



*LIFE Environment and Resource Efficiency*

## **LIFECITRUS**

# **B1 Design and implementation of the demonstration plant**

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## **DESIGN CHARACTERISTICS OF THE NEW NECESSARY MACHINE AND INSTALLATIONS TO BE ACQUIRED AND INTEGRATED IN CTC PILOT PLANT.**

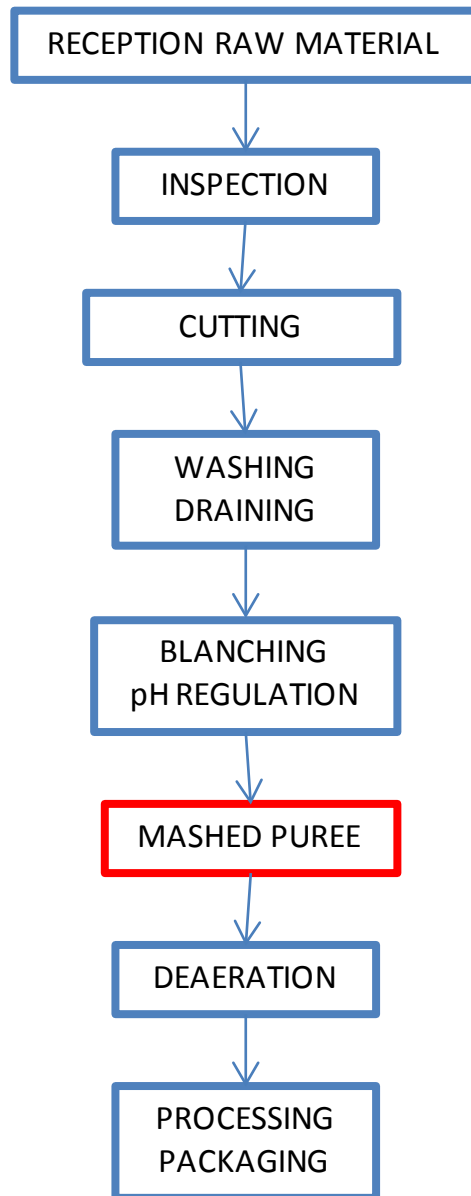
The propose process for the treatment of the citrus industry scrap at CTC pilot plant is in order to transfer the technology to the agroindustry sector, it is to demonstrate at semi-industrial scale the effectiveness of this innovative process, accurately define all the involved parameters, determine the specifications of the obtained products and verify the economic balance and feasibility of the method.

Most of these techniques are common at food industry (washing, rinsing, and cutting) and canned industry (blending, heat treating, and packaging). These unit operations are frequently applied in the food sector so a deep knowledge about its management is had. CTC has positively tested, at laboratory scale, an innovative process for treating residues coming from the citrus juice and citrus essential oil industries, particularly lemon discarded parts, with which a natural gelling ingredient is obtained to be used in the food industry. This method also works using other citrus fruits scrap, even with the rejected stuff from fresh citrus fruits packing or the citrus discarded rinds.

The proposed process is in accordance of laboratory scale results and it is based on physical operations only, no dissolvent or chemical agent is needed. This optimizes the production of a valuable citrus puree, with minimum water consumption and high performance rate, recovering hesperidin, essential oils, sugars, etc.

CTC already has a pilot plant installed in its industrial building in Molina de Segura (Spain). Throughout this action, this plant is been enlarged and improved to be usable as semi-industrial scale plant and perform the new process in optimal conditions. So firstly, It has been done the definition of the essential additional equipment to complete the plant for demonstration.

Proposed process is based on physical operations. It aims to optimize the production of a valuable fruit or vegetable semi-elaborated, with minimum water consumption, high performance rate, low energy consume, etc. The Diagram 1 represents the flow chart of the process of citrus scrap treatment to obtain high added value natural gelling agents (citrus puree) implemented at CTC Pilot Plant.



**Diagram 1.** Flow chart of citrus puree

The different steps of the process consist in the following operations:

- **Reception of raw material:** By-products will be stored under refrigeration conditions (4°C) until their processing, no more than 1 day.
- **Inspection:** Rotted by-products will be discarded and only those with a good appearance will be used in the food process.
- **Cutting:** In this step will be use a cutter Urschel (**picture 1**) model GK-A for producing crinkle dices or crinkle strip cuts of 8x8 mm of the citrus peel.



**Picture 1.** Cutter Urschel

- **Washing and draining:** The objective of this step is elimination of essential oil of citrus peel and other bitter compounds. This operation will be carried out in a vegetable washer and centrifuge. It consists of 2 tanks for washing (**Picture 2**) and 1 tank for draining water (**Picture 3**). The tank bottom is profiled for total water discharge. It has automatic loading and unloading water, timer for regulating washing time and an automatic washing system with air burbling.



**Picture 2.** *Vegetables washer (FMA). (FMA)*



**Picture 3.** *Vegetables Centrifuged (FMA)*

- **Blanching and pH regulation.** The product obtained, after washing and centrifugation steps, will be heat up to 100°C in a open tank with a steam jacket (FMA, **picture 4**) for enzymatic inactivation. In this step the pH have to be regulated below 4.6, if it necessary a lemon juice will be use for regulation pH of the citrus puree.



**Picture 4.** *Open tank with steam jacket (FMA)*

- **Mashed puree.** This stage of the process cannot be performed at semiindustrial scale with the current available equipments of CTC pilot plant. Then, the device to be incorporated is a "high speed knife cutter" with the following main technical characteristics: Bucket capacity: 40 l. Full stainless steel construction, according to UE requirements, fitted with 2 independent engines, control panel by switches, with electric control panel and knife holder for more 6 knives. The objective of this equipment is for obtain a finishing liquid or slurry of citrus puree, available for use like food ingredient.

It has been required 5 different offers of high speed Knife cutter for obtaining a finished puree with a maximum particles size down to micro dimensions.

- **Deaeration.** In this step the oxygen present into finished puree is eliminated by a vacuum system (**picture 5**). This equipment consist in a 300 liters tank (HRS) connected to a vacuum pump. It is necessary the oxygen evacuation of the product to avoid oxidation reactions of nutritional and sensorial properties of the puree.



**Picture 5.**Deaeration tank (HRS)

- **Processing and packaging.** It is foreseen to pack these purees in a "bag-in-box" aseptic system (HRS) (**picture6**), after a controlled heat treatment "HTST" of 1 minute at 93,3°C and cooling down 25°C before aseptic packaging in aseptic bags of 10 liters. If this heat treatment process leads to a short shelf-life or sensorial degradation occurs, freezing preservation system will be used as an alternative to heat treatment using a cryogenization tunnel (Linde) (**picture 7**), after deaeration

step, the finished puree will freeze at  $-18^{\circ}\text{C}$ . CTC pilot plant has both “bag-in-box” aseptic filling system and freezing preservation system.

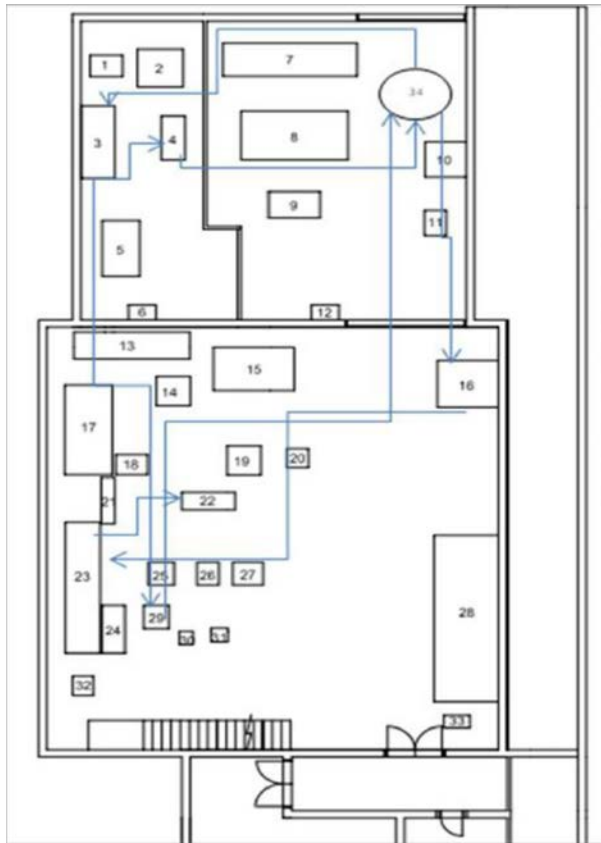


**Picture 6.** “Bag-in-box” aseptic filling system (HRS)



**Picture 7.** Freezing preservation system (Linde)

The equipments of citrus waste treatment, according with the proposed new process in flow chart (**diagram 1**), are distributed in CTC pilot plant according with **diagram 2**.



- 4-Inspection table
- 5- Cutter
- 3- Washer and drainer
- 32- blancher
- 25- Deaerator
- 29-23-22 HTST
- 7- Freezer

**Diagram 2.** *Distribution of CTC pilot plant equipments*

At CTC pilot plant exist facilities to supply electricity, water and steam to the new device, not being necessary any investment to connect installations.

In the same way, the semi-industrial plant will use lighting, security, loading and unloading, sewage treatment, waste management and all the available CTC facilities, without changes.