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UNIDO Contract No. 83/87
Project No. CD/BGD/81/003
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RICE BRAN OIL EXTRACTION PLANT

DHAKA

THE PEOPLE'S REPUBLIC OF BANGLADESH

TERMINAL REPORT

BUREAU OF FOREIGN AFFAIRS
MINISTRY OF COMMERCE
THE PEOPLE'S REPUBLIC OF CHINA

May 25, 1986

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ANNEXES

I. General Description

The project of rice bran oil extraction plant is implemented according to the Contract No. 83/87 signed on January 19, 1984 between the United Nations Industrial Development Organization (UNIDO) and China National Complete Plant Export Corporation(CNCPEC) for the supply of machinery, equipment and parts and provision of expert services for the establishment of a rice bran oil extraction plant in the People's Republic of Bangladesh.

The input of the project is planned 3,161,000 $ US (contributed by UNCDF 1,452,000 $ US, UNIDO 469,000 $ US, Bangladesh Government 1,240,000 $ US) among which 2,424,000 RMB Yuan is paid to CNCPEC for the supply of machinery and equipment, and 900,000 RMB Yuan for the provision of expert services 150 man/month(in fact 1,290,000 RMB Yuan paid for 215 man/month).

Acting in agreement with UNCDF and the Bangladesh Government, UNIDO engaged the Chinese Contractor to supply all the machinery, equipment and spare parts required for the establishment of the plant and also send the experts to supervise the construction of the plant.

The project objective is to assist the Bangladesh Government in utilizing rice bran as raw material to establish the rice bran oil extraction plant with a daily throughput capacity of 40 ton rice bran and with an output 4.49 ton crude bran oil and 35.44 ton bran meal per 24 hours, annually producing about 1,000 ton edible bran oil, which strives to make up the national demand of edible oil and strengthen the capacity of self-reliance in this field. Moreover, through the trial-run and training a number of skillful operators can be trained to operate various types of machines and equipment in the plant.

The project was entirely completed by the end of 1985 over a period of 21-month civil construction, mechanical erection, trial-run and training. The trial-run and performance tests have been conducted with all technical indexes fully upto the requirements specified in the UNIDO Contract 83/87; besides, the training work was extended to the end of March, 1986 on the request of UNIDO.

II. Project Activity

1. Machinery, Equipment and Spare Parts

All the machinery, equipment and spare parts supplied by the Chinese Contractor for the plant were shipped to Chittagong port in 11 batches, starting from July 1984. Due to improper handling and delivery during the transportation from Chittagong to the plant site the packing was seriously damaged. 3 motors were found missing upon checking in two separate shipments and later re-shipped by the Chinese Contractor on the request of UNIDO.

2. Despatch of Supervision Experts

The experts supervising civil construction, equipment erection, trial-run and training of local operators as well as administrative officers, as required by the contract, were sent to the project area in three groups respectively in March, November 1984 and May 1985, whose total service term upto 215 man/month.

3. Technical Supervision

a. Total building area of the plant is 1,579 m^2 including 4 sections of pretreatment, extraction, meal treatment and dewaxing as well as some auxiliary facilities such as power transforming, distributing and control room, weighbridge, forklift truck garage and solvent discharging shed. Civil construction began on April 4, 1984. During this period the monsoon and frequent power failure in the area made it very difficult to do civil work. Meanwhile, in the original design the Sai Balli wood(6m length) was surposed to be used for piling purpose to consolidate the foundation of main buildings. But the wooden piles provided by local contractor were unstraight with many bucklings on both ends which didn't meet the requirement of piling. Since the Bangladesh side was unable to get straight wooden piles available and requested to modify the design, it was decided through mutual discussion that the expansion of foundation area was given to the pretreatment and meal treatment sections because the load of building was even. The extraction section, due to uneven load caused by high concrete water tank on its western top of the building,the solution was to drive 43 cast-in-situ piles(diameter 16", length 35-45'), which required that

each pile should have a bearing capacity not less than 25 tons. That was why the progress of civil work was delayed 3 to 4 months. However, in order to start mechanical installation earlier, the necessary measures were taken to concentrate building force, as a result, the pretreatment section and meal treatment section were handed over for equipment erection in November 1984 and, the extraction section ready for erection in March 1985.

b. The mechanical erection started in November 1984. But, because the local carrying agency failed to transport the consignments from Chittagong to the plant site in time, main equipment(extractor and toaster) arrived at the site in May 1985 so that the erection work all had to be complete by August 1985. In spite of it the equipment erection was ended on schedule if the delayed time excluded.

Beginning from August 15 as planned, no-load running and dry-material running were given several times to the pretreatment, meal treatment, extraction and dewaxing sections and some other machines and equipment, which indicated that the equipment were running normally and the trial-run of the plant may commence under this circumstance.

c. The trial-run of the plant began on November 27, 1985. Because the local power authority(PDB) could not guarantee a continuous power supply and the power interruption happened frequently in the evening, the trial-run had to be arranged for the time being from 8 am. to 5 pm. everyday on one shift. After December 10 when the standby diesel generator(305 kw) was tested sucessful the plant switched over to run continuously on three shifts. The machines and equipment were performed quite well in a certain period of trial-run. Therefore it was decided by mutual consultations that the performance tests would be conducted on the oil extraction equipment from December 29,1985 to January 1, 1986 for a period of 4 successive days of continuous operation for 24 hours a day and, the tests on dewaxing equipment were performed from January 17 to 19, 1986.The results of the tests indicated that all indexes fully achieved the requirements specified in paragraph 2.08 of UNIDO Contract 83/87.

The outcome of performance tests is shown as follows:

Test Items	Contract Standard	Test Result
(1) Throughput capacity (ton/per 24 hours)	40	43.68
(2) Crude oil produced (ton/per 24 hours)	4.49	4.03
(3) Oil recovery rate (%)	11.24	9.23
(4) Bran meal produced (ton/per 24 hours)	35.44	39.46
(5) Residual oil content in meal (%)	2	0.52
(6) Steam consumption (Kg/per ton rice bran)	980	593.18
(7) Water consumption (M^3/per ton rice bran)	42.6	37.86
(8) Power consumption (KWH/per ton rice bran)	44.4	30.51
(9) Hexane loss (Kg/per ton rice bran)	≤	3.11

(10) Dewaxing requirement: Dewaxed oil remains clear and transparent in a static placement for 24 hours under the temperature 25°C.

Notes: The Contract requires that the oil content of rice bran would be 12.5% and oil recovery rate 11.24% accordingly, and now the oil content of rice bran is only 10.19% with 9.23% oil recovered, which is upto the required standard.

The Munites of Certification on Performance Tests were confirmed and signed by the representatives of two sides between the Chinese Contractor and the Bangladesh Government Implementing Agency on March 15, 1986. **(See Annex 1.)**

d. Training work began in the middle ten days of August 1985 that 33 trainees(shift-in-charge, operator) were attended. The training subjects were mainly centred on the extraction plant principles, technological process, equipment structure and operation rules as well as knowledge and education on safety operation and fire prevention. In order to make the trainees understand both theory and practical operation, the ways of oral lecture in the class and demonstration at the machines were adopted, meanwhile the demonstration performance of fire-fighting tools and equipment have been shown.

The operators are now able to run the machines and equipment through the training and practice over a period of time. But, due to not a long time experience the operators need to get a further technical guidance if they really become skillful, capable of finding and solving the operative problems.

4. Project Tripartite Review Meeting

The tripartite review meeting was held on July 16, 1985 and attended by the representatives of UNDP, UNCDF, UNIDO, Bangladesh Sugar & Food Industries Corporation(BSFIC), Dhaka Vegetable Oil Industries Ltd.(DVOIL), Chinese Expert Team and the officers from concerned departments of Bangladesh Government. The meeting reviewed with satisfaction the implementation of the project and discussed some outstanding matters in the progress of the project and remedial actions. The effective decisions were made during the meeting on trial-run of the plant, the generator, laboratory, extension of technical supervision and training of operators which need to be solved in future operation of the plant. The meeting gave a great deal of impetus to successful implementation of trial-run and future full capacity operation.

5. Trial-Run Inspection Group

The Chinese Contractor timely sent a trial-run inspection group to inspect preparatory work of trial-run of the project and helped resolve the problems existed in the trial-run, which greatly facilitated a smooth implementation of trial-run of the project.

6. Project Terminal Tripartite Review Meeting

The meeting was held on March 29, 1986. The representatives reviewed the achievements of the project and discussed outstanding problems and remedies and, also considered the measures to ensure fully efficient capacity operation of the plant at the second phase technically and commercially. The representatives opined that the project of rice bran oil extraction plant had been established ahead of schedule; that the investment spent was less than the budgeted; that the experts from China worked highly efficient, setting an example of co-operation among the developing nations. The meeting hoped that during the Third Five-Year National Plan of Bangladesh either China would be requested to aid more projects , or Bangladesh would import several more equipment from China as same as the rice bran oil extraction plant. The meeting told the representatives that the document of the project at the second phase had been authorized; the purchase of generator and laboratory equipment was in process; the extraction expert was coming soon and all necessary work was in full swing. The problems unsolved in the plant such as poor quality of raw material, inadequacy of storage facilities were taken up by the authority. The rice bran oil and bran meal were going to be marketed via advertisement of television, broadcasting or newspapers. The situations of the project, hopefully, would be getting better.

III. Output

1. Production

The plant should, as designed, process 40 ton rice bran per 24 hours, producing 4.49 ton crude bran oil(The raw material contains 12.5% oil content) and 35.44 ton bran meal. The results of trial-run indicate that the production capacity of the plant may exceed by 10 to 20 percent with all technical and economical indexes upto the specified requirements and, the bran oil, after being refined, meeting the standard of edible oil.

2. Existing Problems in Production

a. Inferior quality of raw material. The raw material all comes from dozens of privately-owned small rice mills where the equipment are old and obsolete, technical level is low and parboiling time is too short. Some rice mills follow the operative way of processing paddy in one pass(hulling and whitening simultaneously), whose bran produced in this way is unsuitable for oil extraction. Therefore the bran contains husk as much as upto 40% or more, the quality is badly deteriorated, even mixed with red bran. As a result the extracted crude bran oil has a high wax content and excessive acid value(in general 50 - 60, individually high upto 104). So the refining loss is high as the recovery rate is only about 25%, darkening oil colour and increasing production cost.

b. No buyers are found to purchase the bran meal. The tenders were floated several times, but the offer was only 12 Taka per maund.

c. Abnormal supply of power. The power fails at least once or twice everyday, sometimes 5 to 6 times, maximum 11 times a day. The generator works very efficiently and is essential to the operation of the plant. The plant has to re-start with heavy load each time the PDB power disconnects. In this case the mechanical breakdown may be likely to occur, creating a threat to safety of plant operation, furthemore, to reduce life span of machinery and equipment.

3. Recommendations on Improving Quality of Product

a. To thoroughly improve the quality of rice bran, it is necessary to upgrade the technological process in the rice mills, add hulling machines and separate husk and impurities from the bran, at the same time, care should be taken to improve parboiling conditions, making rice bran not easily deteriorate during the storage and transport.

b. The suppliers should be requested to sieve rice bran at the collecting points so as to reduce husk and impurities in the bran and, also the quality specification of bran must be specified, for instance, oil content should be more than 12.5%, husk content less than 20%, moisture less than 10%, the acid value of crude oil, after being extracted, should not be more than 20, ect. To motivate the suppliers

to procure quality bran, DVOIL may pay more for the good and pay less for the bad, or simply reject.

c. Strengthen procurement work, reject unsuitable rice bran from one-pass process, formalize testing and analytical work, equip and staff well the laboratory. All these things are required to be done for the improvement of rice bran quality.

d. Add oil refining facilities and expand refining capacity. The crude bran oil would be timely refined and not stored in the tank for a long time.

IV. Evaluation of Project

1. The machinery and equipment supplied by the Chinese Contractor are good and, meet or even better the needs of various requirements of the rice bran oil extraction plant;

2. The experts sent from China, under the guidance and support of UNIDO, UNCDF and in the close co-operation of BSFIC and DVOIL, have completed the establishment of oil plant and implemented all requirements specified in the UNIDO Contract 83/87 over a period of 21-month supervision. The way to co-operate like this is effective and the work of the experts is in earnest;

3. The rice bran oil extraction plant is the first mechanized plant extracting oil from rice bran for edible purpose in Bangladesh. It would not only increase supply of edible oil, but also train a number of skilled operators who are able to run the plant. The plant is constructed half a year ahead of schedule and the investment spent is less than the budgeted, which acts as a model project of UNIDO in Bangladesh for quiker construction speed and less cost. Therefore, the objective of the project is achieved.

V. Conclusion

Although the plant, at present, is run intermittently, the production cost is high and profit is low due to poor quality of raw material, yet it is only a temporary phenomenon. The plant has a great future if this situation is improved. It is well known that Bangladesh is a rice-growing country with an annual output more than 20 million tons. This plant, with a daily capacity of processing 40 ton rice bran, only utilizes about 0.17 million ton paddy per year, but is able to turn out some 1,000 ton edible oil. The national capability of self-reliance on vegetable oil supply will be strengthened gradually if more paddy is used to process for this purpose. Therefore, the direction to erect the rice bran oil extraction plant in Bangladesh is absolutely correct, from the view of development the establishment of the plant suits the conditions of Bangladesh, too. Acting as a mechanized oil extraction demonstration plant, it may be considered to be popularized under the circumstances of improving rice-milling technology step by step which provide qualified rice bran for oil extraction.

Minutes of Certification on Performance Tests of Rice Bran Oil Extraction Plant in the premises of Dhaka Vegetable Oil Industries Limited, Fatullah, Narayangan j, Bangladesh.

1. According to stipulation specified in paragraph 2.09 of UNIDO Contract 83/87, both sides have jointly conducted the performance tests of the Rice Bran Oil Extraction Plant. The tests on the oil extraction equipment were performed from December 29, 1985 to January 1, 1986 over a period of 4 successive days of continuous operation for 24 hours a day, and the tests on the oil dewaxing equipment were performed from January 17 to 19, 1986.

2. All technical indexes on production capacity and consumption rate through the performance tests are shown as follows :-

	Test Items	Contract Standard	Test Result
(1)	Throughput capacity (ton/per 24 hours)	40	43.68
(2)	Crude Oil produced (ton/per 24 hours)	4.49	4.03
(3)	Oil recovery rate (%)	11.24	9.23
(4)	Bran Meal produced (ton/per 24 hours)	35.44	39.46
(5)	Residual Oil content in meal (%)	2	0.52
(6)	Steam consumption (Kg/per ton rice bran)	980	593.18
(7)	Water consumption (M^3/per ton rice bran)	42.6	37.86
(8)	Power consumption (KwH/per ton rice bran)	44.4	30.51
(9)	Hexane loss (Kg/per ton rice bran)	8	3.11
(10)	Dewaxing requirement :	Dewaxed oil remains clear and transparent in a static placement for 24 hours under the temperature 25°C.	

Notes: The contract requires that the oil content of rice bran would be 12.5% and oil recovery rate 11.24% accordingly, and now the oil content of rice bran is only 10.19% with 9.23% oil recovered which is upto required standard.

3. It is certified by representatives of both sides with signatures that both sides affirm that all above-indicated indexes of performance tests have fully achieved the requirements specified in paragraph 2.08 of UNIDO Contract 83/87.

Government Implementing Agency
Dhaka Vegetable Oil Industries Ltd.

General Manager

M.H. Khan

Date : 15.3.86

Representative of
Chinese Contractor
Chinese Expert Team

Team Leader

Zhu Zhonglin

1986.3.15.

Annex 2.

Services of Project Experts

No.	Name	Position	Arrival Date	Departure Date	Duration (month)
1.	Zhu Zhonglin	team leader	March 25 1984	March 31 1986	24
2.	Li Jinsheng	technological engineer	"	"	24
3.	Zhang Changhong	civil engineer	"	September 10 1985	17
4.	Xiao Mingli	structure engineer	"	April 9 1985	12
5.	Jiang Kemin	equipment engineer	November 10 1984	March 31 1986	17
6.	Gong Jiaxing	technological engineer	"	"	17
7.	Ma Mingcai	electrical technician	"	"	17
8.	Zhu Lianfu	installation technician	"	"	17
9.	Yuan Guanhua	refrigerating technician	"	"	17
10.	Chen Guangxi	electrical engineer	"	December 10 1985	13
11.	Li Chenglin	extraction technician	May 25 1985	March 31 1986	10
12.	Jin Songqi	"	"		10
13.	Wu Honglin	"	"	"	10
14.	Shen Xincai	oil refining technician	"	"	10

Total 215 man/month

Annex 3.

Rules of Operation in Sections
Rice Bran Oil Extraction Plant

Contents

Rules of Operation for Pretreatment Section

1 Technological process

Rice bran → Cleaning → Cooking → Extraction section

↓

Coarse impurity

2 Technical indexes

2.1 Coarse impurity(diameter 5 mm. above) retained in the bran after cleaning is no more than 0.01%;

2.2 Addition of water during cooking depends on moisture content of raw material, in general, the material on upper layer should be moistened to 13 - 16% with a temperature of 100 - 105 ^{o}C and that on lower layer, moisture below 6 - 8% with a temperature of about 100 - 105 ^{o}C;

2.3 Steam pressure at the cooker jacket is 5.5 - 6.0 Kg/cm^2.

3 Operation methods

3.1 Preparatory work before start-up

3.1.1 First, fully understand the source and quality of raw materials such as oil content, impurities and moisture content, then, take suitable technical measures;

3.1.2 Check all the machines and equipment if they have any defective or damaged part. Repair or replace it immediately if found;

3.1.3 Check lubricant level of all conveying equipment. Lubricant or grease should be added to the part where is in need after running of machine;

3.1.4 Check all the conveyors, equipment or pipeline if there are any tools, machine parts or other objects left inside, clean all out if found;

3.1.5 Check all the valves on the equipment and pipeline of steam system whether they are in right position;

3.1.6 Check all switches, pressure gauges, safety valves as well as various meters on each equipment whether they are working properly;

3.1.7 Get available of spare parts or articles before-hand, which would be used during the operation;

3.1.8 Feeding and cleaning process;

3.1.8.1 Prior to feeding, place the grate in position on the dump-pit so as to avoid unnecessary accident;

3.1.8.2 Check the cleaner. The screen surface should be level without being blocked. The screen should be properly placed with no defective part;

3.1.8.3 Check the waste collector beneath the cleaner. Remove the waste out if full.

3.1.9 Cooking process

3.1.9.1 Check the aperture of steam ejection pipe on upper layer of stack cooker if jammed;

3.1.9.2 Check fitness of clearance between agitator blades and cooker bottom(usually about 5 mm.) and also check agility of the outlet;

3.1.9.3 Check accesibility of exhaust duct;

3.1.9.4 Before start-up open the bypass pipe of steam trap, remove the condensate from cooker bottom by using low steam pressure, then slowly increase indirect steam up to pressure 1 kg/cm^2, after preheating 20 - 30 minutes and further increase steam pressure to 5.5 kg/cm^2, then start the cooker.

3.2 Cautions for pre- and post-startup

3.2.1 Turn on the machines in a direction contrary to feeding procedure, i.e. turn on cooker 105 first, then Redler conveyor 104, holding bin 103, cleaner 102 and the motor of Redler conveyor 101. A short time no-load running should be given to each machine after it sets in motion,for the purpose of observing normality of each running component and correctness of running direction. Feeding may start after everything proves okay;

3.2.2 Feeding should be evenly distributed, approximately one and half a minutes for one bag of rice bran, so as to keep equal thickness of bran layer over the screen surface;

3.2.3 When the cleaner is operating, a regular inspection should be given to screen surface. Repair or replace it if broken, and clean it if blocked;

3.2.4 Remove excessive size of impurity immediately from screen surface if there is any;

3.2.5 The throughput of double screw conveyor from holding bin should be regulated dependent on thickness of the material in the 1st layer of the cooker;

3.2.6 After coming into the cooker, the material should be added with cold water dependent on its original moisture so as to adjust it to a suitable condition which can meet process requirement;

3.2.7 Open the exhaust pipes to a proper extent at 3rd, 4th and 5th layers of cooker so as to adjust temperature and moisture of the material inside;

3.2.8 Check cooking suitability of the material from time to time and keep close contact with extraction section so as to know whether the cooked material is acceptable to extraction process. Due measures should be taken if find material supplied too more or too less.

3.3 Cautions for emergency shutdown. Necessary measures for emergency shutdown should be taken when an unexpected accident happens within the section or outside the section;

3.3.1 Stop feeding and turn off all the machines(except cooker 105) in sequence beginning from feeding point;

3.3.2 Stop discharging of cooker, close steam valves and suspend water addition immediately;

3.3.3 In case the motor of cooker stops more than one hour due to unexpected accident, the operator on duty must check the colour of material in the cooker through manhole. If the colour of material becomes darker, the operator has to pull it out to avoid combustion caused by too high temperature.

3.4 Preparatory work before shutdown and cautions after shutdown

3.4.1 Before shutdown, inform each process to get ready for shutdown;

3.4.2 Sweep all materials dropped on the floor in the section;

3.4.3 Check emptiness of all machines in sequence of production process;

3.4.4 Stop the machines and equipment in the principle of "first empty, first stop".

3.4.5 Drain out the condensate from cooker 105 soon after shutdown;

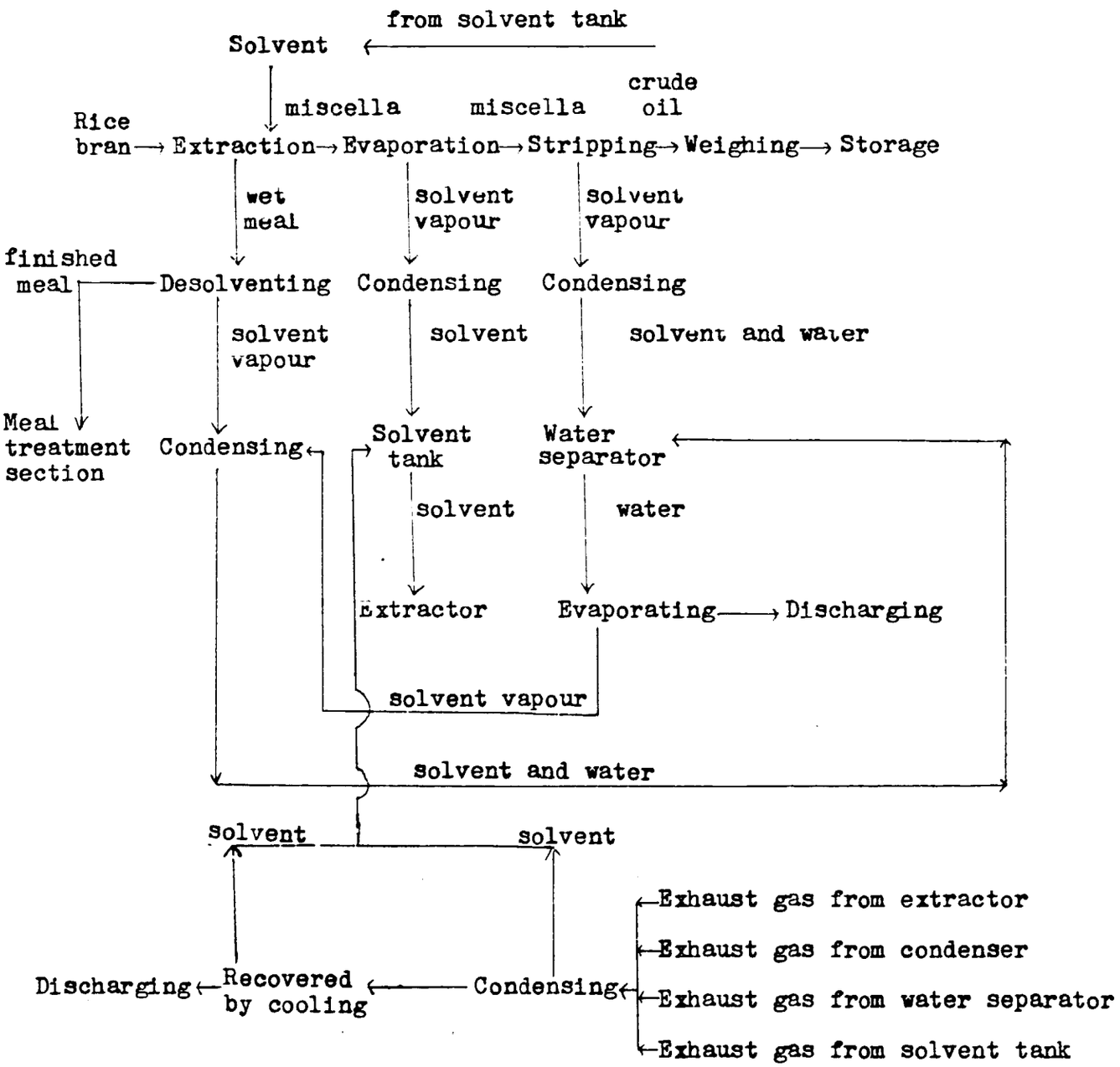
3.4.6 After shutdown give an overall inspection to all machines and equipment. Repair or replace the defective if found;

3.4.7 Put in order the tools and materials used in operation and place them at a fixed location;

3.4.8 Clean the operative machines and the area around.

Rules of Operation for Extraction Section

1. Production process(detailed in the flowsheet)



2 Requirements for production process

2.1 Extraction process

2.1.1 A certain amount of material should be kept inside the holding bin to act as material-sealing. The thickness is generally not less than 1.2 m;

2.1.2 The extractor rotates 120 minutes or 150 minutes per round which requires 1.0 - 1.4 m. height of material in the cells as standard for rotation speed regulation;

2.1.3 Solvent(hexane) temperature is 50 - 55 ^{o}C;

2.1.4 The concentration of miscella is controlled at the range of 13 - 18%;

2.1.5 The extractor is operated at a pressure of 10 - 30 mm/water column(minus);

2.2 Desolventizing process

2.2.1 The pressure of direct steam in the toaster is about 0.1 kg/cm^2 which controls 65 - 70 ^{o}C gaseous temperature in the top portion as standard for operation. The jacket is heated with a steam pressure of 4.0 - 5.0 kg/cm^2.

2.2.2 The thickness of material at 4th and 5th layers should be regulated between 200 - 250 mm. with a temperature about 85 ^{o}C at 5th layer;

2.2.3 After desolventizing the meal has a moisture below 12%, residual solvent below 0.07% and residual oil below 2%;

2.3 Miscella evaporation process

2.3.1 The brine is filled into the miscella tank with a concentration of 5%;

2.3.2 The heating steam pressure in the evaporator jacket is 0.5 - 1.0 kg/cm^2, outgoing liquid temperature is about 80 - 95 ^{o}C, and miscella concentration about 85%;

2.3.3 The steam superheater has a steam pressure of 10 kg/cm^2 between its tubes and about 0.6 - 0.7 kg/cm^2 inside the tubes;

2.3.4 In the tube-type stripper indirect steam pressure is 2 - 3 kg/cm^2, direct steam 0.15 - 0.20 kg/cm^2;

2.3.5 In the disc-type stripper indirect steam pressure is 2 - 3 kg/cm^2, direct steam about 0.15 - 0.20 kg/cm^2. The operating temperature is 115 - 120 ^oC. The extracted crude oil outgoing from the stripper has a solvent content of 0.1% with a temperature below 100 ^oC.

2.4 Solvent recovery process

2.4.1 The cooling water entering the condenser should have a temperature not more than 25 ^oC;

2.4.2 The cooling water in the final condenser 226 is controlled at about 150 kg/hr., the gaseous temperature coming out of final condenser is 30 - 35 ^oC;

2.4.3 The gaseous temperature at the outlet of exhaust gas condenser 227 is not more than 5 ^oC;

3 Operating ways

3.1 Preparatory work before startup

3.1.1 Before start-up check all running equipment whether there is any tools, machines parts or other objects left over inside;

3.1.2 Check lubricant level of all conveying equipment. Lubricant or grease should be added to the part where is required after running of machine;

3.1.3 Check all manhole, cover and sight glass on each equipment whether it is completely closed;

3.1.4 Carefully check all valves on pipeline and equipment whether they are properly open or closed, and at the same time check whether the blind plate put between flanges for maintenance has been removed or not;

3.1.5 Check soundness of various meters and instruments(pressure gauge, thermometer, safety valve, ect) installed at the different places;

3.1.6 Prepare brine which will put into miscella tank(method: add 5 kg. of salt in 95 kg. of water);

3.1.7 All running equipment, before going into formal feeding, should be trial-run for several minutes, make sure no abnormal running first, then go into formal operation;

3.1.8 Fill in cold water upto routine level and close all condensate valves on the condensers;

3.1.9 One day before startup check holes for ejecting direct steam in the toaster, if blocked, make them accessible.

3.2 Cautions for pre- and post-startup

3.2.1 Turn on tubewell pump and get water into water tank first, then introduce water into each condenser which is rendered in the state of operation;

3.2.2 Turn on cooling water for refrigerator, then start refrigerator, making exhaust gas condenser 227 under low temperature, next turn on steam ejecting pump 229 to create negative pressure after the extractor is feeding;

3.2.3 Fill cold water into waste-water evaporator 222 and open the steam to heat it to 80 - 90 ^{o}C;

3.2.4 Extraction process

3.2.4.1 Turn on solvent pump at the discharging shed to pump solvent into solvent circulating tank;

3.2.4.2 Inform the pretreatment section of sending raw material slowly forward, making holding bin material-sealed;

3.2.4.3 Start fresh solvent pump 232 to turn the leftover water in the circulating tank into water separator, then pump fresh solvent into the extractor and heat fresh solvent to a required temperature by solvent preheater steam;

3.2.4.4 Turn on No. 1 miscella circulating pump when the solvent enters No. 1 miscella cell;

3.2.4.5 Start the extractor, feeding screw conveyor, Redler conveyor 202, double-screw conveyor. The extractor starts feeding. Whenever the material is coming above each miscella hopper, turn on the miscella circulating pump relating to each miscella hopper;

3.2.4.6 When miscella reaches up to $\frac{2}{3}$ level in the filter, turn on miscella pump 230 to pump it into miscella buffer tank;

3.2.4.7 When the solvent-wet material rotates over to the dripping zone, ask the operator at the desolventizing process to get ready for startup; When the "wet" material is dropping down, ask the operator to start the equipment;

3.2.4.8 In normal operation a certain level of material should remain in the holding bin. When the material level changes , ask the pretreatment section to do some adjustment;

3.2.4.9 In routine operation, operators should take a serious attitude to control material level in the extractor, amount and temperature of fresh solvent as per Operation Rules. The amount of fresh solvent is adjusted depending on concentration of miscella at outlet;

3.2.4.10 The amount of miscella spraying into cells depends on that miscella should submerge the material not more than 50 mm. In routine operation, pay an attention to percolation of miscella through material layer and adjust spraying amount in time;

3.2.4.11 When the plant is running, check each equipment and machine frequently by looking and hearing. In case something abnormal occurs such as jamming of pipeline and bridging of outgoing meal, deal properly with it immediately.

3.2.5 Meal desolventing and drying process

3.2.5.1 When informed of getting ready for startup by extraction process, open the by-pass valve of steam trap for indirect steam heating on the desolventizer-toaster, turn in a small amount of steam to drive out leftover water inside, then close by-pass valve of steam trap. Pre-heat the machine with steam pressure of 0.5 kg/cm^2. When informed of formally starting , increase indirect steam for preheating to 5 kg/cm^2 gradually;

3.2.5.2 Open hot water circulation pump and meal dust catcher on the top of toaster as well as spraying nozzles in wet-dust catcher to circulate hot water;

3.2.5.3 Open direct steam at the third layer of desolventizer, remove the air existed at desolventizing and preheating layers;

3.2.5.4 Start the desolventizer-toaster, feeding screw conveyor, Redler conveyor 205 and double screw conveyor, then the toaster starts feeding;

3.2.5.5 When feeding material is about to reach the required level in the desolventizing layer, adjust direct steam pressure thereby, making gaseous temperature at the 1st layer about 65 - 70 ^{o}C, toasting for five minutes more, then open the rotary valve of desolventing layer from which the material can drop down to 4th, 5th drying layers. At the same time inform the meal treatment section of getting ready for starting. When the material at 5th layer reaches a required level, ask the meal treatment section to start machines and also start screw conveyor 209, 208, Redler conveyor 207. Open the outlet of the toaster to discharge the meal;

3.2.5.6 At the routine operation, pay a regular attention to keep the toaster a certain level of material inside, make a good adjustment to gaseous temperature and outlet temperature and alsc take care of hot water circulating and spraying as well as speed reducing box;

3.2.5.7 At the routine operation, pay a regualr attention to the exhausted air vented from air pipe, making all air pipes accessible on each layer in time if working improperly;

3.2.5.8 At the routine operation, take sample at least twice on each shift, conduct explosion-inducing test by laboratory. In the case of unsatisfactory test result, analyse the cause and take necessary measures immediately.

3.2.6 Evapration process

3.2.6.1 When miscella starts to flow into miscella buffer tank, the heating device in the evaporation system at the same time starts to drive leftover water out of jackets and to introduce steam for preheating purpose. The steam pressure for preheating is 0.5 - 1 kg/cm^{2};

3.2.6.2 When miscella in the tank reaches 70% of the volume, increase the steam in the jackets of heating device to a required pressure. Open direct steam both in the tube-and disc-type strippers, then miscella starts to come into the evaporator. At the beginning miscella should flow into it at a small rate, increase step by step in order to prevent against more solvent retained in crude oil because of insufficient temperature at the initial stage of evaporation;

3.2.6.3 When crude oil in the bottom part of disc-type stripper reaches to 50% of the volumn, open cooling water. When the oil level is higher than overflow hole, discharge crude oil to weighing vessel and after weighing send crude oil to outdoor storage tanks by crude oil pump 233;

3.2.6.4 At the routine operation the operators should take a serious attitude to meet the technical requirement of this process, control precisely the miscella level, incoming or outgoing flowrate, temperature, concentration and steam pressure, and ensure the extracted crude oil to a required quality standard;

3.2.6.5 Discharge oil foot in the miscella buffer tank once everyday and replenish the brine to the required level. The discharged oilfoot and brine flow together into the brine evaporator, open a small amount of direct steam for evaporation purpose. Close direct steam when no solvent smell is sensed from the vapour evaporated, then drain waste liquid to sewer;

3.2.6.6 At the routine operation, pay a regular attention to separator 216 and separating chamber at upper part of disc-type stripper whether there is any oil foam entrained out. If so, reduce oil intake flow immediately and also reduce indirect steam properly. After oil foams disappear, increase oil oil intake flow and indirect steam gradually. It is imperative to root out cause of oil foams occured;

3.2.6.7 At the routine operation, if the evaporator and tube-type stripper are found running inefficiently. Shutdown the machines for washing or cleaning, then resume operation. The evaporator and tube-type stripper should usually be cleaned once over a period of 2 - 3 month running.

3.2.7 Solvent recovery process
As mentioned previously, all the condensers, before setting for solvent recirculation, should get cold water in and enter the state of working;

3.2.7.1 After all machines are running, spray a certain amount of cold water into the final condenser for cooling purpose, but attention should be paid to cold water whether the amount sprayed is upto the requirement;

3.2.7.2 Pay a regular attention to working condition of steam ejector 229. In case no negative pressure is found at the exhaust gas system, check ejector nozzles immediately if blocked;

3.2.7.3 Often check solvent layer in the water separator whether there is any micella existing thereby. If any, check the evaporator and stripper immediately if there is any phenomenon of "flood" inside;

3.2.7.4 Observe the bottom part of solvent buffer tank at a fixed time whether there is any water staying there. Draw the water into water separator at once if any;

3.2.7.5 Pay a regular attention to working condition of exhaust gas condenser. In the case the temperature at outlet rises, check the working condition of refrigerating machine;

3.2.7.6 After four-six months of operation the condensers should shutdown for cleaning.

3.2.8 At the routine operation, all the processes should take a record every hour on pressure, temperature, flowrate, ect. If any accident occurs, take down a detailed note on accident, time, place, cause and measures taken, ect;

3.3 Shutdown and emergency shutdown

3.3.1 Normal shutdown

3.3.1.1 Inform the pretreatment section to stop feeding. After all remaining material empty, stop the feeding conveyors before the extractor one by one;

3.3.1.2 In the extractor when empty cells pass each miscella spraying nozzle, close the nozzle accordingly and meanwhile open the by-pass valve at the bottom of extractor to drain miscella remainder into the filter. The rest should do same as

mentioned above, so on and so forth. After material-filled cells pass fresh solvent spraying nozzle, close the solvent pump to stop supply of fresh solvent. Close the hot water valve of solvent preheater;

3.3.1.3 After the extractor is completely empty, stop the extractor, double screw conveyor and Redler conveyor 205 and feeding and feeding screw conveyor of toaster as well;

3.3.1.4 After the meal in the preheating layer of the toaster leaves completely empty, close indirect steam in the preheating layer. After emptying of meal in middle toasting layer, close all heating steam in the toaster and also stop hot water circulating pump. After all meal in the toaster leaves completely, stop the toaster, Redler conveyor 207 and other conveying equipment, then open by-pass valve of steam trap to drain residual vapour and water therein;

3.3.1.5 After the miscella is evaporated and stripped, close in sequence the oil inlets of the evaporator, tube-type stripper and disc-type stripper respectively. Close all heating steam, then open the by-pass valve of each steam trap, discharging left-over water and vapour;

3.3.1.6 The intake of water into the condensers can only be stopped 30 minutes after the solvent is completely removed out of the systems for miscella evaporation and meal toasting during which the water flow may be reduced;

3.3.1.7 If the plate would be shutdown for a long time, open water inlet valve of steam trap and introduce cold water slowly to press the solvent into solvent buffer tank. But be careful not to let water into it, then discharge all solvent to underground tanks;

3.3.1.8 Finally stop steam ejector and refrigerating machine 228;

3.3.1.9 If shutdown for more than one month the material, oil water remained in the pipeline of all equipment in the extraction section should be completely discharged. Evaporate all solvent residual and pump all solvent into the underground storage tanks;

3.3.1.10 After shutdown, take an overall inspection to all equipment. In the case of any parts damaged or malfunctioned, inform the mechanic of repairing or replacing;

3.3.1.11 Identify and put in order all the materials and tools to a fixed place for next-time use;

3.3.1.12 Clean the areas around the equipmet;

3.3.1.13 Upon all jobs done for shutdown, the section officer in charge should organize some people to give an overall inspection to all machines and equipment whether they are in safe condition or not, especially the toaster. Is there any material left inside the toaster? Main steam control closed or not? Electric source disconnected or not? After all requirements are satisfied, the section officer in charge will have to sign on the inspection notes.

3.3.2 Emergency shutdown and re-start after emergency shutdown. The extraction section should take some effective measures to shutdown the machines in time of emergency, for instance, a sudden interruption of power and water or serious accident in other sections;

3.3.2.1 Immediately open the water tank valve to let the water into the condensing system;

3.3.2.2 Immediately close the main valve of steam in the section and release steam out of toaster jackets. If shutdown for more than one hour, check the colour of material in the toaster every other 10 minutes. If colour becomes coffee-like, the material should be pulled out. During the pulling process security should be tightened and nobody is allowed to drop something. The whole process should be directed by the person who is in charge on duty;

3.3.2.3 Close oil inlet valves of evaporator, tube-type stripper and disc-type stripper, also stop direct or indirect steam heating;

3.3.2.4 Discharge miscella from the extractor hopper to the miscella filter until it is filled full;

3.3.2.5 The operators can not leave the workpost during emergency shutdown;

3.3.2.6 For re-starting, open tubewell pump to send water both to water tank and condensing system;

3.3.2.7 Start the refrigerating machine. When the temperature in the exhaust gas condenser reaches 0 ^{o}C, open steam ejector to draw off the air, making the system in a state of negative pressure;

3.3.2.8 Ask the meal treatment section to start the machines. Start the toaster, first, direct and indirect steam, then motor of the toaster;

3.3.2.9 Send the miscella from the filter to buffer tank, then open the evaporating and stripping system to remove solvent;

3.3.2.10 Get fresh solvent into the extractor after miscella is discharged empty in the miscella hopper, then start miscella circulating pump one by one. Inform the pretreatment section to deliver the material, and feed the extractor;

3.3.2.11 Make adjustment to flowrate, temperature, pressure, ect. when the machines are running, and keep the whole plant working at optimal state.

Rules of Operation for Meal Treatment Section

1 Technological process

Bran meal --> cooling --> weighing --> bagging

2 Technical indexes

Bran meal is cooled down to 55 °C below by the meal cooler.

3 Operation method

3.1 Preparatory work before startup

3.1.1 Check all the machines and equipment if there is any defective or damaged part. Repair or replace it immediately if found;

3.1.2 Check lubricant level of all driving devices. Lubricant or grease should be added to the part where is required after running of machine;

3.1.3 Check all the conveyors, equipment or pipeline if there are any residual material, tools,machine parts or other objects left inside. Clean all out if found;

3.1.4 Get available of spare parts or articles before-hand which would be used during the operation such as jute bag, linen thread, ect;

3.1.5 Check the accuracy of platform scale in advance.

3.2 Cautions for pre- and post-startup

3.2.1 When the extraction section is working, turn on all machines in this section to check normality of each running part and correctness of running direction. Stop the machine if everything proves okey, waiting for further notice of startup coming from the extraction section;

3.2.2 When the notice of startup comes from the extraction section, turn on the machines in a direction contrary to feed procedure;

3.2.3 The platform scale should be operated as accurate as possible which would be calibrated twice on each shift. Weighing tolarance should not exceed ± 0.25 kg. per bag;

3.2.4 After bags are closed by sewing machine, sent them to open space by barrow cart and place them in order. No jumbling is allowed;

3.2.5 If the holding hopper is found empty, get in touch with the extraction section immediately;

3.2.6 The helper for bagging should take a sample from meal every half an hour;

3.3 Preparatory work before shutdown and cautions after shutdown

3.3.1 Before shutdown, inform every operator of being prepared for shutdown;

3.3.2 Sweep left-over meal or dust on the floor;

3.3.3 Check emptiness of all machines and equipment in sequence of production process;

3.3.4 Stop the machines and equipment in the principle of "first empty, first stop";

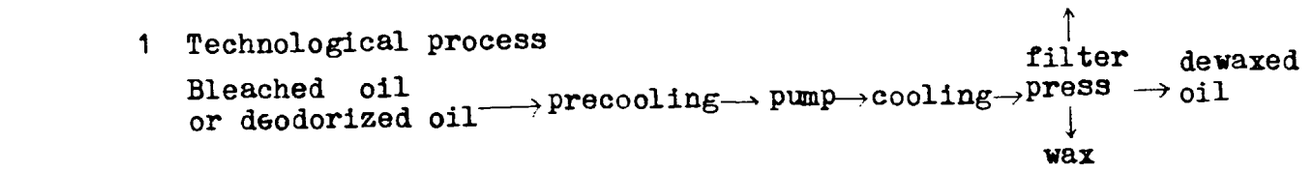
3.3.5 After shutdown give an overall inspection to all machines and equipment. Repair or replace the defective if found;

3.3.6 Put in order the tools and materials used in operation and place them at a fixed location;

3.3.7 Clean the operative machines and the area around them.

Rules of Operation for Dewaxing Section

1 Technological process



2 Technical data

2.1 The oil temperature should be cooled down to 40% ^{o}C below during the precooling;

2.2 The oil is further cooled for 72 hours in the cooling trough;

2.3 The temperature of cooling room is set at about 20 ^{o}C;

2.4 Dewaxed oil is heated to 80 ^{o}C, then kept in a static statement under the temperature 25 ^{o}C for 24 hours, remaining clear and transparent;

2.5 The refrigerating machine is operated at about 8 - 10 kg/cm^{2} at high side and 1 kg/cm^{2} at low side;

3 Operation method

3.1 Preparatory work prior to startup

3.1.1 Check lubricant level inside the refrigerating machine and air compressor whether it is up to the requirement;

3.1.2 Check each valve in the pipeline or equipment whether it is in right position, open or close;

3.1.3 Check the pressure gauge, thermometer and safety valve at all points whether they are good or defective;

3.1.4 Check the filter cloth in the press filter whether it is suitably fit and tightened;

3.2 Cautions on startup and post-startup

3.2.1 Open the cooling water and oil intake valve of precooling tanks, then ask the refining section to send oil onward;

3.2.2 After the oil coming into the precooling tank, turn on refrigerating machine, cooling water and blower to reduce the temperature gradually to 20 ^{o}C in the cooling room, at the same time, start the air compressor to stir the oil in the precooling tank for 2 minutes, from that time on,

stir it once every other 20 minutes, but, be careful not to blow too much compressed air during the stirring operation;

3.2.3 Start the oil intake pump when the oil in the precooling tank reaches 40 ^{o}C and send oil to the cooling trough for a period of 72 hours cooling, then discharge the oil into the supply tanks;

3.2.4 Start the air compressor and open the inlet valve of compressed air in the supply tank, the oil is pressed into the filterpress by the pressure produced in the supply tank.

3.2.5 The oil filtered at start should be sent to the turbid oil tank, and after it becomes clear, send it to the clean oil tank;

3.2.6 When the filtration is proceeding very slowly and the reading on pressure gauge indicates about 4 kg/cm^2, the filtration has to stop. Open the compressed air valve to blow away filter residue and remove the oil from it, then loosen the filter plates to shovel the wax retained inside;

3.2.7 Before sending dewaxed oil to refining section, ask them to get ready. Care must be taken to give a regular inspection to the oil level in the clean oil tank. If oil full, start the pump to send it to refining section for deodorization;

3.2.8 During the operation, give a regular notice to running condition of refrigerating machine and check the high and low pressure sides, oil pressure and also the cooling room whether they are normal or not;

3.2.9 The cooling room should remain clean and neat, close the door whenever you come or go out;

3.3 Shutdown and emergency shutdown

3.3.1 Before the machines are scheduled to stop, the remaining oil should go through same processes as usual, i.e. cooling for 72 hours in the cooling trough, then filter out and remove wax residue from the press cloth;

3.3.2 Close the liquid outlet valve of refrigerating machine and air compressor, stop cooling water of refrigerating machine;

3.3.3 Clean the rooms;

3.3.4 When the power suddenly cuts off, the cooling water of precooling tank and refrigerating machine must be closed, to save water for use of extraction section, and also close high and low pressure valves of refrigerating machine;

3.3.5 When the power resumes, first open the high and low pressure valves of refrigerating machine and get water supply available, then start the refrigerating machine.

Oil Measurement Table for Dewaxing Section

1. Precooling tank(at the temperature 40 °C)

   Vertical body: 411 kg. per 10 cm.

   Conical body: 412 kg.

   12 kg. should be deducted from each round of coil, i.e, 19 rounds of coils, totally 228 kg, should be deducted.

2. Cooling trough(at the temperature 20 °C)

   290.7 kg per 10 cm.

3. Dewaxed oil vessel(at the temperature 20°C)

   87.2 kg per 10 cm.

4. Turbid oil vessel

   58.9 kg. per 10 cm.

Regulations on Fire Prevention for Safe Operation of Rice Bran Oil Extraction Plant

1 Production Management

1.1 It is strictly prohibited to bring matches, lighter, non-explosion-proof electric torch and other easily inflammable explosive objects into the extraction section, solvent discharging shed and meal treatment section where nobody is allowed to wear pure synthetic fabric knitwears such as polyvinyl choloride fibre, acrylic fibre, nylon and also the shoes with iron nails on. It is prohibitive to use any kind of photoflash within the anti-explosion zone;

1.2 It is strictly prohibited to do jobs such as welding, forging, pressing or grinding around the area within 10 m.(boundary wall) to 30 m.(fence) of extraction section, solvent discharging shed, underground solvent tanks and meal treatment section. Ignition can be done only after completely removing all solvent vapours out of equipment and pipelines at the time of maintenance. No truck, tractor, battery car, animal-pulled cart or iron wheels are allowed to pass over;

1.3 Without permission, no admittance into the extraction section, solvent discharging shed, meal treatment section, even if the visitors get permmision, they can enter those places accompanied by responsible staff of the plant;

1.4 It is strictly prohibited to hang out washed clothes for drying and to bake the food inside the extraction section, solvent discharging shed and meal treatment section;

1.5 Don't keep the solvent in the open containers and don't use the solvent to wash anything or bring it out of the section;

1.6 It is a must to check grounded devices for lightning conductor, anti-static and electric apparatus once a year, whose resistance should be upto to the requirement;

1.7 The meters and instruments for measurement or control purpose in the extraction section such as pressure gauge, flowmeter, thermometer, vacuum-meter and safety valves should be checked up or calibrated once a year;

1.8 The newly-recruited worker, trainee, temporary labourer who has not gone through professional training are not allowed to individually operate the machines;

1.9 During the period of shutdown, there should be somebody on duty for 24 hours watching the extraction section and prohibited zone.

2 Safety operation

2.1 During the production in the explosion-proof sections it is strictly prohibited to open any anti-explosion equipment or replace light tube, bulb or fuse, ect. before cutting off the electric source;

2.2 Frequently check the sealing properties of pumps, pipelines, pipe fittings and valves, work out an immediate solution to any spill, drip, leakage or emission if found. When solvent loss is abnormal, shutdown the machines to trace the cause. The machines may start again after proper remedy is given;

2.3 Make a regular inspection to water which is drained from water-sealed pond. Check the cause immediately if the solvent is found entrained with water, and remedy it;

2.4 All equipment, pipe fittings and valves working for solvent-miscella system can't be opened or taken sample at will. The sample, if required, may be taken only from special opening or valve;

2.5 Stuffings for sealing up solvent or miscella pumps should not be fit neither too tight nor too loose so as to avoid ignition by friction and solvent leakage;

2.6 Special operator should be assigned to take care of all electric equipment in the extraction section, solvent discharging shed and meal treatment section. They should regularly inspect the sealing and grounding conditions of electric equipment;

2.7 Shutdown the machines in case of following accidents occured in the extraction section:

a. Water supply breaks off or insufficient;

b. Steam pressure lower than 4 kg/cm^2, moreover, for the time being, unable to restore to normal pressure;

c. A great deal of solvent or miscella escapes or the concentration of solvent vapour appears too high;

d. Electric equipment produces sparks;

e. Machine parts rub with each other producing a temperature more than 85 ^{o}C, or sparks;

f. Sparks or ignition partially produced inside the equipment or partial explosion of solvent vapour happens.

2.8 A special grounding device should be provided at the solvent discharging place. The copper wire should be wrapped outside or placed inside the solvent hose to conduct the static current. The sectional area of copper wire should not be smaller than 2.5 mm.(It should be $\geqslant$ ϕ 1.8 mm. if round-shaped wire available.)

2.9 Before entering the solvent discharging operation zone, the truck carrying the solvent should block up its exhaust pipe with fireproof cover. Close the motor immediately after truck stops and remain it closed until discharging work complete;

2.10 It is strictly prohibited to store the solvent in the open air.

Rules of Operation for Electrician

1. The power transforming, distributing and control room should remain neat and clean. No materials are allowed to stack around the panel boards(including top portion) and louver windows so as to keep operating space accesible and good in ventilation. Care must be taken to stop rat, bird and insect into the room.

2. Regular inspection and maintenance should be given to all electric devices to keep them in a good working condition. If any part or element goes out of order or defective, repair or replace it in time.

3. Put repair tools, meters and spare parts in order at a fixed place where the electrician can get it easily without delay in time of need.

4. The electrician on duty should operate and inspect the electric system with a concentrated energy, pay a regular attention to running of equipment and variation of power load, assuring safety operation. If anything abnormal happens, take a proper measure to overcome the problem immediately. The log-sheet should be noted down daily with accurate readings.

5. The methods and steps to operate the switches should be precise, especially when sending power to the sections, make sure of everything before physically switch on. When the circuit is on load, it could be disconnected with the circuit breaker. The knife-type switch is only used to cut off no-load current.

6. If the circuit system is out of order, the breakers automatically disconnect or the fuses blow out, don't switch on again in a hurry without enquiring information. First, find out the cause and eliminate it, then switch on.

7. The fuse wire should be chosen in accordance with specified rated current. It is not allowed to fit too big fuse wire.

8. Rectifying value of thermal relay should be regulated in accordance with the rated current of pretected motor. It should not be more than rated current of the motor. When the machine is stopped by action of thermal relay, clear the breakdown first, then start the machine again.

9. Replace the defective bulb with required watt. Don't replace it with bigger watt so as to avoid too heavy load on the circuit.

10. If one unit of drawer-type panel board is out of order and could not be remedied at once, replace it with spare one to resume operation. But the external trouble should be eliminated before replacement. Care should be given to replace the unit with correct number. No mis-replacement is allowd.

11. The capacitor should have certain load in the power distribution system and could be put in operation when the power factor is low. Similarly, it should be cut off immediately when the load drops too low or power factor is too high, so as to avoid over-compensation running.

12. The electric source should be cut off and put up warning sign when repair or maintenance work is on all the electric devices. In particular, at the explosion-proof location nobody is allowed to repair or inspect the electric trouble without disconnecting the power(including replacing bulb). The power could be switched on after switch cover is fixed with screws, held tight.

13. Give a regular inspection and maintenance to anti-explosion electric devices, in particular, following points should be cared:

(a) No injure to anti-explosion joined parts which may be covered with grease to pretect it from rust, but the paint is not allowed;

(b) No injure to insulating sheath of power cable, the sealing devices for inlet connection should be held tight, no looseness is allowed;

(c) External cover should have a reliable grounding;

(d) All screws should be held tight.

14. The anti-explosion electric equipment should be installed and operated in the explosion-proof production section. The electric equipment could be replaced or added only after the officer in charge approves and gives a check on whether it is in keeping with anti-explosion standard. In the routine operation it is absolutely prohibited to use non-explosion-proof tools such as welding machine and electric drill. If the electric tools, welding machine or drill have to be used in a short time for maintenance purpose, it could do so only after proper precautions have been taken and the officer in charge has given approval.

Laboratory Tests

It is essential to have a normal laboratory work in the rice bran oil extraction plant.

It is particularly important to test oil, moisture and impurity contents of rice bran, to detect residual oil and moisture contents of bran meal and concentration of miscella, and to check dewaxing result of bran oil by cooling, which can provide the base for economical calculation, giving an effective supervision over the production of rice bran oil plant and monitoring product quality.

A. Test on Impurities

This method is applied to sort out solid impurities such as sand, mud, ect. from a sample of rice bran.

1. Apparatus

   a. Balance b. Mixer c. Sift d. sample bottle which can be sealed to keep the sample after impurity test for further testing of moisture and oil content.

2. Method

   a. Take precisely about 1,000 g. of sample, sift away fine impurities which can go through the meshes, then put the sample on the clean plate or white paper, sort out sand, mud or other foreign matters with a tween, weigh the pure bran;

   b. Take two parts of pure bran sample(each about 100 g.) by dividing it into four equal parts in the mixer, one sample for further testing of moisture and oil content, the other for reserve;

   c. Calculation:

   Impurity content% = Sample weight - Pure bran weight x 100/sample weight

B. Test on Moisture and Volatile Matter

1. Apparatus

   a. balance b. oven c. desiccator d. aluminium box with cover

2. Test method

   a. Take and weigh 10 g. of bran quickly and precisely from the

prepared sample to the dry and weighed aluminium box;

b. Open the box and put it into 150 ^{o}C ± 1 ^{o}C oven, drying for 3 hours;

c. Take out the box and put it in the desiccator and weigh after cooling, then put it again in the 105 ^{o}C oven for half an hour and take it out again to weigh it after cooling in the desiccator. Repeat this process until constant weight achieves;

3. Calculation

Moisture/Volatile matter% = lost weight x 100/sample weight

4. Notes

It is required to test two samples simultaneously from which the error should not exceed 0.3 - 0.5%.

C. Test on Oil Content

The outcome of the test is indicated for dissolved matter of petroleum.

1. Apparatus

a. fat extractor b. oven c. filtration paper

d. absorbent cotton e. balance f. desiccator

2. Solvent

Petroleum ether 30 ^{o}C- 60 ^{o}C grade AR

3. Test method

a. Weigh precisely approximately 5 g. of bran in the aluminium box, put it with the cover open into the oven(temperature 105^{o}C) for 2 hours, then move it into the desiccator, cooling for further use;

b. Put the cool and dry sample into the filtration paper tube carefully. It is strictly prohibited to scatter the sample material;

c. Obtain accurate weight of clean and dry extraction bottle. Put the filtration paper tube with sample inside into the extractor, then add about 50 ml petroleum ether, finally fit the condenser with extraction bottle properly;

d. Place it on the table pot and extract by heating(rice bran should be extracted for 6 - 8 hours, and bran meal for 2 - 4 hours), monitor the dropping rate of solvent from the condenser;

e. After the extraction process is over, cooling for sometime,

then take out the extracted sample and recover the solvent;

f. After most of solvent is recovered, take down the extraction bottle, evaporate the solvent by putting it on the table pot and disperse solvent vapour inside the bottle from time to time with hollow rubber ball;

g. Put the extraction bottle into 105 ^{o}C oven for 2 hours, then place it in the desiccator for weighing.

4. Calculation

Oil content of original sample = oil weight x 100/sample weight

Oil content of dry matter = oil content of original sample / (100 - sample moisture)

5. Notes

It is required to test two samples from which the error should not exceed 0.3%.

D. Oil Cooling Test

This method is applied mainly for checking the oil, under the temperature of 25 ^{o}C, if there is any crystal separated out or phenomenon of non-transparency.

1. Apparatus

a. beaker 50 ml. b. electrothermal oven

2. Test method

a. Put the oil(about 30 ml.) into the beaker(50 ml) and place it static in the oven with a temperature of 25 $\pm$ 1 ^{o}C for 24 hours;

b. Take out the sample and observe it at a bright place if there is any phenomenon of crystallization or turbidness;

c. If any turbidness appears, repeat above test after the sample is dehydrated.

E. Test on Solvent Distillation Range

1. Apparatus
   a. two-mouth beaker b. thermometer c. condenser
2. Test method
   Put the sample in the two-mouth beaker which is placed in the table pot for distillation. Observe carefully the temperature at the times of initial, peak and final distillation.

F. Test on Miscella Concentration

1. Apparatus
   a. balance b. oven c. table pot d. desiccator
   e. aluminium box with cover
2. Test method
   a. Take and weigh approximately 10 g. miscella precisely and quickly in the dry and weighed aluminium box;
   b. Open the box and evaporate most of solvent by placing it above the table pot, then move it into the oven($105 \pm 1\ ^{o}C$), drying for two hours;
   c. Take out the sample and put in the desiccator for cooling, finally weigh it.
3. Calculation
   Miscella concentration = oil weight x 100/sample weight

Specifications of Oil Tanks

1. Dimensions

Diameter: Outside 4,000 mm. inside 3,988 mm.

Height of conical bottom: 1,151 mm.

Height of cylindrical body: 4,460 mm.

2. Volume

Conical bottom: 4.728 m^3 1,040 imperial gallon

Cylindrical body:

1 cm equal to 0.125 m^3 27.5 imperial gallon

10 cm equal to 1.249 m^3 275 imperial gallon

3. Conversion Table

Calibration (cm)	Volume (m^3)	Capacity (imperial gallon)
001	4.852	1,068
010	5.977	1,315
100	17.218	3,788
200	29,708	6,536
300	42.198	9,284
400	54.688	12,031
430	58.435	12,856
440	59.684	13,130

Annex 4

PROTOCOL ON HANDING-OVER OF OPERATION
MANAGEMENT OF RICE BRAN OIL EXTRACTION PLANT IN BANGLADESH

1. The Rice Bran Oil Extraction Plant has already been established. The trial-runs and performance tests of the plant have also been completed indicating that the machinery and equipment achieved the requirement of efficient plant operation.

2. The spare parts received from the supplier, list of which is enclosed herewith.

3. DVOIL management is now capable to run the plant with their own operators/technicians for which they were given on-the-job training.

4. All the above-mentioned points are certified by two sides with signature that the operation management of Rice Bran Oil Extraction Plant is handed over to DVOIL with effect from April 1, 1986.

Dhaka Vegetable Oil Industries Ltd(DVOIL)

General Manager

M. H. Khan

Dated : 5th April, 1986

Chinese Expert Team

Team Leader

Zhu Zhonglin

Dated : 5th April, 1986.