, will certainly add to the income of the processors because of increase in processing capacity and extraction efficiency and decrease in energy consumption and maintenance cost. Additionally it will also add to the availability of edible oil from the locally produced oil seeds by processing them more efficiently than at present.

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