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CASHEWS!

a delicious gift from nature
of which nothing is wasted!

01/07/2025 *(dd/mm/year)*

technology introduction

something about us

We study and develop, on industrial-scale, systems capable of transforming the causes of pollution into a source of wealth.
Our patents range from the denaturation of asbestos to the treatment of almost every type of waste, from water purification to the production of aluminum without waste.
What's the point of devastating the environment around us to collect a few crumbs of resources when we can use our technologies to live great and achieve anything in a sustainable way?

Our goal

Since we don't have a second home were to go, we need to make our planet more livable without stopping technological development!
Our goal is to make our planet more livable without stopping development.
For this reason we have developed industrial systems that transform the causes of pollution into an immediately usable source of opportunities: low-priced raw materials ready to be reused through further sustainable processes.
Let's protect nature without stopping progress!

Smartly sustainability

Mission:

- **Social progress**
- **Clean environment**
- **Wealth production**
- **Sustainable Development**

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- acceleration of natural processes without organoleptic alterations
- contained implementation costs
- minimum maintenance: a few hours a year to check seals and bearings
- mature technology as it has already been used for nearly 20 years in various fields
- possibility of killing bacteria, microorganisms, viruses and pathogens

who we are...

We born close to the COVID pandemic. We immediately became a meeting point for numerous professionals, research institutions and production companies. All this started in Italy and is now spreading to other countries.

Often our projects precede the times of several years.

Our proprietary technology is totally innovative **but consolidated** and is essentially based on: cavitation, gasification and Coanda effect.

After having implemented and made the above more effective, we have adapted it to everyday life by creating complete processes whose application increases both the quantity and quality of the products obtained, decreasing energy requirements but paying great attention to the creation of a greater number of jobs compared to those eliminated by mechanization.

In addition to the real innovations, we are specialized in engineering and then applying improvements of technologies, mature in their field, to other areas often obtaining, this way, several real technological leaps simply because we had the courage to do what was before under everyone's eyes but no one dared to put it into practice.

We develop technology both independently and in collaboration with Universities (Sassari, Perugia, Amsterdam, Algarve, etc.) or with other public institutions (for example the National Research Center - CNR, Fundación Circe etc.).

We boast a vast proprietary product portfolio with several pilots viewable, by appointment, and several completely innovative process lines.

Some of our products have been defined extremely innovative and promising at international events by panels composed of scientists from all over the world. Our technology and our demo site have been deemed valid and usable in several Horizon Europe projects.

Our patents and innovations have made us immediately designate as members of technology suppliers within the Italian Biogas Consortium.

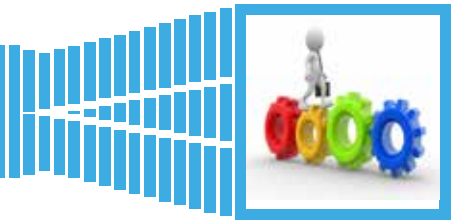
We have a framework agreement with RINA Consulting - Centro Sviluppo Materiali S.p.A. which allows us to request their supervision and therefore also to certify the production and engineering phase of our products wherever we choose to produce them. Therefore, choosing us also gives access to all the wealth of experience and technology gained in over 70 years by Centro Sviluppo Materiali which, I remember to everyone, was since its establishing the research and development department of IRI (Institute for Italian Industrial Reconstruction, among the top 10 companies in the world by turnover up to 1992).

Numerous specialized industrial plants, centres of excellence on their specific sectors, have made the production slots we need available to us; we are equipping ourselves with proprietary factories to carry out final assembly and to start specific productions.

We are present with companies in numerous European countries. We are opening companies in several African countries and in Asia. We have projects underway in various European, African and Asian countries. Our international staff represents our essence: motivated people with a wealth of personal experience who believe in what they are doing and who come from many different countries. In every nation in which we appear we respect local customs and traditions, bringing a bit of Italianness to the place and "*stealing*" part of their culture to ensure that no one is a ***Stranger in a Strange Land***.

Dr Bruno Vaccari

… and what we do



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- HOSPITAL EQUIPMENT
- SOIL WASHING
- WATER TREATMENT
- WTE & WTC
- DESALINIZATION

OUR MAIN GOAL: environment and workers' conditions respect

our core team

Bruno Vaccari

CEO

Sabrina Saccomanni

LAWYER

Fabrizio Di Gennaro

CMO

Antonio Demarcus

CTO

Paolo Guastalvino

CIVIL WORKS

Gianni Deveronico

LEAD ELECTRICAL ENGINEERS

Faris Alwasity

ENGINEERING

Massimiliano Magni

ENGINEERING

Antonio Piserchia

COMMUNICATIONS EXPERT

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Papa Ndiamé Sylla

COO Senegal

Noel Sciberras

COO Malta

Appiah Fofie Kwasi

COO Ghana

Eugen Raducanu

COO Romania

Awa Khady Ndiaye Grenier

COO Guiné-Bissau

Giorgio Masserini

Marketing

Pantaleo Pedone

Italian energy-intensive

Gianluca Baroni

Hospital Stuff

Stefano Diambu Nkazi

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CCIMRDC Italie

cashews

A cashew plant is a tropical plant that is sensitive to the cold and does not do well in temperate regions. However, as long as conditions are otherwise favorable, they can grow in warm climates around the world: its range extends just beyond the limits of the tropics, between 25°N and 25°S, wherever the average minimum temperatures do not fall below 16 °C, and drops below 10 °C are rare: it does not tolerate frost. The tree, however, is very resistant to drought and grows even in areas with around 500 mm of annual rainfall: it is well-adapted to hot lowland areas with a pronounced dry season, where the mango and tamarind trees also thrive.

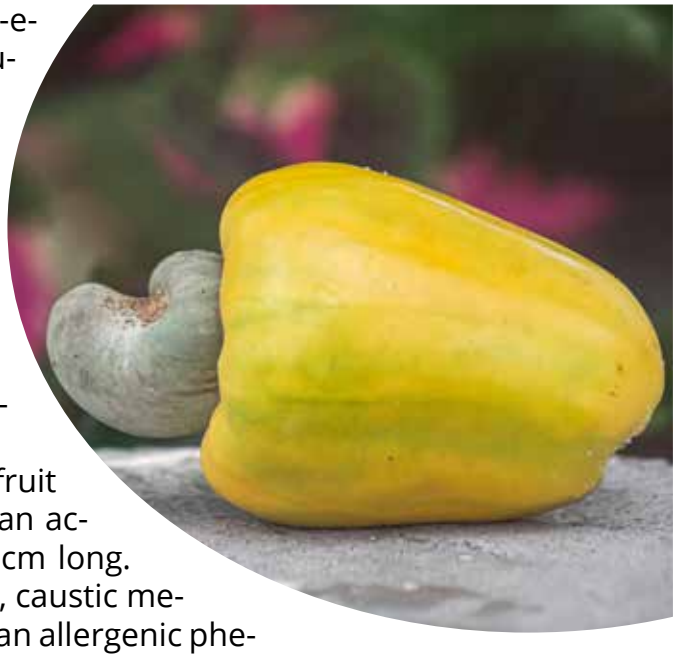
It takes three years from planting before it starts production, and eight years before economic harvests can begin. More recent breeds, such as the dwarf cashew trees, are up to 6 m tall, and start producing after the first year, with economic yields after three years.

Cashew farming, outside of harvest season, is relatively low maintenance requiring minimal agricultural inputs

The cashew nut yields for the traditional tree are about 0.25 metric tons per hectare, in contrast to over a ton per hectare for the dwarf variety. Grafting and other modern tree management technologies are used to further improve and sustain cashew nut yields in commercial orchards. The tree produces wood as well as for a gum that is similar to gum arabic. The resin within the shells of the fruit is used as an insecticide and in the production of plastics; it also is important in traditional medicines.

Cashews are the seed of the fruit of a tropical tree native to South America, more specifically, it

is native to the north-east of Brazil and the south-east of Venezuela but is quite widespread throughout the tropics, where it was introduced by the Portuguese in the sixteenth century.
In India and sub-Saharan Africa it has even naturalized, forming extensive forests.
The tree has a tortuous, pinkish and not very tall trunk, normally between 5 and 10 meters in cultivation, 15 m in nature.
The fruit is shaped like a kidney, and is a nut. Each is encased in a hard shell, sometimes referred to as a “pod” or “drupe”.



The edible part is the seed inside the drupe. The fruit grows at the base of a yellow or red false fruit, an accessory fruit, called “cashew apple” about 5–11 cm long.
The walnut has a smooth epicarp and a resinous, caustic mesocarp. This layer surrounding the seed contains an allergenic phenolic resin, anacardic acid. The hard exterior shell of cashews contains an oil called urushiol.
The false fruit derives from the hypertrophic development of the flower peduncle and the receptacle (in a process similar to what happens with the apple widespread in Europe). It has the shape and size of a small pear and contains an edible, fleshy, succulent, sugary and astringent pulp, from which highly appreciated juices are obtained.
The cashew apple is used also in jams, and jellies, though most cultivation is directed toward production of the valuable seed crop.
Almost all cashews produced in Africa between 2000 and 2019 were exported as raw nuts which are much less profitable than shelled nuts.

as food

There is no real system of cultivars selected in the various producing countries. Generally we rely on the characteristics of the plant, such as the height, color and more or less developed size of the false fruit, or on the commercial, American and Indian typology.
The American type is characterized by a large and juicy false fruit, while the Indian one has a small pome of little interest, which is why it is used exclusively for walnuts.
The harvest takes place towards the end of summer.
Cashews are a source of fatty acids with protective properties for cardiovascular well-being and antioxidants which can also protect the health of the heart and arteries.
Copper can also improve antioxidant defenses, but that's not all: this mineral, a fundamental component of many enzymes, contributes to the production of energy and the development of bones, connective tissues and melanin present in skin and hair.
Eating cashews can also be good for bone health due to the magnesium contained in these seeds, which also helps control nervous and muscle tone, thus counteracting muscle spasms, high blood pressure, tension, migraines and fatigue.
However, cashews also contain oxalates, which, in high concentrations, can promote the formation of stones. For this reason, their consumption may not be recommended for people with kidney or gallbladder problems.
Their inclusion in the field of "good" foods is due to the progress of scientific research, which has identified in cashews the preponderance of a type of monounsaturated fatty acid, oleic acid, which is very precious and friendly to health.
In fact, this fatty acid, better known as Omega-9, helps reduce cholesterol, high triglycerides and decreases the risk of heart disease and stroke.
Furthermore, these good fatty acids, together with the presence of tryptophan, carbohydrates, B vitamins and iron also act as promoters for good mood and to ward off anxiety.
Walnuts proper, rich in oil and with a characteristic flavor, are commonly used in South and Southeast Asian cuisine and are a characteristic ingredient of numerous South Indian chicken and vegetarian dishes.
In Western countries they are mainly consumed as a snack rich in high-quality proteins.
The properties of cashews overall resemble those of other

oilseeds of the nut group, especially those of walnuts and hazelnuts. Therefore they represent a significant but lower caloric source than that of other nuts (about 500 calories per 100 g), and their lipid component (about half their weight) is very significant.
A small portion of 30/40 g of cashews is enough to fill up on health without exceeding the calories. Cashews are perfectly suited to snacks to break hunger between meals, allowing you to face the table without that aggressive feeling of hunger that leads to consuming beyond your needs.
These nuts constitute a very rich source of nutrients which, like other nuts or oilseeds, are particularly suitable for those who need a very caloric diet with high nutritional value.
100 grams of cashews contain:

Edible part (%)	100		Iron, mg	6		Vitamin B1, Thiamine, mg	0,2
Water (g)	3		Calcium, mg	45		Vitamin B2, Riboflavin, mg	0,02
Protein (g)	15		Sodium, mg	16		Vitamin C, mg	0
Lipids(g)	46		Potassium, mg	565		Vitamin B3 or Vit. PP, Niacin, mg	1
Cholesterol (mg)	0		Phosphorus, mg	490		Vitamin B6, Pyridoxine, mg	0,43
Available carbohydrates (g)	28,8		Zinc, mg	6		Total folate, µg	68
Starch (g)	23,2		Magnesium, mg	260		Pantothenic acid (Vit. B5), mg	1,08
Soluble sugars (g)	5,6		Copper, mg	2,00		Vitamin B8, Biotin, µg	13
Total Fiber (g)	3		Selenium, µg	12		FAT-SOLUBLE VITAMINS	
Energy (kcal)	544		Chlorine, mg	18		Vitamin E (ATE), mg	1
Energy (kJ)	2258		Iodine, µg	11		Vitamin K, µg	34,1
			Manganese, mg	1,8			
			Sulphur, mg	380			

beyond the nut!

Although in non-cashew producing countries there is a tendency to believe that only the cashew nut exists, in reality this represents only a small part of the entire fruit complex. The apple constitutes 75% by weight, the actual walnut just 10%. Of this remaining 90% nothing is thrown away.

Ripe **cashew apples** can be eaten fresh, cooked in curry, or fermented in vinegar, citric acid, or an alcoholic beverage. It is also used to prepare preserves, chutneys, jams and is used to flavor drinks, both alcoholic and non-alcoholic. Cashews are more widely marketed than cashew apples, because the fruit, unlike the nut, bruises easily and has a very limited shelf life. It has a slightly astringent taste and are usually used in the preparation of a variety of products, including cashew juice (CAJ), jams, jellies, ice creams and other laboratory-prepared products such as burgers, pastries, cakes, granola bars, etc.

The **cashew kernel** is enclosed in a reddish-brown membrane called the husk, which represents approximately 5% of the total nut. In the outer skin of the cashew there is approximately 25% tannins (it is a chemical substance present in plant extracts), which has properties similar to those of the wattle bark used in the leather industry. The foam is waste, but the tannin content makes it a high-value product for the development of thermostable environmentally friendly compounds. Cashew husk is used in emerging industrial applications, such as adsorbents, composites, biopolymers, dyes and enzyme synthesis. In recent years the head has also been added as an alternative food to wheat bran in the diet of pregnant sows.

Cashew bagasse is rich in organic compounds and could be a valuable source of materials suitable for the production of bioethanol (a liquid fuel obtained from the fermentation process of agricultural products with high sugar content) and other microbial products through biological processes.

Cashew shell oil, also known as **CNSL**, is a caustic liquid rich in non-isoprenoid phenolic lipids and makes up 15 to 30 percent of the cashew shell. It is a viscous liquid that is greenish-yellow or reddish-brown in color. Recent studies highlight its enormous application potential in the pharmaceutical field, in the formulation of resins, coating and lining materials, laminates, adhesives, biofuel derivatives and insecticides. It can in fact completely or partially replace some currently very polluting “ingredients” used in the development of the products listed above.

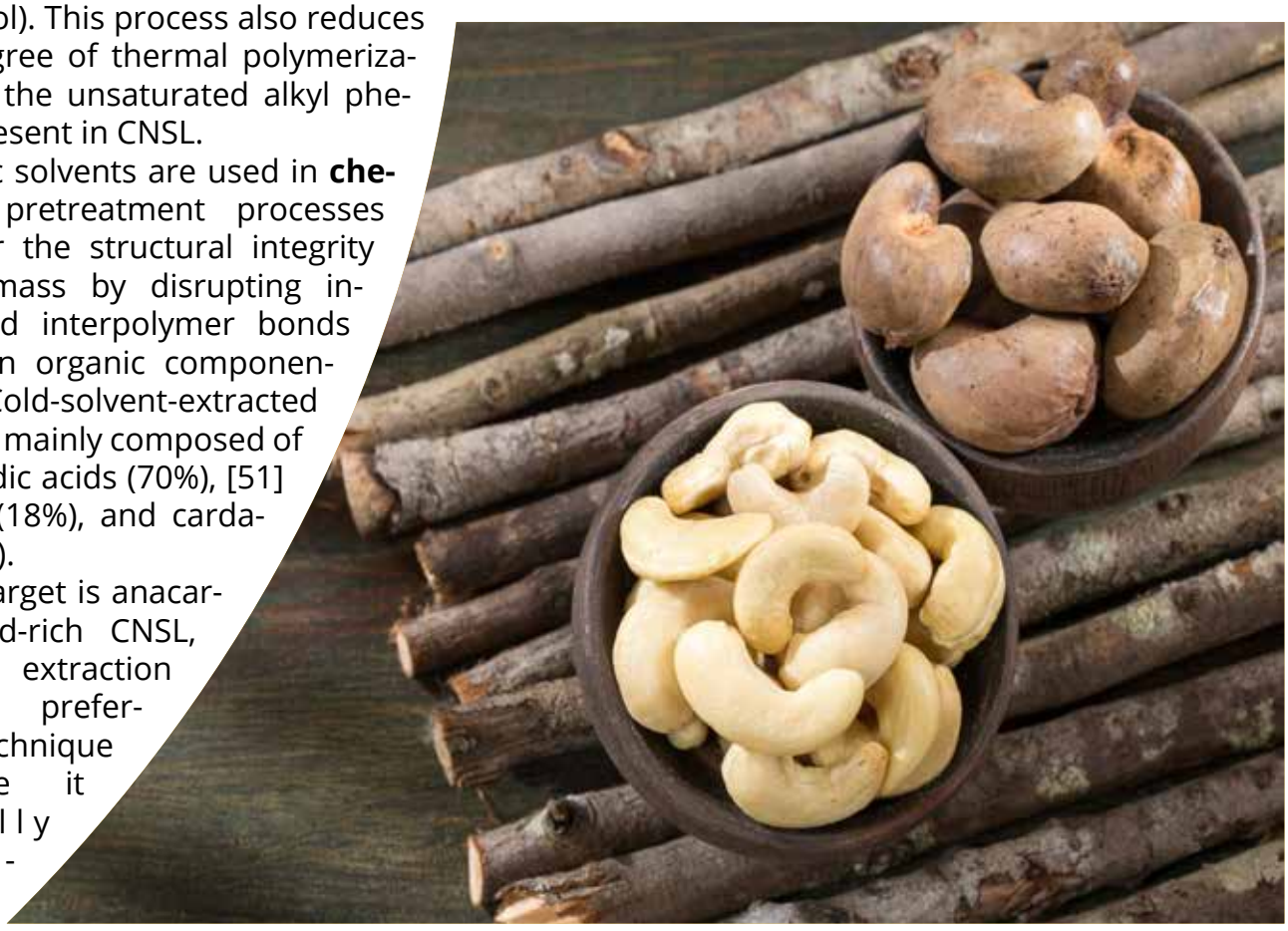
The same nut can be used to produce **cashew oil**, which is a dark yellow oil derived from pressing cashews and is used for cooking or as a salad dressing. The oil is considered of the highest quality and is produced by a single cold pressing.

transformation des noix

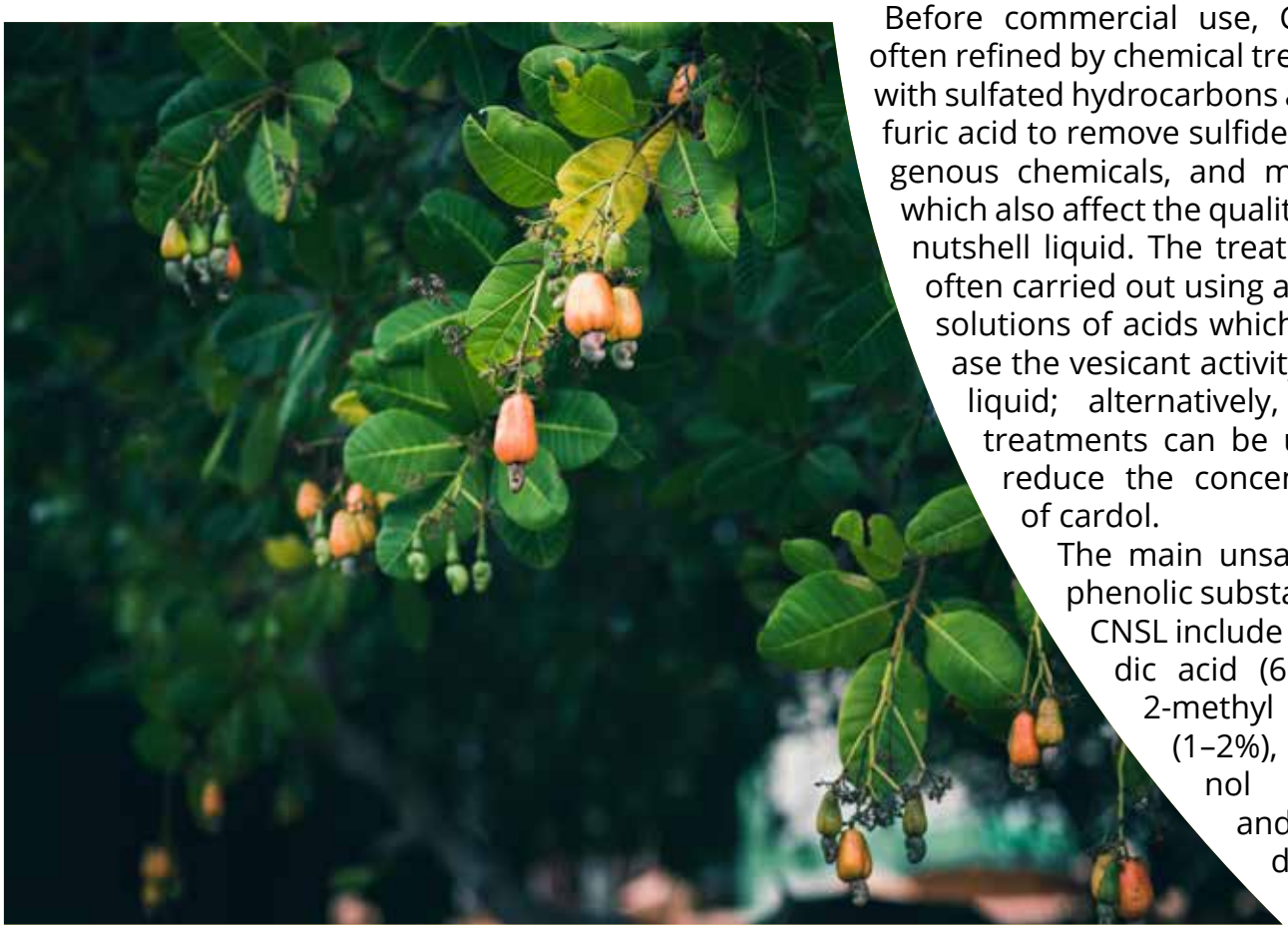
Ce système a été pensé et conçu pour obtenir une quantité homogène de produit de même calibre pouvant ensuite être traité par les décortiqueuses.
Le système est conçu pour charger des noix en vrac et les restituer propres, ensachées et calibrées sur la base d'une taille nominale qui varie de 18 à 30 millimètres.
Les noix brutes sont nettoyées des corps étrangers et ensuite passées dans des cylindres équipés d'ouvertures en forme de "tube" qui garantissent que le produit ne tourne pas sur lui-même, permettent un calibrage homogène et uniforme et assurent enfin une variabilité limitée de la taille de la noix. au sein de la même classe de calibre.
Ensuite, les noix sont transportées vers un four à vapeur continue, un tunnel, doté d'une trémie de chargement avec préchauffeur. La chaleur est extraite du biodigesteur ou du gazogène ainsi que l'énergie électrique nécessaire au système.
Il suit la ligne de décorticage automatique qui permet de décortiquer et de séparer les noix calibrées en différentes tailles. Après le décorticage, les noix de cajou sont automatiquement séparées des coques, prêtes pour la prochaine étape de séchage et de pelage.
Le séchage est effectué au moyen d'un séchoir continu, deuxième tunnel, composé d'un ou plusieurs modules, en fonction des besoins en capacité de séchage souhaités. A la fin du système de séchage, un dernier module est placé dans un but inverse aux précédents : il refroidit les noix de cajou.
Les noix sont envoyées à l'éplucheur à géométrie cylindrique. À l'intérieur, ils entrent en contact avec les ressorts, montés sur un arbre excentrique, qui pendant la rotation effectuent délicatement le pelage tout en préparant l'écrou à l'action ultérieure de l'air comprimé.
Le cylindre de l'éplucheur est perforé pour faciliter l'entrée et la sortie des noix, tandis qu'une trémie évacue les peaux ainsi détachées. L'air comprimé à haute température retire la tête de l'écrou.
Les noix de cajou sont enfin emballées sous vide tandis que les coques et les peaux sont envoyées au processus d'extraction CNSL.

CNSL

CNSL (***Cashew nutshell liquid***) is a natural resin with a yellowish sheen found in the honeycomb structure of the cashew nut shell and is a byproduct of cashew nut processing.
The percentage of CNSL is approximately 15 – 30% of the weight of the cashews. Approximately 3.3 kg of cashew shells are needed to produce 1 kg of CNSL, and approximately 20% of the nut shell oil is found in raw cashews.
To extract it, we start by pre-treating the biomass of cashew shells.
There are numerous pretreatment techniques, each with advantages and disadvantages. They can be substantially divided into four categories: mechanical, thermal, chemical and pyrolytic extraction.
CNSL can be **mechanically** extracted using a screw press or panel. Using this technique, natural CNSL is extracted from raw cashew shells by applying intense pressure. The extraction process is quick and simple and produces high-quality CNSL.
By roasting nuts at 180–185°C, **thermal** extraction causes the anacardic acids to decarboxylate, thus breaking the shell cells and releasing the oil. Open pan roasting, drum roasting, and hot oil roasting are all thermal extraction methods. The extraction process uses higher temperatures to convert anacardic acid into cardanol. Accordingly, a thermal extraction strategy is applied when the target is cardanol-rich CNSL. Distillation of this material provides a technical distillate CNSL containing 78% cardanol and 8% cardanol (cardanol has one more hydroxyl group than cardanol). This process also reduces the degree of thermal polymerization of the unsaturated alkyl phenols present in CNSL.
Organic solvents are used in **chemical** pretreatment processes to alter the structural integrity of biomass by disrupting intra- and interpolymer bonds between organic components. Cold-solvent-extracted CNSL is mainly composed of anacardic acids (70%), [51] cardol (18%), and cardanol (5%).
If the target is anacardic acid-rich CNSL, solvent extraction is the preferred technique because it usually produces

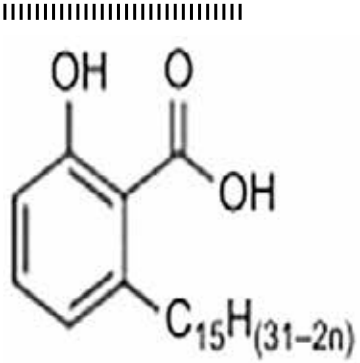


more CNSL than other techniques.
Since organic solvents are dangerous, their use in the extraction process leads to a number of unwanted effects on both the environment and human health. Cost is another issue due to the large quantities of solvents needed in many cases.
To overcome these problems, the extraction takes place via **hydrodynamic cavitation** in water inside the **EMPOWERING DEVICE**: thus both the mechanical and thermal effects are combined. In fact, the bubbles that form during the physical phenomenon explode and generate very high but limited temperatures and also generate micro-hydro jets that destroy the cell walls. The system has been used for the extraction of olive oil with notable advantages; in fact, the maximum temperature that the solution can reach is 30°C, a temperature that avoids the deterioration of thermosensitive molecules such as polyphenols.
The properties of CNSL acquired through the various extraction procedures vary to a certain extent: they are in effect extracts with different properties and quantities. The cold pressing solvent extraction method of CNSL needs to be elaborated to remove metallic impurities and residual sulfur compounds.
The properties of this treated CNSL differ from those of raw CNSL. With a better understanding of each extraction process, an appropriate strategy can be chosen to obtain a high yield of CNSL, a desired ingredient in CNSL, or favorable properties of CNSL.

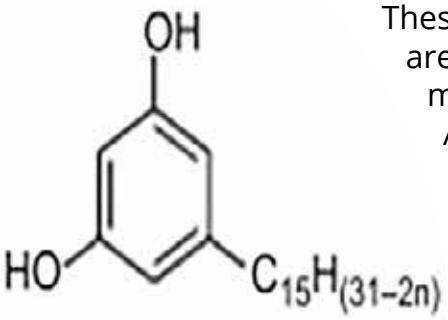


Before commercial use, CNSL is often refined by chemical treatment with sulfated hydrocarbons and sulfuric acid to remove sulfides, nitrogenous chemicals, and minerals, which also affect the quality of the nutshell liquid. The treatment is often carried out using aqueous solutions of acids which decrease the vesicant activity of the liquid; alternatively, amine treatments can be used to reduce the concentration of cardol.

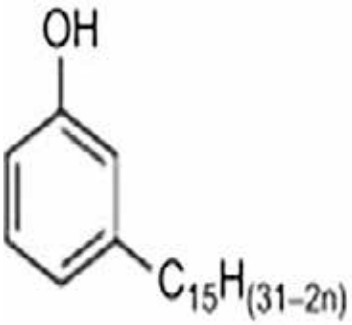
The main unsaturated phenolic substances in CNSL include anacardic acid (60–65%), 2-methyl cardol (1–2%), cardanol (10%), and cardol (15–20%).



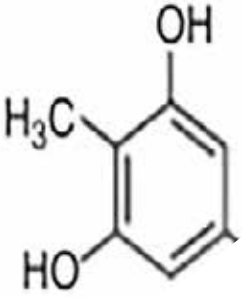
Anacardic acid



Cardol



Cardanol



These ratios vary depending on the area and the cashew processing method used.

A bioeconomy-based economy is always an environmentally friendly response to regional and global pollution problems. The efficiency, simplicity, cost-effectiveness and environmental friendliness of CNSL-based technology have made it the answer to today's sustainability problems.

The valorization of the CNSL has led to the creation of various products that compete with those obtained from fossil fuels. Furthermore, many of them are already in use and others are in development.

Four naturally occurring phenols make up CNSL: it has good possibilities as a substitute for commercial phenolics in several applications, with results at least as good. As raw material in azo compounds/dyes; friction linings; surface coatings, adhesives, paints; resins and rubbers; foun-

dry chemicals; pesticides, larvicides and termite killers; pharmaceutical products; and biodiesel production, CNSL has a wide range of industrial applications.

CNSL can be used as a resin for carbon composite products. CNSL-based novolac is another versatile industrial monomer derived from cardanol typically used as a cross-linking agent for epoxy matrices in composite applications providing good thermal and mechanical properties to the final composite material.

This natural oil phenol has interesting chemical structural characteristics that can be modified to create a broad spectrum of biologically derived monomers. These take advantage of the chemically versatile construct, which contains three functional groups: the aromatic ring, the hydroxyl group and the double bonds in the flanking alkyl chain.

These include polyols, which have recently seen increased demand due to their biological origin and key chemical attributes such as high reactivity, range of functionality, reduction of blowing agents and natural flame retardant properties in the field of rigid polyurethanes, aided by their inherent phenolic nature and a greater number of reactive units per unit mass.

juices and purées

Our technology can be successfully applied to the production of fruit juices, obtaining significant savings in terms of energy used and evident advantages in terms of homogenisation, stabilization and sterilization of the product.

Obviously for some products a pitting sub-phase will be added or, possibly, a pre-treatment to eliminate a too solid bowl or shell.

At the end of the sorting, the product is rinsed with drinkable water under pressure, then subjected to **shredding**.

In "traditional" productions, this is forced to pass between combs, housed in the system and others placed on a rotating cylinder which fit perfectly into the former, or hammer mills can be used which allow a much finer shredding such as to allow the its more rapid heating, reasoning in terms of a conventional process, i.e. offering a greater surface area for the action of cavitation, based solely on our process.

In the traditional process, once finely shredded, the product was sent to the **scalder**, where it was subjected to heating. The purpose of the heat treatment was to facilitate the detachment of the peel in the subsequent juice extraction phase. The heat, in fact, activates the action of the pectolytic enzymes, causing a rapid detachment of the bonds between the peel and the mesocarp of the fruit. The maximum activity of pectolytic enzymes occurs at a temperature of approximately 70-75°C.

- ***Cold-break technique.*** It operates at a temperature between 60 and 75°C, and its objective is to safeguard the organoleptic and qualitative principles as much as possible. A more fluid juice is obtained, because this treatment facilitates the strongest reduction of the fruit's pectins.
- ***Hot-break technique***. It allows to obtain the maximum yield in the extraction by exceeding temperatures between 45° and 80° (where the activity of the pectolytic enzymes is maximum) in the shortest possible time and reaching 100° C; the product obtained is therefore denser and more viscous than that obtained with the cold break system.

ith our cavitation-based process, the fine shredding and blanching steps are performed simultaneously within the **EMPOWERING DEVICE**.

The chopped agricultural products are fed into the cavitator, equipped with a rotor geometry that allows a double physical-mechanical effect to be obtained; with hydrodynamic cavitation there is a very fine shredding and the activation of the pectidic enzymes at **just 35° C**, allowing an easy cold detachment of the peel and pulp of the product.

The system has the advantage of having reduced dimensions and reaction speed, all at

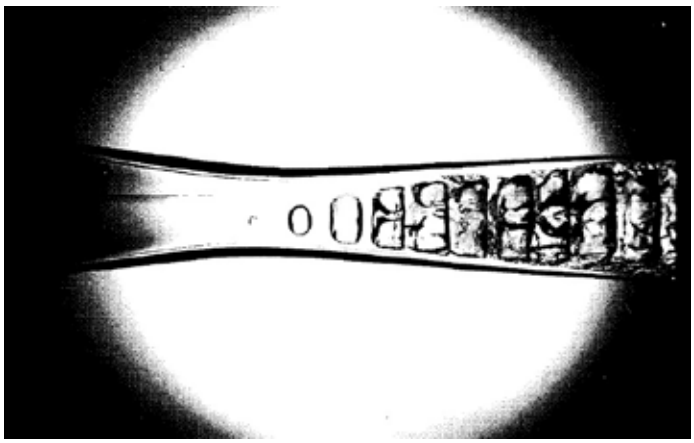
a low temperature which guarantees maximum protection of the organoleptic substances, giving a high quality product.
The product then passes into the pulper/refiner group in order to separate skins and seeds from the juice.
In this case the shredded mass is forced to pass through the centrifugal action caused by a rotating system of suitably modified metal bars to be able to exploit the cavitation effect in this case too and keep the product sterile.
Through cylindrical or truncated conical perforated sheets, with sieves with progressively smaller holes (from 1.2 to 0.5 mm). In the first sieve (purifier) the 1.2 mm holes allow the removal of the seeds, stalks and a good part of the peels.
The bars are mounted so as to give the shredded material a continuous advancement, always keeping the surface of the sieve clean. In the refiner, the sieves, with passage openings of 0.8-0.6 mm, allow the elimination of fragments of seeds and peels and other particles that escaped during the previous transit through the mill.
The juice is then collected in a stainless steel tank, which serves as a “lung” to continuously feed the next phase.
To avoid phenomena of alteration of the juice due to excessive storage at ideal temperatures for microbial growth, which can cause an increase in acidity in the finished product, the tank will be sized according to the quantities absorbed by subsequent processing.
The juice, which initially contains around 95% water, in traditional processes was generally concentrated in large containers, called “concentrators” or “evaporators”, until the desired concentration was reached; these systems (which can be double or multiple effect) work at reduced pressures (vacuum), to damage the organoleptic characteristics of the product as little as possible.
The live steam, which undergoes a condensation process in the heating section of the evaporator, transfers the remaining heat to the next stage, adding it to the heat generated by the solution. The steam produced is used again by sending a second evaporator to the heating section, which, with an even lower working pressure, operates at lower temperatures. The system can be pushed up to four successive effects, with temperatures ranging from 40° to 90°C.

Our cavitation-based process involves **concentration at room temperature** using membranes of our own design that allow the elimination of water, maintaining the organoleptic characteristics of the product unaltered and guaranteeing high product quality.

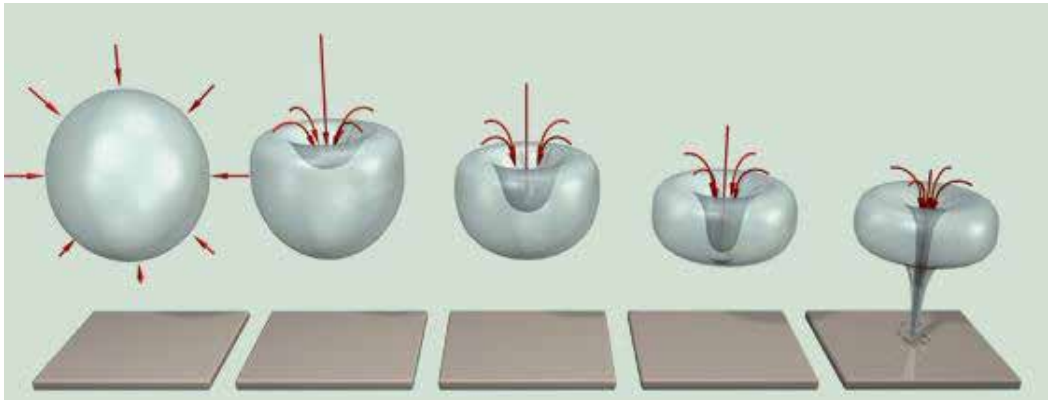
bottling

Apple juice, oil or spirits will be stored in refrigerated metal containers waiting to be bottled.
They can be added or flavoured, if necessary, with the other production ingredients previously prepared and, again if necessary, diluted with water.
The packaging, after a further passage in the cavitator also in order to obtain cold pasteurization and therefore guarantee the sterility of the product and its longer preservation over time, will take place using the container chosen for that specific final product. Consequently, you can use aluminum cans, metal drums, tetrapak briks, plastic or glass bottles and plastic bags indifferently: just add the packaging module of your choice. For example, part of a possible production could be chosen to be packaged in an aseptic environment using metal drums, in which a bag made of special material is inserted, or destined for subsequent processing in another industry.
Before entering the packaging line, the containers are washed with a cavitating water shower in order to sterilize the internal walls.
An aseptic filling of the containers can take place using the cavitator. After sterilization, the filling phase begins inside a special chamber, absolutely isolated from the possibility of external contamination.
The feeding nozzles are introduced into the appropriate inlet hole of the chosen container to close it hermetically. This practice which, by not putting the product in contact with oxygen, definitely helps the preservation of the product.

cavitation



Water has the ability to convey many substances thanks to its particular chemical and physical properties: very high solvent power, high chemical reactivity and considerable specific heat. Moreover, its molecular capacity, two hydrogen atoms bound to an oxygen atom, allows it to behave like a crystal: not only in the solid state (ice) but also in the liquid state.
Cavitation applied to water acts mainly on this characteristic.
Through the violent implosion of the bubbles, it causes the release of nascent oxygen, allows the elimination of viruses and bacteria present; furthermore, it supports the magnetic conversion of calcite (responsible for the formation of scale) insoluble in soluble aragonite and not able to aggregate in the formation of limestone.
Finally, since the molecular structure of water is not uniform, the distance between the molecules is never the same, nor is the reciprocal attraction force; there are therefore areas or points of emptiness or pockets of gas (oxygen, nitrogen) and foreign bodies, sometimes not totally wet.

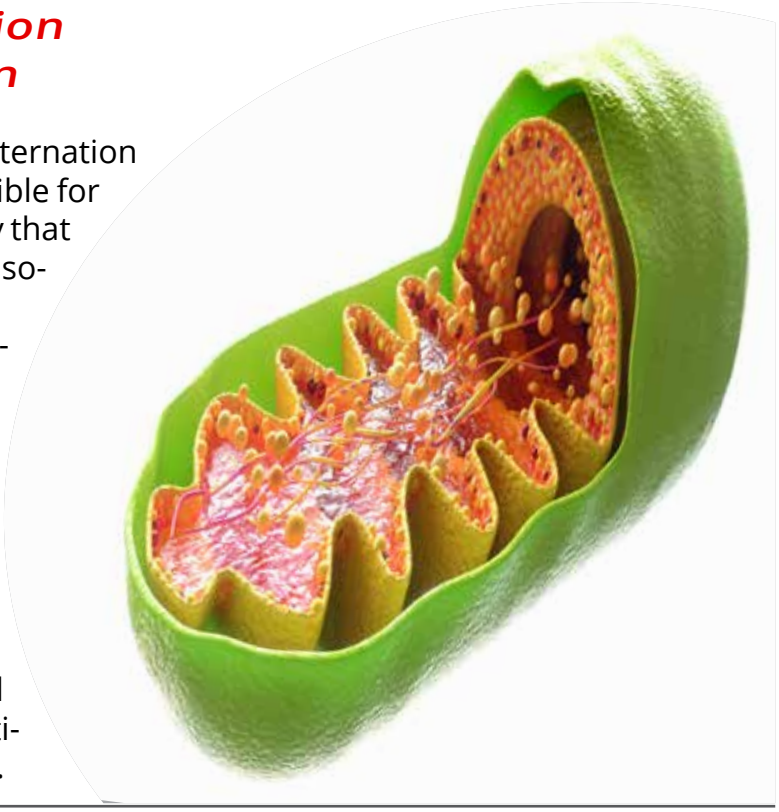


As the pressure decreases, the air pockets expand, the liquid evaporates and the steam fills them. The subsequent phase of implosion violates the oxygen, which can thus exert all its oxidative action on the surrounding organic substrate, mimicking the action of hydrogen peroxide.
Another fundamental aspect of cavitation with respect to all other water purification and filtering treatments consists in the fact that with cavitation they are the same water molecules that, after the implosion phase, assume a homogeneous crystalline configuration, which gives the water the original characteristics of the formation from the source.
Therefore, unlike the other treatments applicable to water, nothing is added or removed, such as ion exchange resins for inserting and subtracting ions or magnetic filtering to subtract iron, but on the contrary it is amplified and enhances the natural ability of water to biodegrade and break down pathogens by oxidation.
Furthermore, our equipment also includes an ozonator that further enhances the oxidation of any pollutants present.

why is it so innovative?

The enormous forces staked during the cavitation phenomenon allow an extremely effective mixing and far better than that the one obtained with conventional technologies as the reduction in microscopic parts of what is present inside the fluid subjected to cavitation increases the area surface contact.
Furthermore, the forces released by the cavitation process are far greater than those present in normal mixing and, therefore, the results obtained are on enormously higher scales than those normally measurable by the application of traditional technologies.
Controlled cavitation can be applied to all processes of extraction of natural substances and treatment / conservation of emulsions or liquids, without damaging the original active ingredients of the original substance unlike what happens with other conventional methods of extraction, pasteurization and fermentation.
With our equipment we are able to provide an evident economic advantage on all possible chemical processes and therefore on:

- ***Process intensification***
- ***Gas / Liquid Mixing***
- ***Liquid / Liquid Mixing***
- ***Liquid / Solid Mixing***
- ***Hydration of Gels and Rubber***
- ***Emulsification***
- ***Homogenization***
- ***Pasteurization***



This is made possible because the alternation between low and high pressure is responsible for an intense mechanical and thermal activity that is exerted on each element present in the solution.
In the presence of organic materials, cavitation results in the consequent partial physical destructuring, a lysis of the cell walls and the consequent release of the intracellular content. This action translates into a greater availability of cellular juices, an acceleration of the hydrolysis processes and, consequently, an acceleration of the anaerobic digestion process as a whole. In this case, the rate of bacterial degradation can accelerate up to over 10 times compared to conventional treatment.

Therefore, the destruction / rupture of cellular structures leads to a marked improvement in the biodegradability of organic matrices.
Our apparatus, in addition to being able to work completely independently, can be easily inserted online in any pre-existing industrial cycle: our apparatus can replace a pre-existing chemical process or multiplies a pre-existingit process by accelerating and strengthening it by over several times.
Having said all this, the areas of application of our apparatus turn out to be all those in which there is the presence of a chemical process of any kind.
The advantage for the users of our machinery can be summarized as follows:

- ➔ *cut in production costs;*
- ➔ *reduction of costs related to the expansion of production;*
- ➔ *reduction of process times;*
- ➔ *increase in the quantities of treatable matrix;*
- ➔ *reduction of costs related to disposal.*

With regard to **hydration**, this thanks to cavitation can be continuous, consistent and competitive, at the same time reducing the amount of matrix necessary to obtain the same desired level of viscosity. With regard to aeration, this is always uniform with both small and large volumes of gas and, therefore, it is optimal for both viscous liquids and rubber.
With regard to **pasteurization** and **homogenization** cavitation prevents the formation of incrustations on the walls of the apparatus, cutting the downtime required for cleaning. Furthermore, the lower degradation of the proteins present allows the lengthening of the storage periods and even the creation of entirely new products.
With regard to **emulsification**, cavitation prevents the formation of air pockets trapped inside the fluid thus maintaining the quality of the products always constant. In addition, the possibility of continuous processing allows easy control of the degree of emulsification.

EMPOWERING DEVICE

EMPOWERING DEVICE has been fully conceived, developed and implemented by our team and is able to simultaneously manage different types of controlled cavitation, of which 5 of a different nature but which coexist harmoniously to the point that no significant vibrations are detected.

The summation of the effects produced by each cavitation further implements the efficiency of the chemical, physical and biological processes that take place within the apparatus, resulting in a subsequent cut in the already low energy consumption as well as a sharp reduction in processing times.

A prototype with a special set-up, prepared for experimentation and of 1:1 size, has been used by us since the beginning of 2017 to conduct the required tests on the samples of materials brought by our customers.

Our machinery is equipped with test certificates and international operating certifications with different types of liquids on different chemical, physical and biological processes.

What makes our system, today, unique compared to what the market offers in the field of controlled cavitation is the fact that although it is already extremely difficult to control a cavitation, in our system there are controlled cavitation's numerous and of different kinds, at least one of which is sonic.

The machine body has an element, with the functions of a static mixer, called by us "Il Cedro" (the Cedar) for the peculiar conformation of the "leaves" that make up its design.

This special monobloc mixer, in the presence of processes that involve the formation of crystalline chemical elements, has the ability to favor the formation of Crystallization Germs, with further acceleration of chemical reactions.

Another significant improvement compared to what has existed so far is represented by the evident lower pressure drops compared to machines equipped with motors of similar installed power, with a sensible and consequent energy savings during operation: the **EMPOWERING DEVICE** requires only a fraction of the electrical energy used by the other cavitators.

This is due to the fact that the machine body of the **EMPOWERING DEVICE** is structured to form a true "diffuser", with the consequent recovery of a percentage of the outlet

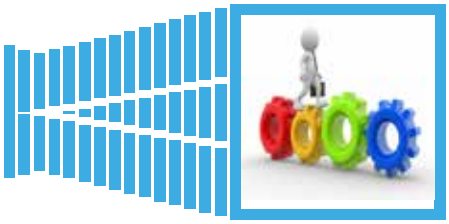
pressure.
Furthermore, it has been designed to be easily and quickly reconfigured according to the use: some of its parts can be removed if very dense and / or viscous liquids have to be treated and / or with extensive granularity or they can be added, inlet or outlet, accessory elements suitable for almost any use.
Moreover, in the presence of organic matter, cavitation leads to the consequent partial physical destructuring, a lysis of the cell walls and the consequent release of the intracellular content.
This action translates into a greater availability of cellular juices, an acceleration of hydrolysis processes and, consequently, an acceleration of the anaerobic digestion process as a whole.
In our cavitator, based on experiments conducted and certified by third parties, the rate of bacterial degradation can accelerate from 4/5 times to over 10 times compared to conventional treatments.
The certifications performed by the Rina Group show that the COD of the waste water from a gasifier is reduced by 90% in just 15 minutes.
By using the supplied inverter system, at the start, consumption is less than the 25kWh of rated installed power, similarly during full use; in the absence of an inverter, at least 36kWh would be required to start.
The standard version can treat up to 60 cubic meters of fluid per hour.
Compactness, simplicity of installation and use, are undoubtedly some of the peculiarities of our cavitation apparatus but it is the total flexibility of use that makes it unique.

SAMPLE	COD mg/L
AS IS material	15.380
after cavitation material	1.508
COD reduction percentuage	90,2%

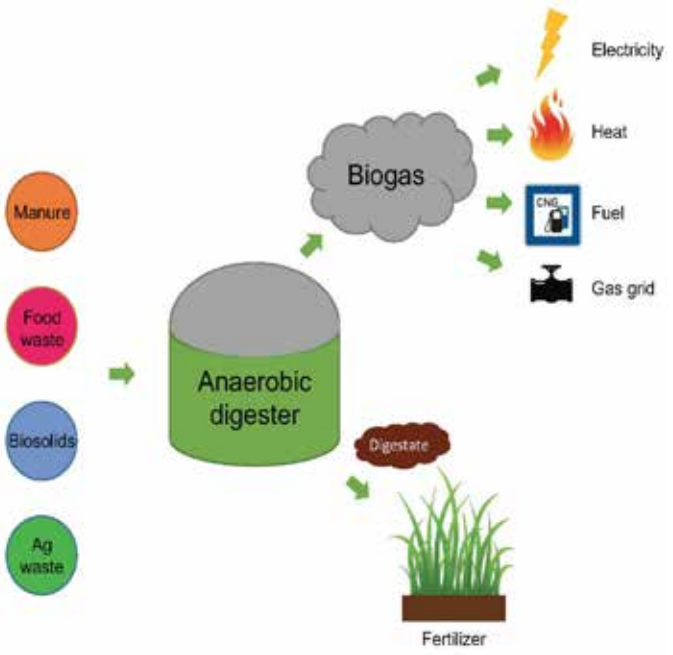
biodigestion

The preparation of the substrate consists in obtaining the physical-chemical characteristics considered optimal for introduction into the digester.
This occurs through the introduction of the matrices, possibly diluted by sludge and / or water, with a correct degree of humidity inside the **EMPOWERING DEVICE** which will homogenise all the matrices entered and pre-treat the result obtained, also contributing to the increase of the its temperature.
The permanence time of the matrix inside the biodigestor, normally 14/40 days (mesophilic reactors) or 14/26 days (thermophilic reactors), thanks to the pretreatment in the **EMPOWERING DEVICE** this permanence can be reduced to about one day and therefore reactors can be of extremely smaller dimensions than in the past can be made.
These are fed and, alternatively, emptied in cycles of 6 hours. They are equipped with biogas collection systems. During the pemanence, the material is continuously stirred through an innovative helical device that is moved only by exploiting the rise of the gas from the bottom to the top, without consuming additional electricity. This allows to avoid the presence of dead zones, to homogenize the temperature and the release of the biogas and to avoid the sedimentation of the mud and the formation of superficial films and above all it facilitates the contact between bacteria and substrate.
The biogas obtained can be either upgraded to biomethane or, once purified, used for the low yield production of thermal or electric energy. It is a gaseous mixture composed mainly of methane and carbon dioxide, but also containing small quantities of hydrogen and occasionally traces of hydrogen sulphide.
The material exiting the digester is a liquid sludge (Solid Fraction: 5-25%) not completely stabilized (the organic matter is not completely degraded). It is stabilized through a second passage in the **EMPOWERING DEVICE**, which remove its bacterial load and accelerates its oxidation; subsequently, excess moisture is drained by means of a belt press. Any excess nitrogen can be eliminated chemically, via bacteria or naturally with the compost rest. The liquid fraction thus obtained, having already undergone treatment within the **EMPOWERING DEVICE**, can be used immediately for irrigation purposes or to be returned to the cycle by finding new use in the biodigestor. The dry fraction is used as a biological fertilizer (high quality compost).
The electricity produced by anaerobic digestion is considered totaly green energy because the gas is not released directly into the atmosphere and carbon dioxide derives from an organic source characterized by a short carbon cycle, the biogas with its combustion does not contribute to the increase of atmospheric CO_2 concentrations and, therefore, is considered a low environmental impact energy source.

anaerobic digestion



Anaerobic digestion is a biological process by which, in the absence of oxygen, the organic substance contained in materials of plant and animal origin is transformed into biogas, consisting mainly of methane (CH_4) and carbon dioxide (CO_2). The percentage of methane varies, depending on the type of digested organic substance and the process conditions, from a minimum of 50 to about 80%. The anaerobic microorganisms that carry out this transformation exhibit low growth rates and low reaction rates; hence the need to maintain, as far as possible, optimal conditions of the reaction environment to promote its metabolism.
Anaerobic digestion can be carried out in **mesophilic conditions** (temperatures of about 35 ° C), **thermophilic conditions** (about 55° C) or, more rarely, in cold conditions (**psychrophilic digestion**). The reaction temperature also generally determines the duration of the process (residence or retention time).
The times are on average between 15 and 50 days if the process occurs in mesophilia, between 14 and 16 if it occurs in thermophilia and 60-120 days in psychrophilia. Anaerobic digestion is a very complex process operated by different groups of bacteria acting in series. The transformation takes place with a sequence of successive phases which, to a small extent, tend to overlap. The first two phases can be considered preparation and only in the third phase there is production of biogas. More specifically, in the first phase, the hydrolytic bacteria “break up” the complex organic compounds (ie carbohydrates, proteins and fats) into simpler substances (hydrolysis phase). In the second phase these substances are transformed into
a first stage, in organic acids through acidogenesis reactions and, subsequently, in acetate ($CO-OH-CH_3$), carbon dioxide (CO_2) and hydrogen (H_2), through acetogenesis processes (fermentation phase). In the last phase, the most delicate one, the methanogenic bacteria transform the products formed in the previous phase into methane (CH_4) and carbon dioxide, the main constituents of biogas (methanogenesis) The organic substance is then degraded releasing biogas, the energy vector of the process, to a variable extent from 30 to 85%. Low levels of biogas yields can be attributed to several factors: low temperatures; retention times too short for a given temperature; incorrect hydrodynamic management of the reactor (dead zones); significant presence of antibiotic substances.
The biogas yield also depends on the type of biomass used. The next chapter reports an extensive review of organic matrices and the related functional characteristics to anaerobic digestion (AD). In the first instance, the biogas yield and the percentage of methane contained in it are indicated, correlated to the organic composition of the starting materials. The greater methanogenic capacity is attributable to fats (≈ 0.85 m3 / kg), followed by proteins (≈ 0.5 m3 / kg) and finally by carbohydrates (≈ 0.4 m3 / kg).



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