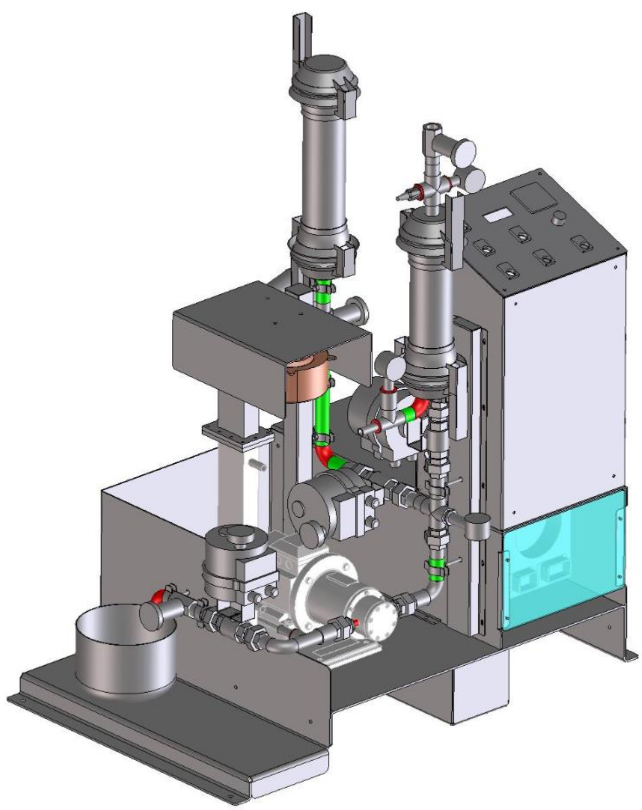
MICROWAVE REACTORE

CUSTOMIZED EXTRACTION SOLUTION FOR JUST IN TIME PRODUCTION

REDUCED ENERGY CONSUMPTION

REDUCED REACTION TIMES

INTRODUCE GAS REAGENTS, PRESSURES AND TEMPERATURES INDEPENDENT FROM THE PROCESS



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MICROWAVE TECHNOLOGY – EXTRACTION REACTOR

Extraction Reactor is developed there by increasing the overall efficiency of the processes and reducing pollution of the environment through the reduced use of solvent. The Microwave assisted Extraction technology is a high-speed method used for the extraction of selectively targeted compounds from various raw materials. Natural bioactive compounds include a broad diversity of structures and functionalities and some of those compounds can be found at very low levels, so that massive harvesting is needed to obtain enough amounts, and their structural diversity and complexity make chemical synthesis unprofitable.

A new Microwave approach - enhanced reactions for the green chemistry and the circular economy. The entry of microwave technology in the chemistry laboratory has made it possible to carry out many transformations with greater efficiency and ease of work. In recent years, the use of microwave has become very attractive for different field of applications so that many more microwave-assisted reactions will be deployed on the marked and they will simplify time consuming conventional procedures. The future for the application of microwave technology looks bright because of its efficiency and it's potential to contribute to clean products. The principal of microwave assisted chemistry is to very selectively apply a great quantity of energyinsidethereactionmixturethatistoimprovethereactionconditionswhilealso helping to safely improve productivity and to reduce operations costs.

USE OF THE REACTOR: EXAMPLES / APPLICATION AREAS

CHEMICAL-PHYSICAL:

→ Extraction of policosanols (with a high concentration of triacontanol)
→ Production of nano crystals

PHARMACEUTICALS:

→ Extraction of active ingredients to produce drugs

COSMETICS:

→ Extraction of active ingredients to produce creams and perfumes

FOOD INDUSTRY:

→ In addition to chemical reactions, microwaves can also be used in, for example food sanitation processes. In fact, as regards to the conservation process of the heat, currently conventional systems expose food to high temperatures for times long enough (necessary to break down most of the microorganisms or, for one sterilization, all microorganisms) causing significant variations in the chemical characteristics physical and organoleptic properties of food. The consequences that can be detected in the food are:

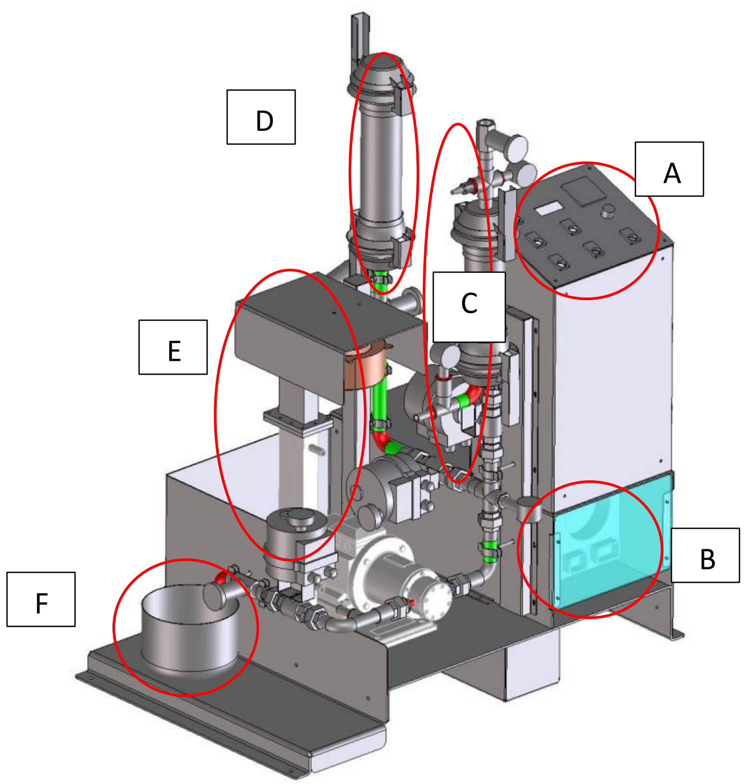
- Protein denaturation
- Oxidative rancidity and hydrolysis of triglycerides with increased acidity
- Caramelization of sugars
- Thermolability of some vitamins
- Changes in flavor, texture and color

Use microwave energy and pressure also for the processes that allow remediation of food with heat offers significant advantages for the speed in heating it allows to decrease the consequence described on the food, thanks to the lower exposure of the same to high temperature.

In this case, in the industrial sector, there are no machines that allow such treatments on liquids using microwave sources and checking parameters such as pressure and temperature.

- Pasteurization of liquid substances (for example fruit juice to break down microorganisms such as lactobacillus, Leuconostoc, yeasts and molds)
- Sterilization of liquid substances (for example beer to break down all microorganisms such as Bacillus macerans, clostridium, pasterianum, Bacillus coagulans)

DESCRIPTION OF THE REACTOR



Identification	Description
A	Control zone: Controls all the devices of the machine.
B	Power supply: area where all the electrical and electronic parts that supplies power to devices of the machine are installed.
C	Reactor: container inside which the reaction or the process takes place.
D	Secondary container: container for process cooling water or secondary reagents or machine cleaning water (or any product that must be used later than the start of the process).
E	Microwave heating zone: passage area where the product is subjected to microwave radiation.
F	Unloading area: product unloading area at the end of the process.

DIMENSIONS:

- → Width: 1300 mm
- → Height: 1700 mm
- → Depth: 800 mm

ELECTRICAL CHARACTERISTICS AND PRESSURE:

Operating voltage	400 Vac (3F + N + PE)
Frequency	50 Hz
Current	5A
Microwave	P installed = 2 kW
Total Power	
Adjustment Parameters	
Microwave	Total installed P 2 kW, adjustable from 25% to 100%
Heating cables resistors	Ability to preheat and maintain the reactor temperature and piping
Pressure	Adjustable from 0 to 6 bar
Possible use	In vacuum or in the atmosphere created by gas inerting

TECHNOLOGY BENEFITS:

The innovative device will bring the benefits of technology recognized in the field of microwave laboratory in industrial applications:

- ✓ Low environmental impact
- ✓ Total applied energy exploitation
- ✓ Volumetric heating and without contact
- ✓ High heating rate
- ✓ Good interacting with insulating
- ✓ Poor interaction with many non-ferrous metals and gaseous materials
- ✓ High yields of reaction
- ✓ Possibility of not resorting to the “classic” catalysts
- ✓ Advantage to carry out reactions without catalysts
- ✓ Opportunities to use water as solvent
- ✓ Low cost

Furthermore, the application in the innovative machine, the pressure regulating, and the temperature control will add additional advantages to the industrial application:

- Total control of the process as it happens in the laboratory
- Possibility of working with different pressures from those due to equilibrium given by the process, controlled by a special device (such advantage is also innovative compared to laboratory machines that maintain and control the pressures due to the process)
- Possibility of carrying out processes in the environment with the presence of depression or atmosphere created with inerting gas
- Possibility of maintaining constant process temperature, or to vary it in a controlled manner

PROCESS EXAMPLES

To give an idea of the advantages in the use of microwave in chemical reactions, it is reported in the table below a comparison between some performed reactions, assisted by microwave and conventional synthesis:

REACTION ASSISTED BY MICROWAVE	**TRADITIONAL REACTION**	
REACTION BIGINELLI		
- Temperature: 110°C - Time: 20 min - Scale 100 mmol	- Temperature: 80-90° C - Time: 4-8 h	- Temperature: 25°C - Time: 12h - Scale: 0.05 mol

- Excess urea 3% - Molar ratio: 1:03: 1:1 - Catalyst: HCI / EtoH (25 ml) - Yield 75%	- Scale: 0.01 – 1 mol - High excess of urea - Molar ratio: different - Catalyst: HCI / EtoH - Yield: 78%	- Excess of urea of 50% - Molar ratio: 1.5: 1:1 - Catalyst: HCI / EtOH (5 mL) - Yield: 70%
FISCHER GLYCOSIDATION OF GLUCOSE WITH METHANOL		
- Temperature: 140° C - Time: 40 min - Scale: 27 mmol - Molar ratio: 1:37 - Catalyst: acetyl chloride - Yield quantitative	- Temperature: 70-75° C - Time: 8-24h - Scale: 0.01 – 10 mol - Molar ratio: different - Catalyst: different acids - Yield: 80%	
POLYCONDENSATION OF Ɛ-CAPROLATTAME		
- Temperature: 200° C - P: 50 mbar - Time: 45 min - Scale: 25 mmol - H 2 O: 10-25 mmol - Yield: 80%	- Temperature: 250°C - P:> 1 bar (vial) - Time: 4 h - Scale: 25 mmol - Catalyst: HCL (1 drop) - Yield: not determined	
ESTERIFICATION POLICOSANOL FROM BEESWAX		
- Temperature: 120° C - P: 6 bar - Time: 21 min - Yield: 90% - Scale: 1g	You cannot run the esterification process with conventional reactions. The know processes are based on the saponification or hydrolysis, which have the disadvantage of having a very low yield, high process costs and demand for long time.	