



# **SIMPLEX EXTRACTION SYSTEM**

## ***LOW-COST COCONUT PROCESSING IN THE FARM***

From Vergara Machineries

**Patent Applied for**

### **Introduction**

VR & E ENTERPRISES is proud to introduce to you our "Simplex Extraction System". The Simplex Extraction System was developed as a means to convert coconuts into their main items of commerce namely, oil and cake, right where the coconut comes from - the coconut plantation. Because of this objective, the SIMPLEX machines were also designed so they can be owned and operated by the people who planted and make their living out of the coconut tree - the coconut farmer. Therefore, we were constrained to make the system simple to operate and maintain, reasonably acceptable to the community and the environment, relatively inexpensive to own and suited to small-scale entrepreneurs and cooperatives.

In pursuing the foregoing objective, we discovered that to make the system practical the number of whole coconuts that can be processed with the system should not go beyond 2000 nuts per 8-hr day.



2000 nuts is equivalent to about 380 Kg dried meat which in turn is equal to about 245 Kg coconut oil and about 130 Kg coconut cake. In terms of coconut hectareage, area covered is 200 to 500 hectares.



Research work on the system, with the above objective in mind, was started in 1983. With the help of our machine shop and experience accumulated in over 20 years making plastics processing machinery, a small, efficient coconut oil expeller was produced in 1985. The final design of Simplex Extraction System is the result of extensive testing and observations of conditions on the farm where some of our expellers were deployed. The expeller then became but one of other equipment designed for the system that we started promoting in 1987. Since then, we have been constantly reviewing and modifying the system.

## **The Process in Brief**

The SIMPLEX EXTRACTION SYSTEM is a combination of designs, procedures, and machines devised by VR&E Enterprises of Caloocan for safely, efficiently and expeditiously accomplishing the following tasks at low cost (depicted on the last page):



1. Breaking of dehusked nuts into halves.

2. Separation of the fresh coconut meat from its shell with the SIMPLEX Demeater.



3. Reduction of the meat into kernel-size particles by running it through the SIMPLEX Granulator.

4. Dehydration of the coconut meat particles in a hot oil bath in the SIMPLEX Dehydrator fired with indigenous fuels.



5. Separation of oil and its residue or cake from the dried coconut meat utilizing the SIMPLEXTRACTOR Expeller.

A typical batch of 150 whole nuts takes about 3 hours to convert, going through Steps 1 to 5, into 24 kgs of crude oil and 13 kgs. of cake. The extracted oil has been found suitable for refining to cooking oil and the cake fit for animal consumption. Using the "Simplex Extraction System", coconuts can now be plucked from the tree at eight in the morning and turned into oil and animal feed by noontime.

## **Design Background**

Machinery involved in the Simplex Extraction System, notably the SIMPLEX GRANULATOR and the SIMPLEXTRACTOR EXPELLER, were the result of knowledge and experience acquired from more than twenty-five years in design and fabrication of machinery particularly plastics processing equipment. Both machines were designed using theories and practices applicable to plastics converting. A plastic pipe scrap crusher, for example, was used as the model for the SIMPLEX granulator. An extruder used in making plastic bags was adapted for coconut oil extraction in the SIMPLEXTRACTOR EXPELLER.

In the Simplex Extraction System, coconut meat does not go through the Copra stage where the material is subjected to prolonged exposure to the environment and its deleterious effects on wet coconut meat. Our system tries to preserve the freshness of the material by exposing the meat to the atmosphere for no more than a few minutes. This attention to exposure is one reason for the adoption of the following drying system.

The drying method was partly inspired by an observation in a book called "COCONUT - Production and Utilization" written by Dr. Julian A. Banzon and Dr. Jose R. Velasco, from which we quote:

"There are some novel dryers worthy of note. In a Hiller patent, the coconut kernels are immersed in hot coconut oil, which serves as heating medium. There is intimate contact between the heating medium and the coconut meat so heat

transfer is better. In the usual dryer, air is heated; in the Hiller method, coconut oil is the thing heated with increased advantages. By keeping the oil at 100 deg C or slightly higher, the water in the coconut meat virtually boils off and comes out bubbling (as steam) through the hot oil. The inventor claims that such a situation is actually the process of steam deodorization of oil and thus is an added feature of the process. To date (1982), however, no such drying system is known to exist in the Philippines. It should be noted that this immersion drying as it may be called is in general used in deep fat frying of foods although the objective in such cases is not necessarily for complete drying."

## **Equipment Involved**

**SIMPLEX DEMEATER** – scoops coconut meat out of its shell. The meat comes off in strips more suitable for processing in the **SIMPLEX GRANULATOR**. Manually operated, it can scoop up 1000 nuts per day (depending on the skill of the operator).



**SIMPLEX GRANULATOR** - dices chunk coconut meat into a fixed particulate size suitable for the process. It is powered by a 1 Hp, single phase, 220 volt electric motor and has a through put of up to 100 Kg/Hr..



At 3 Pesos per kW/Hr, typical electrical consumption is about one and a half centavos per kg of fresh coconut meat.

**SIMPLEX DEHYDRATOR** – reduces the diced fresh coconut meat's moisture content to an ideal level suitable for processing in the **SIMPLEXTRACTOR EXPELLER**.



The apparatus consists of a large stove and a deep, open cylindrical cauldron with a slowly rotating stirrer or agitator powered by a 1/2 HP single-phase electric motor. It uses husk or shell as the heating fuel.

Wet material is top-loaded into the cauldron in batches of granulated meat equivalent to 150-160 nuts. Batch temperature is constantly monitored with a temperature gauge.

Once the right temperature is reached, dried material is promptly discharged through a toggle-locked, tangentially mounted quick-opening swing door into a specially designed box to drain out the hot oil. This drained, still hot oil is then reused for the next batch.

Two of these units are needed to meet the capacity of the **SIMPLEXTRACTOR EXPELLER**. If the fuel used is coconut shell, approximately two thirds is consumed. Electricity used by the stirrers costs about 2 centavos per kg of fresh coconut meat.

**SIMPLEXTRACTOR EXPELLER** - extracts oil from dried coconut meat at 60 to 63% recovery by weight in a single pass without scorching either the oil or cake. The secret is a carefully engineered and precisely crafted water-cooled solid hardened alloy steel screw rotating in a cylindrical chamber that has a unique cantilever design which minimizes stress and facilitates cleaning. Cake thickness, oil recovery and throughput are easily adjusted with one lever at the front of the machine.



Dried meat through-put is 30 to 40 Kg/Hr, when driven with a 3 Hp, single-phase electric motor, 50 to 60 Kg/Hr with a 5 Hp, three-phase motor, and 70 to 80 Kg/Hr with a 7.5 Hp three-phase motor.

Electrical consumption is about 21 centavos per kilo of dried coconut meat for single-phase motors and 12 centavos per kilo for three-phase motors.

Operation is easy to learn. No special knowledge is needed to produce quality products. Quality can be readily monitored at several checkpoints during processing.

## **Product Quality**

It should come as no surprise that the SIMPLEX EXTRACTION SYSTEM is able to produce end products that possess wholesome characteristics.

For one thing, the raw material comes from a substance that's fresh, natural and pure. And for another, freshness of the raw material, coconut meat, is preserved by not unnecessarily subjecting it to prolonged contact with the open air and its deleterious effects on coconuts when it is most vulnerable - while it's still wet.

Crude oil extracted has a light yellow color and a sweet, nutty aroma. Soap, made from this crude oil, is commonly accepted to be gentler on the skin.

The Cake or "sapal" discharged has a very pronounced and sweet coconut or "latik" smell. Since it undergoes no heat or microbial deterioration, the cake should be edible to both humans and animals. Tests have shown that it is aflatoxin-free.

## **Manpower Involved**

To process 2000 dehusked whole nuts a day (8 hours), a typical mini oil mill adopting the SIMPLEX EXTRACTION SYSTEM should have a complement of the following personnel:

- 1 Mill Manager - Bookkeeper
- 1 Expeller Operator/Mechanic
- 1 Granulator Operator/Nut breaker
- 1 Dehydrator Operator
- 3 or 4 Deshellers
- 2 Helpers

Mill Manager - will be responsible for the operation and maintenance of all property and behavior of personnel within the confines of the plant. He will also make sure that only the right raw materials are allowed into the premises, will keep track of these materials and will permit these materials to be processed only at the proper time.

Expeller Operator/Mechanic - will perform the correct procedures for each startup and shutdown of the expeller. He will also supervise the cleaning and the scheduled maintenance of the machine and should be the one to handle breakdowns of this and other machines in the plant.

Granulator Operator/Nut breaker - will start and stop, feed and clean the granulator at the end of the day. It will also be his duty to break nuts into halves for the deshellers.

Dehydrator Operator - will load, monitor, and unload the dehydrator. It will be his duty to make sure that the oven is kept stoked with fuel and firing kept to the right level. He will also supervise the regular cleaning of the whole dehydrator assembly, including firebox and flue.

Deshellers - will pry off meat from coconut halves. May be on a piecework or daily wage basis. Production should keep in step with or exceed dehydrator needs. Number of deshellers may be reduced or increased accordingly.

Helpers - will assist expeller, granulator, and dehydrator operators in performing their tasks or in whatever other chores the mill manager assigns them.

## **Cost of Acquisition**

The SIMPLEX machines, as a package of the same capacity cost less than other Mini Coco Oil Mills packages in the market today. The cost of acquisition as of June 2002 is as follow:

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**Simplex Extraction System (SES)\***  
**Machinery and accessory**  
**1,500 up to 2,000 nuts per day capacity**  
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<u>Quantity Needed</u>	<u>Description</u>	<u>Price**</u>
1 unit	SIMPLEX Granulator	Php 95,000.00
1 pair	SIMPLEX Dehydrator (2 units)	330,000.00
1 unit	SIMPLEXTRACTOR Expeller 3HP***	195,000.00
	<b>Total</b>	<b><u>Php620,000.00</u></b>

\* Price as June 2007

\*\* Price subject to change without notice. Please call for an updated quotation and terms. Prices do not include crating & freight costs. Delivery is 4 to 6 weeks upon order.

\*\*\*with single phase motor. Higher capacity expellers with 5HP or 7.5HP 3-phase motors are also available at higher cost.

### **Power requirements**

Common household single-phase electricity (of normal voltage and amperage) and available indigenous fuels are all that is needed to run the lowest capacity plant (3HP expeller). The next higher capacity machines need a three-phase circuit that may not be so common in the countryside.

Total electrical power requirements are from 4 kW for the low capacity facility to 8 kW for the highest capacity mill in our present equipment packages.

Some of the units we delivered are now using Diesel engines in localities where electric power supply is either unavailable or unpredictable.

### **Space Requirement**

Because of the self-imposed capacity limit of 2000 nuts per day, we have been able to give the machines a certain amount of portability. Sizes and weights of the components are such that they can be located almost anywhere that's safe from the elements.

The SIMPLEX EXTRACTION System uses equipment that would fit onto a 5m x 6m floor level space with room to spare. Except for the drying apparatus, the components are easily movable and may, in fact, be mounted on a trailer to serve as an ambulant Mini Oil Mill.

### **Outstanding Features**

From the previous description of the steps of the process, three very basic and very desirable advantages of the "SIMPLEX EXTRACTION System" easily stand out.

1. Freshness of the coconut products are preserved. Coconut meat is not subjected to prolonged exposure to molds and bacteria when the meat is most vulnerable - while the coconut meat is wet.

2. Transport and storage costs are reduced to a bare minimum. With oil and cake produced at or close to the plantation, only compact but high value items are stocked and moved to end users.

3. The time needed to convert raw coconuts to value added products is greatly reduced. Using recommended equipment, a typical batch of 150 dehusked whole nuts takes only about 3 hours to turn into oil and cake.



## **Other Features**

Other advantages of greater or lesser significance are attributable to the "SIMPLEX EXTRACTION SYSTEM". Some of these are:

1. Has potential for opening new business opportunities in the countryside. Bringing the technology to where the coconut comes from would awaken the coconut farming communities to the other products that can be derived from the coconut tree.
2. More oil is recovered per nut. Molds, fungi and other microbial organisms feed on the oil in the coconut. So the longer coconut meat is under attack by these organisms, the less oil there is to recover and the more the contamination.
3. Moisture content is not critical. In expeller operation it is essential to have a small amount of moisture in the material being processed. To achieve low oil content in meal, pressure is required but heat is formed and scorching occurs in the cake. To minimize scorching which burns protein in meal and still attain high oil recovery, moisture is needed to create steam that cools the machine and aids in the extraction of oil.
4. Not weather dependent. Processing can be done almost any place, at any time, rain or shine.
5. Contamination by solid foreign matter (stones, dirt, excrement, etc) is easier to prevent.
6. Maturity of coconut is not an absolute necessity for the system. Although oil yield is somewhat less, younger coconuts are not any harder to process.
7. Temperatures reached by the material during the drying process effectively deters attack by bacteria, molds, and fungi. Typical temperatures attained for proper drying are within 120-130C.
8. Coconut meat is never exposed to products of fuel combustion such as smoke, soot, ash etc. as it is in a "tapahan".
9. Coconut oil produced by the process had been found to be better suitable for conversion into other products such as cooking oil, soap, coconut methyl ester (CME), medicinal oil, etc.
10. Less oil is lost to conversion to unusable stock because the oil undergoes less treatment because the Free Fatty Acid (FFA) content of the oil is naturally much less.
11. The possibility of oil and cake buyers paying a premium price for better quality materials is improved.
12. Low initial investment.

## **Plant Site Requirements**

1. Location should have access to 2,000-2,500 coconuts per day.
2. The storage area in the location should be large enough to store up to 10,000 nuts at any one time. This space should not be excessively exposed to the weather.
3. The site should permit waste disposal and smoke dispersal within the premises.
4. The location must have easy access to sources of cheap indigenous fuels. Fuels may be husk, shell, stalks, rice hull, etc.
5. The processing area should be in a walled and covered space of at least 100 sq m with concrete flooring and a proper floor drainage system. Room for an office, laboratory and repair shop may be set aside in this area. The work area must be easy to clean and floors should have drainage canals.
6. Water supply should be able to provide at least 200 liters of fresh, potable water daily. Wastewater should be led to a concrete septic vault.
7. Electric power, if used, may either be bought or self-generated. It may be single or three phase. 3-phase is preferred for motors with horsepower ratings higher than 3Hp. Circuits capable of providing 8 kilowatts are recommended.



A hybrid engine direct drive and generator combination (where the engine drives the expeller through belts and at the same time drives a dynamo for other electrical utilities) is suggested if reliability is a serious consideration. Portability is an added bonus of this arrangement.

8. Storage tanks should be provided for crude oil. An elevated crude oil settling tank should have a 1000-liter capacity – it may be made of BI or SS sheet.

9. The plant should be located outside of densely populated areas or in a place where operations will not be a source of irritation for the general populace.

10. The facility should be so designed as to have furnaces, ovens and other sources of heat situated in unconfined spaces or minimally covered areas.

11. Heating equipment should be designed with a minimum of conditions where open flame is exposed.

12. Fire fighting equipment must be available in strategic locations in the plant ready for use at all times. Fire extinguishers of a non-liquid or powder type are recommended.

### **Coconut Statistics**

The volume and weight reduction of coconuts when converted into oil in the farm is quite significant.

Coconuts with husk or “bunot” occupy 30 times more space than oil and are 10 times heavier.

Coconuts without husk occupy 13 times more space than oil and are 6.4 times heavier.

### **About the Equipment**

SIMPLEX EXTRACTION SYSTEM was devised by Filipinos for the Filipino farmer. All techniques, methods, accessories and machines are all tailor-made for countryside conditions. Most parts used in the machines are available in hardware stores even in small towns.

Regular maintenance is simple and reasonably far between. People who can fix other farm or road machinery can do repairs. Our experience working in the countryside has proven that technical knowledge is not too far behind even in the smallest barangays and we have taken this fact into consideration.

Filipino engineers design components of the system and Filipino artisans fabricate all critical machined parts. Replacement parts, if called for, are therefore readily available. Any improvements in design and fabrication techniques can be readily adapted to existing machines and accessories.

### **About VR&E Enterprises**

A company to be successful requires a basic direction, an area of expertise to concentrate on and develop. We consider that our specialty is in developing a proficiency in manufacturing specialized machines and equipment of a high quality but modest price.

Our 40 years experience in this field provides the expertise essential for the successful implementation of this philosophy.

The basic direction of the company over the next five years will be towards custom-designed, quality production and computerized machine work. Inevitably, there will be changes as the Philippine marketplace evolves and we expect a trend toward producing a standard range of machines that would also be suitable for the export market.

We believe our strength lies in the quality of our personnel, resources and experience and the market's future need for a company that can provide local sourcing of machinery for industry that meets international quality standards.

VR&E Enterprises is a 100% Filipino owned and operated company. Its office and plant is located at Grace Park, Caloocan City. GPS Coordinates: 14° 38' 16" N // 120° 59' 03" E .

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