

PN-ABU-860
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**A REPORT ON THE TRAINING
OF
SMALL SCALE EDIBLE OIL MILL
OWNERS AND OPERATORS
IN
UGANDA**

**THE UGANDA COOPERATIVE ALLIANCE AND U.S.A.I.D.
COOPERATIVE AGRICULTURE AGRIBUSINESS SUPPORT
PROJECT**

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**TRAINING PERIOD
17 JANUARY TO 9 APRIL 1994**

CONTENTS

Page 1.	Contents
Page 2.	Scope of work
Page 3.	Acronyms
Page 4, 5.	Background
Page 6, 7.	Summary
Page 8, 9, 10.	Recommendations
Page 11,	Training subjects
Page 12 to 23	Content of subjects
Page 24 to 37	Activities
Appendix	Names of participants
	Operating manual
	Attendance certificate
	M i n i 4 0 m o d i f i c a t i o n
	sketches

SCOPE OF WORK

1. Train women's groups whose oil mills were wholly or partially funded by the cooperative bank with PL 480 funds. Training would include day to day operations, troubleshooting, preventive maintenance and repairs.

The groups include;

- a) Kinakulya Women's Cooperative Society - Kiboga
- b) Bugiri Women's Industrial Society - Bugiri
- c) Alimugonsa Women's Industrial Society - Masindi

2. Train on an individual basis, oil mill operators who received oil mill loans or grants of seed or loans from the cooperative bank. This training would include preparation of seed for milling, mill maintenance and repair. specific mills where training would be carried out include;

<u>Name of mill</u>	<u>Location</u>	<u>Type of mill</u>
East African Industries	Kampala	Tiny Tech
AFYA Enterprises Ltd	Mbale	Tiny Tech
Okonyi Ochori	Lira	Carrera
To be named	Gulu	Hander
Ateki Oil Mill	Masindi	Hander

3. Set up group training sessions, by mill type, to train small groups of oil mill operators in the peculiarities of various manufacturer's machines. This would include any interested small or medium mill operator who wants to top up his/her training. Group training sessions would be organized in small groups and would take place in various locations of the country.
4. Assist the Oil Millers Association in any way possible in designing and establishing a proper long term training program.
5. Review and make any amendments he recommends to the draft "Training Manual for the Operations of Small Scale Oil Presses" prepared by Rico Cruz. This will then be printed for distribution

In addition to the above scope of work I was requested to attempt the redesign of the De-smet Rosedown Mini 40 expeller wear parts so that they could be made locally. This machine has been widely distributed in Uganda by various charitable and implementing agencies and many of them are not operational because of extremely expensive imported spare parts.

LIST OF ACRONYMS USED IN THIS REPORT

ACDI..... AGRICULTURAL COOPERATIVE DEVELOPMENT INTERNATIONAL

CAAS..... COOPERATIVE AGRICULTURE AGRIBUSINESS SUPPORT

PL 480..... A USAID EDIBLE OIL MONETIZATION PROJECT

RONCO..... RONCO CONSULTING CORPORATION

RPM..... REVOLUTIONS PER MINUTE

SG..... SPECIFIC GRAVITY

UCA..... UGANDA COOPERATIVE ALLIANCE

UCB..... UGANDA COOPERATIVE BANK

USAID..... UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

USH..... UGANDA SHILLING

BACKGROUND

In the late 1960's and early 1970's Uganda was self supporting in edible oil which was derived from the seed of the cotton industry. In this period, Uganda was exporting more than 400,000 bales of cotton and the seed from this cotton was processed in medium and large scale factories which were predominantly owned by the Asian community in Uganda.

During the dictatorial reign of Idi Amin the Asians were instructed to leave Uganda and consequently the edible oil and cotton industry went in to rapid decline. The result of this decline in the production of edible oil is still apparent to-day because of the large amount of imported edible oil which is in the market place and the implementation of the USAID PL 480 monetization project.

The lack of production of edible oil in Uganda on a self sustaining basis, is of major concern to the government, the Cooperative Alliance and the donor community. This concern has initiated the implementation of a variety of small scale edible oil seed processing projects, the production of oil seed for planting and seed distribution to farmers to increase the production of oil bearing seeds for the edible oil industry.

The need to revitalize the edible oil industry in Uganda has brought the author of this report to Uganda on two other occasions. In 1989 he was here for a period of three months to assist Mr Warren Enger of Ronco in assessing the operational capability and the mechanical condition of the process equipment which existed in the Uganda edible oil industry at that time and again in September 1992 at the request of the contractors representative of the Cooperative Agriculture and Agribusiness Support (CAAS) project Dr Vic Amann. On this occasion, it was to assist in the viability assessment of the proposed installation of a 25 ton per day edible oil mill for the Lango cooperative society in Lira, see reports, UGANDA OIL SEED PRODUCTION AND PROCESSING ANALYSIS and OIL SEED PROCESSING IN UGANDA, A SMALL SCALE APPROACH.

In each of these reports it states that the main reason for the lack of edible oil production in Uganda, is the low production of oil bearing seeds by the farmers compared to the late 60's and early 70's. The need for local manufacture of spare parts for the processing equipment, technical training in the production of these parts, training in the processing of oil seeds and training in the production of edible oil.

In line with the recommendations of these reports, the USAID, ACDI, CAAS project has been providing technical assistance and financial support via the PL 480 monetization project to the UCA since 1993.

A large percentage of the funds derived from this project, was designated to support the development of small scale, cooperative, edible oil processing enterprises. This support has been provided in various ways such as the multiplication of a high oil content sunflower seed called "Sunfola", loans from the Uganda Cooperative bank to entrepreneurial small scale cooperatives for the purchase of buildings and equipment to house oil expellers, store materials and provide the expertise for training these small scale entrepreneurs in the activities required for oil seed processing and edible oil production.

SUMMARY

The training sessions for the edible oil producers that have been held in various parts of the country has been very well received by the owners, operators and potential owners who have taken part in the training. The high level of participation in the subjects discussed, interest in the mechanical and practical applications of the process equipment and requests for repeat sessions has confirmed this.

The training activities at the various sites, particularly the dismantling of process equipment in the practical sessions, has revealed that there is a tremendous need for training in the mechanical engineering disciplines which are applicable to edible oil seed processing such as the installation of machinery, repair and welding practices, steam equipment installation and the applications of this equipment in the processing of oil seeds and the production of the edible oil. Some examples of this lack of knowledge are expeller main shaft metal fatigue breaks caused by misalignment during installation, the removal of expeller pressing worm flights by electric arc gouging to facilitate shaft rotation after the wrong installation of expeller parts. The inverted installation of steam traps and the removal of the traps internal working parts to facilitate condensate discharge from the heated vessel and many other examples which will cause expensive repairs and failure of equipment.

There appears to be no coordination of the efforts of the various agencies who are involved in the promotion of the edible oil industry in Uganda. Very little training of any kind is being provided to the recipients of oil seed processing equipment and there is a lack of knowledge of edible oil processing technology by the agencies who are distributing this equipment, and very little consideration is given to the suitability or the sustainability of this equipment. For example, some types of edible oil expellers whose wear parts are very difficult and in fact in some cases are impossible to repair in Uganda and can only be maintained in an operable condition by replacing the wear parts with expensive imported parts from the foreign manufacturers, are the Mini 40 and the Komet machines. Many of these installations become defunct when the wear parts supplied with the machine have been used.

Examples of other oil seed processing equipment which was examined during the course of the training sessions was a decorticator, winnower and a hand operated ram press.

It was reported by the recipient Bugiri Women's Group that these pieces of equipment were made in Tanzania and supplied by E.D.F. All three pieces were made to extremely poor manufacturing standards, the decorticator in particular, has a heavy internal rotor that is rotating in excess of 2,000 rpm. It was very poorly secured to the drive shaft and was already loose after only a few weeks of operation. The potential for a serious accident to occur is very high under these conditions.

The modifications to the wear parts of the Mini 40 expeller has progressed fairly well and testing of the parts is being carried out.

The training subject which appeared to be the most popular and the least practiced, was Record keeping. The format was kept very simple and the type of records that were discussed consisted of production, maintenance, sales and accounts under a heading of Operational records. The demonstrations of how these basic records can be used in a small scale business promoted a lot of participation and appropriate questions.

This training period of 12 weeks was very successful, it only scratched the surface of what is required in the small scale edible oil industry and hopefully a much more in depth training scheme can be provided to assist the growth and sustainability of this essential nutritional food producing activity.

RECOMMENDATIONS

Edible oil production and the processing techniques used in processing the oil bearing seed to produce a highly nutritious food suitable for human consumption, is a highly skilled and complex procedure when it is done correctly. A fairly common assumption is that it is a very simple activity requiring little if any basic education and or mechanical aptitude. Unfortunately, this wrong assumption is probably one of the main causes of the failure of small scale enterprises in the edible oil producing category. With this in mind, the following recommendations should be considered;

1. The efforts of all agencies which intend to participate in the promotion and growth of the edible oil industry in Uganda should be coordinated.

The situation that exists at the present time is quite chaotic, several agencies who are participating in this activity such as the European Development Fund, World Learning, Uganda Cooperative Alliance, USAID, Uganda Development Bank, the Cooperative Bank, etc, are doing so with the best intentions in the world but very often because of the lack of information and knowledge which is pertinent to the edible oil industry, the people who are the recipients of these good intentions are very often subject to failure of a business enterprise, insurmountable financial hardship and disillusionment. Also, a substantial monetary loss is experienced by the financial institutions.

How this occurs, is because generally, the people who apply and get funding or equipment granted to them are not vetted as to experience and or having the capability or aptitude necessary for the edible oil producing enterprise they are embarking upon. If they were, the potential for success would be much greater. Training in the operation and management of an oil mill is very rarely given and generally, they are not advised of the cost, availability and supply of spare parts. Installations of oil mills are sometimes adjacent one another so that one of them is forced out of business and this means that the financial or implementing institution which is backing the enterprise will lose money. Very often edible oil mill project proposals which are presented to these agencies have a processing capacity many times in excess of the available raw material produced in the proposed area of installation.

Examples of adjacent oil mills is in the small town of Bugiri there are two mills within a hundred yards of each other, one has the Mini 40 equipment and the other has the Komet. In Masaka there are two mills in the same street, one is a Komet and the other an Indian made Alfa mill and the latter mill has a processing capacity of approx, 16 tons per day of oil seeds, a few weeks ago I heard of

a proposal to install a 50 tons per day capacity mill in Masaka also. Without the coordination of the agencies and the financial institutions efforts, the promotion and development of the small scale edible oil industry in Uganda will be deleteriously affected.

2. Some agency or institution which the implementing agencies could refer to, should determine which type of oil seed processing equipment is suitable for Uganda.

This means the evaluation of edible oil processing equipment that is sustainable, which can be repaired and maintained, that wear parts and other parts of the equipment can be refurbished or produced locally and that the equipment is competitively priced relative to processing capacity.

3. A fully operational small scale edible oil mill should be provided and installed for training the owners and operators of existing mills and also for potential owners and operators.

This training model would include equipment and machinery which is required to process oil seeds and the treatment of the edible oil up to the packing stage. Training in workshop and mechanical skills which are required to maintain the mill and training in business management would be provided. Training would be provided at a fee. The value of products produced by the mill would contribute towards the operation of the mill and it would provide the hands on training that is required to reinforce the training as a whole.

4. A training course should be provided for the training of personnel who are attached to the various agencies involved in the promotion of the edible oil industry.

This course would be to familiarize the personnel with the financial requirements of a proposed small scale oil mill, the type of operational records that are pertinent to an oil mill and which should be a standard requirement of the agency to monitor the progress of the venture. An introduction to and the familiarization of the various oil seeds which can be used in the edible oil producing enterprises in terms of oil content, cost and how these characteristics affect the profitability of the enterprise.

5. An agency such as the recently created Oil Millers Association should have the ability to import edible oil processing equipment, spares and maintenance items such as hard facing electrodes which would be used to refurbish expeller pressing worms and other wear parts.

For this concept to be realized the association would require financial and technical assistance. The present membership of the association does not have this expertise or the financial

capability.

6. The same agency as in 5. should have access to a laboratory that has analytical equipment installed for analyzing the products produced and used in the edible oil industry.

This is required to determine the oil content of oil seeds for value analysis, the oil content, protein and fibre content of oil seed cake for monetary and stock feed value and the free fatty acid level of the edible oil. This latter analysis is for calculating the chemical requirement for the refining procedures which are carried out on the edible oil to sterilize it, stabilize it and preserve it.

TRAINING SUBJECTS

DAY 1.

1. Types of oil seeds, sunflower, sesame, groundnuts, cotton seed, soybean and castor.
2. Components of oil seeds, hull content, oil content, importance of planting and harvesting at the right time.
3. Effect of hull content, process wear, loss of oil, loss of capacity, value to processor.
4. Establishing a Value of oil seeds, process sample, separate hull from kernel and weigh to establish a percentage.
5. Effect on the farmer in the future, better value better crop.

QUESTIONS AND ANSWERS

6. Oil Seed Processing, as per literature distributed.

QUESTIONS AND ANSWERS

DAY 2.

7. Process equipment, description, operation.
8. Maintenance and repair, welding demonstration, pressing worm gauge, importance of dimensions.
9. Record Keeping

QUESTIONS AND ANSWERS

CONTENT OF SUBJECTS

1. Types of oil seeds.

The types of oil seeds that were discussed was; sunflower, sesame (simsim), groundnuts, cotton seed, soybean and castor.

All the seeds and beans except castor can be used to produce edible oil, the reason castor was discussed was because of the interest shown by some of the participants and because of this interest it was felt that the participants should be made aware of the dangers of processing the beans in the same equipment as edible oil seeds.

Castor beans are extremely poisonous and the residual cake that is produced from the processing of the beans has a very high allogenic toxicity, particularly if a solvent is used to extract the oil. However, castor bean oil has been used for medicinal purposes and the residual cake solids used for fertilizer for many years by the rural communities in many countries in Africa. The most common method of processing the castor bean at the rural level is to pound the beans into a paste, then boil the paste in water until the oil is released from the paste and then the oil is skimmed from the surface of the water into a container. The oil is used on the skin, the hair and for babies sore spots, it can also be used as a lubricant on slowly rotating equipment such as Ox cart wheel bearings, bicycles and sometimes as a lamp oil.

The discussion on the edible oil seeds, took the form of the differences in the seeds that is pertinent to oil seed processing. All the seeds are harvested differently and the effect of this on the oil seed processor is usually in the form of contaminants such as soil, sand, stones, manure and tramp metal. These contaminants can cause the processor to have to make expensive repairs to his or her equipment and in some cases where the complete systematic steps in oil seed processing are not practiced the oil and cake can be contaminated with unhealthy bacteria.

2. Components of oil seeds.

This subject is mainly concerned with the sunflower seed as this seed is the only one which is bought by the oil seed processor that has a hull. This oil seed is expected to become the major source of edible oil in Uganda because of its high oil content relative to cotton seed, 30% to 40% and 18% to 20% respectively. The hull of the sunflower seed can be 25% to 40% of the weight of the whole seed and it does not contain any oil. Consequently, the hull content of the whole seed is the main single factor that determines the profitability of processing sunflower seed as far as the processor is concerned. The relationship between the hull content of the seed and the oil bearing kernel inside the hull is

determined by planting the seed at the right time to achieve good germination and harvesting at the right time when the plant has matured. The maturity of the plant is important, because the sunflower seed's kernel reaches it's maximum oil content in the final weeks of maturity.

There are several things that a farmer has to be aware of if he is to produce a good oil bearing sunflower seed. The "Sunfolia" variety which is the type that is being multiplied by the CAAS project, is an open pollinated variety, it is somewhat drought resistant, it requires the minimum of management during it's growth and it will produce good yields per given area without fertilizer provided it is rotated with other crops. The oil content of the seed will deteriorate if the seed from the subsequent harvest is planted more than once. It's quality as an oil seed will be degraded if it is subject to cross pollination by indigenous sunflowers which have been planted many times and is within approx, 5 km and the smaller the area planted the greater the percentage of the crop will be lost to birds.

All these things have a bearing on the oil content of the sunflower seed which affects the profitability of processing the sunflower seed by the processor. These are the main reasons why the processor became the candidate to be the connection between the sunflower seed multiplication program which was initiated by the CAAS project and the farmer. The seed for planting can be distributed to the farmers by the processor, who has a very good reason for passing on this information about what produces a good crop because it has a direct bearing on the profitable operation of his or her business.

3. Effect of hull content.

The hull content of the sunflower seed should be of great concern to the oil seed processor because the larger the percentage of hulls there are in the whole seed, the larger is the financial loss to the processor. The hull of the sunflower seed can be very abrasive and this represents a cost to the processor in terms of repair and replacement of wear parts in the process equipment. The hull is also porous and it will absorb the edible oil from the oil bearing kernel of the seed during the processing operations. By not removing the unwanted amount of the hulls by decortication and winnowing, the hulls represent lost oil producing capacity of the expellers by taking up space in the expeller which should be occupied by oil bearing material.

This loss can be measured by comparing the value of the cake and the value of the oil which is produced by the expeller. The oil has a value of approx, UShs. 1,300 USH per liter, the cake has an approx, value of UShs. 60 per kg. The cake which is discharged from the expeller has approx, 10% oil content, if an excessive amount of hulls from the sunflower seed are allowed to be processed

they will absorb oil and become expeller cake. The accepted amount of hulls which are left in the material to be processed is 10% to 15%, this has been determined as the optimum amount for good expelling efficiency. If the sunflower seed which has been bought for processing has a hull content of 40% and the production rate of the oil mill is 1 ton per day, the excess amount of hulls would represent 25% of 1 ton, which equals 250kg. The oil content of the cake is 10% and that equals 25kg of oil. The difference between the value of the cake and the oil is; $250 \times 60/- = 15,000/-$, $25\text{kg} / 0.92$ the S.G. of edible oil = 27.2 liters $\times 1,300/- = 35,360/-$, diff, or loss = 20,360/- per day.

The added abrasion of the wear parts of the machinery is an additional cost for repair and maintenance and the processing capacity of the expeller in terms of a reduction in edible oil produced per hour is another loss.

4. Establishing a value of oil seeds.

The oil seed processor is or will be the agent for establishing a value of the oil seeds which he purchases from the farmer and the value will be based on the value of the products produced by the processor less the cost of operation of the mill and his or her profit margin. The processor will also have to take into consideration the comparative value of the oil seed crop to any other cash crop which is produced on the same area of land by the farmer.

The small scale oil seed processor can establish a value of the oil seeds by processing a given quantity of the oil seeds and then calculating a value of the products produced.

In the case of establishing a value of sunflower seed, the processor can also determine the hull and kernel content of the oil seed by manually separating the hull from the kernel, weigh each portion and determine the percentage of each. It has been established that the oil content of mature sunflower seed kernel varies very little, it is the hull content of the seed which determines the whole seed oil content, therefore, the higher the hull percentage, the lower the oil content of the whole seed.

For example; if the common indigenous variety of sunflower seed has a value to the farmer of 180/- per kg and the hull content of this seed is 40% the remaining kernel which produces the oil is 60%, if 60 is divided into the price paid of 180/- the value of the sunflower seed is 3/- per percentage of kernel in the seed. Tests applied to the "Sunfola" type sunflower seed which is being multiplied and distributed show that this seed consists of 25% hull and 75% kernel. If the same calculation is applied to this seed, the value would be; $75 \times 3/- = 225/-$ per kg.

5. Effect on the farmer in the future.

This subject was discussed with reference to the previous subjects, which illustrate the need of the processor to understand the raw material he is buying and processing and how, with this knowledge, he can assist in the promotion and production of an oil seed crop by communicating with the farmer and establishing a bond in the oil seed processing industry between the producer and processor.

6. Oil seed processing.

The trainer had written a paper on this subject which was distributed to the participants at each of the training sessions and the contents of the paper was discussed. The paper is as follows;

OIL SEED PROCESSING

There can be many steps to oil seed processing, all are important and some are essential to produce good quality edible oil and cake. The cake is usually used in animal feed rations as it is a good source of digestible protein.

The first step in the process, is the CLEANING of the oil bearing seed, this is one of the essential steps because if the seed is dirty with soil, sand and other materials these contaminants will wear out the machinery very quickly causing expensive repairs, they can and will reduce the quality of the oil and cake produced, this means a lower monetary value for the products which means less profit. It could also mean a health hazard to the consumers of the oil and cake.

In small scale oil seed processing, particularly with sunflower seed, cleaning is usually done by winnowing in the prevailing wind or with small winnowing machines which allows the oil seeds to pass through an air stream that is generated by a fan or blower. In the case of small seeds such as simsim or sesame the cleaning can be done by agitating the seeds on a fine wire mesh screen. Sometimes, when sunflower is being used it can be washed with water but if it is it must be thoroughly dried before processing.

The next step when using sunflower seed is to DECORTICATE the seed this is a mechanical method of separating the hull of the sunflower seed from it's kernel which is the part of the seed that contains the oil. This separation takes place when the whole seed is thrown or impacted against the wall of the decorticator by the rotor or impeller of the machine, this action cracks the hull into two halves which releases the kernel. The reason for this step is that the hull of the seed contains no oil, it can be very abrasive which wears out the machinery, when it is present in the expelled cake it reduces the protein value of the cake and as the hull of the seed

can be as high as 40.0% of the whole seed it represents a loss of production capacity of the expeller. The hull is also porous and when it is processed with the kernels it absorbs oil to the same content as the cake which is produced by the expeller. However, in general it is accepted that 10.0% to 15.0% of the hulls mixed with the kernels is necessary to achieve efficient extraction of the oil.

After decorticating the sunflower seed it is then winnowed as in the cleaning step to remove the hulls from the kernels.

If the small oil seeds are being used for processing such as simsim or sesame they don't require decorticating because they don't have a hull.

The next step in the process is CRUSHING. This procedure is usually carried out by passing the seeds and or kernels between steel rollers or in the case of very small scale production, pounded in a mortar and pestle. The reason for this step is that when the seeds are crushed, the tiny oil cells in the seeds are exposed and this prepares the seed for the next step in the process.

This step is CONDITIONING AND HEATING. The normal moisture or water content of oil seeds prior to this step is approx, 06.0% for conditioning purposes the water content needs to be approx, 12.0% so it is necessary to add water to the crushed seeds and then thoroughly mix the material to ensure the water is evenly distributed in it. The heat is then applied to the mixture which can be by steam as in the "Tiny Tech" system or by a wood fire under a container. The heating stage is complete when the mixture becomes free running and very oily looking. It is at this point that the material is introduced to the expeller or press for oil extraction.

The step of operating the expeller or press to extract the oil is covered very well by Dr Rico O Cruz in the operating manual he wrote, in the section on page 6 titled PROPER OIL PRESSING PROCEDURES. The subjects of Familiarization of the process equipment, Lubrication and the importance of, Safety in the work place and Start up procedures was greatly enlarged upon. This paper on Oil seed processing will be added to the manual which will then be distributed as a reference manual to small scale edible oil producers. A copy is added to this report.

This next section under the heading OIL SEED PROCESSING is the basic method of processing the oil from the expeller to produce a quality edible product.

The oil being produced by the expeller or press will contain fine particles of solids. The color is very dark and can even be black looking if black sunflower seeds are being processed. This oil needs to be collected into a holding tank which can hold approx, 5 days production. The sloping bottom tank should be fitted with two outlets, one at the bottom to facilitate the removal of the fine material which will settle out of the oil and one approx, 10.0" or 250mm from the bottom of the tank for removing the settled and clarified oil.

To determine how much time is required to settle the oil and produce a clear oil for use or sale, fill a clear glass bottle approx, 750cc with the oil from the press and observe how long it takes to clear.

The clarified oil from the tank should then be transferred to a heated tank, preferably heated by a steam pipe coil and with a thermometer attached to the tank with the sensing stem immersed in the oil. Turn on the steam and raise the temperature of the oil to just over the temperature of boiling water, approx, 105° C.

This heating of the oil will remove any excess water, it will make the filtering of the oil much faster and it will sterilize the oil which in turn will give the oil a much longer shelf life.

The settled fine material in the bottom of the tank which will contain a lot of oil should be removed every week. To separate the oil from the sludge put the sludge in a container, add water equal to approx, 10.0% of the volume of the sludge, mix well, heat the mixture to approx, 75° C, allow to settle and skim the oil from the surface of the mixture. The wet sludge which remains can be used as a fertilizer.

The final stages of processing the oil before putting it in bottles or containers is FILTERING.

The most common method of doing the filtering stage, is to pump the hot oil through a plate and frame filter, this piece of equipment consists of several cast iron plates with oil channels in them and which are separated by filter cloths. The oil inlet pipe to the filter is equipped with a pressure gauge, this allows the operator to be able to tell, by the increase in pressure when the filter cloths are blocking with fine material and need cleaning and or changing. Other methods of filtering are by gravity through a cloth or as per the illustration in this booklet using a car engine oil filter, although this latter method would only be used for very small applications where the oil only requires the removal of very small quantities of contaminants. Under the average type of edible oil filtering the frequency of having to clean the filter would make the method prohibitive.

NEUTRALIZING. This method of treating the oil after the settling stage, is very rarely practiced by small scale processors of oil seeds except for the ones who are processing cotton seed. In this case this stage is required because cotton seed oil is not palatable until it has been through this stage of treatment. The following is the commonly accepted method where a laboratory facility is not available to determine the amount and efficient use of chemicals.

The quantity of oil and the amounts of the chemicals used in this example are relative and can be calculated as a percentage for different volumes of oil.

A steel tank is required with a conical bottom of approx, 3,000 liter capacity, 3 meters tall by 1.5 meters diameter which is fitted with a steam heated coil, an agitator, a thermometer, a drain valve and a clean oil drain valve approx, .5 of a meter higher than the main drain valve.

STAGE 1.

This tank is filled with 2,200 liters of clean settled oil. The steam to the heating coil is turned on, the agitator started and the temperature of the oil is raised to 80° C. While the oil is being heated, 30 kg of caustic soda is mixed with 120 liters of warm clean water, 8 kg of salt is mixed with 20 liters of warm clean water. Add these solutions to the oil in the tank and continue heating and agitating until the oil and chemicals are at the required temperature. The caustic soda solution mixes with the free fatty acid in the oil and produces soap stock which is used in the manufacture of soap. The salt solution increases the specific gravity of this soap stock and any fine particulate contaminants and this increases the rate of settlement. Turn off the steam and stop the agitator. Allow the mixture in the tank to settle for approx, 8 hrs. Using 200 liter drums drain the soap stock from the tank.

STAGE 2.

Reheat the oil to 80° C with the agitator rotating and add 20 liters of warm water. This is to wash any remaining contaminants from the oil. When the temperature is reached, turn off the steam and the agitator and allow to settle for approx, 6 hrs. Drain the water from the bottom of the tank and discard.

STAGE 3.

Repeat STAGE 2.

STAGE 4.

Turn on the steam and the agitator and heat the oil to 120° C. This stage is to dry and sterilize the oil. Transfer the neutralized oil into a covered tank and allow the oil to cool below 100° C and then filter and containerize for sale or storage, the containers must be air tight to prevent air and moisture from recontaminating the edible oil.

These various stages of oil seed and oil processing are what the small scale oil seed processor should adopt to produce good quality products and attain an efficient and economically viable operation. Many processors don't have the equipment to carry out this processing procedure and they still produce oil for consumption but it is at a cost of lost product and very often an inferior quality product. It is hoped that this information will help the oil seed processor to understand why these processing steps are taken and assist them in producing good quality products.

7. PROCESS EQUIPMENT.

At each of the training locations the process equipment was dismantled where possible and discussions were held as to it's design, purpose and operation.

The process equipment which was discussed at the locations was;

CLEANING. (Oil seeds), Winnowers, rotating, static, oscillating and vibrating screens.

DECORTICATORS. Impact and attrition.

CRUSHERS. This equipment was not in evidence at the training sites visited but sketches were made so that the participants understood the discussions about the equipment. This stage comes under the heading of Flake and Roll machines.

CONDITIONING AND HEATING. There were two basic types of heating arrangements which were used at some of the training sites, the steam jacketed screw conveyer and the steam jacketed vertical cooker which is fitted with a centrally motorized agitator. It is a significant fact that all the Indian manufactured processes come supplied with heating and conditioning equipment as standard, this is because they understand the importance of this step in oil seed processing.

EXPPELLERS. A fairly wide range of small scale expellers was examined and discussed during the training sessions, they had processing capacities ranging from 400 kg per day to 8 tons per day. The types were as follows;

1. Komet.....German
2. Mini 40.....U.K.

3. Hander.....Japanese
4. 6YL - 95Y.....Chinese
5. Tiny Tech.....Indian
6. United.....Indian
7. Alfa.....Indian

The main interest of the participants when these discussions were underway was the repair, sustainability and spare parts availability for the wear parts of the expellers.

Every one of these expellers had different main shaft flight arrangement designs and there were three different oil drainage barrel designs. The first four types are very difficult to repair because the design of the pressing worm assembly and the drainage barrel configuration is relatively sophisticated compared to the Indian manufactured machines. All the Indian types can be repaired locally to some degree and the main shaft pressing worm configuration can be changed to suit the duty of the machine and the type of oil seed which is being processed. This was most evident when the United expellers were examined, the wear pattern on the pressing worms was excessive and irregular due to the wrong design for the duty and material being processed.

SETTLING TANKS. The discussions on this equipment was directed at the positioning and design. Most of these tanks and vessels were at ground level or in the ground with flat bottoms which makes removing sludge and cleaning very difficult so alternative designs were suggested and discussed. In most of the locations of the training sessions the sludge which was removed from the tanks was discarded as a waste product, so a simple method of treating this sludge to reclaim the oil was demonstrated.

NEUTRALIZING TANKS. It was explained to the participants why these tanks are almost always of a vertical and relatively narrow cylindrical design with a conical bottom and that is to best facilitate the gravity settling of the soap stock and contaminants which are formed in the oil when the chemicals react with the free fatty acid in the oil and for the removal of the water after washing.

FILTERS. The most common type which is supplied as standard equipment by the Indian suppliers of oil processing equipment is the plate and frame filter. This comprises of a series of cast iron plates with oil ways cast in the internal surfaces and filter cloths which are placed between the plates to filter out any particulate contaminants in the treated oil. The discussion on this equipment was relative to the treatment of the oil in general terms and how the importance of this treatment before filtering had

a bearing on the cleaning of the filter and consequently the wear and tear on the cloths. It was also stressed that if the oil was expected to have a good shelf life or storage potential this treatment of the oil is essential as it sterilizes and stabilizes the oil before containerization.

CONTAINERS. It was emphasized that regardless of the type of container whether it be plastic, glass or tinned plate, if shelf life is expected then the container must be air tight to prevent the recontamination of the oil in the container with air born moisture and bacteria.

8. MAINTENANCE AND REPAIR.

The subject of maintenance was discussed and treated as general maintenance of the oil mill as a whole and as an opportune time to recap on the subjects that had been covered. Particular emphasis was directed to cleanliness and how this could effect the edible products being produced and how a dirty and unkempt mill could be extremely dangerous to the people working there. Several examples of accidents were related that could happen when in the presence of dirty and greasy floors which prevail in an oil mill, together with unguarded transmission machinery and a lack of concentration and awareness by personnel in a factory environment. This subject got a lot of attention because in nearly every location that the training took place this type of environment existed and when the participants saw an acted accident demonstrated they took notice.

Maintenance was also related to start up procedures and the creation of progressive checks on oil levels, grease points, free and not ceased machinery before pressing the start button for the machine.

The accompanying subject of repair was directed at the wear parts of the equipment particularly the expeller because the participants were already aware that when their existing wear parts have been used their oil seed processing operation will stop and also the cash flow. There was not one case where the oil mill owner was anticipating and making financial arrangements for the renewal of spare parts but at the same time it was of concern to them and they were hoping that the trainer would have the solution. In the case of the Mini 40 expeller, it is thought by the trainer that some redesign of these parts can be achieved to enable them to be repaired and manufactured locally, some have been done but there will be insufficient time in this consultancy period to complete the research and development which is required to come to a conclusion.

The Komet expeller wear parts are not reproducible locally so the owners of these machines will have to import the parts when they are required.

The Hander and the 6YL-95Y expeller pressing worms could possibly be repaired locally but to retain a good dimensional relationship to the expeller which is critical to these machines will require hard facing welding electrodes, very good machine tools and expertise to achieve it. The drainage barrel bars which are used in these machines can also be reproduced locally but good expertise in the application of heat treating carbon steel is required or serious damage to the expeller will occur if the heat treatment makes the steel too brittle.

The Indian made equipment wear parts can be repaired locally although the use of mild steel welding electrodes which is a standard procedure in Uganda is a very poor substitute for the hard facing electrode which should be used. Unfortunately, this is another commodity which has to be imported.

Another alternative supply of these wear parts maybe an alloy steel foundry in Nairobi, Kenya. This company does have a representative here in Kampala called Mr Sunil Upadaya of Super Traders, Kampala, P.O. Box 7590, tel, 242406. The trainer arranged for him to obtain a sample of a pressing worm from East African Industries to send as a sample to Nairobi for a quotation.

9. RECORD KEEPING.

This subject was well received by the participants because very few of the owners and operators kept records other than some form of accounting for the material bought for processing.

The records which were discussed and demonstrated were Production, Maintenance, Sales and a simple two column accounts and these were presented under the heading of Operational Records.

Some examples of what the Production record may consisted of, was the record of purchases of material for processing, daily or weekly production volumes, production periods, start and stopping times, breakdown time and causes, amount of labor used and time, etc,

The Maintenance record would contain activities and materials that were relevant to keeping the mill operating such as, repairs carried out, spare parts fitted to the equipment, cleaning of tanks and equipment, the time taken to do these jobs, how many people are employed doing these things, what are they doing when the mill is operational, do they have dual responsibilities, etc,

The sales record is mainly self explanatory, it contains the record of everything such as the products produced by the mill which are sold or had an exchange value for other products or services.

The accounts record can be as simple as a two column page which listed Costs and Income. It was at this point that the financial requirements of doing business were discussed, examples of the calculation of the amount of money the repayment per month was, that was required to service the loans which had been obtained from the lending institutions. The relative cost of oil seeds, what this represented as far as operating capital was concerned and how this was related to the value of the products produced. When these items were listed as costs and the products sold as income, many of the participants were aghast at the amount of products they had to produce to earn the income to pay the costs of doing business.

When it was explained how all these records were related and how they could be used to project material requirements for the future, profitability projections to take advantage of forward buying of materials when the prices were low and investment in better yielding trading, the participants attention was assured.

It was also explained, that very often each of these headings were split into separate categories and that it was up to the owner or operator or both to design the type of record which would provide them with the information they required to know about their business.

FIELD TRIP REPORT

January

Kampala, Jinja, Bukedi, Tororo, Mbale.

Visited Intraco (U) Ltd oil mill in Jinja, there were two badly maintained chinese expellers, approx, 4" dia shaft, 1 press has broken gear box and the other will break soon, very dirty plant. Processing sunflower seed which was cleaned by shoveling over a wire mesh screen at an angle on the floor and then heating in the sun before processing. The capacity was reported to be 200kg/hr. Oil sold for 23,000/- per 20 litres, cake 100/-/kg. Equipment was only 3 years old, mild steel welded pressing worms last for 1 ton of product processed.

The 2nd oil mill in Jinja, Odongo Agencies had newer chinese machines same size, well maintained but not running because of lack of raw material which is soybeans, mechanic did own welding with mild steel rods and without grinding to size, need for gauge. Capacity reported, 30 * 50kg bags/9hr day, soybeans 350/- per kg, too expensive, oil 3,000/- per liter, original worms lasted 3 years, but when welded with mild steel electrodes only 3 months. The pressing worms were wearing at the root of the flight and gouging through the boss, the diameter was worn only very little.

Visited with the women's group in Bugiri, between Iganga and Tororo they have been given a Mini 40 expeller, a decorticator, winnower and ram press said to have been made in Tanzania. They are having problems operating the machines because of the absence of the male operator and lack of training. I am planned to go there on the 24 Jan.

Visited AFYA Estates Ltd oil mill in Mbale, they had two Tiny Tech expellers including the rest of the standard equipment. The expeller pressing worms are welded on site and last approx, one month. The tanks and storage hopper were made of oil drums. 20 liters oil cost 20,000/-, plastic gerry can cost 2,000/-, cake sold for 60/- kg. The owner was installing his own feed stock mill.

A visit was made to a research center in Serere where Vic Amann had initiated the growing of 200 acres of sunflower seed for this next planting season, they are expecting approx, 60 tons, the seeds were planted at 100cm * 60cm centers with two seeds per hole, on looking at the crop it appeared as though the majority of the seeds had germinated so this next planting will be at 60cm * 30cm, it was reported that 4kg of seed was used per acre at a cost of 550/- kg. 200 people are employed harvesting the seed at 500/- per day ea, it takes 100 people to harvest 15 acres per day, the type of seed is "sunfolia" which is an open pollinated variety not a hybrid and it is reported to have a whole seed oil content of 40%.

A hectare is $100\text{m} \times 100\text{m} = 10,000 \text{ sq m.} = 2.5 \text{ acres}$, the number of holes at $100\text{cm} \times 60\text{cm} = 16,500 \times 2 \text{ seeds} = 33,000 \text{ seeds to } 10\text{kg}$, at $60\text{cm} \times 30\text{cm} = 55,000 \text{ holes} \times 1 \text{ seed} = 55,000 \text{ seeds}$ and require 16.6kg of seed or 6.6kg per acre, for the 200 acres it will require $1,320\text{kg}$. The 60 tons yield will plant 9,090 acres. The quantity of oil produced by this area if the yield is the same at 300kg per acre and the oil content remains the same at 40% with a 90% recovery will be 981.72 tons.

The design of a rotary paddle would be beneficial to the harvesting of the seeds from the flour heads as the heads are beaten with a stick to remove them.

Lira. Visited an edible oil mill which is under construction, at the moment it consists of Indian manufactured equipment comprising of 2 "United" expellers probably with 6" dia pressing worm shafts and 30" long barrels, capacity maybe 1 ton per hr each. There were horizontally mounted oscillating screens with decorticator and aspiration equipment connected and a plate and frame filter press.

The Akonyi kori oil mill was the second one visited and it has two Italian made "Carera" expellers, these machines were in disrepair in 1989 when I first saw them, it is a miracle that they are still producing oil. With constant weekly welding of the pressing worms on the shaft the original cylindrical shape of the pressing worm shaft is now oval and the pressing worm flights are completely deformed. The shaft still retains the original progressive taper which enlarges the dia towards the choke end of the machine, the feed end dia, is approx, 6" increasing towards the choke end to approx, 7.5". One of the machines is inoperable because of broken and worn choke assembly components, the barrel bars had approx, $3/8$ " gouged out of them by the seed. We were told that the choke components were on order in Italy and that Afro Engineering of Kampala were going to attempt to manufacture the pressing worms and the barrel bars. These machines have a very slow shaft rotational speed of approx, 6 rpm and this is one of the significant things about an oil expeller which is in extremely bad condition but because the shaft is rotating slowly it can still produce oil.

Some trading in oil was going on at the time we were there, the price was 30,000/- per 20 liters. The oil is only settled before being put in the container.

We visited the Lango Cooperative Union cotton gin, they have approx, 15 gins operational now. The farmer gets 250/- per kg and he gets approx, 150 kg per acre. After ginning and bailing the bale at 185kg is worth 1100/- kg = 203,500/-. Labor costs 500/- per day.

Another seed growing station was visited at Kigumba where Dr. Vic Amann had contributed sunflower seed production under the seed multiplication scheme. Some sunflower had been harvested but the

soybean crop had been left in the field and was now shattering. We found the officer in charge at his home.

We arrived in Masindi in the afternoon, checked in the hotel and went to visit the Bunyoro seed plant to enquire about availability of sunfola sunflower seed and soybeans for planting, they will have plenty they said.

We then visited the Ateki oil mill, they have two Hander expellers, a decorticator/grinder, a hand operated winnower and a plate and frame oil filter press of Japanese manufacture, the plant manager does the welding maintenance on the expellers with mild steel electrodes but he does grind the pressing worms to size. Each expeller produces approx, 20 liters per 45 mins. The oil is sold at 23,000/- per 20 liters and the plastic gerry cans cost 2,000/- ea,.

Kampala.

Visited C.E.I. (Commodity Export International) at Plot 5, Nyondo Close, Kampala. P.O.Box 10241, ph, 250212.

Plant manager, Frank Kiggundu. Assistant, James Jarret. (father of assistant controller USAID)

This plant has two Chinese expellers of type 6YL-95Y, a settling tank and a plate and frame filter press. They are processing sesame seed at present and are having some problems, they have also processed sunflower but it was low in oil content, approx, 15%.

Some of the questions they asked about processing were, 2 pass expelling when using sesame, I told them that it was normal when processing cold seed. Oil filtering was very slow, I found that they had changed the filter cloths in the filter press with locally produced or available cloth and the weave of the cloth was too close plus the oil was cold after settling for 24 hrs, I suggested to them that they should settle the oil longer and possibly apply some heat to the oil to dry and sterilize the oil as they were getting complaints about rancidity after a short shelf time. I informed them of the advantage of having a pressure gauge in the inlet oil line to the press so that they could determine when the press was blocked with fines.

When I got back from Bugiri on Tues the 25 Jan I had a phone call from them asking if I would supply them with a flow diagram of the process they should adopt, I said I would get back to them on Thursday 27 Jan.

I took some modified sketches of the spindle press to Afro engineering Fri pm to ask them to give a quotation for a model for testing oil seed for oil content, will see them also on Thursday.

Wrote up methodology for oil seed processing for U.C.A. handbook.

Visited Bugiri Women's Group, stayed the night in Tororo.

This group was initiated in 1993, there are 35 members and they applied and got a 15,000,000/- guaranteed loan at 23% per annum with a monthly loan repayment of 300,000/- per month commencing after a 3 month grace period in August 1993. As of to-day they have not made a payment. The group received a grant of a Mini 40 expeller from E.D.F. in Sept, 93. they received a decorticator, winnower and a ram press which were made in Tanzania in Dec, 93. They have worn out two sets of barrel rings and the third set I installed on the 25th Jan. It was reported to me that each set of rings had processed 1000kg or 20 bags of sunflower seed probably whole seed and not too clean.

I checked the operation of the press and found the process rate very slow due to the worn barrel rings, the gearbox of the press required 1.5 liters of oil to bring it up to operating level. The decorticator worked well, it is a similar to the "Kit" process machine except that it has a discharge chute, an air inlet comprising of 5 * 3/8" holes and it is fitted with a closed impeller the same as a blower. I explained to the group that because of this design they could process the seed from the decorticator and just use the winnower for seed cleaning as winnowing the decorticated seed removed too many of the hulls which reduced the press's efficiency. I filed key slots in the worn barrel rings to see if the performance would improve, the initial test was good but within 1/2 an hour the rate had dropped again. I checked the barrel ring shims and they appeared to be satisfactory, I explained the principal of operation and design of the press to the group which I believe they understood but they are not happy with the press because of it's low process rate and would like to have a bigger machine, unfortunately they do not have sufficient money to buy enough raw material for the Mini 40 so a bigger machine would not solve their financial problem.

I discussed with the group the need for a method of determining the value of the oil seeds that they were buying based on the oil content of the seed and in their case they could use the ram press to process a sample. The ram press needs to be fastened down before they can do that.

To illustrate the groups financial problem, their loan is for a 3 year period, the press will not be sustainable that long, mainly because of the high imported cost of the spares and the rapid wear of them. The group also does not have any operating capital but if they did and the process equipment could produce a 20% yield of oil from the seed, their cash flow would look something like this.

300kg of seed per day @ 180/- per kg,	=	54,000/-
A 5 day cycle, (settling time)	=	270,000/-
Value of oil @ 20% yield @ 1,000/- per liter	=	326,000/-
Value of cake @ 60/- per kg	=	14,400/-
Gross profit	=	70,400/-
1 week or a 1/4 of a month loan payment	=	75,000/-

Another view of their financial situation would be;

The group has 30 acres planted with sun flower and they are expecting 300kg per acre, @ 2 harvests a year that would give them 60 operating days and a gross profit after processing of, 4,080,000/-, the annual loan repayment is 3,600,000 that would leave them 480,000/- for 1 year of operating expenses.

An estimate of spares required for the press consisting of 2 sets of barrel rings and 1 worm shaft would be 2,000,000/- per year.

Had meeting with Rita Ojok, wife to owner of Afro Engineering, she is country rep or team leader for A.T.I. new project introducing the ram press and she will be at the U.C.A. seminar on small scale oil presses to-morrow. Visited Afro Engineering to get quote on spindle press, 1,800,000/-, Manfred Jung in Kitwe, Zambia. produces them for 140,000/- equivalent. Will have to get in touch with him. Visited C.E.I. again, spoke to the owner this time, he is going to get new filter cloths, make oil heating tank and fit a pressure gauge to the filter inlet line. They were blowing air through the filter with the pump this time and making the oil foam. He will call me when he gets these things done.

Attended seminar put on by U.C.A. for small and medium scale oil seed processors in the Conference Center at the Nile Hotel, Kampala.

Charles Kabuga from U.C.A. was the chairman. I gave a talk on the problems of oil seed processing and answered questions from the floor. There was a lot of response to the session and many people who intend getting into oil seed processing require assistance on equipment selection and processing methodology.

Went in to U.C.A. and designed training schedule,

February

Tuesday, we left for Mbale with 1 ton of sunflower seed for distribution by the owner of the APYA oil mill where the first training session is to take place. This mill has the Tiny Tech equipment. Got there at 18.30, checked in the Mount Elgon hotel.

We used the owners office for the training session. The oil seed processing write up went well, a good discussion, also included Rico Cruz press operation. Some of the participants from Musenze Industries are trying to refine oil straight from the press including fines so this training will be good for them.

Thursday, Vic Amann attended the course in the morning before going back to Kampala, the subject Process equipment went well with good questions and participation, the size gauge for welding pressing worms was useful with emphasis on the importance of dimensions relative to the wear parts in the expeller. Practical opening of the expeller went good. Processing sludge went very well, the practical subjects get good participation. The owner was throwing the sludge it away. The "records" subject got a lot of attention because very few of the participants do it and they didn't realize how much operational information could be derived from it.

I think the course went good and with some polish, should be very good.

Returned to Kampala arriving at 12.00, had lunch with Vic Amann and Charles Kabuga. On our way back to the office we visited the UCA vehicle workshop to have a look at the equipment they have to see if it could be used to produce expeller spares. I gave them a sketch of a Tiny expeller shaft to see what kind of prices they can come up with.

Vic Amann and I left for Kabale and the Kasese area, we called in to see the Hander oil expeller, at the Kagando hospital. I remembered the place from my visit in 89 with Warren, we invited them to the training session next week at Masindi. In Kasese, we visited a company who makes jam and sauce etc, they have a Danish spray dryer and mixing equipment, they also make their own foam mattresses and foam blocks which they cut the mattresses from and then put a material cover on it. We visited the local coop cotton ginnery which was ginning and producing 4 bales of 185kg ea an hr, the manager expects to produce about 10,000 bales this year. Cotton is a once a year crop because it has a 6 month growing season and it is planted in the second rains which are the heaviest in September, yield is about 800kg per Ha at 250/- per kg to the farmer, when he finds out how easy it is to grow sunflower and get a better income he will stop growing cotton!! We had lunch at the Margharita hotel, this is the same name as the highest mountain in the Rwenzori range at 16,726ft or 5,109 meters, then we returned to the lake view hotel in Mbarara, The rate of exchange this week

dropped to 900/-:\$1, this hotel was \$55.00.

Thur. Left Mbarara for Kampala calling in at a small oil mill in Masaka called Mosewa trading company, the equipment here was a twin barrellled Komet with a granulator, the expeller has a variable speed drive and they process ground nuts, the red variety, the brown ones are not grown in the area. After expelling the oil which is sold at 2,000/- per liter, the cake is ground in a maize or Cassava hammer mill to a powder, a little oil is added and then it is sold as ground nut sauce mix at 200/- per 200 gram in a plastic package, a good profit because they pay 600/- per kg for the nuts. Vic Amann arranged a training session there. In the mill shop they had a bag of a type of nut I had not seen before, the girl in the shop called it a ground nut but it is a bit bigger than the old dollar coin and 3 times as thick and the kernel inside tastes the same as a brazil nut. I asked her where it came from and she said she would take us about 5 miles down the road in the bush to see the tree. It turned out to be an enormous vine with no leaves that wound it's way around the tree until it reached the top where the sun was. Where it came out of the ground the stem was approx, 6" in dia, the local family who lived in a hut about 20 yards away said the boy of 11 planted it 2 years ago and that it formed and dropped big pods twice a year in the rainy seasons so I'm hoping to see one before I leave. The woman there said the pods hold from 30 to 80 nuts of which some are male and some female and you have to plant one of each to-gether to produce a vine. I'm going to see if I can analyze the nut for oil content.

Did some sketching of expeller parts to get quotes for local manufacture,

Visit Wills International Busungu Oil Mill (Hoima Rd).

Three partners, ex bankers, Mr J.W.K. Turyahwerwa, Mr Macko Mpagi and Mr George Sseki'sambu.

The plant is situated about 1 hr from Kampala, 1 km off the black top left.

They were processing cotton seed when I visited, the seed is elevated to a platform where it is fed into the decorticator over a magnet. This machine was built in Kampala but there is some confusion about who produced the stationary and rotating plates. The dimensions of the plates are approx, 24" in dia, and about 1.5" thick with raised ribs approx, every 2" of circumference, the seed inlet was approx, 12" in dia, it was belt driven with even pulleys at either 1,400 or 3,000 rpm. From there the crushed seed entered a revolving drum screen which was turning at approx, 20 rpm. An in ground conveyer carried the meats of the seed to an elevator where it deposited on a platform floor and it was fed to the first expeller by hand. The expellers, 2 of them, are of Indian manufacture and called United, they are fitted with steam heated cookers and are a duplicate of the old Rosedown 33" machine which

they had in Burma at the Mandalay oil mill I was at, even the drive was the same, a standard reduction box with bottom outlet drive shaft. The main shaft rotation was 12 rpm with choke outlet at the drive end of the press, unfortunately they didn't take delivery of a manual for the expellers so I couldn't determine the pressing worm configuration, I will try to get one from, another processor.

They were double pressing the material by elevating the cake from the first machine and feeding it to the second expeller, a good flow of oil was discharging from each expeller. The oil was collected in a tank in the ground, from there it was pumped to a conical bottom tank for "Neutralizing" the first stage of refining. The tank processed 2,200 liters of oil at a time, size, approx, 36" dia, by approx, 8 ft high including the cone.

The method was as follows;

Heat the oil with the steam coils to 80° C, add 30kg of caustic soda in a warm water solution with 120 liters of water at 20° Baum and 8kg of salt in solution with 20 liters of warm water, continue stirring for 30 minutes then allow to settle for 8hrs or more then remove soap stock from the bottom of the cone, approx, 600 liters.

The next stage was repeated twice, reheat the oil to 80° C, add 120 liters of warm water, stir for 20 mins and settle for 6hrs, remove water from the cone and throw away.

Heat oil to 120° C for 1hr, this is to dry and sterilize the oil, the oil was then drained to an in ground tank and allowed to cool before filtering and putting in containers, I suggested to the manager that he might try filtering while the oil was hot as it would filter much faster.

The prices of the various prices were as follows;

Oil sold for 1,300/- per liter.

Cake sold for 140/- per kg, probably good protein.

Soap stock sold for 40,000/- per drum of 200 liters.

The make up the soap stock is, 30kg of caustic soda, 8kg salt, 140 liters of water, free fatty acid content of the oil, solids and oil. They don't have laboratory facilities that would allow them to determine the free fatty acid level of the oil which would facilitate a more economical use of the chemicals.

I was told that 1 ton of seed produced 100 liters oil and 600kg of cake, this equates to approx, 30% of removed hulls and fuzz from the seed.

Cotton seed cost 120/- per kg.

I was told that the decorticator plates were made by a Kampala company called Musa Body, so I visited there expecting them to have a foundry, unfortunately they didn't and neither did the Ministry of works workshop. I was thinking maybe the expeller pressing worms could be made in chilled cast iron as we did in Mandalay, Burma.

Got an easel and a flip chart from the print room below U.C.A.

Left Kampala for Masindi. This training course is for the Japanese Hander expeller, same shaft assembly as the Mini 40 but with barrel bars instead of rings. The last part of the road to Masindi is very bad.

Got to the Ateki oil mill in Masindi just after 8.00 am. I had brought the mill owner 10 bags of sunflower seed, some for the course and some for distribution to the local farmers.

I had 4 people from the mill and 6 others participating in this course and we got started about 9.00. This training session had very good participation. Vic Amann arrived in the evening.

This second day of the course was a practical day, I helped the students take the equipment apart, explained what each piece did and why and this day went very well too, so much so that the owner of the mill decided to invite us all and some local dignitaries to a cocktail party that evening at the hotel where the district representative thanked the C.A.A.S. project for providing the training and my expertise. I am now referred to as "Engineer Derrick".

Friday, this morning I finished off the training with some advice on record keeping and why it is important in operating a business and then I demonstrated how to separate the edible oil from the settled sludge, this procedure is always well received because the sludge is normally thrown away.

Back in Kampala, I was requested to meet with people from A.T.I. to discuss the development of the ram press and the modifications I carried out in Zambia. A project is commencing which is being headed by Rita Laker-Ojok and involves the dissemination of this technology. I gave them some sketches of the ram press which I had worked on in Zambia.

Made copies of my presentation to USAID and then went to the meeting, I told them about the type of training I was doing and gave them all a schedule of the subjects. We also discussed this weeks training session which is in Bugiri where they have the Rosedown Mini 40. The spare wear parts for this machine are very expensive and the efficiency of this machine is quite poor. I had done an economic analysis of this operation to illustrate the problems the people with these machine were having and it turned

out that I had an ally in a professor from Makerere university who had also experienced this and who was at the meeting. This meeting also gave me the opportunity to confirm the importance of the sunflower seed multiplication project which Vic Amann has initiated and how essential this type of sunflower seed will be for the new A.T.I. project. I also make them aware of the training which is needed for processing oil seeds at the small scale level and the importance that all this was going to be for the survival of the new A.T.I. project which is going to disseminate the Tanzanian designed ram press.

Left for Tororo and the Bugiri training session.

Wednesday, This course was a little different because the majority of the participants were women and when the process equipment sessions were being discussed I had to describe the operation of the equipment in a way the women could understand because they don't generally have the level of mechanical aptitude of some of the men but the course was well received and the record keeping session got their attention.

Back in Kampala, I visited Laker Ojok's workshop to get some measurements of the Mini 40, in an attempt to try and design some cheaper parts for it.

Vic Amann and I visited East African Industries (U) Ltd, just past the island on the way to Namulonge on the right, the office is, Plot #10 Nakivubo Rd, P.O.Box 10601 Kampala. fax, 235241 in town. This plant has two production lines operating on sesame, each line has two Tiny Tech expellers doing the first pass and a Chinese 3" machine doing the second pass, there are the usual boilers and filter presses. The oil looks and tastes very good and he charges 27,000/- a 20 liter container although he has a lot of stock. He also has 6 Chinese 200A expellers still in their crates the same as I worked on in Burma up in Mandalay, he says they will be installed in Kawempe when they get the money to build a factory. After we got back I went to EDF European development fund offices, to see if they had any Mini 40 expellers because these are the people that have been distributing them out to the women's groups and I wanted to take some measurements of the press for designing the cheaper parts but they were all distributed and the nearest one was Jinja.

From there I went to CEI near the PL 480 warehouse, they had called and were having trouble with the electric heater they had made for heating the oil before filtering, they had used copper heating elements at 3 kw each which was burning the oil and the elements were corroding. I advised them to fit rheostats to control the heat of the elements and that they would have to coat the elements or change them for stainless steel.

March.

Did training paper work and got it copied.

I took Redhi, the engineer from CEI, to the East African Industries oil mill to look at Indian Tiny Tech operation which also has Chinese expellers like his. He does not have much knowledge of oil seed processing and I wanted him to see the steam heating arrangement which is an integrated part of the Tiny Tech system.

Wednesday, Started the training session at the CEI oil mill in Kampala. This course was very well attended and the participation was excellent but factory has a tin roof and it was very hot in the afternoon.

Thursday, Doing the practical side of the training course to-day, discussing the design of the Chinese expeller particularly the barrel ring design with the serrated edge which provides the oil drainage. This is a much beefier ring than the Mini 40 and I believe can be reground to extend it's life, the choke end pressing worms will be difficult to repair with weld metal because they are not very thick. The record keeping session went well, headings used were raw material and Production with sub headings, process, maint, finished products and finally simple accounting by dividing the page in half and calling one side Costs and the other income, explained what break even was.

Friday, went to East African Industries to borrow a new Tiny Tech pressing worm to show the engineer at UTCU, Uganda cooperative transport union workshops, I told them how to make it and they are going to fabricate one to come up with a price and they are requesting a price from their company in Nairobi, Kenya. Alloy Steel Castings Ltd, Baba Dogo Rd, Ruaraka. P.O.Box, 65163. tel, 803418, 802604/5/6/7 and fax, 802885. Guys name, Milan S. Raval.

Went to see Laker Ojok at his workshop to see if we could borrow a 17" "A" size Vee pulley to slow down the Mini 40 at Bugiri he said OK and I gave him 15,000/- to get an A 63 belt I will take Nick his young machinist with me next week, Tues is a holiday, if we can get the test done in a day we will be back Wed night if not we will come back to town on Thur.

Worked on designing the oil drainage barrel for the Mini 40.

Monday, went to the C.A.A.S. project office, attended the regular Mon morning meeting of contractors. Copied sketches of drainage barrel design and went to see Laker Ojok to show him and to see if he could make them and arrange for the visit to Bugiri.

Visited the CEI oil mill in Kampala to ask the engineer to return the filter cloth he had borrowed from East African Industries.

Had meeting with Minister of finance's assistant about an oil mill for a women's group of 1,300 just west of Mbarara, I recommended the Tiny oil mill with plenty of spares, then we took him to look at the East African Industries oil mill to look at the operation there.

Wed, went to Bugiri to fit 17" sheave to the women's group Mini 40, took Nick from Laker Ojok's workshop with me. Expeller worked OK, the oil was cleaner with less fines in it but production dropped approx, 40%. We got back to Kampala at 18.00.

Thursday, Went to Laker Ojok's workshop to take him 4 barrel rings from Bugiri. He can make my redesigned drainage barrel with them, he estimates 50,000/- each, if two of them work OK that's a lot better than 650,000/- for a set of rings from Magric.

Went on to Masaka to the Kiryatabwala oil mill, the owners name is Mr Joseph Kiyimba, to see if I could get a used, scrap Mini 40 shaft, I'm going to try and modify that too by increasing the feed end flight pitch from 1" to 2.5" and then progressively smaller towards the choke end. Didn't get a shaft because the owner of the mill was in Kampala. I will have to call him to-morrow. His Mini 40 is not operational because of the lack of spare wear parts. He now has an Alfa process from Bombay consisting of 3 expellers which are also copies of the old Rosedown 33" just like the United and the ones in the oil mill in Mandalay and this plant is set up to neutralize the oil from the cotton seed he is processing. I checked out the hotels for the training session starting on the 23 March and then I came back to kampala.

Friday, took a trip to Lowero and then 25Km off the black top to a French sponsored project with a Mini 40, they didn't have a spare shaft I could have. They had a 3 cylinder Lister engine driving a generator which had powered the Mini 40 and a hammer mill for gr'nding maize, the Mini 40 had been shut down for over a year because they have no spare parts. The hammer mill was vibrating very badly and the engine looked in bad shape. I think this will be another project which will fail pretty soon for the lack of spares.

In the afternoon an Indian called Sunil Upadayay of Super traders Kampala, P.O.Box 7590, tel 242406, off, 236976, res, fax,251354. These people have a foundry in Nairobi, Kenya and he says they can produce the pressing worms for the Tiny tech expellers so I took him to East African Industries to get a sample of the pressing worm which he wants to send to Nairobi for a pattern, then they will give a price for producing them, he says he is familiar with pressing worms and knows about having to heat treat them.

Monday, attended the contractors meeting in the C.A.A.S. office. Designed the certificate of attendance for the training sessions, a lot of the people have been asking for them. Fortunately, UCA has a print shop in the basement of the building so they will probably make a good job of producing them.

Laker Ojok has started making the oil drainage barrel for the Mini 40 expeller.

Went to Busunju for the first day of the training course, they have a couple of United expellers and other equipment for processing cotton seed. It went very well with a lot of enthusiasm.

Thursday, A good practical day at the course, opened up the expellers and discovered an obviously bad pressing worm configuration, the wear pattern was very wrong, the center worm was not worn at all and the second worm after the feed worm was almost worn out, but all the spare pressing worms were for that configuration including the knife bars. The final subject, record keeping was the clincher for another good training session, the demos of assessing the viability of an operation got a lot of attention.

Dirk Van Hook the consultant at the Uganda Cooperative Bank ltd. is requesting that I address the loan officers at the bank and discuss with them some of the financial aspects of operating and owning an oil mill.

At the C.A.A.S. office I did the training paper work for a session with the cooperative bank loan officers next week.

Went to Laker Ojok's workshop to check on the Mini 40 oil drainage barrel modification.

Visited the new coop bank office, they were just moving in.

Went to the research station at Namulonge to get the results of germination tests, result good, 84% germination.

Left Kampala for Masaka for the Komet training session.

This course had participants from the oil mill with the Komet equipment and the oil mill with Indian made Alfa equipment. These mills are only 100 meters apart and have capacities of 1/4 ton per day and 8 tons per day respectively. The Komet is processing groundnuts and the Alfa is processing cotton seed. Combining the two processes was appreciated by the participants particularly when we discussed the process equipment because I was able to cover the whole processing procedure. Examining the internal parts of the expellers revealed that during the installation of the machines they had been very badly damaged and part of the steam heating system had been installed incorrectly, this created some good

participation. This was another course which was of a lot of interest to the participants and was very well received by them.

I took a bag of groundnuts to the Komet installation for demonstration purposes and it was interesting that the Komet expeller had great difficulty processing them because I believe the oil content was greater.

I met the Masaka local farmers Co-op chairman, he was requesting approx, 1.5 tons of Sunfola seed to distribute amongst the farmers.

Went to Bugiri to fit the modified drainage barrel to the Mini 40. The press was ceased up solid with pressed material. I dismantled the machine, cleaned it out and fitted the modified parts but the area has no power because several of the power line poles are down in the swamp area near Bugiri and it is expected it will take 4 or 5 days to rectify the problem. Returned to Kampala.

Signed the participation certificates and arranged for delivery.

April.

Vic Amann and I went to Bugiri to test the oil drainage barrel which was fitted to the Mini 40, the modification was a complete success. It achieved several things, the expeller's theoretical capacity doubled from 40 kg per hr to 80 kg per hr, this meant that the main shaft rotational speed could be reduced by 50% from 125 rpm to approx, 60 rpm, this in turn reduces frictional wear by the same amount or reduces it even further because the bar Configuration has key slots which are parallel to the center of the shaft instead of 90° to the center of the shaft which increases the efficiency of the expeller dramatically. I reduced the rotational speed of the shaft and the efficiency of oil extraction improved, this was indicated by the pressed cake being discharged from the expeller and the quantity of oil produced.

The most important achievement in doing this modification is that this wear part can be produced in Uganda and at 25% of the price of the imported one.

The operation in Bugiri will be monitored by the C.A.A.S. project to determine the long term effect of this modification until September when the project comes to a close.

PARTICIPANTS AT THE SECOND OIL MILLERS SEMINAR
INTERESTED IN TRAINING
=====

NAME	ADDRESS	TYPE OF SEED	TONS/BAGS OF SEED	TRAINING SESSION BY MANUFACTURER
1. OMOR PETER MINOR	MULTI-PURPOSE TRAINING AND EMPLOYMENT P.O BOX 93, IGANGA.	SUNFLOWER SOYBEANS	500 KGS 300 KGS	INDIAN MAKE BUSUNJU
2. OKETCHO VINCENT	BENEDICTINE FATHERS P.O BOX 669, TORORO.	BLACK SUNFOLA		CHINESE MAKE CEI
3. ONYAKE JOSEPH	BENEDICTINE FATHERS P.O BOX 669, TORORO.	BLACK SUNFOLA		CHINESE MAKE CEI
4. SSUNA LAULI	KIBINGE OILS LTD. P.O BOX 5921, KAMPALA.	SUNFLOWER	200 KGS	TINY TECH NEALE
5. ANNET KASIGWA KIIZA MONICA	ALIMUCONZA SELF HELP WOMENS GROUP P.O BOX 219, MASINDI.	SUNFLOWER	300 KGS	U.K - BUGIRI INDIA - BUSUNJU
6. KUNYA SAMUEL KISIRA JULIUS	MUSENZE INDUSTRIES LTD P.O BOX 4703, BUNENGE.	SUNFLOWER	500 KGS	MINI-40 BRITISH - BUGIRI
7. MUSENZE SULAIMANI	MUSENZE INDUSTRIES LTD. P.O BOX 4703, BUNENGE.	SUNFLOWER	500 KGS	TINY TECH - NEALE INDIAN - BUSUNJU
8. MANGALAMA FRED PAUL	P.O BOX 6345, KAMPALA. TEL NO: 230108	SUNFLOWER SOYBEANS	500 KGS 500 KGS	CROMPTON INDIA - BUSUNJU
9. OKETCHO VINCENT	BENEDICTINE FATHERS P.O BOX 669, TORORO.	SUNFOLA	100 KGS	CHINESE MAKE CEI
10. ST MARY'S OIL MILL EDIOFE	P.O BOX 135, ARUA.	SUNFOLA	1000 KGS	M.G. ITALIAN LIRA

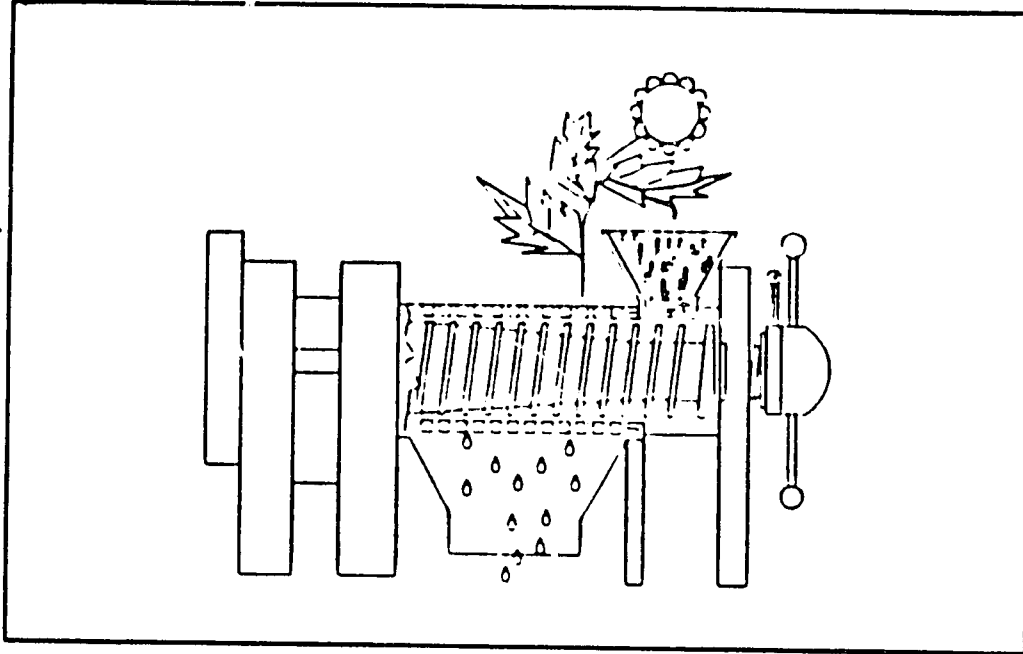
11. QUOK POLLO	UCTU	SUNFLOR		CHINESE - CEI
12. NENYA ODIDA PATRICK	P.O BOX 2589, KAMPALA.	SUNFLOWER SOYBEANS	5 TONS 3 TONS	HANDER INDIA - BUSUNJU
13. NABENDE RUTH A.	AFYA ESTATES LTD. P.O BOX 654, MSALE	SUNFLOWER SOYBEANS	4 TONS 1 TON	TINY TECH MSALE
14. ONAM DAVID	P.O BOX 229, KONY KORI, LIRA	SUNFLOWER	5 TONS	CARRERA
15. PARIEL MIXED FARM LTD.	P.O BOX 81, MASINDI.	SUNFLOWER SOYBEANS	3 TONS 3 TONS	
16. KWEBIHA Z. FENEHEMS KALJABAIHOIRE ERNEST KVALIGONZA ERIA WANDERA HERBERT BYAKAGABA FREEDOM SAULO	KTEKI OIL MILL P.O BOX 14238, KAMPALA.	SUNFLOWER	1 TON	HANDER
17. OKODI CHRISTOPHER	BREKNER & PARTNERS (U) LTD	SUNFLOWER	3 TONS	INDIAN - BUSUNJU
18. OKWI MICHAEL	KUMI LEPROSY CENTRE P.O BOX 9, KUMI.	SUNFLOR	200 KGS	MINI 40
19. KIGGUNDU FRANK	COMMODITY EXPORTS INTERNATIONAL P.O BOX 10241, KAMPALA			CHINESE CEI
20. MOHAMMED SSEKUYA	MOSSEMA LTD. P.O BOX 1050, MASAKA	SUNFLOWER	200 KGS	INDIA BUSUNJU
21. JOSEPH KIVIMBA	KIRITA AFABALA GENERAL OIL FACTORY P.O BOX 530, MASAKA	SUNFLOWER	1000 KGS	
22. FREDRICK SSALI	MITYANA MILLERS LTD. P.O BOX 5080, KAMPALA	SUNFLOWER	1000 KGS	INDIA BUSUNJU

23. J.F. KYAGULANYI - KAGGWA	S.G.A INDUSTRIES (FOOD) P.O BOX 1758, KAMPALA PHONE 257658	SUNFLOWER	5 TONS	INDIA BUSUMJU
24. GEORGE KALEMA	INTRACO (U) LTD. P.O BOX 1429, JINJA	SOYBEANS SUNFLOWER	1000 KGS 1000 KGS	CHINESE CEI
25. ELIZABETH LAPENGA DR. KENETH OKELLO	KEMREX LTD GULU P.O BOX 4851, KAMPALA	SUNFLOWER SOYABEANS	2.5 KGS 2.5 KGS	INDIA - BUSUMJU INDIA
26. BUZAAMA CO-OP SOCIETY LTD.	P.O BOX 4615, BUKINGE	SUNPOLA	1000 KGS	CANATEC - MASAKA BERLINBERG
27. JOMERIA MUKALYOMA SSEKYEMA	MOSSEWA LTD. MASAKA P.O BOX 1050, MASAKA	GROUNDNUTS	300 KGS	ROSEDAWN UK BUGIRI
28. LEMBISI M	UCTU	SUNPOLA		CHINESE - CEI
29. MENYA ALEX	BUSEMBATIA OIL MILL P.O BOX 68, BUSEMBATIA	COTTON	5 TONS	BRITISH BUGIRI
30. CHRISTOPHER R. MUGENYI	KYARUBOGA VILLAGE, PORT PORTAL P.O BOX 627, PORT PORTAL	SUNFLOWER		MINI-40 OIL MILL
32. PAUL MUKOOZA	P.O BOX 212, KAMPALA	SUNFLOWER	200 LTRS	MAWDER
33. MZAMO KENNETH	P.O BOX 4703, JINJA	SUNFLOWER COTTONSEED	10 TONS	INDIAN BUSUMJU
35. OGWANG SAM	JINJA AMALGAMATED INDUSTRIES P.O BOX 156 JINJA	SUNFLOWER	3000 KGS	INDIA BUSUMJU
36. FRED AGUM OBONYO JULIUS	JINJA AMALGAMATED INDUSTRIES P.O BOX 156 JINJA	SUNFLOWER	3000 KGS	ITALY LIRA
38. OKELLO JOSEPH STEVEN OKALEBO	AMURIA OIL MILLERS	SUNFLOWER COTTON		BRITISH BUGIRI
39. DENIS EPURIA	SOROTI	SUNFLOWER		MINI-40

40. MARTIN OGWANG KATE JOSEPH	TESO DEVELOPMENT ORGANIZATION		CHINESE CEI
41. RWAKAIKWA JOSEPH	LUMERO SOAP AND OILMILLS P.O BOX 2580, KAMPALA	COTTON	INDIA BUSUNJU
42. PROSCOVIA KIRUMIRA	ALIMUGONZA SELF HELP WOMENS GROUP P.O BOX 219, MASINDI.	SUNFLOWER	INDIA BUSUNJU
43. SARAH MAKENDO KITWA/ULE MRSUSERA	BUGIRI WOMENS GROUP BUGIRI WOMENS GROUP		INDIA - BUSUNJU INDIA
45. MULOAT SAM			CHINESE - CEI
46. KIDAMBIRE STEPHEN	BUGIRI WOMEN'S INDUSTRIAL CO. GROUP		GERMANY MOSSWA, MASAKA
47. MRS BERNEDETE ELUDAI	MULTI-PURPOSE TRAINING AND EDUCATION ASSOCIATION P.O BOX 93, IGANGA.		INDIA - BUSUNJU GERMANY - MASAKA
49. MRS MUGOBERA	TUGEZEKU WOMEN'S GROUP		KOMMET - MASAKA GERMANY
50. ROBERT MUBONGOYA	TRIBUNAL		INDIA - BUSUNJU GERMANY - MASAKA
51. KANAMURA SILVER KABALA	MBARARA		GERMANY MASAKA
52. BWAMBALE JOSHUA	KARUCHE FARMERS PARTNERSHIP P.O BOX 507, BWERI, KASESE		BRITISH BUGIRI
53. YONA KULE	KYEMPANA FARMERS GROUP, KASESE		BRITISH - BUGIRI
54. CHARLES MAHARI	KAGANDO RURAL DEVELOPMENT, KASESE		BRITISH - BUGIRI
55. AMUZA MAGULUGANTUNGO	CEI		
56. MAMA ALFRED	CEI		

57. BEMGO DAVID	CEI
58. MUMANGA ROBERT	CEI
59. SERAJUGO GODFREY	CEI
60. SERUJWASI STEPHEN	CEI
61. A.N. RAJENDER REDDY	CEI

TRAINING MANUAL FOR THE OPERATION OF SMALL SCALE OIL PRESS



Prepared by

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AND
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September 1993 *AND* *April 1994*

Kampala, Uganda

This manual was developed for the intended use of small scale oil expeller or press which are run by electric motor or engines. This can be used also in medium scale presses which have machines similar or identical oil expellers. No part of this manual may be reproduced without permission from ACDC/CAAS and VOCA.

TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
DEFINITION OF TERMS	3
BASIC REMINDERS	4
PROPER OIL PRESSING PROCEDURES	6
GENERAL MAINTENANCE	7
USUAL PROBLEMS AND SOLUTIONS	9
RECOMMENDATIONS	11

INTRODUCTION

The process of obtaining oil from seeds involves the separation of oil from the oil-bearing material by either mechanical or chemical means, or a combination of both. In large processing operation, vegetable oil separation is usually accomplished through the steps of seed cleaning, crushing or pressing, cooking, drying, filtering and refining. In smaller production of vegetable oil, many of the steps are removed, particularly the chemical extraction (solvents) and refining steps, refer to Fig.1. In order to produce high quality oil and cake, the seed should be as clean as possible. The presence of permanent or electromagnets is always essential to remove steel and iron contaminations that are mainly responsible to the damage and rapid wear and tear of the oil mill.

The expelling or pressing step in oil milling is essentially the transport of the raw material from the seed hopper to the cake exit. This is accomplished by the rotation of the worm or screw shaft that fits in the drainage barrel or cage. Along its length, the shaft diameter increases until it reaches that of the worm. At the exit end, the shaft has a smooth tapered section that seats with a removable end ring, thus forming the choke mechanism. As the raw material is transported, it is forced or squeezed against the interior of the barrel due to the increasing shaft diameter. See Figure 2 for a schematic diagram of one of the most common oil mills. The barrel is usually lined with cage bars or rings. The grooves formed between each bar or spaces between rings provide a channel for the release of oil which flows out in streams along the bottom side of the barrel.

The entire shaft can be axially moved by a hand operated choke lever in order to narrow down the exit opening, thus, adjusts the cake thickness. After the oil has been expelled, the cake continues on through the outlet where it usually exits as a continuous flake formed by both pressures of the shaft and the choke mechanism. In general, the small oil mill is designed to exert a pressure of 60-100 MPa on the seed and should extract 75-95% of the total available oil in the seeds. The cake should have a residual oil content of 4-12 percent.

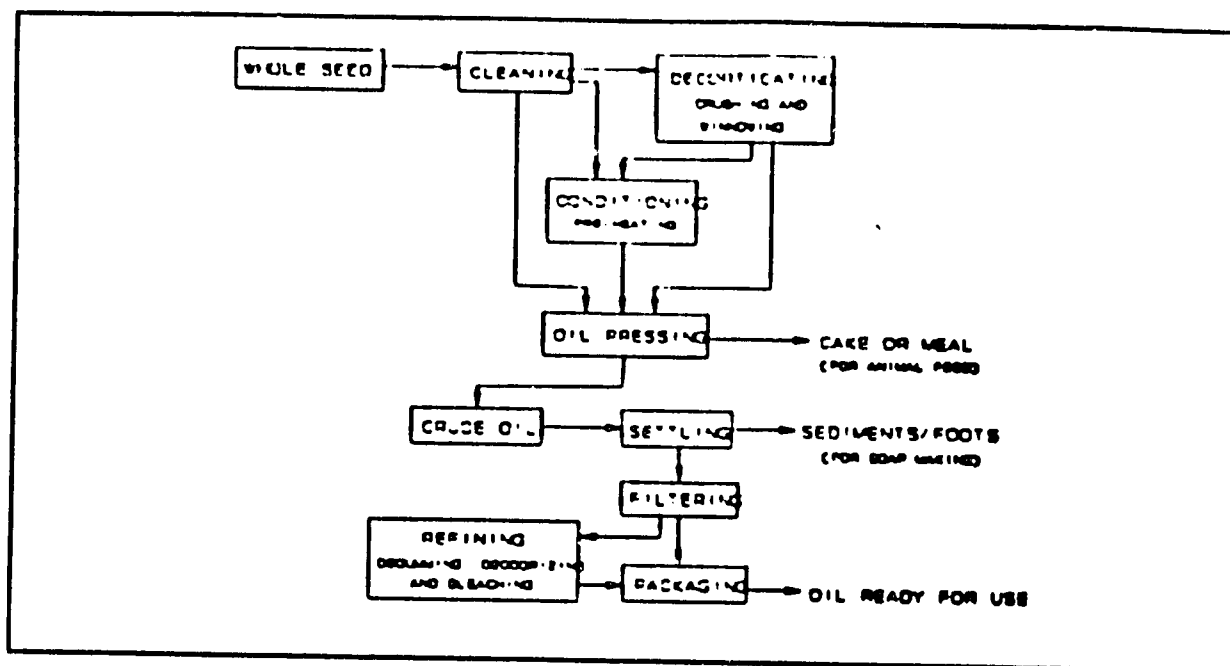


Figure 1. Small and Medium Scale Oil Milling.

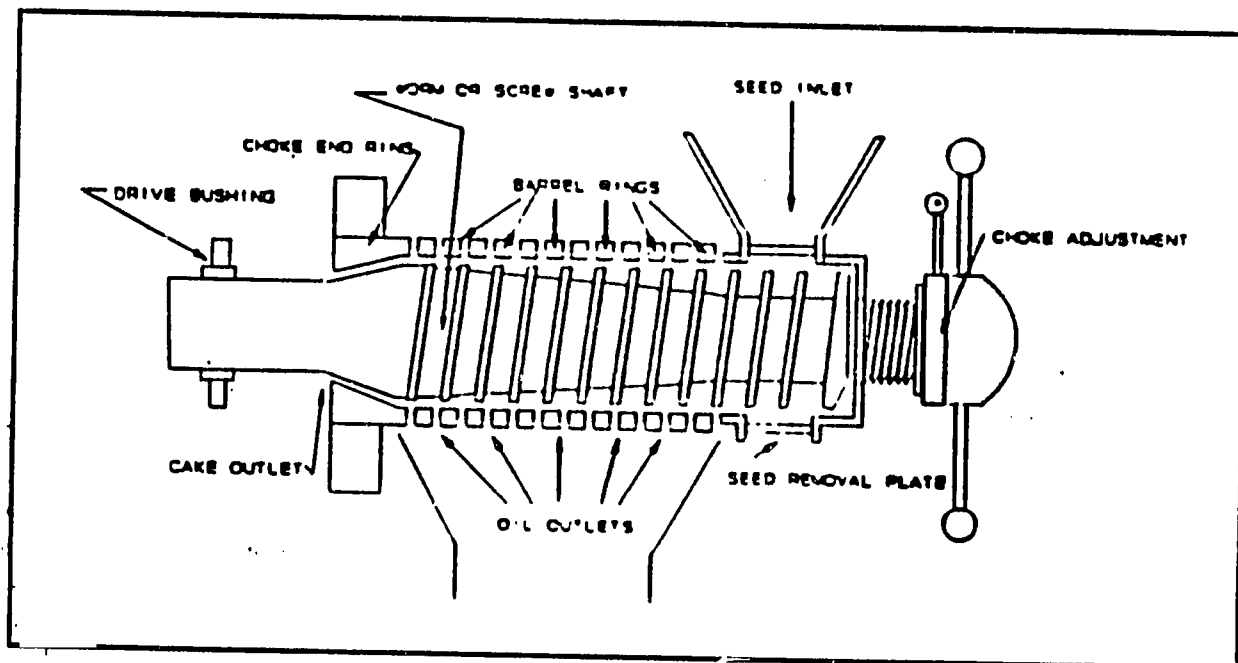


Figure 2. Schematic of one of the most common oil expeller.

DEFINITION OF TERMS

Barrel rings or cage bars - close fitting steel rings or bars against which seeds are pressed by the worm for oil extraction.

Cake or meal - the product that comes out from the outlet in the choke end ring.

Choke - the space between the tapered end of the worm shaft and the choke end ring. It is the mechanism for adjusting cake thickness and pressure on the seed.

Crude oil - end product of the screw press operation. The oil that comes out from the spaces between the barrel rings or cage bars.

Decortication - the process of removing the husks or hulls of the seeds.

Choke end ring - component of the screw press that is seated with the tapered end of worm to form the cake exit.

Expeller or press or mill - mechanical screw press for extracting oil from seeds or kernels. The press is also called the oil mill.

Extraction efficiency - the ratio of the amount of oil extracted to the total amount of oil available in the seed or kernel.

Foots - the solid particles or sediments mixed with the extracted oil.

Footling - the event by which more feet come out from the barrel rings or cage bars. This is caused by worn bars or rings or spacing between rings or bars.

Oiling - the event by which no oil comes out from the spaces between bars or rings. This is caused by blockage in the spaces of the rings or bars.

Worm or screw shaft - the whole assembly containing the shaft, the worm or screw mechanism and the tapered end.

BASIC REMINDERS

There are few things required for the better and long lasting operation of the machines. As long as the operators follow these basic normal activities, then the machines are expected to be of service for an extended period.

FAMILIARIZATION

- * The operator should spend some time in becoming familiar with the working mechanisms and adjustment, and names of important parts of the press. An illustration or drawing of the press can be placed near the machine. A brief operating manual can be placed on or near the machine. (A drawing of your equipment can be copied from the manufacturers manual.) Factors like choke adjustment, feeding rate, press warm up, shot-down, and trouble-shooting should be considered. The manager should let the available workers familiarize the press. This will allow continuous work in case the main operator is sick or not around.

LUBRICATION

- * Follow strictly the lubricating instruction of the oil press. This is very important. The instructions for lubrication are usually indicated in the manufacturer's manual. In general, put one to three drops of oil into the gear box before operation. Most gear boxes will be filled first during the initial use of the oil press, (usually 1 liter of oil). However, in cases where the machine has not been operated for a long time, check the oil reservoir by dipping a piece of skinny stick. If no or very little oil can be found, you must refill the gear box reservoir before use. Use the recommended oil per manufacturer's instruction. In some cases, you can always use the oil you produce, provided it is clean or filtered. For the grease requirements, add two or three squirts from a grease gun through the available port. If your machine has no grease port, then remove the worm or screw shaft, and add a liberal amount manually. This is more convenient, since it allows you to check the overall condition of the worm shaft. In general, add grease every 50 hours of operation, or twice a month for machines without port holes. (Check with the manufacturer's manual for more details of your machine.)

MAGNETS AND INSPECTION

- * Make sure you have magnets installed at the lowest portion of the oilseed hopper or any machine hopper that have metal to metal contacts. The magnets should be located closest to the portion where the pressing starts, (just above the feed regulating plate, refer to Fig. 3). In most cases, oil press without magnets ran for only short time (even one day), and then damaged or injured because of metal to metal contact. Check and inspect any accessible parts for foreign matters. Remove them before any press operation starts.

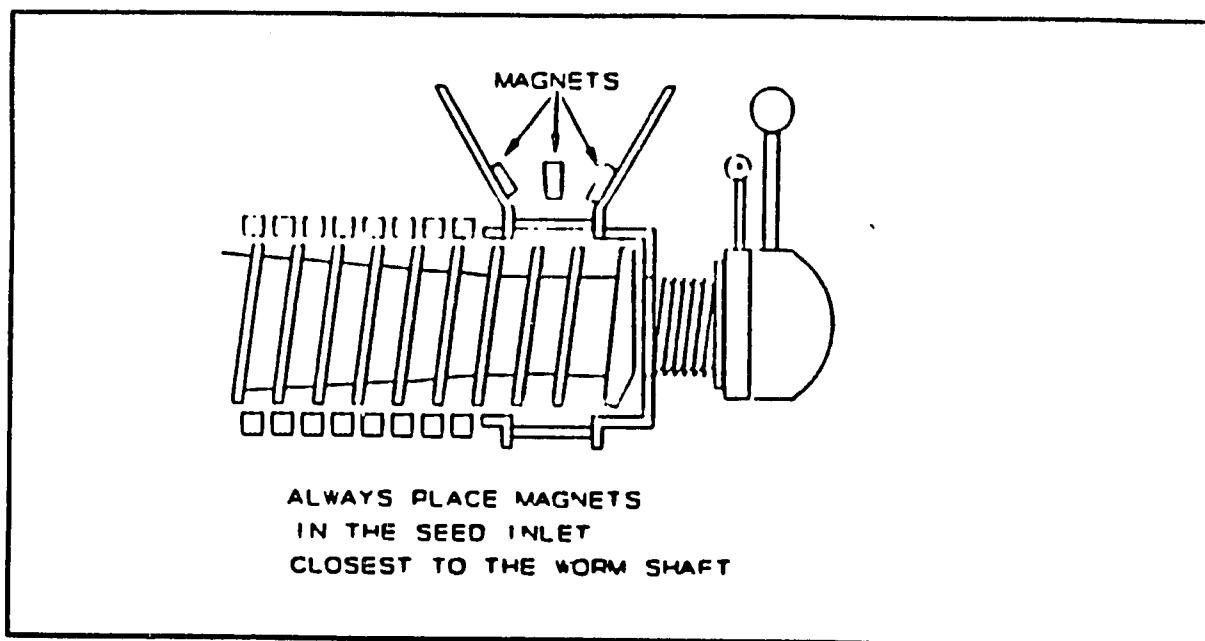


Figure 3. Best location for magnets.

CLEAN AND GOOD QUALITY SEEDS

- * Use clean seeds always. It is preferred that there are no foreign materials along with the seeds. Small stones will also do some damage on the worm shaft. Sack and rope fragments may cause stoppage of the rotation and proper discharge of the meal. Winnow the seeds as clean as possible. The purer the seeds, the more oil you can get, and the less wear on the worm shaft, the barrel rings or cage bars, and the choke ring. It is recommended to use decorticated or dehulled seeds. Seeds like rapeseeds and simsim (or sesame) does not need decortication. If your oil press have the capability of heating or frying the seeds, then it is recommended. Heat the seeds to at least 40 degrees Centigrade, but don't overheat them. Heating usually increase the pressing efficiency of your machine.

SAFETY IN THE WORK PLACE

- * Always be safety conscious and work with caution in and around moving parts. If you are using electricity for power, make sure the motors, lightings, and fixtures are properly wired. Put a fire extinguisher, or put buckets of water and sand in the vicinity. The work area should be well lit. Clean up any oil spills in the floor. Add sawdust or dusts from husks on the spills and let it stay for few hours. Ensure always that all guards and cages for belts and pulleys are in place before running any machinery.

By following the simple reminders, it is likely that your machines and work place will last for a long time.

EXPELLER START UP

Know the operating parts of your machines. Be very familiar with the adjusting mechanisms especially the locking handles and cranks.

1. Loosen the locking handle by turning clockwise. Then retract the worm shaft by turning clockwise its adjusting crank for 1-2 turns.
2. Oil or grease the parts that needed to be lubricated.
3. Turn on the engine or the motor.
4. Open the feed hopper regulating plate (if it is provided) and start feeding small amounts of cake or seeds by hand. (Small enough to take about 30 seconds to feed.) Excessive amounts will usually clog up the barrel rings and sometimes stop the motor or engine. If this happens, follow the procedure in the GENERAL MAINTENANCE PROCEDURES FOR WORM OR SCREW SHAFT ASSEMBLY. It is advisable to feed raw materials that have low oil content to provide greater friction. CAKES from previous pressing operation will suffice. DON'T use foots (oily cake) and seeds with very high oil content in the first 5-15 minutes of operation.
5. A small amount of cake will come out from the choke end (cake end) of the machine. Continue feeding by hand in sufficient amount and slowly tighten the worm shaft assembly by turning its adjusting crank counter-clockwise. After about 5 minutes, the cake will be warm, so gradually increase your feeding of the cake or seeds. After 10-15 later, the cake will become too hot to touch, then start feeding SEEDS into the hopper. Gradually adjust the choke handle and the worm shaft adjusting crank by turning counter-clockwise, until you get the desired thickness or dryness of the cake. Also gradually increase the amount of seeds being fed. Once you got the desired thickness (usually the maximum setting of the choke), leave the adjustments until you stop the pressing operation or when the machine was stopped due to power failure or when clogging occurs. When this happens, close or stop the feeding of the seeds, then slide the opening underneath the shaft assembly. Then retract the shaft immediately about halfway through (clockwise turning of handles and cranks).

GENERAL MAINTENANCE

The main oil press as discussed earlier is usually grouped into 5 essential parts:

- a. Feed hopper and safety covers
- b. Worm or screw shaft assembly
- c. Feed end casting, barrel rings (cage bars) and choke assembly
- d. Drive assembly and bearings
- e. The electric motor or engine

FEED HOPPER AND SAFETY COVERS

After pressing operation each day, always check for metals that stick to the magnets at the feed hopper. Make sure that the feed regulating plate of the hopper is closed. This is to prevent foreign materials to get into the worm shaft. You will be surprised to find ferrous materials and debris. Make sure that the covers for belts and pulleys are in place before running the pressing operation. **SAFETY FIRST AND ALWAYS!** Always work with caution near uncovered moving parts.

WORM OR SCREW SHAFT ASSEMBLY

Always retract the shaft after pressing operation and even during any stoppage. On most machines, this can be done by turning the choke adjustment handle and the shaft assembly clockwise. Other machines use lever or nuts to adjust the cake thickness. To retract the press means to increase the cake thickness. Before turning off the motor, make sure that the shaft is empty. By closing the feed regulating plate (or hopper lid) few minutes before stopping the motor will empty the shaft. Grease the bearings of the shaft assembly as recommended. In case the shaft got stuck, open the slot below the shaft (or the feed removal plate) to remove any remaining materials in the shaft. Scrape any hardened materials in the shaft. If you have access to rotate the pulley or belt then try to turn by hand for about 20 revolutions in the reverse direction, (opposite the operating direction). This will allow the clogging materials to be discharge on the opening beneath the shaft. Then slowly retract the shaft assembly by rotating the choke adjustment handle and worm shaft assembly crank clockwise. In some machines, you need to remove the ring retainer mechanism first. When the worm shaft assembly is disengaged (rotate as far as you can and you can sense the complete retraction), pull the shaft towards your body. In some machines you need to loosen few bolts in the main frame in order to remove the shaft. In some machines, the other end of the shaft can be accessed through the belt/drive line end. By pushing this other end with a comparable or smaller size rod will expedite the removal of the shaft, refer to Fig. 4. This can be done by carefully tapping the rod or bar with a solid material, preferably a hammer. For machines without such access, a pulling or lever mechanism can be improvised.

If in doubt about removal of the shaft assembly, consult your manufacturer's manual.

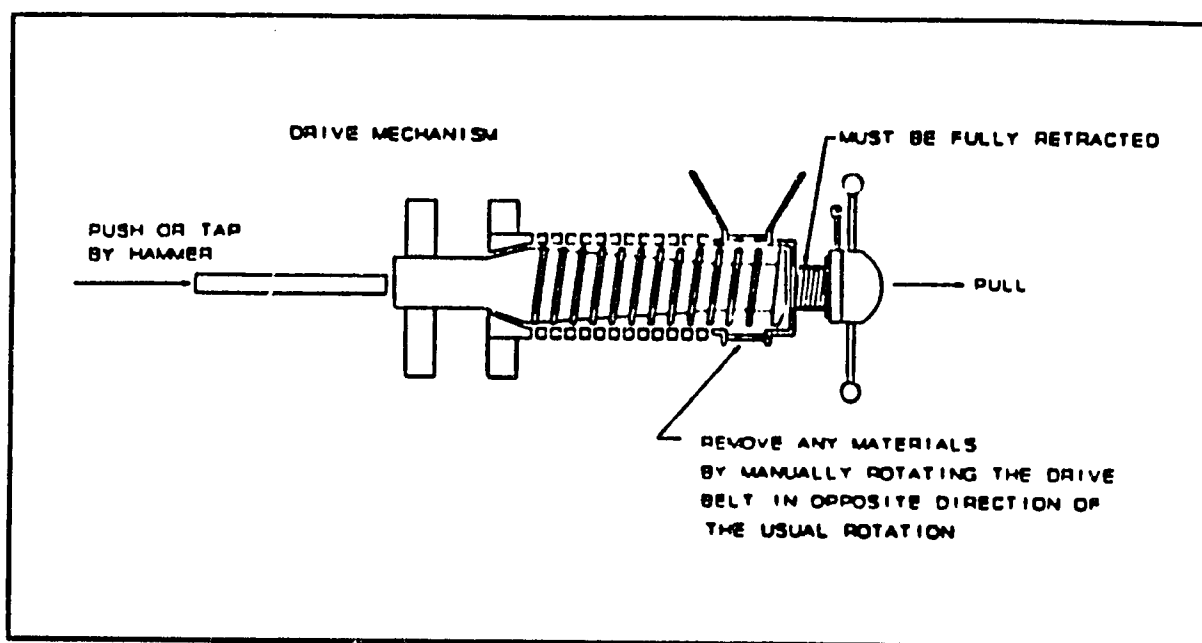


Figure 4. Shaft removal strategy.

CASTING, RINGS OR BARS AND CHOKE MECHANISM

Check the whole assembly for foreign materials. It is always recommended to clean them immediately after use. It is not necessary to disassemble the whole assembly. In case disassembling is required, remove the worm shaft assembly first. Machines that have barrel rings are easy to remove. First untighten and remove the three nuts of the tie bars (long bars that go through the rings). Then knock out the choke end ring by tapping it from the barrel side. Remove the rings and spacers as required. Clean them. For machines that have cage bars, over turn the drum using the bolts as pivots, remove the end ring, and then just knock down the bars. Remove the bars and clean the inside of the drums as well as the drums. The bars are always numbered. Refer to the manufacturer's manual if in doubt.

MAIN FRAME AND DRIVE ASSEMBLY

The main frame is the whole structure giving support to the whole oil mill assembly. In bigger expellers, the main frame are bolted to the foundation. In smaller machines like the Mini 40, securing to the foundation is not needed. This will allow to move your machine. Always clean the main frame every after use.

The drive assembly is usually composed of the reduction gears which are connected to the motor or engine by means of belt and pulleys. The gears reduces the speed at the worm shaft in order to provide enough power to expel the oil. The gear box

must always contain oil. A good operator always put three to five drops of lubricating oil into the box every day of operation. The absence of oil in the gears usually cause rapid wear or breakage of the gear teeth.

ENGINE OR ELECTRIC MOTOR

This is the part that powers the oil mill to expel the oil. At installation of your machines, always make sure the rotation is right. In some cases, the polarity of wires at the motor side are reversed, such that expelling the oil maybe impossible. Make sure the belts and pulleys are in good condition. Presence of oil in the belts and pulleys will cause slippage of rotation, resulting to unsatisfactory operation. Make sure the belts are tight enough. Loose belts also cause slippage. Cover the belts with guards and cages, if possible for safety reasons. Change damaged or broken belts.

USUAL PROBLEMS AND SOLUTIONS

PROBLEM: CLOGGING - Usually caused by power failure (electricity down or circuit breakers tripped) or when hard materials jammed the choke. This problem is characterized by the difficulty of removing or retracting the worm shaft assembly.

SOLUTION: Open the slot below the shaft (or the feed removal plate) to remove any remaining materials in the shaft. Scrape any hardened materials in the shaft. If you have access to rotate the pulley or belt, then try to turn by hand for about 20 revolutions in the reverse direction, (opposite the operating direction). This will allow the clogging materials to be discharge on the opening beneath the shaft. Then slowly retract the shaft assembly by rotating the choke adjustment handle and worm shaft assembly crank clockwise. When the assembly is disengaged (rotate as far as it can be retracted), pull the shaft towards your body. In some machines, the other end of the shaft can be accessed through the belt/drive line end. By pushing this other end with a comparable or smaller size rod will expedite the removal of the shaft (refer back to Fig. 4). This can be done by carefully tapping the rod or bar with a solid material, preferably a hammer. For machines without such access, a pulling or lever mechanism can be improvised.

PROBLEM: FOOTING The problem by which too much foots (oily solids or sediments) comes out with the oil. It is caused by worn out bars or rings, or too much spacing between rings or bars.

SOLUTION: Let the machine warm up for about 15 minutes or follow the start up procedure strictly, which is feeding the cake by hand

for 15 minutes, followed by the seeds, and gradually adjust the shaft back to its operating condition. If condition persists, stop the pressing operation. Remove the shaft assembly, then the barrel rings or the cage bars. Replace worn rings or bars if needed. In the case of barrel rings, interchange them, (the ring closest to the cake end will be placed farthest away, now nearest to the feed side). Use the thinner sets of spacers close to the cake end. Always replace the whole set (three per set) to get uniform spacing. In the case of cage bars, turn the bars around, (the ends are reversed).

PROBLEM: OILING-

This happens when no oil comes out from the spaces between bars or rings. This is caused by blockage in the spaces of the rings or bars, oil is being expelled at a faster rate than it can be discharged, and the interiors become fluid. Almost all oil just stay inside, and the feeding becomes sluggish. If the hopper is empty, you can see backlashing oil by looking down at the hopper hole.

SOLUTION:

While the press is still running, open the hole underneath the shaft assembly (slide the seed removal plate) to get rid of the oily materials. Then close the opening and feed dry cakes by hand for few minutes and check if the exiting cakes are dry. If no oily material can be seen by looking through the empty hopper, then resume to feed the seeds. You may repeat this technique several times.

**PROBLEM:NO OR LITTLE
OIL**

Very little or not oil coming out from the press. This is caused by any of the following:

- 1) seeds with very little oil content,
- 2) damaged or injured worm or screw,
- 3) damaged choke end ring,
- 4) choke opening is large,
- 5) oiling problem, and
- 6) no seeds in the hopper

SOLUTION:

1. Use good quality seeds.
2. Replace damaged worm or screw shaft.
3. Replace damaged end ring.
4. Adjust choke to maximum or near maximum setting.
5. Follow solution for oiling problem above.
6. Feed the seeds steadily and regularly.

**MAGNETS WILL ALWAYS PREVENT DAMAGE IN THE WORM SHAFT AND THE CHOKE
END RING.**

INTRODUCE OIL SEED PROCESSING HERE.

RECOMMENDATIONS

FILTERING

Before filtering, make sure that the crude oil has settled for at least 24 hours. The best practice is to filter those oil which were pressed or processed two days before. Pump or take only the upper layer. The bottom part are mostly solids (sediments or foots). Remove or shovel out the solids when they are at least a quarter of your settling tank or container. Refer to Figure 5 for a guidance on proper settling mechanism.

Most of the oil milling system used in this country does not necessarily require sophisticated filtering. Sunflower oil can be used without filtering. However, you have to wait for at least one week before you can carefully decant or remove the clear liquid and transfer them in jerry cans or packaging containers.

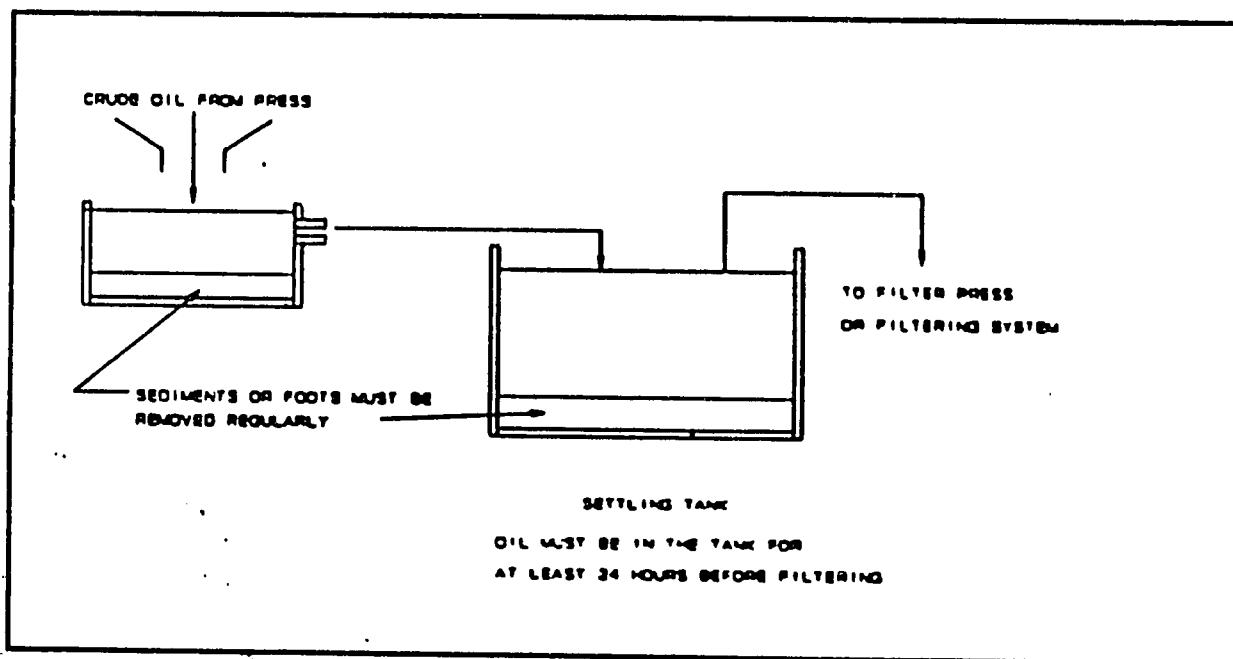


Figure 5. Proper settling mechanism.

If you have a filter press or any other filtering mechanism, always use very efficient pumps, such as the positive displacement pump. Most of the filter press in use in this country are using outdated and cumbersome pumps. Some are still using pumps like those used in manual artesian wells. These type of pumps require much power at very low capacity. Some positive displacement pumps can be powered by about 1/4 hp with capacities comparable to the present systems. Also make sure there is minimal or no leakage in the piping system of your filter press. Any leakage will result to lower pmping capacity.

This filtering unit is actually a double filtering system (referred by most of you as double refining). However, you must use only efficient pumps, those that have large capacity at very low power requirement. The first filter is washable with warm or hot water. You can use your old filter press as your first filter. The second filter is a regular fuel or oil filter used in cars or lorries. It is very convenient to use this filter because it is disposable. This filter may be cleaned by reversing the flow during washing of this filter.

The best way to improve your filtering system is to change your pumps and strictly follow the suggestions above in settling the crude oil.

OIL PRESS OR MILL

The best performing machines are expensive to purchase. The Hander (Japanese-made) is one of them. Simon-Rosedowns (Mini-40, British), Hander and Komet (German-made) are easy to operate and disassemble. The Mini 40 and Komet (German-made) have very low capacities. In addition, the Mini 40 is expensive with respect to its capacity. The Chinese and Tinytech (Indian-made) are cheaper to purchase, but they are large and cumbersome to operate. If you are constrained with equipment capital, Chinese-made oil press would be a good start-up unit, since there are a number of them already in the country. Try to ask around to be informed of what group or company owns a particular unit. This will guide for any trouble-shooting in the future. However, if you just follow good maintenance and take good care of your machines, any of the machines will perform efficiently. Buy the cheapest possible unit (capacity considered) that have spares with them. In my assessment of several brands and output, I am quite sure that good maintenance and proper machine operation play a vital role in obtaining high efficiency in oil milling operations. Along with proper seed cleaning, heating and better filtering system and more hours of operation (or better management), your oil milling enterprise will surely be successful and profitable.

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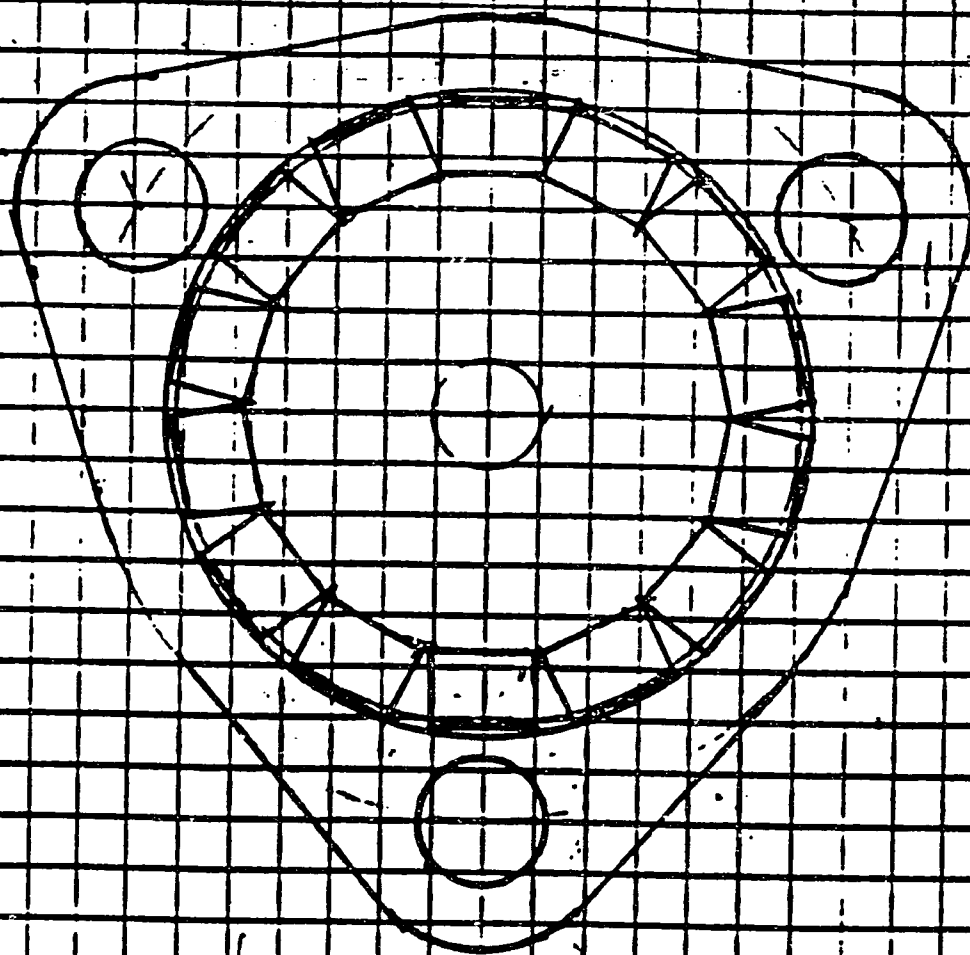
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2 1/2"

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