

A GUIDE FOR A JUICE CONCENTRATING WORKSHOP

1 - PRESENTATION

1-1 Nature of the Activity

- The manufacture of juices allows for the utilization of tropical fruits which otherwise would not meet the requirements for fresh commercialization (notably export).
- One can extract the juice from the fruit and sell it directly to the consumer after pasteurization.
- One can also concentrate the juice to obtain a product :
 - . which is more easily preserved
 - . whose transport cost is reduced

Concentrated juices are then :

- . either sold as intermediate products intended for industry (domestic or for export: manufacture of juice, of fruit drinks, or flavourings and powders...),
- . or stored in the production plant itself, for redilution into fruit juice between harvests.

1-2 Alternatives

* Finished Products :

There are different means of preservation and levels of quality, different ranges, different destinations :

- Means of preservation : the international commerce of juice concentrates deals more and more (and almost exclusively) with frozen concentrates. There exist, however, three other means of preservation :
 - . aseptic packaging and preservation in positive cold (notably for apricots and tomatoes)
 - . pasteurized barrels (slowly disappearing)
 - . barrels or boxes preserved with SO₂.
- Range composed of numerous fruits, or of specialized production (1 or 2 fruits). The technologies being very different (notably at the pretreatment level) one finds more and more units that produce one product (citrus fruits, pineapple, passion fruit, etc.).
- Sale of intermediate products intended for industry or for use in the manufacture of juices from concentrate, and even the manufacture of jam using the same pretreatment.

- Finished products can be more or less concentrated : the degree of concentration is expressed in degrees of Brix (the concentration of soluble solids expressed in percentage of sucrose).

* Technology

The technological choices are linked directly to the finished products and the size of the unit.

- Concentrator :

. continuous with double or multiple effects : its permits low temperatures, and energy savings. It is adapted to large capacities,

. discontinuous : vacuum-concentrator, very flexible and adapted to small units.

This technology is being used less and less.

- Packaging :

. frozen concentrate in metal barrels (in general 220 l) with double polythylene envelope : by far the most frequently used..

. aseptic filling : delicate technology which permits preservation in positive cold (0°C to +2°C) used especially for apricots and tomatoes. For all ways, thermal treatment and rapid cooling are necessary.

. pasteurized barrel : easier preservation but problems with quality of products. This technology is slowly disappearing.

- Recycling of flavourings : volatile flavourings evaporate in heat treatment. It is important, therefore, to reincorporate the flavourings during the reconstitution of the drink or the juice destined for the consumers. Today, this reincorporation of flavourings is done by the manufacturer with two possibilities.

. addition of concentrated flavours : prepared by flavour makers from flavours supplied by juice concentrate producers (recuperation with evaporator),

. mixture of fresh juice with a base of super-concentrate (10 % fresh juice for example) : this is the cut-back technique.

Therefore the juice concentrate factory manufactures both juice concentrate and flavouring.

1-3 Types of Possible Units

3 main types of units will be discussed :

Unit A : large unit (3 to 5 tons of fresh fruit/hour), specializing in one product. It uses sophisticated equipment (continuous concentration, double or multiple effects with mechanical compression of steam). It sells competitive products on the international market in frozen packaging (or possibly aseptic packaging).

An orange juice concentrate unit will be illustrated (by far the leading product on the international market) delivering barrels of 220 litres of frozen concentrate to an intermediate clientele or big, important industries.

Unit B : medium unit (2 t/h capacity), relatively multi-functional : it uses a continuous concentrator with single effect. It sells a more or less classic range of frozen products for export.

Unit C : small unit (1 t/h), multi-functional, equipped with a discontinuous vacuum-concentrator, and sells 5/1 cans of pasteurized concentrate to the regional and domestic markets. The quality of the concentrate obtained is incompatible with international commercial standards.

This unit can be equipped with a dilution unit for the local market.

2 - TECHNICAL AND ECONOMIC GUIDE

2 - 1 Description of Unit

2.1.1. Finished Products

| Line | A 3 -5 t/h fresh fruit | B 2 t/h fresh fruit | C 1 t/h fresh fruit |
|--|--|---|---|
| Range of fruit (examples) | 1 fruit (orange) | Limited range | Large range (pineapple, orange, lime, mango, guava, passion fruit) |
| Type of packaging | Frozen metal barrel with polyethylene sack | Frozen sacks pasteurized | pasteurized (+ diluted juice not described here) |
| Size of packaging | 220 l | 5 and 10 Kg frozen sacks | cans 5/1 |
| Production - daily - annuelle (150 days base) | 300 to 500 Kg/h of concentrate 42° Brix 600 to 1000 t/year | 200 Kg /h of concentrate 42° Brix (orange equivalent) 400 t/year | 100 Kg/h of concentrate 42° Brix (orange equivalent) 200 t/year |

2-1-2 Technological Choices

| OPERATIONS | TECHNOLOGICAL OPTIONS | SOLUTIONS | | |
|---|---|---|--|--|
| | | LINE A : 5 t/hr | LINE B : 2 t/hr | LINE C :1 t/hr |
| <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Reception</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Washing-Sorting</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Preparation</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Slicing, crushing or pressing</div> <div style="border: 1px solid black; padding: 2px;">Straining, Refining</div> | <p>Pre-treatment line more or less mechanized</p> | <p>Pre-treatment line mechanized, specialized (orange)</p> | <p>Multipurpose production line with manual posts</p> | <p>Multipurpose production line with manual posts</p> |
| <div style="border: 1px solid black; padding: 2px;">Deairating</div> | <p>Necessary if pasteurization is done before concentration (prevents oxidation)</p> | <p>yes</p> | <p>yes</p> | <p>no</p> |
| <div style="border: 1px solid black; padding: 2px;">Pasteurization</div> | <p>Pasteurisation after concentration or before concentration</p> | <p>before concentration</p> | <p>before concentration</p> | <p>After concentration</p> |
| <div style="border: 1px solid black; padding: 2px;">Concentration</div> | <p>Evaporator: - continuous, multiple effect - discontinuous -- vacuum with or without recovery of flavours</p> | <p>Double effect evaporator capacity: 4.2 t/hr</p> | <p>Continuous single-effect evaporator Capacity :1.7 t/hr - Finisher : smooth surface heat exchanger</p> | <p>Discontinuous vacuum-evaporator : 1 t/hr</p> |
| <div style="border: 1px solid black; padding: 2px;">Freezing</div> | <p>Prechilling in smooth surface heat exchanger before packaging or direct freezing Plate or cart freezer</p> | <p>Prechilling Smooth surface heat exchanger 1 t/hr</p> | <p>Direct chilling in a plate freezer</p> | <p>no</p> |
| <div style="border: 1px solid black; padding: 2px;">Pasteurization</div> | <p>- Continuous, spraying or bath - Discontinuous (autoclave or water bath)</p> | <p>Treatment before concentration</p> | <p>Treatment before concentration</p> | <p>Discontinuous with autoclave</p> |
| <div style="border: 1px solid black; padding: 2px;">Aseptic Packaging</div> | <p>Barrel with double envelope for aseptic filling (no alternative)</p> | <p>no</p> | <p>no</p> | <p>no</p> |

2-2 Economic Analysis

2-2-1 Investments

| Equipment | OPTION A | | OPTION B | | OPTION C | |
|---------------------------|--|---------------------|--|--------------------|--|--------------------|
| | Description | Price FOB US \$ | Description | Price FOB US \$ | Description | Price FOB \$ US |
| Preparation | Filling non-aseptic | \$ 200 000 | | \$ 150 000 | | \$ 110 000 |
| Treatment | | \$ 160 000 | | \$ 100 000 | | \$ 130 000 |
| Concentration Freezing | | \$ 500 000 | | \$ 320 000 | | \$ 130 000 |
| Packaging Treatment | | \$ 300 000 | | \$ 300 000 | Pasteurization | \$ 50 000 |
| TOTAL EQUIPMENT | | \$ 1 160 000 | | \$ 870 000 | | \$ 420 000 |
| Building : | - 600 m2 covered - receiving area 500 m2 - storage area (with pallox) 500m2 - cold chamber (not included) | | - 500 m2 covered - receiving area 500 m2 - storage area 300 m2 - cold chamber (not included) | | - 340 m2 covered - receiving area 250 m2 - storage area 100 m2 - cold chamber (not included) | |
| Other investments | | | | | | |
| - Electrical power | 200 KW | | 120 KW | | 80 KW | |
| - water * | 20 m3/h | | 10 m3/h | | 3 m3/h | |
| - vapour | 200 Kg/h | | 100 kg/h | | 50 kg/h | |
| Total investment | \$ 3 to 3.5 million | | \$ 2.2 to 2.6 million | | \$ 1.3 to 1.6 million | |

* washing water not included

2-2-2. Functioning

| LINES | A | B | C |
|--|------------------------------------|--------------------|-----------------|
| Labour | | | |
| - Skilled (by team) | 10 | 8 | 5 |
| - Unskilled (by team) | 50 | 30 | 15 |
| Total personnel (for two teams) | 120 | 76 | 40 |
| Consumption annual | | | |
| - Fruit | 8000 t | 4000 t | 2000 t |
| - Packaging | 4500 (220 l) barrels (recuperable) | 4000 (10 Kg) sacks | 40 000 cans 5/1 |
| Energy | | | |
| - Electricity | 300 000 Kwh | 168 000 Kwh | 100 000 Kwh |
| - Vapour | 200 t | 100 t | 50 t |

3 - KEY FACTORS TO THIS PROJECT'S SUCCESS

3-1 Supply

It is necessary to have access to abundant raw materials at a competitive price, with a time lapse between harvest and processing of not more than one to several days. The duration and schedule of harvest determine the occupation rate of the unit and its economic return.

One may foresee contracts for supply (with advice on cultivation, conditions of sale, and premiums according to quality) to prevent competition with fresh market.

3-2 Technology and Equipment

The most delicate point in the process is found at the level of heat treatment, which affects the quality of the final product :

. risks of :

- evaporation of the flavourings
- a "cooked" taste
- browning : particularly frequent in vacuum-concentrators.

3-3 Personnel

- Pretreatment calls for mechanical equipment.
- The concentration is delicate : automation and regulating of temperature require a specialized technician. Training in a juice concentrate unit is necessary.

3-4 Quality Control

- Normal controls :
 - . dry matter
 - . acidity
 - . relation of sugars/acid
 - . microbiology
 - . colour.

A small laboratory should be set up in the unit.

- Control of the performance of equipment and the quality of the juice : identification and measure of volatile products with measuring instruments or with developed sense of smell.

3-5 Distribution and Commercialization

- For export, foresee stock (1 season at maximum) to permit a certain commercial flexibility regarding these speculative products. These products are easily preserved.
- Foresee the volume of the cold chamber and the cost of preserving frozen products.
- An excellent knowledge and following of the international market are necessary. An introductory commercial partner who knows everyone (or a working manager, who works directly with the unit) is recommended.
- On the local market.

3-6 Financing

- The ratio of investment/turnover is not high, but the stock of finished products (and sometimes wrapping) may necessitate significant working capital (no stock of raw materials).

3-7 Other Specific Problems

- Treatment of waste : possible valorization in cattle feed or compost.
- For export to the EEC (European Economic Community), pay attention to sugar content.

4 - INDUCED ACTIVITIES

- Development of contracts with producers. The unit consumes from 1 to 5 tons/hour, or 2,000 to 10,00 tons of fruits a year.(Seasonal activity which depends on harvest).
- Depending on the local market, possibility of planning a unit for redilution of concentrated juice and distribution of drinks (carbonated or not).
- Possibility of starting a jam factory using the same pretreatment equipment for fruit.
- Possibility of developing the extraction of essences (synergy possible at the level of raw materials and of sales).
- Utilization of waste can be studied (possibility of extraction of pectin from dried orange peels...).

The unit will lead to the development of subcontracting (minor mechanics, building, transport).