

A GUIDE TO A UNIT PRODUCING POTATO FLAKES

1 - PRESENTATION

1-1 Nature of Activity

Potatoes can be consumed in their natural state, or they can be utilized by means of various procedures. It is possible to produce potato chips, french fries, mashed potatoes, or canned items. These processed foods allow the manufacturer to bypass the difficult procedures of peeling and cutting.

Remark that fecula (potato starch) is obtained from those potatoes with the highest starch content.

Dehydration facilitates the preservation of the tubers while reducing storage and transport costs.

The basic product obtained from the dehydrating of potatoes is potato flakes. The manufacturing of powders from the flakes is not practiced because it is expensive and the results are of mediocre quality.

As for potato granules, created by atomization, they are being used less and less because of the cost of transformation. These are the reasons why we will only consider potato flakes.

These flakes can be sold to consumers, collectives, restaurants, or to second transformation industries which make soup mixes, frozen specialities, extruded products, baby food...

1-2 Alternatives

* Raw Materials:

Large scale cultivation of potatoes can be envisaged only in non-tropical countries (or in rare tropical zones which favour potato growth).

Other starchy products are prone to dehydration : cassava, sweet potatoes and yams.

The most interesting products have been obtained from yams.

* Finished Products :

Variations of natural purée are vegetable purées (which remain a marginal product we will not insist on).

Purée with milk can be interesting for its balanced nutritional value (carbohydrates, lipids, proteins).

Depending on how they will be used (consumption or second transformation), the flakes will vary : crushing will be more or less fine.

There are two main packaging methods :

- bulk packaging : 25 kg bags, manually packed,
 - automated packaging in varying-sized bags, according to consumers' demands.
- Because there are many variations for automated packaging (and therefore, many variations for cost), we will only consider bulk packaging in this guide.

* Technology :

To dehydrate potatoes or yams, a cylinder dryer with 5 satellites and a scraping knife is generally used. There is no technological variation for dehydration.

There are, however, alternatives in the :

- pretreatment,
- packaging (according to the product's purpose).

Potatoes can be peeled :

- by abrasion,
- by steaming,
- by a mix of steaming and abrasion,
- with soda

Peeling with soda causes too much water pollution and so it is not practised.

Peeling by abrasion is very rarely used for making purée ; this process is used to peel tubers for chips.

Potatoes are traditionally peeled by steaming.

Yams are the most difficult to peel. They require a mixture of steaming and abrasion.

1-3 Types of Possible Units

A reduced capacity unit is not plausible for this process : the related technology doesn't scale-down very easily and international competition for this product is very stiff.

Units of competitive sizes will be considered:

- **Unit A** : unit producing potato purée at the rate of 440 kg/hr. Plain purée and purée with powdered milk are manufactured.
- **Unit B** : a unit producing yam purée at a rate of 200 kg/hr (due to the higher added value, we can reduce the unit's size).

The setting up of small units could be envisaged in situations outside of international competition.

2 - TECHNICAL AND ECONOMIC GUIDE

2-1 Description of the Unit

2-1-1 Finished Products

LINE	A 440 Kg/hr of potato flakes	B 200 Kg/hr of yam flakes
Range of products	Potato flakes (plain + with powdered milk)	Yams flakes (plain)
Packaging	25 kg bags	25 kg bags
Production - daily (3 x 8) - annual	10 tons 2000 t/yr of flakes (15 000 t potatoes)	5 tons 1000 t/yr of flakes

2-1-2 Technological Choices

	TECHNOLOGICAL OPTIONS	SOLUTIONS	
		UNIT A (potato)	UNIT B (yam)
Calibration of raw materials	Sieve	yes (eliminate potatoes < 35 mm diameter)	yes
Removal of stones	- By density with water - De-stoner	yes	yes
Cleaning	In a horizontal rotating cylinder	yes	yes
Peeling	- Steam or mixed steam and abrasion (abrasion or soda)	steam	steam-abrasion
Paring	- Quality controlled on tables	yes	yes
Cutting	- By rotor	yes	yes
Pre-cooking	- Screw blancher (10 mn at 60-70°C)	yes	yes
Cooling	- Water cooler endless screw tank	yes	yes
Cooking	Continuous steam cooking (endless screw)	yes	yes
Crushing	- Against a grid at the end of cooking (varying grid hole sizes)	yes (varying grid hole size)	yes
Addition of additives	- Anti-oxidizing agents - Powdered or whole milk	yes yes for puree with milk	yes no
Dehydration	- Cylinder dryer	1 cylinder dryer diameter : 2 m length : 5 m area : 31.41 m ²	1 cylinder dryer diameter : 1,5 length : 2.3 m
Flaking	- Pressing against a grid in a cylinder	yes	yes
Packaging	- Bulk (25 kg) or divided packaging	manual bulk packaging	manual bulk packaging

2-2 Economic analysis

2-2-1 Investments

	OPTION A		OPTION B	
	Description	FOB price US \$	Description	FOB price US \$
Equipment				
Pretreatment	Cylinder washer	\$ 2.7 million	Cylinder washer	\$ 2.4 million
Cooking	steam peeler		steam peeler	
Crushing	screw blancher		screw blancher	
	steam cooker		steam cooker	
	crusher		crusher	
Dehydration + flaking		\$ 640 000		\$ 500 000
EQUIPMENT TOTAL		\$ 3.2 million		\$ 2.9 million
Building :	Storage of raw materials :		Storage of raw materials : 4000 m2	
Description	This unit's building is 4000 m2 (2 500 tons of potatoes), with ventilation using nocturnal negative calories The number of buildings depends on the producer's storage capacity.		unit (the number of buildings depends on the producer's storage capacity).	
	Building (line) : 2 000 m2		Building (line) : 2000 m2	
	Storage finished product : 1500 m2 (hypothesis : 2 months of stock)		Storage finished product : 1000 m2	
Other investments	Individual packaging line : \$ 1.1 million (1)		Individual packaging line : \$ 1.1 million (1)	
	Anti-pollution installation : \$ 1.9 million (2)		Anti-pollution installation : \$ 1.1 million (2)	
Total investment	for the entire installation : \$ 6 to 7 million		for the entire installation : \$ 5.5 to 6.5 million	

The ratio of investment/kilogram-produced is higher for yams. Peeling is especially difficult (more than for the potatoes), and therefore requires a more expensive peeling process.

(1) We can only give an estimate of the costs because they vary in relation to the line chosen : one or two sachets per case, packaging with nitrogen, etc. This cost can not be less than to \$ 0.8 million .

(2) In France, anti-pollution equipment represents around 20 % of the amount of the investment. The cost depends on the current governmental regulation .

2-2-2 Functioning

	UNIT A	UNIT B
Labour	by team (x 3) 22	by team (x 3) 20
- skilled	9	8
- unskilled	13	12
Consumption		
Energy (coal, fuel, or natural gas)	0,90 kg fuel/kg finished product	0,90 kg fuel/kg finished product
Water	3 l/kg finished product	3 l/kg finished product
Antioxydants	Legislation varies according to country	same
Milk powder	8 to 10%	

The units function 3 x 8, non-stop for 200 days (the starting of the cylinder dryers require 6 to 7 hours).

3 - KEY FACTORS TO THIS PROJECT'S SUCCESS

3-1 Supply

12 to 14000 tons of potatoes are needed annually for this unit. The unit should be supplied during 200 days, which demands mastery of the storage process (forsee 8 % weight loss of stock in 8 months).

3-2 Technology and Equipment

Key points are :

- mastery of scheduling of pre-cooking and cooking,
- mastery of the cylinder dryer.

Foresee spare parts for maintenance : 8 to 10% of the amount of investment.

3-3 Personnel

The skilled personnel consist of the following :

- . manufacturing : 1 workshop chief and 1 foreman
 - . maintenance : 1 machinist, 1 mechanic, 1 electrician
 - . boiler room : 1 stoker
- and the administration.

3-4 Quality Control

The usual tests are :

- percentage of dry material in the product,
- bacteriological : counting of yeasts, moulds, bacteria and coliform bacteria.

3-5 Distribution and Commercialization

The finished product should meet the local consumers' expectations : purée more or less thick, spiced or not.

An adjustment of the product to meet the public's demand, is necessary before introduction on the market.

Selling in bags is adapted to the food industry and to large units for collective or commercial restaurants ; foresee an sachet-packaging workshop (aluminium sachet + cardboard packaging).

3-6 Financing

The working capital called for depends on the method of stocking the raw materials (the responsibility of the agricultural producer or the transformation enterprise).

A structured stocking must be established, taking into account the seasonal agricultural production and the continuous manufacturing and marketing of the product.

3-7 Other Specific Problems

- Pollution : as there is a considerable amount of pollution an anti-pollution installation must be set up (expensive : 20 % of investment, based on French regulations).
- Utilization of waste : waste as a result of peeling can be sold as animal feed (5-12 % of the tonnage of peeled potatoes).

4 - INDUCED ACTIVITIES

The production and storage of the potatoes or yams. The unit can also lead to subcontracting (minor mechanics, building, transportation).