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Postharvest Institute for Perishables

ASSESSMENT OF COFFEE PROCESSING EQUIPMENT REQUIRMENTS FOR HAITI'S CENTRAL COFFEE PROCESSING FACILITY

Report Prepared for

USAID/Port-au-Prince

by

Garold M. La Rue

for the
Postharvest Institute for Perishables

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I. EXECUTIVE SUMMARY

Through AID/M/SER/COM the Postharvest Institute for Perishables was requested to provide technical assistance to USAID/Port-au-Prince (Haiti). The services of a consultant with expertise in coffee processing equipment was required for evaluating two bids for the installation of some proposed equipment for a permanent Coffee Processing Facility.

Mr. Garold La Rue went to Port-au-Prince in response to the Mission request. He spent the period of May 15 to 18, inclusive, in Haiti in the evaluation process, and prepared the attached report.

The coffee processing requirements were assessed in relation to the type of coffee to be received from the farms and the quality that was to be produced.

Bids had been submitted by Jahn and Sons, Inc., of New York, and by Bentall Simplex of England. It was concluded that all of the processing equipment with the exception of the drying units should be obtained from John and Sons, and that the driers should be obtained from Bentall Simplex.

It was also recommended that the flow design presented by Jahn and Sons be restructured in order to meet the current and anticipated future needs. Suggestions were made for the design of parallel processing lines.

II. INTRODUCTION

The objective of this visit was to assess the coffee processing equipment requirements of the proposed permanent Coffee Processing Facility (CEPEC), to analyze the proposals submitted to AID/Haiti to supply the equipment, and to recommend which equipment should be installed in the CEPEC center.

III. ASSESSMENT OF COFFEE PROCESSING EQUIPMENT REQUIREMENTS

The coffee processing equipment requirements for the future CEPEC facility were assessed by obtaining information through a series of visits to existing facilities and discussions with appropriate persons as listed below:

1. Visits to the existing CEPEC facility
2. A visit to the Cupping Room (Sensory Evaluation Facility)
3. A visit to the OPRODEX Office
4. Review of literature (including Cleve's reports)
5. Meetings with the following people:
   a) Mr. Yves Saintil, Director of OPRODEX
   b) Mr. Pierre Jean, Manager of CEPEC
   c) Mr. Dauphé, CEPEC Accountant
   d) Agronome Dadaille, Cooperative Extension Agent
   e) Mr. Henry Dufort, BENTALL SIMPLEX representative
   f) Mr. Frank Boncy, Henry Jahn & Sons Inc. representative
   g) Mr. Frank Hadley, Henry Jahn & Sons Inc. representative
   h) Ms. Wendy King, USAID/Haiti Project Coordinator

Observations of CEPEC Installations

CEPEC Installation and the Cupping Room provided the most extensive illustration of the traditional method of processing used in Haiti. The physical characteristics of the Haitian coffee and the physical steps of processing the coffee were reviewed at these installations. Without question, CEPEC urgently needs improvements in the mechanical installations and product flow system. As stated by Cleves and observed in this visit to CEPEC, the following facts of Haitian coffee production must be considered as the basis for designing the coffee processing plant:

1) CEPEC receives 90% of its coffee in the dry hulled state (café pilé)

2) CEPEC receives 10% of its coffee in the washed parchment state (café lavé)

Therefore the proposed system has to be flexible in order to process the coffee as it is currently received and also to plan adequately for the future coffee production which will:

1) Eventually receive a greater percentage as unhulled dry cherry coffee (coque).
2) Eventually receive the majority of the coffee in the washed parchment state.
   a. Washed wet parchment 50% relative moisture
   b. Partially dried parchment.
   c. Dried parchment 12.5% relative moisture

As extensively explained by Ing. Rodrigo Cleves in "El beneficiado del café en Haiti y el proyecto de creación del centro nacional de preparación de café", the future of the Haitian small farmer cooperatives is in advancing the necessary technology in order to control the washed coffee fermentation process, thus increasing the quality and quantity of the final processed product. It is suggested that towards this goal of increasing the quality and quantity of exportable coffee, the cooperatives can immediately adopt the system of buying unhulled, dry, clean, cherry coffee from the producers, transporting it to CEPEC and storing it in that form. Replacing the "pilé" process at the village level with appropriate mechanical hulling at the central processing will significantly decrease the percentage of broken beans, (currently approximately 40%; see U.S. Department of Agriculture Foreign Agriculture Circular, Jan. 83, p. 21) thereby increasing quantity of exportable coffee. The quality of the coffee will also improve because the hull protects the bean and prevents deterioration due to water absorption: "bleaching effect." The increased cost of transporting the slightly bulkier unhulled, dry cherry coffee versus the hulled "café pilé" is negligible in light of the significant increase in exportable quality and quantity of coffee. The success of this proposed system is illustrated in the Brasilian coffee market where Brasilian small-medium farmers market more than 95% of their coffee in the dry cherry state.

The machinery in the existing CEPEC facility has the capability to process unhulled, dry, cherry coffee as recommended above. The equipment recommended

for the proposed facility will also be capable of processing unhulled, dry, cherry coffee as it will account for approximately 90% of the coffee received.

The proposed facility must be designed to have also the capacity to process increasing amounts of washed coffee since the cooperatives' future in coffee is in washed coffee.

IV. EVALUATION OF THE BIDS

Bids to supply the necessary line of coffee processing equipment for the proposed "CEPEC" Center have been submitted by:

1. Jahn and Sons, Inc.
   140 Cedar Street New York, NY 10006
   Proposition No. 2083

2. BENTALL SIMPLEX (E.H. Bentall & Co. Ltd.)
   Naldon Essex CM9 7NW England
   Proposition No. 9171

NOTE ON PLANT CAPACITY:

Generally the capacity of a green processing installation is based on the hulling equipment size. The capacity of the proposed facility is 30,000 sacs/8 hr/150 days (1 sac equals 60 kg exportable green coffee). The bids will be evaluated in two stages, are mechanically independent and can be made completely compatible.

1. Dehydration Equipment

For the dehydration equipment the two existing bids were evaluated on the premise that at the present time, CEPEC receives 10% of its coffee with a relative moisture content of about 20%, and 90% of its coffee as "café pilé" with a relative moisture content already at 13%. In the future, CEPEC should be processing and marketing increasing amounts of washed coffee which will be delivered to CEPEC at approximately 20% moisture content. CEPEC's dehydration requirements are to achieve the premium moisture content of 12.5% for processing (hulling). For homogeneous moisture content, mechanical dehydration is more efficient for this moisture content reduction (20 - 12.5%) than by solar dehydration.

It is the consultant's opinion that the BENTALL SIMPLEX equipment or Guardiola type dryers are the best suited for CEPEC's purposes. The reason being that the Guardiola type dryer was developed specifically for partially dried washed coffee; reducing the moisture content from 20 - 12.5%. The Guardiola type dryer is designed to reduce the moisture content of the coffee slowly, thereby allowing the necessary time for the coffee to dry homogeneously and to produce a higher quality coffee.

In comparison the Jason "Tower Drying" system as proposed by Jahn and Sons, Inc. is used as a pre-dryer unit to reduce relative humidity from 50% to 20%. It is designed with fast drying features which are suitable for grains (i.e. rice, corn, etc.) but is not recommended for production of high quality coffee. The fast drying results in irreparable damage to coffee called "Springer Effect". The Springer Effect is very costly in flavor quality (resulting in cardboard flavor). The Jason "tower drying" system is not recommended for the dehydration equipment in the CEPEC facility because it does not meet Haiti's coffee dehydration requirements and it may result in Springer Effect coffee.

The BENTALL Guardiola type dryers have another very important advantageous feature in that the furnace can be modified to utilize coffee hulls instead of petroleum fuel. This provision can prove to be very economical for Haiti since all its petroleum products are imported. It would be appropriate to ask BENTALL to give greater detailed explanations of the alternate hull-burning systems. As mentioned before, CEPEC's new installations will be a one-level system. A new blueprint should be requested from BENTALL for the dehydration unit which eliminates all pits.

Observation:

a. Consideration for the 11.58 mt elevator by raising the entire dehydration layout by about 2.85 mt, the elevator could cause possible complications.
    1) An alternative would be to install a stationary pneumatic system thus unchanging the holding hopper layout.
    2) Having the elevator go through the ceiling if necessary and change the layout of the holding hopper.

b. Consideration for the support walls for the dryers. If a self empty system is not installed, the support walls for the dryer will increase by about 2.1 mt. Cost considerations should be made in order to eliminate temporarily the exit screw conveyor and have the dried product fall into a non-self unloading bin. Hand labor could be used to gather the dried coffee at this point for sake of time requirements.

c. The hull burning system in the long run can prove to be an excellent investment in terms of energy conservation and waste disposal. Costa Rican Coffee Institute and General C.R. Processors can provide literature and information in this area. The possibility of hull burning systems from Costa Rica or Colombia that may be cheaper than Bentall's should be considered.

2. The Coffee Processing Equipment

Without question, BENTALL SIMPLEX has great experience in green coffee processing equipment and its installations. The detailed proposal is proof of their experience in coffee. However it is the consultant's opinion that the U.S.A. green coffee equipment manufacturing firms can provide the necessary equipment operation in Haiti with the sole exception of the drying units. In the U.S.A. there is no one manufacturer of an entire line of coffee processing equipment like Bentall. However, the premise that a single manufacturer of the entire line of equipment will provide better parts service does not hold true because no two pieces of equipment for major processing equipment have interchangeable parts. In fact, most coffee equipment as described in these bids can be repaired with the materials and technology in the local repair shops. It is to be understood that manufactured spare parts will have to be imported in any case.

Therefore, it is recommended that with the exception of the drying units the coffee processing equipment for the central CEPEC facility be procured from Jahn & Sons, Inc.

A design based on the premise that CEPEC receives 90% of its product as green hulled coffee (café préparé/café pilé) is too limiting in scope. It is recommended that the flow diagram for green as presented by Jahn & Sons, Inc. be redesigned in order to meet CEPEC's present needs specifically and have enough flexibility to adjust to the anticipated future of more advanced methods of preparing coffee at the farmer level.

V. SUGGESTED DESIGNS FOR COFFEE PROCESSING EQUIPMENT

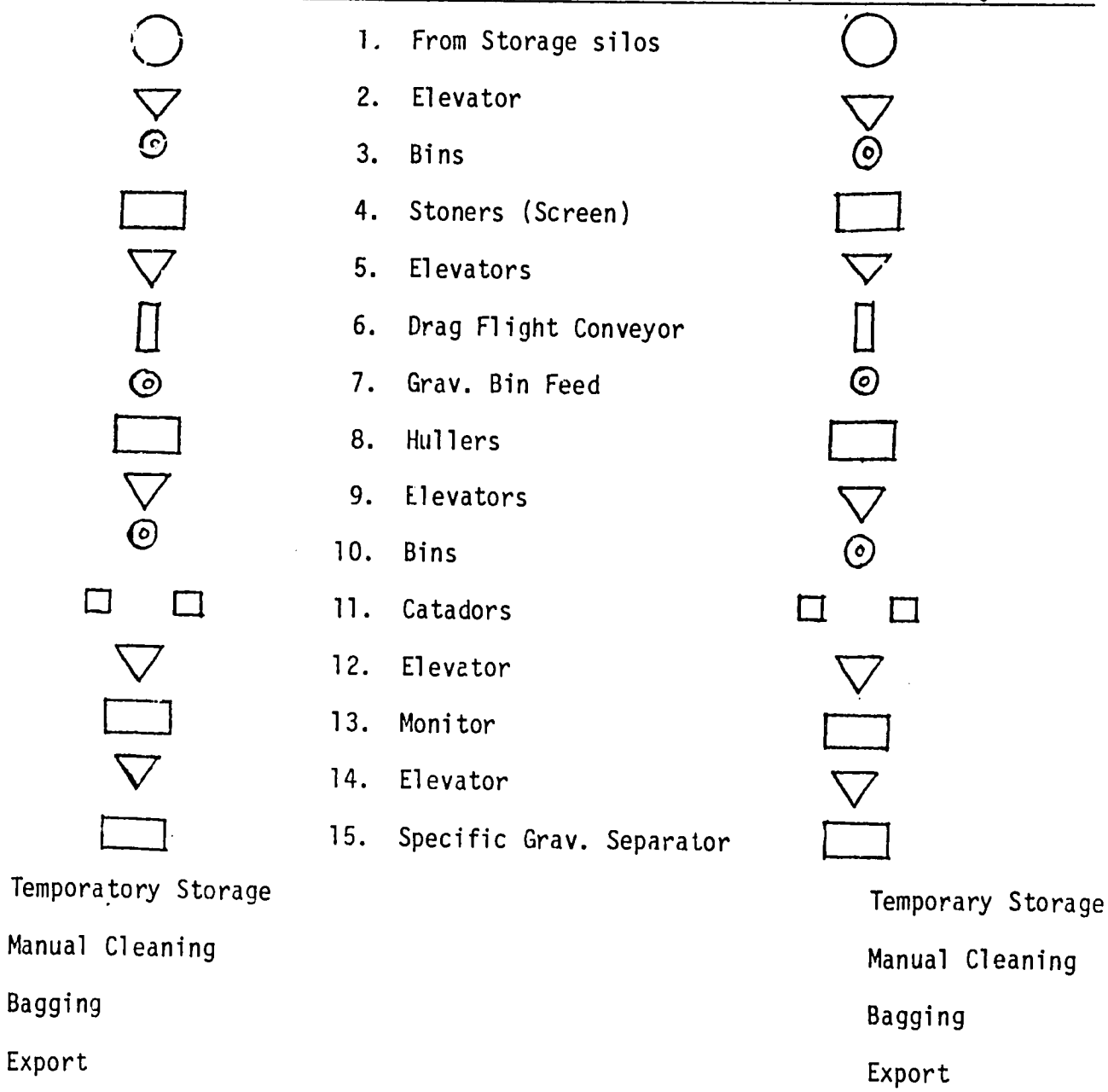
There are proposed here two identical process lines parallel to each other because the failure of one line would prevent a total shutdown of the processing facility.

1) Parallel system to specific gravity sorter
2) Parallel system to monitor

Due to the high water table (85 cm) all suggested designs are on one level thereby eliminating pits of any kind.

Schematic No. 1

General Equipment Diagram for a Parallel System to Specific Gravity Sorter



Equipment Description for Schematic No. 1:

1. Storage Silos:

   Storage silos could be made out of concrete block, self unloading if necessary. Large silos are unpractical for this plant, a good estimate could be 4 ft x 6 ft x 6 ft (high). The facility should have a minimum of three silos.

2. Single Leg Elevator

   Quantity : Two
   Height : To be determined
   Capacity : 1/1.5 HP approx.
   Valve : Single

3. Holding Bin 60°

   Quantity : Two
   Height : To be determined
   Capacity : About 160 cubic feet

4. Stoner

   Quantity : Two
   Capacity : Minimum 2,400 lbs/hr
   Screen : To be determined for
   a. Dried Cherry
   b. Parchment

5. Single Leg Elevator

   Quantity : Two
   Height/Length: To be determined
   Capacity : .8/1 HP approx.
   Valve : Double to adjust to drag flight conveyor

6. Drag Flight Conveyor (Covered)

   Quantity : Two
   Height/Length: To be determined
   Capacity : 1/1.5 HP approx.
   Valve : Single

7. Holding Bin 60°

   Quantity : Two
   Height/Length: To be determined, must feed on huller
   Capacity : 80 cubic feet
   Valve : Single

8. Huller
   Quantity : Two
   Height/Length: To be determined
   Capacity : 1600 lbs green coffee/hr
9. Single Elevator (with hopper to feed from floor level)
   Quantity : Two
   Height/Length: To be determined
   Capacity : .8/1 HP
   Valve : Single
10. Holding Bin 45°
   Quantity : Two
   Length : To be determined, must feed onto catador
   Capacity : About 500 cubic feet
   Valve : Double
11. Catador (Pneumatic)
   Quantity : Four
   Height/Length: To be determined
   Capacity : 1000 lbs/hr
12. Elevator (Single Leg)
   Quantity : Two
   Height/Length: To be determined
   Capacity : .8/1 HP
   Valve : Single
13. Monitor
   Quantity : Two
   Screens : Over No. 17 (Haitian eq XXXXX)
   Over No. 15 (" " XXX)
   Less than No. 15 (" " XX)
   Pea Berry (Caracoli)
   Capacity : 20-30 bags/hour (60 kgs Bags)
14. Single Leg Elevator
   Quantity : Two
   Height/Length: To Be determined
   Capacity : .4/6 HP
   Valve : Single

15. Specific Gravity Separator

Quantity : Two

Capacity : 20/22 bags/hr (60 kgs Bags)

NOTE: All Motor Drives should be "V" Belts and 220/440 Volt 3 Phase/60 HZ.

Notes on the Gravity Sorting Equipment

It is recommended that a gravity sorting machine be included in the line of equipment because the Haitian coffee is of varied densities (p. 15, R. Cleves). The gravity sorting equipment differentiates minute differences in mass which usually correlates to differences in color (i.e. light weight beans are generally black or yellow beans). Therefore the gravity sorting equipment aids in the color separation process, but does not eliminate the need for final hand sorting.

In CEPEC's case the gravity sorting equipment capacity should be calculated on the basis that 60% of the coffee separated by the monitor is No. 17 or larger. The remaining 40% is a combination of No. 15, / No. 15 and caracoli. Therefore the gravity sorting equipment capacity should be slightly larger than the 60% of the coffee. The remaining 3 or 4 grades of coffee sorted by the monitor should be bagged separately and accumulated for further processing in separate runs.

Gravity sorting equipment manufactured in the U.S.A. is based on the same ratio principle, air (bed) to centripetal force. The three major manufacturers are Oliver (Colorado), Sutton (Dallas), and Forsberg (New York). Jahn & Sons should consider bids from all.

Note:

Oliver's products are at times difficult and time consuming to set properly.

Notes on "CATADORS"

The major function of the catadors for hulled coffees are:

a) Fast cooling, decreasing the "bleaching effect" during long periods of green coffee storage (café préparé)

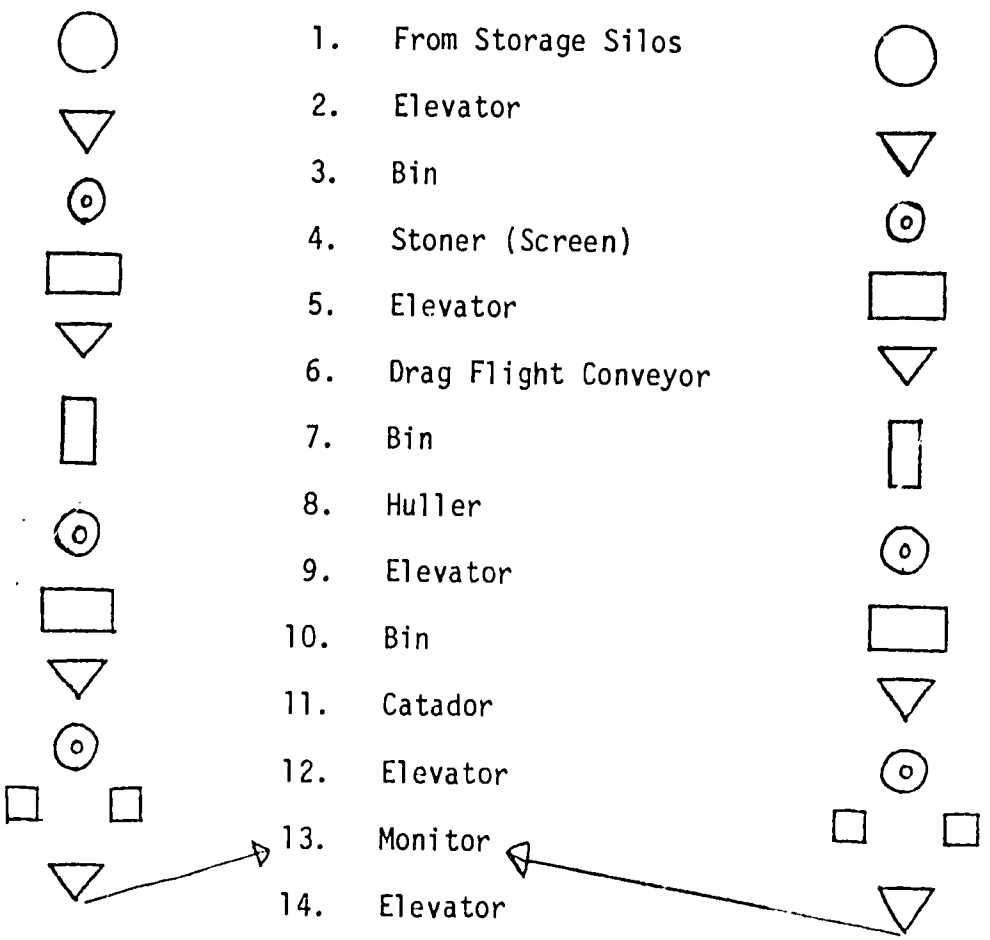
b) Efficiently separates excess parchment allowing flexibility to huller tightness.

c) Efficient separation of broken seeds; if excess is apparent the huller needs adjustment.
d) Low energy consumption
e) Increases Monitor efficiently by previously separating broken seeds.

Catadores Models could be provided by Georsorse/Apollo Export/Houston, Texas. Another supplier is Angel Laverde in Medellin, Colombia.

Schematic No. 2

General Equipment Diagram for a Parallel System to Monitor



1. From Storage Silos
2. Elevator
3. Bin
4. Stoner (Screen)
5. Elevator
6. Drag Flight Conveyor
7. Bin
8. Huller
9. Elevator
10. Bin
11. Catador
12. Elevator
13. Monitor
14. Elevator
15. Specific Gravity Sorter

Temporary storage
Manual cleaning
Bagging
Export

Temporary storage
Manual cleaning
Bagging
Export

Equipment Description for Schematic No. 2

The same equipment capacity and design should hold for all the equipment description in the previous system with the exception of the monitor and the specific gravity sorter capacities.

13. Monitor

Quantity	:	One
Capacity	:	30 to 40 sac/hour (60 kg sacs)
Screens	:	Over No. 17
		Over No. 15
		Under No. 15
		Pea Berry

14. Single Leg Elevator

Quantity	:	One
Height/Length	:	To be determined
Capacity	:	.6/8 HP
Valve	:	Single

15. Specific Gravity Separator

Quantity	:	One
Capacity	:	31/34 Bags/hour (60 kg bags)

The major advantages of this system, besides a possible lower cost, is the possibility of alternating use of each line which allows the facility to batch the coffee in separate grades thus improving the quality of exportable coffee. The two lines will provide ample time for clean-up or repairs while the other line of equipment is operating. The monitor and gravity sorter are practically self-cleaning.

Note on Specific Gravity Stoner:

It was observed by Ing. Muriel Jolivert that a significant amount of sand and stones of the same size of dried cherry (coque) is in the coffee. In this case the screen stoner cannot efficiently separate the stones from the coffee. If the problem is large enough, possibly the installation of a specific gravity stoner after the screen stoner would prove effective.

Moisture Meter:

The proper use of moisture meters should prove to be the most useful tool in this operation.

Good moisture meter qualities are:

a. Portable 1. Dry/cell/AC operated
   2. Travel case

b. Direct Read 1. Parchment
   2. Green Coffee

c. Not Digital

Several (five at least) should be distributed in various locations, especially in the receiving and dehydration areas.

Green Coffee Storage (Café Préparé)

Green coffee should be stored as short a time as possible. Because the planned CEPEC facilities are located in a high humidity area, the most economical way to store it temporarily is in sacs.

Manual Sorting (Trieuse)

The utilization of manual sorting is necessary. At this point the use of a continous hand-sorting table is not recommended. Continuous sorting tables are used mostly for coffee that has a maximum of 3% (wt/wt) color defective grain. Haitian coffee is at minimum in the 10%-plus range of color defective coffee.

As farmer practices change over to washed coffee, this hand continuous sorting table will prove economical.

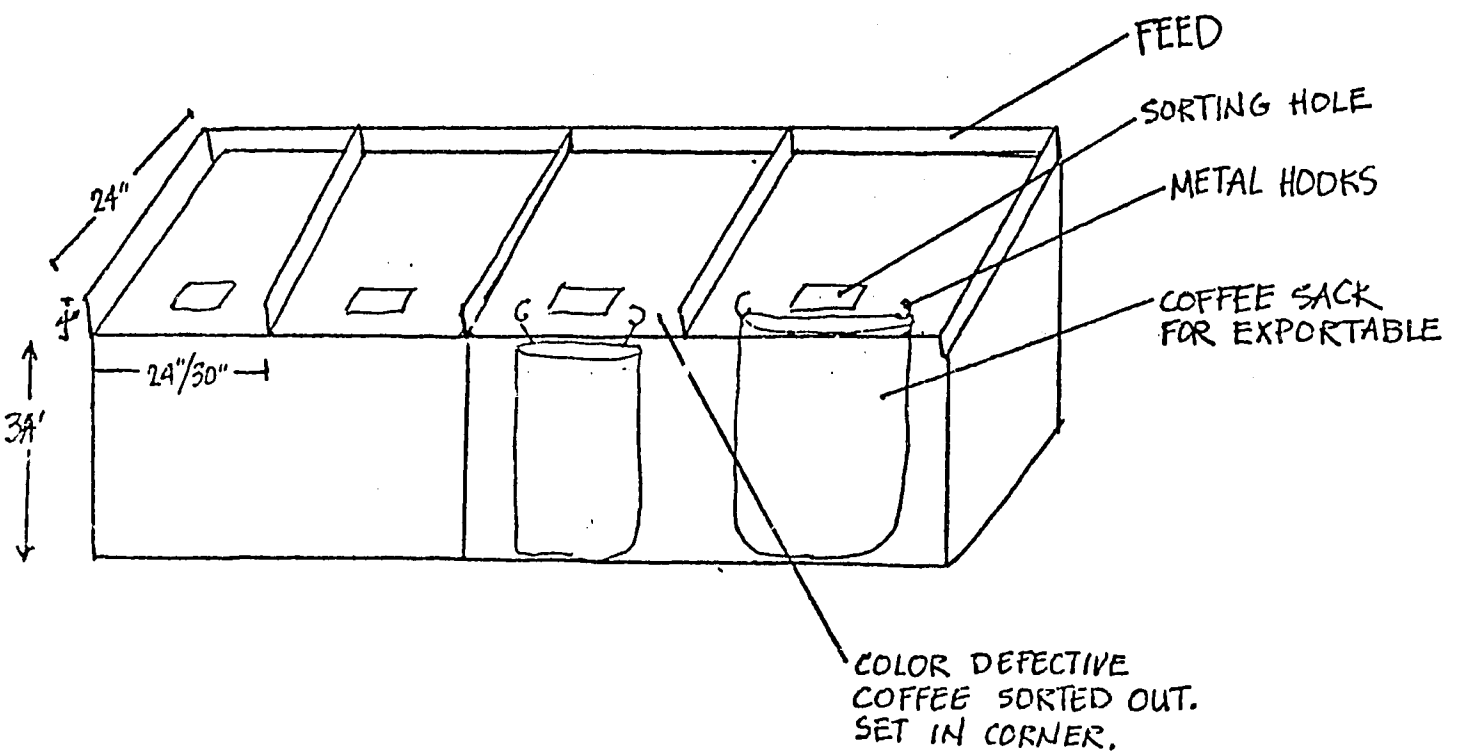
For the present, it is recommended that a table made of wood be made with a hole to hold a sac. The tables are set in rows. A man hand-feeds each table from the opposite end. The sorter drops the sorted (good) coffee in the sac. The color defective ones are put to the side.

In some coffee producing areas the employees are remunerated by the pounds of coffee (color defective) retrieved. What suits best is to be experimented.

The sorter sits on a bench or a stool.

General Designs of a Sorting Table

Material: Wood/Plywood



VI. OTHER SAFETY FEATURES AND COMMENTS

1) Installation of magnets at the huller hopper. Stray bolts are possibly the largest cause for mechanical failures in a green coffee processing plant.
2) Hulls should not be stored in plant facilities until proper safety measures are well understood by all personnel. Hulls are extremely flammable. Hulls could be discharged outside the facilities in the direction of prevailing wind.
3) Design appropriation and possible consideration for the electrical needs for portable pneumatic systems prove to be very efficient and versatile until permanent (silos) installations are made for stored coffee.

   A good estimate of the electrical needs for a pneumatic system is about 50 HP in one single unit.

Scales

Truck scales are not necessary for this installation. Simple scales (750 lbs. max) are transportable and of multiple use. Scales placed at different stages of processing will effectively increase quality control by keeping the coffee in distinct batches. Five to seven scales are needed.

If a larger scale is needed it should not exceed 2000 lbs. Large scales in the case of small non-homogeneous quantities of coffee as in Haiti, tend to mix qualities of coffee previously separated by the farmer or buyer.

Note: A special spare part market survey should be made for the existence in Port-au-Prince of 440 volt electromagnetic starters. If their usage is extensive, where possible, installations should be made at this voltage range. It was also suggested to Ing. Gerald Brun of Tecina that two separate transformers (440/220 and small 220/110 volt) units be installed to provide the possibility of shutting down the 440/220 volt transformer during the off-season, thereby reducing operation costs.