



LIFE TERPENE PROJECT

CONTENTO TRADE SRL

Technological innovation for the environment

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New process for the extraction of terpen and other products of high added value by processing citrus fruits residues



BRIEF DESCRIPTION:

Partners:

Contento Trade srl, Campofornido (UD), Italy
Vomm srl, Rozzano (MI), Italy
Master Green srl, Orciano (PI), Italy
Amici della Terra, Roma, Italy
Geopolimeri srl, Rossano Veneto (VC), Italy.

Objectives:

The main aim concerns the testing of turbo technology applications at pilot plant level, in citrus paste sector (the residues which are linked to the citrus juices production).

It includes:

A series of pastes treatments and working processes, which could guarantee a potential economic profitability to waste producers. A good quality of products and environmental advantages. The most innovative phase of the project is represented by PIDIC process, which is a recently patented thermomechanical treatment, useful for essential oils and terpenes extraction (from citrus peels), without changing aldehydes content

OBJECTIVES:

The main objective of the project was to test at pilot plant level some application of the turbo technology in the field of the organic residues of citrus squeezing called "citrus fruit pulp" (in includes peels, seeds and residues).

In the project a series of processes for citrus fruit pulp working was set up to:

- ✓ extract the oils contained in the peels utricles (terpenes, aldehydes, etc.);
- ✓ extract other interesting components (pectin, pigments) from the obtained extraction residues;
- ✓ the valorization of the final cellulosic residue.



The working developed processes shall guarantee:

- ✓ potential economical return for the residues producer;
- ✓ good quality of the obtained products;
- ✓ environmental benefits deriving both from the reuse of the citrus fruits wastes and from the solvent extraction, that shall represent a good alternative for the organic chlorinate solvents in many applications.

STATE OF THE ART

On the basis of FAO and FASS data for the years 1992-93, in Italy about 2.657.000 tons per year of citrus fruits are produced, while in the rest of Europe about 5.173.000 ton/year are produced. The main world producers are Brazil (15.259.000 ton/year) and USA (13.183.000 ton/year); totally the world production amount to 68.362.000 ton/year, with a growth rate over the 5%.

The industry uses yearly, only in Italy, about 800.000 ton/years of citrus fruits (CLAM data referred to 1995).

The main derivatives from the primary transformation consist in juices (about 300.000 ton/year) and in essences (about 2.000 ton/year).

The residual material, called “pastazzo” (citrus fruit pulp) is commonly landfilled, causing rise in costs for the companies working in this field and a danger for the environment.

Similar situation are found also in other countries producing citrus fruits, as Spain and Greece; in other Mediterranean countries as Tunisia, Israel, Morocco, Egypt and in other countries as Brazil, USA, etc.

In the meanwhile the growing interest towards the environmental aspects of the industrial production (sustainable development) aims at the drastic reduction of the use of products potentially toxic for the workers and users or hardly biodegradable as chlorinates solvents and many solvent paints.

So there is a growing interest by the industry to some kind of natural solvents, as terpene is, because:

- ✓ it's environmental friendly because it's not considered a toxic waste for EPA (American Environmental Protection Agency) and is not included in the EPA's



Chemicals of Regulatory Rules list, in which are listed all the substances that could lead to problems for the environment and for human health;

- ✓ it's not made or it doesn't contain any substance that could damage the ozone layer;
- ✓ is surely biodegradable, because there exist many studies developed by J. Rama Devi and P.K.Bhattacharyya by the Inorganic Chemical Department of Indian Institute of Science, and this confirms that the D-limonene (that is the scientific name of terpene) is used as a food by a soil bacterium (*Pseudomonias incognita*).

At industrial level they try to reduce the consumption of renewable primary resources, as the cellulosic flour obtained by trees, favouring and valorizing some alternative materials with reduced environmental impact (vegetable residues rich in cellulose produced by other working, alternative cultivation as the Kenaf, etc.)

MAIN INNOVATIONS

The most innovative part of the project is surely represented by the PIDIC process, a thermal mechanical treatment recently patented, that is used to extract the essential oils and the terpenes contained in the peel utricles without altering the content in aldehydes (aromatic fraction with high value).

With this treatment the citrus fruit pulp undergo a sudden shift from high temperature and pressure conditions to the vacuum.

This shift makes the utricles explode and the terpene mix comes out in volatile form. The mix is collected and separated in its fractions (essential oils and terpenes) with a condensation system. This process is very quick and can go on continuously thanks to a dynamic supplying system.

The citrus pulp treated with PIDIC process sustain an expansion with the generation of micro bubbles in their vegetal structure: this causes a clear increasing of the specific surface exposed to the air; this effect is called "texturization".

The texturization reduces the energetic consumption of the subsequent processes necessary to desiccate the de-terpened citrus fruit pulp.



RESULTS OBTAINED

Within this project a new process, called Life Terpene process has been set up, integrating the Vomm turbotechnology with an innovative pre-treatment technique of the citrus fruit pulp, called PIDIC, above described.

The Vomm process of turbo drying is based in the creation and the feeding of a thin strata of material in a state of strong turbulence, adherent to the internal wall of a heated cylinder; these strata exchange heat with the walls, with a high thermal efficiency. Consequently the stratum is desiccated rapidly, uniformly and without risk of burning.



Vomm process

The turbodried citrus fruit pulp can be produced in a controlled grain size; the grain size range is chosen according to the final product to obtain.

Thanks to the combined use of the two described plants, it's possible to obtain different products with high environmental compatibility and low costs from the citrus fruit pulp.

With the only PIDIC process it's possible to obtain:

- ✓ deterpenated essential oils, usable in the food industry with very low content of oxidized terpenes (that cause allergy) and of terpenic waxes (that cause instability in the product);



- ✓ Terpene (D-limonene), a natural solvent able to substitute in many industrial application very polluting chlorinate organic solvents as trichlor-ethane, trichlor ethylene, perchlor-ethylene;

With the:

- ✓ Pectin, usable in the food industry
- ✓ Pigments, usable in the coloring section
- ✓ Fillers for paper, substituting the mineral fillers traditionally used
- ✓ Combustible material with a good calorific value
- ✓ Flour for animal feedstuff, very healthy and with excellent nutritional characteristic
- ✓ Thermal insulation grains with characteristics really similar to cork

During the Life Terpene project , some innovative products -based on the by-products of the citrus fruit pulp - have been set up, as:

- ✓ Ecological paper "Citrus Paper"
- ✓ Paints for wood and metal
- ✓ Impregnating agents for wood and stones
- ✓ Ecological paintings for walls

MARKET PERSPECTIVES

On the basis of some estimation developed within the project and on the basis of the developed pilot scale tests, the economic profitability of many developed application is demonstrated.

For example, the extractive process PIDIC needs energetic consumption 10 time less than the traditional thermal techniques and has a yield superior of the 50% compared to the mechanical extraction techniques. The flour for animal feedstuff is obtainable by turbo drying at competitive costs compared to the vegetal feedstuff of similar nutritional properties (es. barley).

For example, a PIDIC plant that is able to treat about 15.000 tons/year of citrus fruit peels costs about 750.000 euros and allow to obtain about 71 tons of pure (99%) terpene, while a turbo drying plant Vomm costs about 1.500.000 euros and allow to produce 3.384.000 tons/year of flour for animal feedstuff.



PIDIC extractive process

So it's evident that this process offers to the juice, jam and other citrus fruits derivatives a valid opportunity to transform their difficult to landfill and expensive to manage residues in a series of products at high added values and desired by the market.

Only basing on these considerations, the environmental value of this Life Terpene process would result very high: on the basis of the life cycle analysis of the obtained finished products it resulted that the advantages of the process are not limited to the use of the residues as raw material, but imply a low energy consumption during the transformation phase, a better biodegradability and a better "sustainability" of the Life Terpene products compared to the ones actually on the market.