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OILSEED PROCESSING TECHNOLOGY IN PAKISTAN
Part-VIII. Development of Semi-Commercial Expeller

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An expeller (Model-3) of screw length 56 cm having two reverse worms, at 4th and 6th places of reduced shoulder height, 0.95 cm was designed, developed and tested for its performance on all types of oilseeds. The processing performance was so increased that it can be adopted at semi-commercial level. The design improvements'details and oilseed processing results are described.

Key words: Expeller, Performance, Worm Gash.

Introduction

In continuation of the earlier studies, further changes and improvements have been incorporated in the expeller (Model-2) [1-2]. This has resulted in realising the objective of the locally developing an efficient expeller capable of processing soft and hard oilseed both at the village as well as the semicommercial levels. Modifications of the design features, with a view to achieving economy in production cost and energy consumption and competitive performance efficiency, have remained the basic thrust.

It is known that the parameters which influence oil extraction, efficiency and capacity are dependent on the length of screw shaft, barrel diameter, choke length, height and width of worm's flight and the rpm of the main screw shaft [3]. Further it is also reported that increasing the screw shaft length results in an increase in the expeller through out and decrease in residual oil in cake [2,4]. As a follow up of the already reported developments, a new semi-commer-cial expeller, Model-3 (Fig.1) has been designed, fabricated and tested in the laboratories as well as in the field. The present report thus describes the design features and performance of the expeller Model-3. The salient features of the expeller Model-3 have been; (i) Enlarging the cage length from 16" (40.5 cm) to 22" (56 cm); (ii) Optimising the screw configuration with two reverse worms of decreased shoulder heights, (iii) Lowering the rpm of the screw shaft from 57 to 37 and (iv) Keeping the power source the same (10.H.P.) as in the case of previously modified expellers [2].

Experimental

An expeller, chamber length 22" (Model-3) was designed, fabricated and tested on rape seeds, sunflower seeds, safflower seeds, soyabeans and cotton seeds. Accordingly increased screw lengths were also fabricated and one design (out of 40) optimised to enhance capacity, oil extraction efficiency and to reduce energy consumption. This screw configuration was consistituted by 7-worm sections, arranged in pitch decreasing order from the feed towards the discharge end, keeping the hub diameter (68 mm) the same in all cases. The lengths of the worms and the respective pitches are shown in Table 1. A 'gash' (25.4 mm) was created by cutting the shoulder generated over all the discharge worms in a straight line, which was useful in the adjustment of the pressure buildup in the drainage barrel. The gash in a gap between two ends of the shoulder generated around a worm section.

The feed worm design was so modified that it could push comparatively more volume of the material inside the drainage barrel at a steady and constant rate. It resulted in the production of high pressure and temperature and consequently the oil yield was improved. It was accomplished by raising the shoulder height (23 mm) at the initial end and gradually decreasing it to 15 mm at the other end of the feed worm. The iron bars which formed a hallow cylinder, were slightly

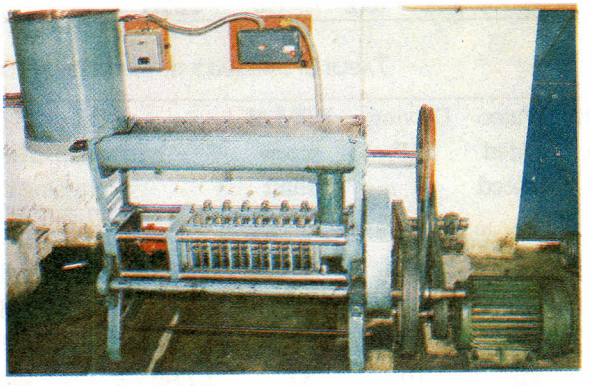

Fig. 1. Modified Expeller Model-3.

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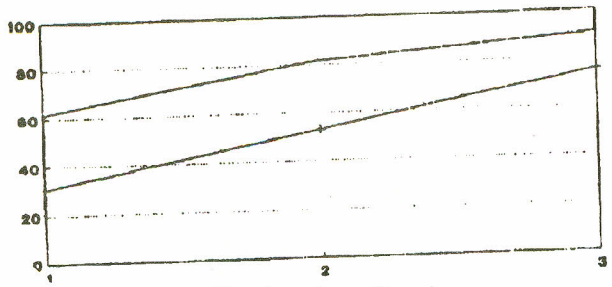
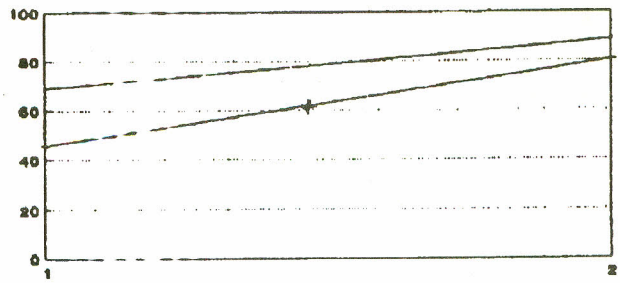
Graph - 1



Pass through expeller

— Oil Ext. Eff. % —+— Energy Consp. Wh/Kg

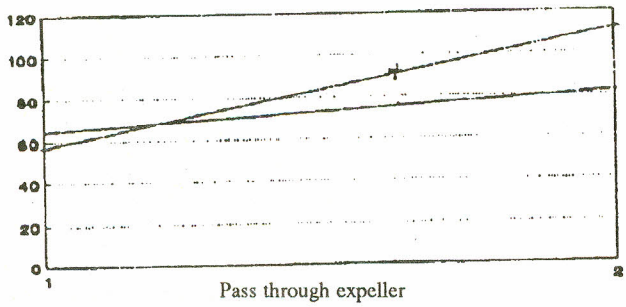
Graph - 2



Pass through expeller

- - Oil Ext. Eff. % —+— Energy Consp. Wh/Kg

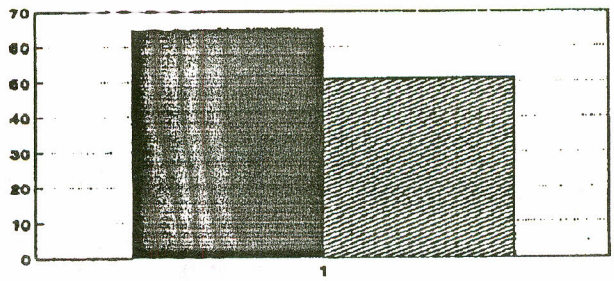
Graph - 3



Pass through expeller

— Oil Ext. Eff. % —+— Energy Consp. Wh/Kg

Graph - 4



Pass through expeller

Oil Ext. Eff. % Energy Consp. Wh/Kg

Fig. 2.

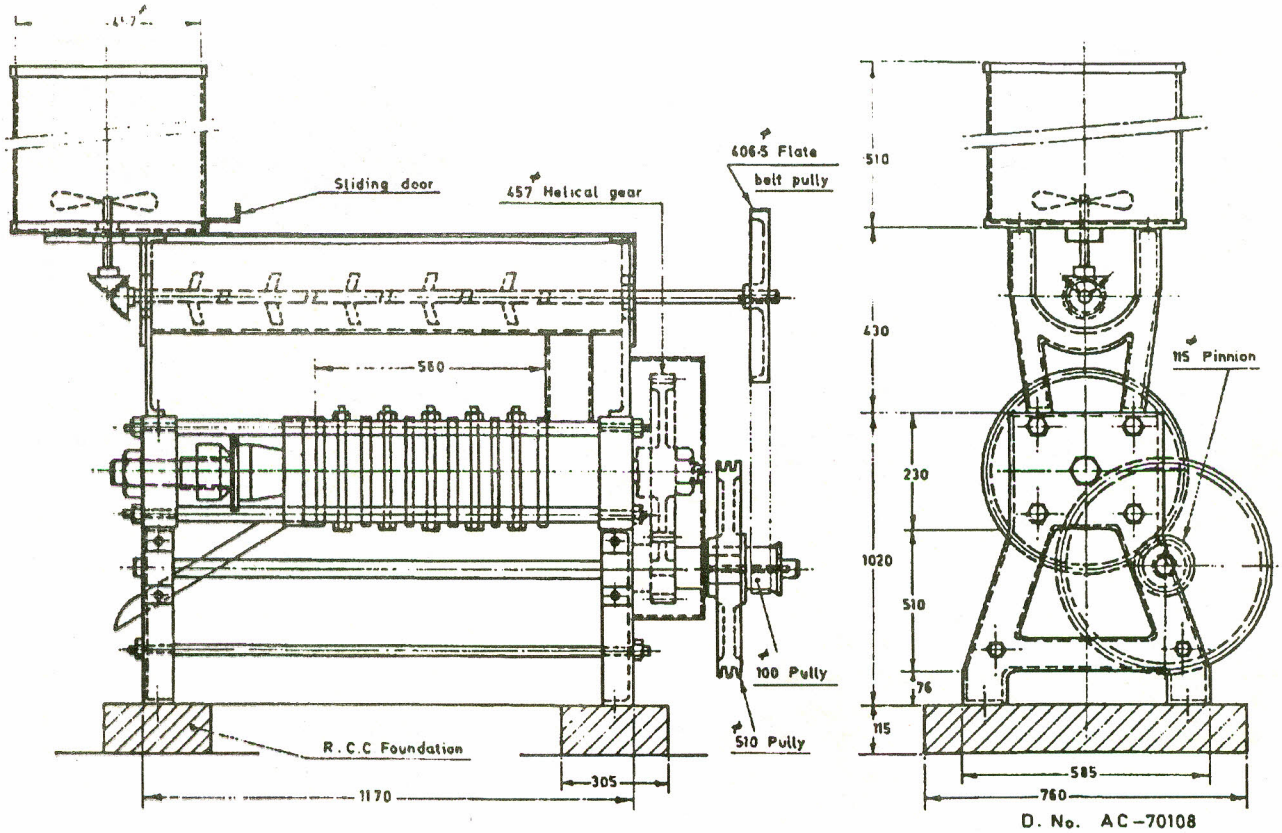
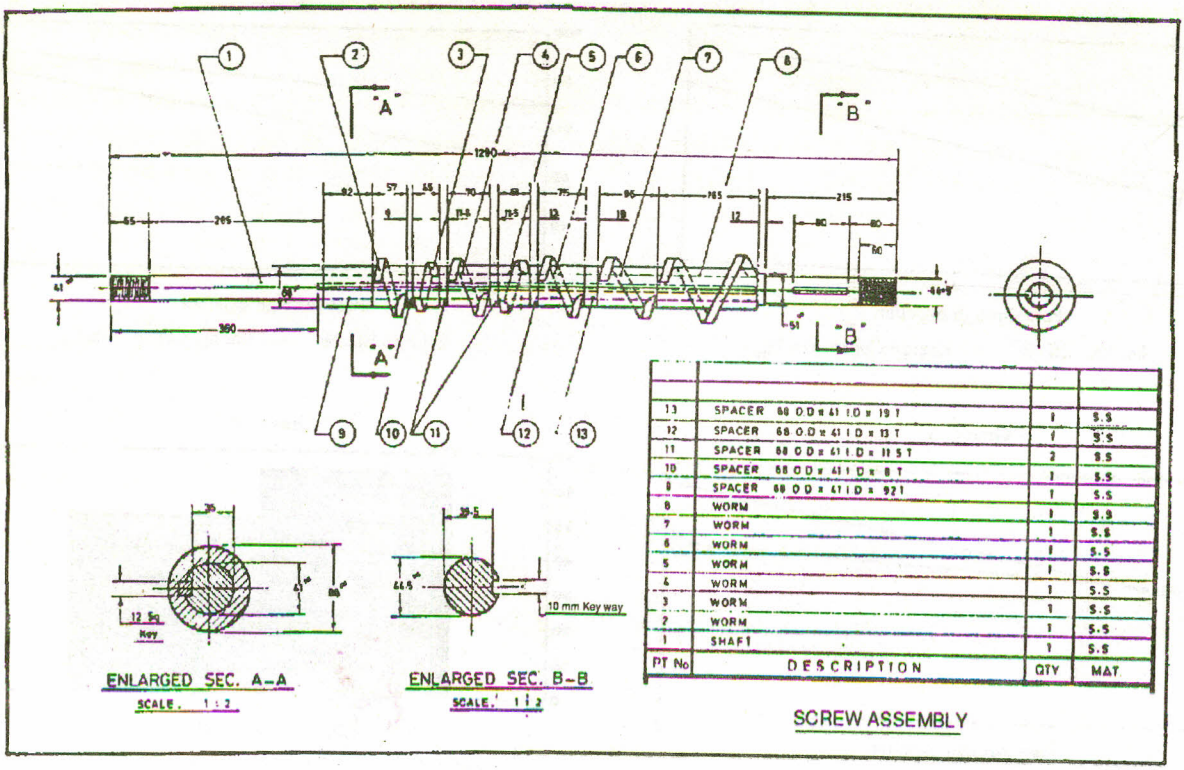


Fig. 3. Modified screw press No. 3 (10 x 65 cm or 4" x 22").



PT No	DESCRIPTION	QTY	MAT
13	SPACER 68 O.D x 41 I.D x 19 T	1	S.S
12	SPACER 68 O.D x 41 I.D x 13 T	1	S.S
11	SPACER 68 O.D x 41 I.D x 11.5 T	2	S.S
10	SPACER 68 O.D x 41 I.D x 8 T	1	S.S
9	SPACER 68 O.D x 41 I.D x 92 I	1	S.S
8	WORM	1	S.S
7	WORM	1	S.S
6	WORM	1	S.S
5	WORM	1	S.S
4	WORM	1	S.S
3	WORM	1	S.S
2	WORM	1	S.S
1	SHAFT	1	S.S

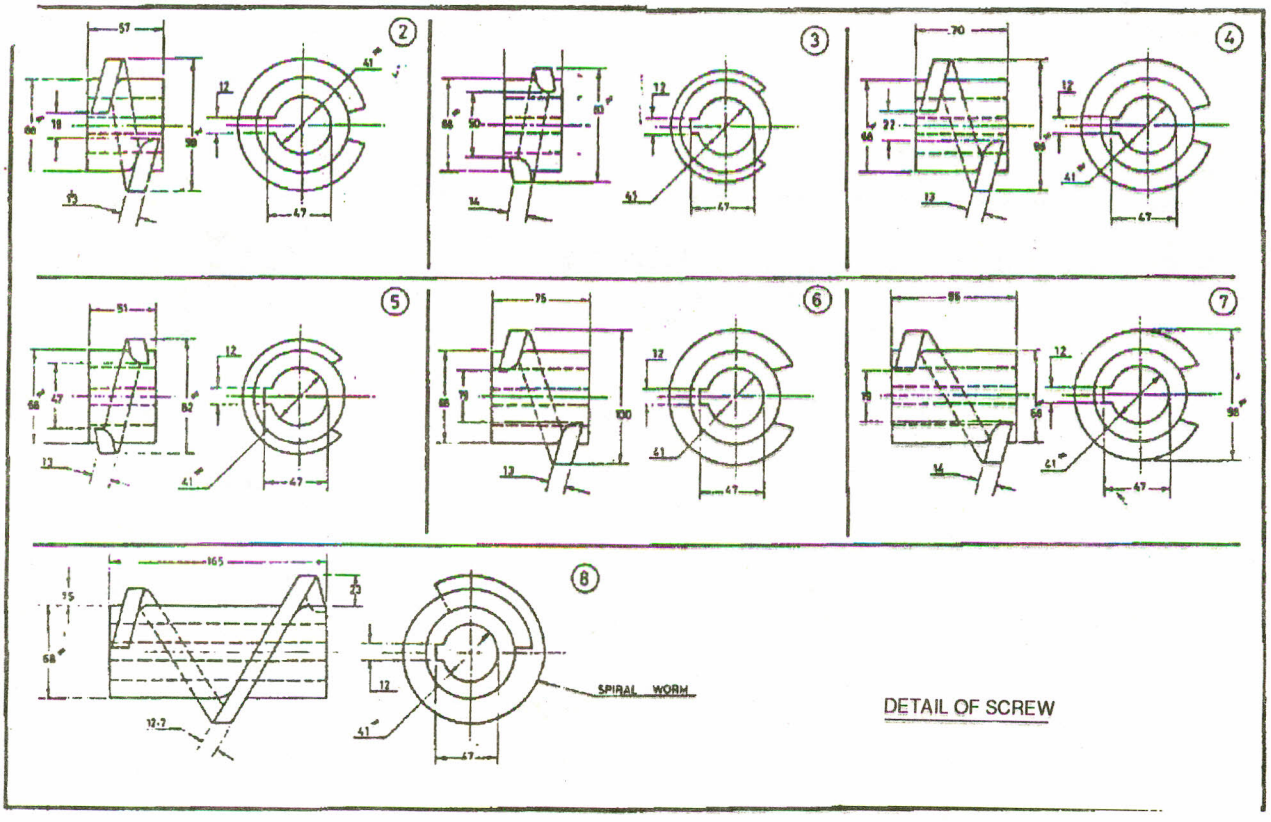


Fig. 4.

The processing capacity on safflower seeds was also 100 kg/hr.; oil yield 81 % in 2-passes only, energy consumption 12 Wh/kg seed and 466.7 Wh/kg oil (Fig. 2, Graph 3).

The cotton seed was successfully processed by the new expeller while the previously modified expeller Models-1 and 2 were not able to process these seeds effectively. The processing capacity on cottonseed was 120 kg/hr.; oil yield 65.2% in 1-pass only; energy consumption 51 Wh/kg seeds and 371 Wh/kg oil (Fig. 2, Graph 4).

As compared to the previous expeller Model-2, whose performance has earlier been reported [2], the new expeller Model-3 resulted in increasing the capacity 43%, oil extraction efficiency 0.5% and lowering energy consumption about 25% while both the expellers were operated by the same H P. 10.

The newly designed expeller Model-3 has thus been operated successfully on a range of different oilseeds. The expeller was also field tested for about 1 year and its performance was closely monitored. The results co-relate with the results obtained in the pilot plant.

The new machine can compete with high priced large expellers in capacity, oil recovery and versitality. It is considerably cheaper and more efficient in its power consumption (10 H.P.) as compared with the large expeller models operated by high power source (20-25 H.P.). Also it is competitive when evaluated against foreign expellers on the basis of its excellent design feature. The foreign expellers usually have screw of low pitch (2.54 cm) which helps in increasing the axial push and reducing the rotaitonal movement of the material [5]. In contrast screw sections having large pitches proessess the tendency of increasing the radial force for decreasing the axial force thus forming an equilibrium of resultant forces and consequently the material is rotated more by the reduced axial push and press performance is adversely effected [6]. In expeller Model-3 more axial movement was, however, achieved by uising two reverse worms and installing proper size spacers in between each worm section of the screw configuration.

It is expected, on the basis of the performance data and cost, that the expeller Model-3 will prove competitive and replace the existing less efficient expellers. Considerable socio-economic benefits can accrue by adoption of this improved technology in addition to the provision of more extracted oil from the same oil bearing materials, which are processed by the current expellers in the field.

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