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A REVIEW ON DESIGN AND ANALYSIS OF OIL EXPELLER SPARES

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ABSTARCT:
The paper review various researches which has been work carried out through design failure analysis of various spares of oil expeller.The research contributes to the problem evaluation of a small scale industry working in the area of oil extraction. The research fruit forward the method diagnosis of failure of the worms and worm shaft of cotton seed oil extraction unit before prescribed life period .This could help the industries working in these area to improve the life and functionability of the unit which would in their term lead to higher productivity.This literature tries to diagnosis the reason of uncertain failures and would suggest the constructional solution in the same regards. The proposed works not only checks the dimensional through traditional method but also implies computerised techniques to evaluate thermal stress analysis. This will in turn would decide the criteria of material selection and dimensional decisions.Thus,the work contributes to reduction of running cost of an industry and sudden breakdowns occuring at the shopfloor.

Keywords: Oil expeller; Spares; Design; Analysis; Failure; Mainshaft; Worms; Bearing.

1. INTRODUCTION

Expellers use a horizontally rotating metal screw, which feeds oil-bearing seeds into a barrel shaped outer casing with perforated walls. The seeds are continuously fed to the expeller, which grinds, crushed and presses the oil out as it passes through the machine. The pressure ruptures the oil cells in the product and oil flows through the perforations in the casing and is collected in a trough underneath.The residue of the material from which oil has been expressed exits from the unit, and is known as the cake. With some types of expellers takes place. This allows for greater oil expression and reduces wear and tear on the machine.

Expellers are power-driven, and are able to process 8 to 300 kg per hour of product or even more depending upon the type of expeller used. Bigger units processing greater quantities of oil are available for use in larger mills. The percentage of oil expressed by expellers is nearly 90% depending upon the type and kind of products as well as the expeller being employed. The friction created by the products being expressed wears down the worm shaft and other internal parts, and also have the problem of uncertain failure of main shaft. With small machines this occurs often after expressing little, after which parts have to be replaced or repaired through resurfacing by welding. Maintenance of an oil expeller, therefore, calls for machinery and equipment rarely found in small repair shops and local manufacture of expellers would be most unlikely at the village /small town level. The profitability of the businesses, including oil processing, depends on reducing the capital and operating costs as much as possible, and at the same time maximising the income.

1.1. Construction :

Parts of oil expeller and its description are given as under;

- *Body*
- *Hopper*
- *Bed*
- *Main shaft*
- *Gear*

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- *Worm and cage gear*
- *Bearing*
- *Barrel*
- *Cone and collar*
- *Cutter*
- *Tray*

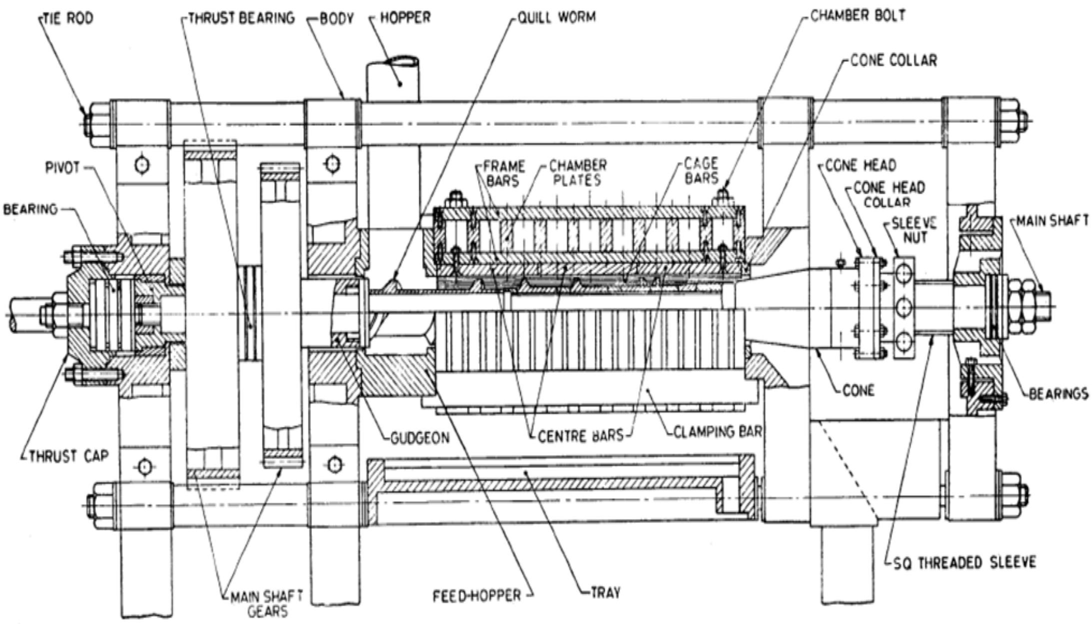

FIG. 1 NOMENCLATURE AND ASSEMBLY OF DOUBLE GEAR OIL EXPELLER

Body:
It is made from highly closed grained casting to ensure continued service without any vibration and accurately machined under the supervision of highly qualified engineers

Hopper:
It is use as to feed the raw material inside of casing to extract the oil. It also controls quantity of seed to supply for crushing.

Bed:
The earlier models having two stands have been replaced by a steel fabricated structure. This ensures better alignment of the machine and the vibration is reduced to a minimum. Oil collecting arrangement has also been incorporated in this structure thus avoiding the addition of an extra oil tank. The tin tanga body and cone body have been integrated to form a single joint body as on the gear box side. The Joint body is cast, machined and bored in one single setting thus giving perfect alignment. The chances of variations in thickness of cake are reduced to a minimum.

Main shaft:
It is main part of expeller. It carries and support to worm gear, cone, collar, cutter, gear etc.

Gears:
The gears and pinions are manufactured out of tested alloy steel to ensure smooth running of gears. Induction and oil quenching hardness is given to gears for long life. The gears are fitted in oil bath case for smooth running.

Worms:
The most essential part of modern oil milling is the shape, design and material construction of pressing worms.

Bearing:
All imported heavy duty bearings, taper bearings, roller bearings and thrust bearing etc.

Barrel:
Chamber Box: This is manufactured from M.S. extra thick plate of 1 1/4 & 1" and suitably machined for assembly of the tempered cage Bars & Frame Bars. The Pinjra is made from extra Thick Square Bars and its bolts are made with extra heavy nuts, Barrel can be easily removed and refilled.

Cone and collar:
Cone is placed at the end of extraction of oil on the main shaft. It is mainly use for maintaining cake thickness. Collar has placed after the cone.

Cutter: Cutter has placed after cone and collar. It is use for cutting the cake.

1.2. Operation :

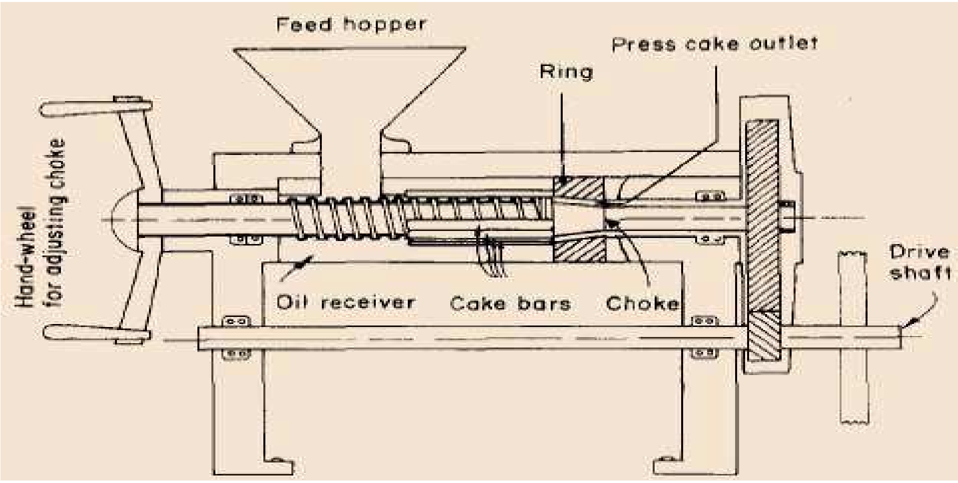

Fig 2. Working Principle of Oil Expeller

The expeller consists of a screw (or worm), rotating inside a cylindrical cage (barrel). The material to be pressed is fed between the screw and the barrel and propelled by the rotating screw in a direction parallel to the axis. The configuration of the screw and its shaft is such that the material is progressively compressed as it moves on, towards the discharge end of the cylinder. The compression effect can be achieved, for example, by decreasing the clearance between the screw shaft and the cage (progressive or step-wise increase of the shaft diameter) or by reducing the length of the screw flight in the direction of the axial movement The gradually increasing pressure releases the oil which flows out of the press through the slots provided on the periphery of the barrel, while the press-cake continues to move in the direction of the shaft, towards a discharge gate installed at the other extremity of the machine.

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Many of the refined seed oil is used for edible purposes such as salad and cooking oils, shortening, margarine and to a lesser extent in the packing if fish and cured meat. Low grade oil is used in the manufacture of soaps, lubricants and protective coatings. The by-product of the proposed plant is expeller cake which is used for animal feed.

2. PROBLEM FORMULATION:NEED AND SIGNIFICANCE OF PROPOSED RESEARCH WORK :

In the oil industries,where screw type oil expellers are used there is a common problems of wear and uncertain failure of machine spares which result in the breakdowns, increasing the running cost and reducing the productivity.The frequency of breakdowns due to uncertain failure and the cost incurred for the repair/replacement in high which increases the running cost of the industry.Many seed oil extraction unit uses the mechanical method of screw pressing for extracting oil from seeds. The seeds are squeezed under high pressure in a single step in a continuous feed which result in the wear among the mating parts with generation of the huge heat, which again increases the chances of failure of the parts.

2. LITERATURE REVIEW:

[1] Mehul.K.Modh and J.R.Mevada;In this paper the author have carried out the thrust ball bearing analysis of oil expeller and results are compared with analytical results to solve the problem of Thrust ball bearing into pieces failure in oil expeller once in 2 to 3 months. The author had calculated the thrust force acting upon the thrust ball bearing, which is quite high which a bearing can withstand. Calculated life of existing bearing is about 5.2 months. Hence it was proposed to change the bearing which gives satisfactory life of 2.5 years by calculation Further static analysis of the Part of bearing on Pro-E wild Fire 4 and Ansys Workbench 11 was carried out. The analysis results the Principle stress, Principle strain and axial deformation found to be reduced.

[2] V. S. Khangar and Dr. S. B. Jaju.;The various methodologies used for the failure analysis of shaft used in different application by various authors are reviewed in this paper. Roll shaft failure can be prevented primarily by introduction of better material design optimization & by using correct manufacturing processes. This paper presents the comparison of the different methodology used, their application & limitation by various authors. The objective of the present work is to study the various methodologies used for the shaft failure analysis & to choose the best methodology suitable for the failure analysis of bridle roll shaft used in continuous steel industry to prevent repetitive failure. Bridle roll failure leads to heavy loss approximately Rs 80000 per hour due to line stoppage & repairing cost associate with the breakdown.

[3] Shankar Haldar,Aniruddha Bhattacharjee,Vineet Jain, and Sudhir Singhal; This is the report submitted by the authors from InsPIRE Network for Environment New Delhi to Department of Science and Technology Government of India which consist of the detailed information about oil expellers including availability of Oilseeds, Elements of Expelling Process, Types of Expellers and their Design Features, Current Expellers, Site Visits.

[4] A.Ibrahim and A. P. Onwualu; Reviewed the technologies for oil extraction from oil-bearing agricultural products and different types of oil- bearing agricultural products,pre-processing conditions including the removal of hulls and shells, pre-processing conditioning such as size reduction, moisture content adjustment, heat treatment and pressure application, as well as the methods employed in the extraction, namely; traditional and modern (improved) methods dicussed in this paper. The improved method include; oil expeller, screw press, and solvent (chemical extraction). Problems (technical, socio-economic and institutional) associated with each method and the need for more research for the improvement of the methods are analysed. It has been shown that for any developing country to effectively adopt modern methods in the production of edible vegetable oils, improvement on the existing traditional methods, environmental factors, government policies, socio-economic

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and cultural considerations of the users need to be studied. This can be achieved through more research in the recommended area of need.

[5] Deli S, Farah Masturah, Tajul Aris, and Wan Nadiah;The effects of physical parameters of a screw press machine on oil yield of N. sativa seeds were studied using a KOMET Screw Oil Expeller. Different nozzle size (6, 10, and 12 mm), extraction speed (21,54, 65 and 98 rpm) and diameter of shaft screw (8 and 11 mm) were applied in this study. Different nozzle size, diameter of shaft screw and rotational speed do effects the percentage of oil yield. By using shaft screw with diameter of 8 mm had resulted to the decrease of oil yield with the increase of nozzle size and rotational speed. While, by using the shaft screw with diameter of 11 mm had recorded the highest percentage of oil yield at 65 rpm when using nozzle with the size of 6 and 10 mm. However, when using nozzle with the size of 12 mm, the percentage of yield had recorded the same result pattern with the result of using shaft screw with diameter of 8 mm which is; the decreased of percentage of oil yield with the increase of rotational speed. The highest percentage of oil yield recorded was at the combination of shaft screw with diameter of 8 mm, rotational speed at 21 rpm and nozzle size of 6 mm. There was significantly different ($p<0.05$) between oil yield with heat temperatures. The oil yield was higher at 50°C (22.68%) and lower at 100°C (15.21%). Most of the results obtained (percentage of oil yield of N. sativa seeds recorded) was significantly different ($p<0.05$) in relation with the effect of physical parameters of machine screw press on the oil yield. The study found that optimum condition for cold press of N. sativa seeds oil is using 6 mm of nozzle size, 8 mm of diameter shaft screw and pressing at speed 21 rpm. The highest amount of oil yield is 22.27% on diameter shaft screw 8 mm and 19.05% on diameter shaft screw 11 mm.

[6] Adesoji M. Olaniyan, Kamaldeen A. Yusuf, Adebayo L. Wahab and Kunle O. Afolayan; A screw press expeller was designed, constructed and tested for palm kernel and soybean oil extraction. The expeller was simple enough for local fabrication, operation, repair and maintenance. Powered by a 15 hp three-phase electric motor, the expeller has average oil yield and extraction efficiency of 13.48 and 22.79 % respectively from palm kernel and 9.47 and 36.55 % respectively from soybean with a production cost of USD1200. The expeller can be used for small scale palm kernel and soybean oil extraction in the rural and urban communities. A cottage palm kernel and soybean oil processing plant based on this technology can provide employment for at least two persons at the same time providing palm kernel and soybean oil at affordable costs for rural dwellers palm kernel cake and soybean cake for livestock feed mill. An improvement in the design of the worm shaft of the expeller is expected to improve the oil yield and extraction efficiency; hence, this is highly recommended.

[7] M. Zamanzadeh, E. Larkin and D. Gibbon; In these paper the author presents the methods of various failure analysis processes applied to all different types of materials. Each class of materials requires special skills and experience to effectively unravel the causes of failure. This paper focuses on these various subsets of materials. These include failures in metallurgy, paints and coatings, plastics and electronics, as well as failure caused by corrosion and principles of root cause determination within that particular field. This paper is primarily concerned with the overall approach to failure analysis and with the applications of that approach to metallurgical failures. In these paper various case studies on materials failure analysis are reviewed.

[8] Aremu A. K and Ogunlade C. A An oil extractor machine was designed, constructed and tested to remove and recover oil from kenaf when used for the absorption and clean-up of crude oil spillage. The machine has a throughput capacity of 36.5 kg/hr and oil Extraction Efficiency (percent oil yield) of 62.2 % and the oil yield was dependent on the moisture content of the soaked kenaf bast and core used for the absorption (clean-up) process. The operation of the machine does not require any technical-know-how and the machine can be easily maintained as it has the tendency of self-lubricating the extraction chamber due to presence of oil in the input materials.

[9] S Sreenatha Reddy, Dr V Pandurangadu and I Srinivas A mini oil expeller is fabricated to find out the effect of variation in compression ratio of the oil chamber and speed of the screw shaft on oil recovery and energy consumption during oil extraction of Pongamia and Jatropha seeds. A mini oil expeller is fabricated by incorporating the adjustments for variation in compression and speed. During the experiment, the compression ratio is changed from 14:1 to 21.5:1, and the speed is altered from 35 rpm to 65 rpm. The interactive effect of these two parameters on oil expulsion is observed critically and compared with the conventional expeller. Compression ratio has shown significant impact on oil recovery and energy consumption.

3. METHODOLOGY

1. Design and validation of dimension of spare considered e.g Worm and screw shaft assembly through Reverse Engineering :

It will involve the measurement of actual dimensions of the spare parts which will mostly includes main shaft, worms, bearings, cage and bars of the oil expeller. By using above data a model will be prepared of designed spare part through the modelling software and the dimensional design will be compared with traditional method of design engineering.

2. Evaluation of Thermal stress analysis through computerized techniques :

The FEM analysis is proposed for thermal stress evaluation of the designed spare like bearing, main shaft, worms of oil expeller by applying the similar constraint with respect to material, temperature and loading conditions, to determine the high stressed regions.After stress analysis decision about changes which could be in dimensions and material will be taken in order to make the optimal changes to reduce the failures.

3. Evaluation of cooling system which already in exist :

The Evaluation of cooling system will be done by measuring the actual working temperature inside the screw chamber and analyzing its effect on various spares like main shaft,worms,bearing by simulating and testing the model using ANSYS with the actual constraints.

4. CONCLUSION

In the oil expeller there is a common problem of the failure of spare parts like bearing, main shaft, worm threads, rings, shaft key, gears etc due to the action of high forces and various stress on these spare parts, also the generation of the huge amount of heat between mating parts lead to wear of the parts and reduction of there strength,resulting in there failure. The failure of the spares leads to reduction in efficiency and even breakdowns. In order to reduce these failures design and analysis of spare parts in necessary, which result in the selection of the optimal parameters for these spares increasing its efficiency and hence the overall productivity of the industry.

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