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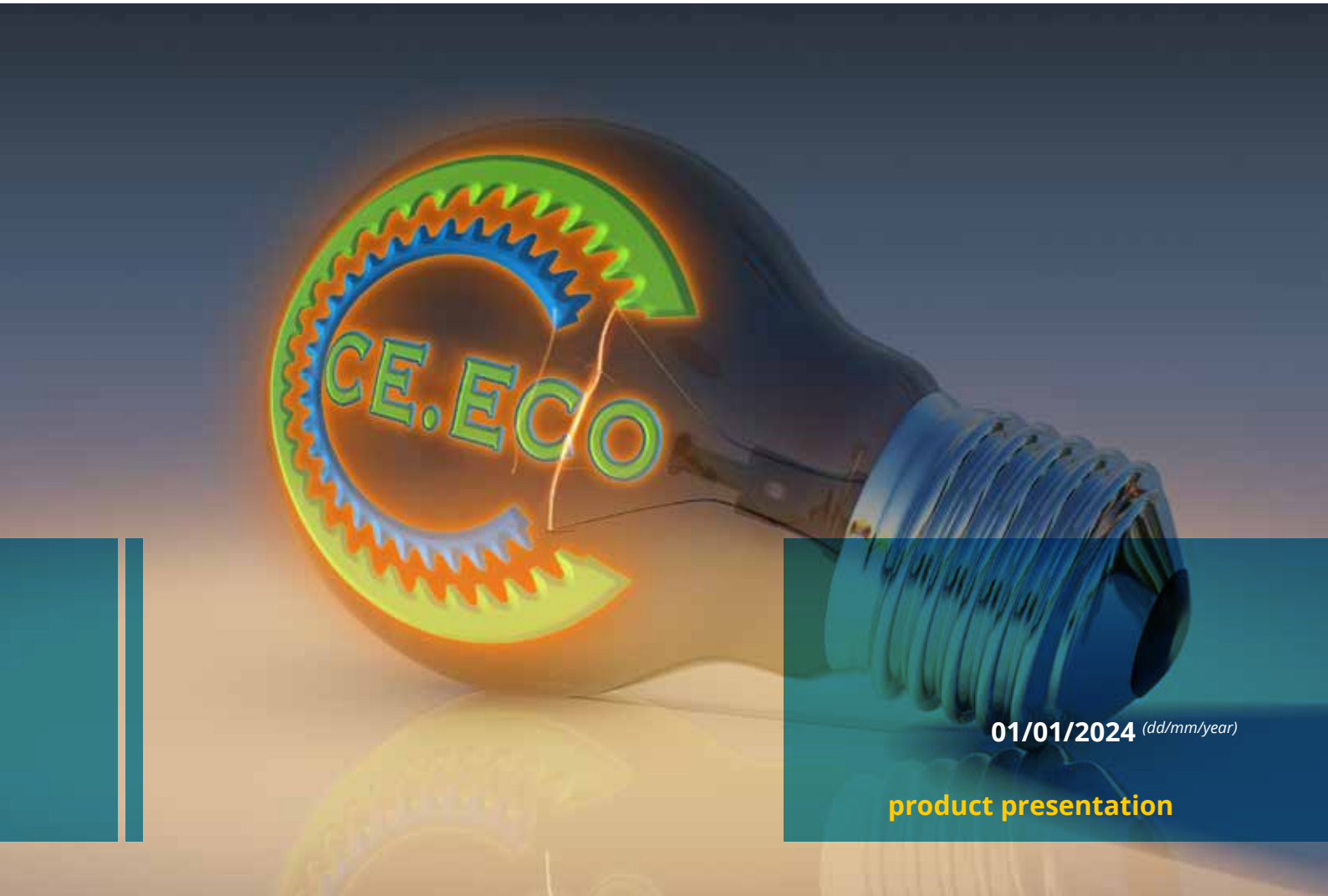
EMPOWERING DEVICE

after "tasting" the results obtained by controlled cavitation
you won't be able to do without it anymore



01/01/2024 *(dd/mm/year)*

product presentation

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?

Smartly sustainability

Mission:

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

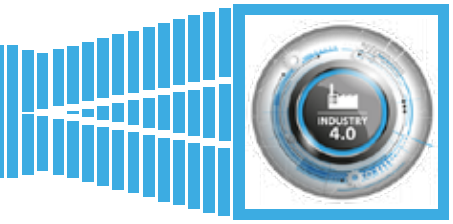
Our goal

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!

index

controlled cavitation will make do to the 21st century a leap forward equal at least to the 20th century one done thanks to personal computing.

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

- BIOZIMMI
- EMPOWERING DEVICE
- ZEB
- BIODIGESTERS
- FROM HEAT TO ENERGY
- THERMOELECTRIC PANELS
- ASBESTOS DENATURATION
- GASIFICATION & PLASMA
- INERTIFICATION
- WEEE
- UREA & AMMONIA
- FOOD PROCESSES
- 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

Jennifer Martinel

Accounting

Massimiliano Magni

Engineering

Antonio Piserchia

Communications Expert

Barbara Spelta

Lab

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

Marketing

Sarr Alioune Badara

Marketing

Jérémie Saltokod

CCIMRDC Italie

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.

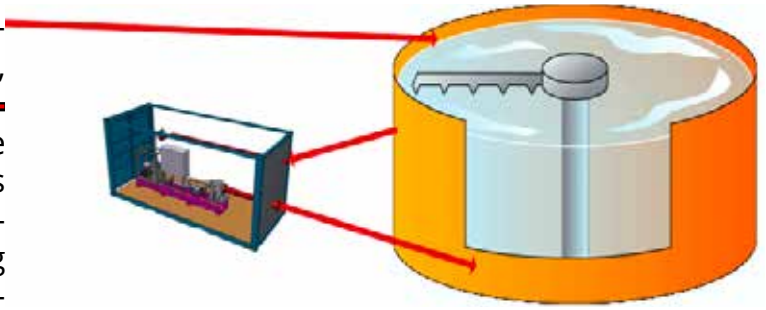
This special monobloc mixer, in the presence of processes that involve the formation of crystalline chemical elements, has the ability to favor the formation of Crystallization Germs, with further acceleration of chemical reactions.
Another significant improvement compared to what has existed so far 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%

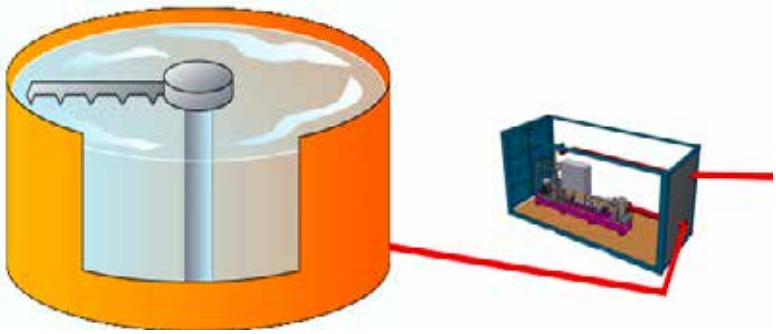
how to place the ED

Our process accelerator can be placed, according to the process needs, at the entrance, in recirculation or at the exit of a tank.



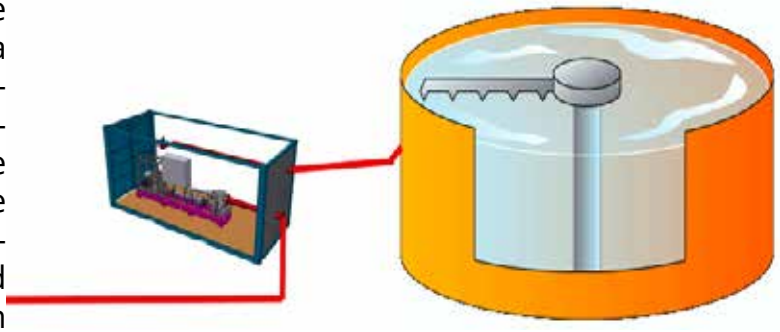
in recirculation: a pump sucks the liquid matrix from the treatment tank, sends it to the **EMPOWERING DEVICE** for treatment and returns it to the treatment tank through a second access pipe. With this configuration, it is possible to treat and improve the functioning of an existing plant, reducing any accumulations of fibrous fractions of the non-degraded matrix quickly enough.
PRO: Implementation costs are reduced to a minimum and existing plants can process significantly higher quantities of matrices before being scaled down or supported by further plants. This location has the disadvantage that part of the fluid will be treated several times.

at the exit of the primary treatment tank: configuration similar to the previous one, the main difference consists in treating the product only once and discharge it into a second tank where it shall receive a subsequent treatment.



PRO: In addition to maximizing the efficiency of the second tank where the matrix will receive a subsequent treatment, this location allows the inertization of the microbial charges of the matrix. This location has the disadvantage that the time used to treat the fluid in the first tank still be the same.

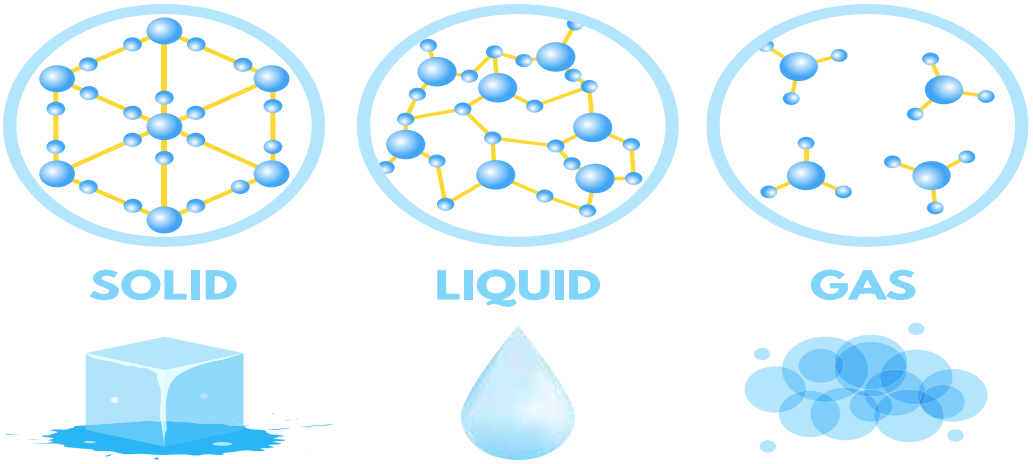
for the input matrix treatment: the matrix at the load can be mixed with a hydraulic vector and sent to the cavitator for disintegration before loading. Depending on the type of plants, the type of matrices used and the intensity of the treatment to be obtained, the technology can be applied on the whole loaded matrix or only on a part (EXAMPLE in biomasses typically those characterized by fibrous matrices and particularly complex to degrade).



PRO: In this configuration, the efficiency of the cavitator is maximized if cavitation is applied to the whole matrix. This location can bring the greatest advantages.

water & cavitation

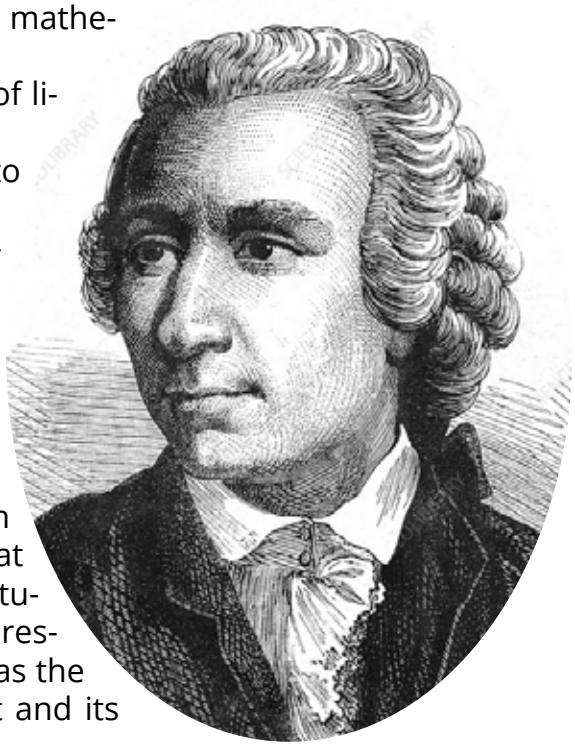
Water has the ability to convey many substances thanks to its particular chemical and physical properties: very high solvent power, high chemical reactivity and considerable specific heat. Moreover, its molecular capacity, two hydrogen atoms bound to an oxygen atom, allows it to behave like a crystal: 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.

history & science

Cavitation is a physical phenomenon, known since the end of the 19th century but hypothesized since 1750 by the Swiss mathematician **Leonhard Euler**.



It is a phenomenon that exclusively concerns the flow of liquids, gases cannot exhibit cavitation.
Only in very recent times has it been understood how to control it and positively exploit its characteristics.
When it occurs in a controlled manner, it does not generate damage or wear of the materials involved, otherwise it represents one of the most degenerative effects that anyone can encounter in hydraulics.
Cavitation, in addition to being a physical phenomenon, is actually also a mechanical process and is influenced by the thermodynamics of the system.
Until few years ago it was understood exclusively as an extremely negative and degenerative phenomenon that can occur in pipes, turbines and pumps; after several studies scientists discoverd that it is linked to the vapor pressure of a fluid: the phenomenon is maintained as long as the balance of the pressure value between the liquid part and its vapor.
It takes place with the local vaporization of a liquid, which occurs with the detachment of the fluid boundary layer. If not sought and desired, it substantially generates yield losses and erosion.
In order to define the amount of cavitation, the unit of magnitude called the cavitation index (K) is used, which is a function of the pressure jump; where p1 represents the upstream pressure, p2 the downstream pressure and pv the vapor pressure. As the cavitation index decreases, there is a more intense development of cavitation.
If at a certain temperature the absolute pressure in the liquid becomes equal to or lower than the vapor pressure, microscopic bubbles of vapor are formed in a while, letterally in few microseconds.
These microscopic bubbles are spherical-toroidal in shape, have a temperature of thousands of degrees centigrade and hundreds of atmospheres (BAR), with localized jets of liquid at speeds of over 100 m/s.
This formation of bubbles, usually with a very short duration, occurs due to the reduction of pressure to values lower than the vapor pressure of the liquid itself. Because of this, the liquid undergoes, very quickly, a transformation into gas, forming bubbles (otherwise called “micro cavities”) which however collapse just as quickly as soon as the flow makes them move away from the region whose peculiar conditions physical had allowed its formation.
The succession of formation and implosion of the “micro cavities” generates, in turn, a sequence of shock waves or ultrasounds.
The process of formation of “micro cavities”, otherwise known as cavitation, occurs mainly where the velocity of the liquid is maximum: the liquid mass loses continuity, creating a gaseous “foam”, particu-

$$K = \frac{p^1 - p^v}{p^1 - p^2}$$

larly rich in oxygen, due to steam and air that are released.
This gaseous "foam", in the event of uncontrolled cavitation, can be extremely erosive and corrosive with metals due the developping of hydrolysis, oxidation, polymerization and depolymerization.
The very rapid collapse of the "micro cavities" generates micro-jets at very high pressure and high concentrations of energy in very short times and spaces which, if not controlled as described above, can cause even considerable damage to the pipes and / or to moving parts of the machines that trigger this phenomenon.

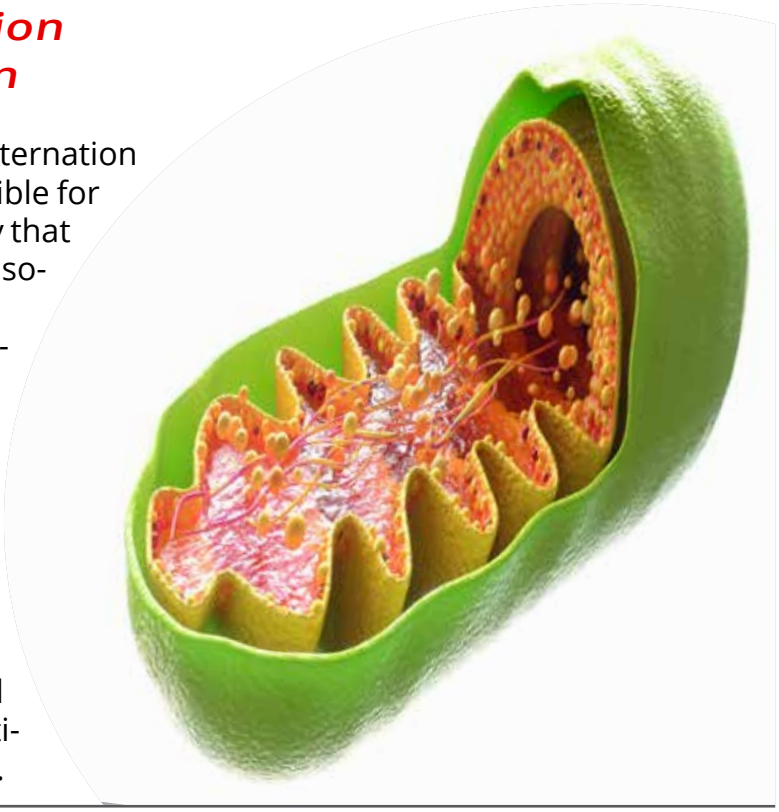
- ➔ *By way of example, in relation to a pipe, the phenomenon of cavitation can develop more in the sections where the piezometric line falls below the axis of the pipe itself, thus forming a more or less pronounced depression.*
- ➔ *By way of example, in relation to a hydraulic machine (centrifugal, axial pumps, turbines, etc.), the phenomenon of cavitation can develop more in the external points of the impeller where the higher the speed and the lower the pressure.*

Cavitation generates friction and turbulence in the liquid causing, if not properly controlled, a significant loss of efficiency, emission of noise, vibrations and damage to components. The decrease in efficiency and power can be greater than 3% compared to similar conditions in the absence of cavitation.
Although the process is similar to the better known one of boiling, the main difference between cavitation and boiling lies in the fact that in boiling, due to the increase in temperature, the vapor pressure rises until it exceeds the pressure of the liquid, thus creating a mechanically stable bubble as it is full of vapor at the same pressure as the surrounding liquid.
In cavitation, on the other hand, the pressure of the liquid suddenly drops, while the temperature and vapor pressure remain constant.
For this reason, the cavitation "bubble" only resists until it leaves the low hydrostatic pressure zone: as soon as it returns to an area of the fluid at rest, the vapor pressure is not sufficient to counteract the hydrostatic pressure and the cavitation bubble implodes, releasing a large amount of energy and the associated shock wave sequence.
The vapor pressure of a liquid is the partial pressure of the vapor when the equilibrium between liquid and vapor is established, it depends on the temperature and increases with it (for water it is 4.6 mmHg at 0° C and 760 mmHg at 100° C).
Once this pressure has been reached, the liquid and the vapor are defined as be saturated (as many molecules pass from the liquid phase to the vapor phase as there are those that carry out the reverse process).
In addition, the cavitation heating is released uniformly over the entire volume of the liquid while a conventional heating takes place by transfer and therefore from a point towards the most extreme face.
This allows you to eliminate hot or cold spots, burns and, if necessary, have precise temperature control.

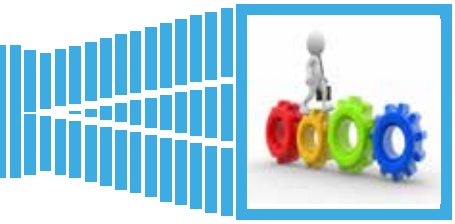
where can it be applied?

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.

what could I do with ED?

Wherever a chemical process occurs, our apparatus can be used with some kind of advantage. It is easily inserable into prexisting process lines multiplying the amount of fluid treated in the same time units and the overall effects over it.
As a rule, although varying from process to process, only in relation to the time required to complete a process with respect to the use of the methods previously used, the achievable improvements can reach also up to 90%.
The fields of application for our apparatus correspond to all those in which a chemical process of any kind and nature is carried out: organic or not.
Below is a non-exhaustive list of examples of applications we have thought of.

1) As part of the production of biogas from biomass

Cavitation is mainly used in situations with matrices that are difficult to degrade or have large sizes. Our equipment finds an optimal location both at the entrance of the biodigestor, after preliminary laboratory characterization on digestate samples taken in order to quantify the specific advantages in the specific case, and at the output to reduce the charge of microorganisms present or, even, in recirculation.
The main benefits are related to the reduction of the size of the organic material, the reduction of the viscosity of the digestate and the consequent ease of mixing inside the digester, in addition to the increase in the homogeneity of the digestate and, therefore, to the better pumpability which result in a overall improvement of the fermentation process.
It should be specified that as the rotation frequency changes, more or less energy can be imparted to the biomass to be treated and therefore greater or lesser treatment efficiency.

- ➔ *Increases the efficiency of the fermentation processes*
- ➔ *Drastically reduces the production time of biogas*
- ➔ *It reduces the consumption of substrates for the same biogas produced*
- ➔ *Increases the production of biogas with the same amount of fed substrates*
- ➔ *Increases the methane content in the biogas*
- ➔ *Reduces the viscosity of the digestate by facilitating pumping and mixing*
- ➔ *It reduces the energy consumption of the mixing and pumping organs*

Furthermore, thanks to the fact that cavitation acts directly on the fibrous component of the matrices, increasing their methanigenous potential, various agro-industrial by-products (straw, pomace, exhausted marc, etc.) can be used which previously could not be adequately valued for energy purposes, thus further reducing the operating costs of the biogas production plant.

Tests conducted on first generation cavitators, capable of a single controlled cavitation, have shown that the peak of methane production is obtained in just 2.5 days from cavitation against the over 25 needed previously in traditional systems. The experimentation conducted on our apparatus further reduced these times to just a few minutes.

2) In animal husbandry

Our device, when applied in animal husbandry, has multiple uses:

- ➔ *It can be used to treat water (see water treatment).*
- ➔ *It can be used to treat excrement (see biomass).*
- ➔ *Can be used to get raw materials from animal urine.*
- ➔ *Can be used to treat fluids produced by animals (e.g. milk).*

The water subjected to cavitation treatment proves to increase the digestibility of the food, allows to reduce bad smelling emissions, favors the growth of the animal in a healthier environment, with less stimulation of the immune system, lower pharmaceutical expenses and lower costs for morbidity and mortality.
The action of cavitation is so long lasting that it persists even in the water of zootechnical wastewater, which is more homogeneous and odors free. The improvement of the characteristics of the water, through cavitation, is also reflected in the use of the same for washing the environment and equipment.

3) In water treatment

Water has the ability to convey numerous substances thanks to its particular chemical-physical properties: very high solvent power, high chemical reactivity and considerable specific heat.
Unlike other treatments applicable to water, nothing is added or removed, such as ion exchange resins for the insertion and subtraction of ions or magnetic filtering to subtract iron, but on the contrary it amplifies and enhances the natural ability of water to biodegrade and break down pathogens through oxidation.
In addition, our system also includes one or two ozonators inside which further enhances the oxidation of any pollutants present.

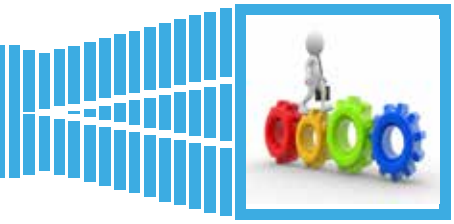
Suitably configured and in the presence of several units in series, it can replace the treatment plants that use traditional technologies.

4) In the food oil industry

Cavitation is also used in various stages of oil processing.
First, it can go to solve the bottleneck of the kneading caused by the technical advancements introduced in the 90s by mechanical crushers, reels, horizontal and vertical centrifuges.
Several scientific studies have shown how cavitation increases the quality, work capacity and efficiency of the extraction system, ensuring its sustainability. In this case the cavitation apparatus is to be positioned between the crusher and the decanter.
Promising analyzes conducted in the laboratory and in oil mills have shown how basic cavitation systems have managed to increase the extraction yield by about 10% compared to traditional methods while increasing both the total polyphenols by about 10% and the chlorophyll content. The latter figure is also detectable with the naked eye thanks to an extremely more intense green color compared to oils obtained with traditional methods.
The analyzes also showed an increase in tocopherols of approximately 50% and of carotenoids of approximately 20%.
Finally, the organoleptic evaluations of the oils obtained by cavitation have shown a better harmonic taste than the traditional ones, perceived as more aggressive.
As a result, experimental tests performed on a full-scale mill plant have shown the simultaneous increase in oil yields and polyphenol content in treated olive oil.

5) In oenology

Cavitation is also used in winemaking as it acts on the kinetics of the extraction of phenolic compounds during the maceration of red grapes and on the lysis of the yeast.
Careful laboratory analyzes have shown that the increase in the times of application of cavitation on the matrices corresponds to an increase in the indices of total polyphenols (over 50%) as well as anthocyanins (over 100%). These data were confirmed by subjecting different grape varieties to the same treatment.
With regard to fine lees, experimentation has shown that soluble colloids increase in less time. Total soluble proteins are significantly increased in proportion to the duration of cavitation.
A further test carried out on the lees showed that the soluble colloids present in samples subjected to cavitation were equal in number to those developed after 30 days in samples handled with traditional techniques.
Even racking can therefore be accelerated by cavitation, reducing the time required by up to 60%: about 2 days against the 5 days normally necessary with traditional methods.



Furthermore, at the end of the supply chain, it should be remembered that cavitation acts directly on the fibrous component of the matrices, increasing their methanogenic potential, therefore the pomace, previously mainly destined for pulping as they could not be properly valorised, can be used for energy purposes thus reducing disposal costs.

6) On brewery

In recent decades there have been incredible improvements in the field of technology, chemistry and fermentation, but the basic principles of beer production have remained unchanged since the beginning. Cavitation can upset basic principles.
The malt grains, from which the fermentable sugars are extracted, thanks to cavitation, can be reduced to less than 100 microns in size in a few minutes, completely skipping the grinding.
These very small dimensions increase not only the speed with which the starch will pass to the must (the sweetened water that is boiled with the hops before being cooled and transformed into beer by the yeast) but, above all, they optimize the process to the point that everything passes starch making final washing with malt water unnecessary to try to extract the last traces of precious starch.
It should also not be underestimated that the greater speed and efficiency also allow that the transformation into simpler and fermentable sugars can take place at lower temperatures, and therefore the unpleasant and volatile gases degass more quickly, denaturing the enzymes in the must and allowing to mix easily the flavors of hops.
Therefore, it is clear that the must must boil for a fraction of the time previously necessary, drastically reducing production times and costs.
A further “undesired” effect that emerged during the experiment was a drastic reduction in the gluten in the must and beer produced with 100% barley malt.
The experimental tests indicate the degradation of the proline residues, the amino acid responsible for the problems of intolerance and sensitivity to gluten, due to the improvement of the assimilation of the proline by the yeasts.
Considering that the current systems used to eliminate gluten mostly alter the taste and quality of beer, this “undesired” effect opens up numerous and interesting scenarios.

7) As part of liquors’ aging

Being an especially effective process accelerator in the presence of oxidations, **EMPOWERING DEVICE** can significantly accelerate and catalyze the aging of any alcohol-containing liquid. Therefore, in liqueurs, it allows all those chemical processes that alter the flavors and for which, often, take years to be carried out, in a few minutes or days.

The natural aging of liquors and spirits is therefore accelerated. This is achieved by extracting aromas and colors from the wood shavings dragged into the fluid that flows through the appliance, as opposed to the traditional static aging of the barrel.

Cavitation can also help in the rapid demolition and removal of natural compounds with a hard taste naturally present in alcohol which also deteriorate as part of traditional aging.
Furthermore, not to be underestimated, the drastic increase in yield due to the loss of evaporation loss associated with traditional aging as well as the possibility for producers who will not have to wait decades to understand how their product will evolve but will be able to conduct aging tests in few minutes.

8) As part of the pasteurization of food liquids

The persistence of microbiological activity in food liquids is one of the critical aspects of the production processes, given the considerable risk of development not only of metabolites with negative impact on the organoleptic and qualitative properties, but above all for the potential release of compounds toxic to human health.

The microbiological stabilization process of food drinks therefore requires extreme care and attention in order to break down the totality of microorganisms such as yeasts or bacteria present in solution.
Thanks to recent studies conducted by the main government bodies, cavitation has proven to be the simplest, most flexible and controllable technology as well as the most energy efficient, while the potential advantages of its application to the pasteurization and homogenization of food liquids, aimed at their introduction to the consumption, derives not so much from energy efficiency, comparable with that of an ordinary electrical resistance, but from the homogeneity of the heating obtained.
The combined effect of the average temperature of the liquid and the localized, diffuse and homogeneous release of large quantities of thermal and mechanical energy, allows to reach the required food safety parameters, at average temperatures significantly lower than those of traditional processes.
As a direct consequence, there is a marked energy saving and superior ability to control critical issues in the food process and product quality.
A research conducted by the Italian CNR ("**C**onsiglio **N**azionale delle **R**icerche" - National Research Council) has aimed to inactivate Saccharomyces cerevisiae, the yeasts most commonly used in the food industry for the fermentation of wine and beer, but at the same time responsible for the alterations and deterioration of the juices fruit and milk, as well as among the microorganisms most resistant to thermal and mechanical shocks.
Cavitation applied in food areas has several benefits:

- ➔ *bacteria and microorganisms are eliminated at lower temperatures than traditional systems*
- ➔ *less energy consumption for the same results obtained*
- ➔ *preservation of the organoleptic and nutritional qualities of the products*

It can be applied at the entrance, at the exit or on the whole process. The use in the queue also minimizes any risk of oxidative processes.
The synergistic application of thermal and cavitation processes allows the temperature associated with the mortality of yeasts to be lowered by several degrees in an aqueous solution, therefore, in addition to the obvious benefits in terms of the quality of liquid foods, energy savings are quite significant: at least 2.7% for every 1° C drop in the maximum process temperature.

9) Applied to traditional balsamic vinegar (Italy)

A research conducted by the Italian CNR ("**C**onsiglio **N**azionale delle **R**icerche" - National Research Council) has had as its objective the application of cavitation technology to cooking traditional balsamic vinegar.

In the production of traditional balsamic vinegar, the cooking of grape must with at least 15° Brix (1° Brix corresponds to 1-2% by weight of sugar), takes place at natural pressure, with direct fire, in containers open for about 12-24 hours at a minimum temperature of 30° C, until the total mass is reduced to about 2/3.
All additives are banned.
Too high cooking temperatures could lead to unwanted crystallization of sugars with unwanted slowdowns of alcoholic fermentation and consequent production of furanic compounds; so the most recent trend is that of cooking between 75 and 90° C, for no more than 14 hours, with a reduction of the must up to 28-30° Brix.
The process of cooking grape juice to obtain reduced cooked must and the subsequent formation of the organic species that characterize it represent an extremely delicate stage due to the many variables involved that are linked to the different chemical and chemical-physical transformations which take place inside the matrices during the cooking phase.
In particular, the decrease in the percentage of water during cooking can lead to the formation of furfurals: compounds that not only negatively connote the final product but which are even harmful to the health of the consumer as they are potentially carcinogenic.
Proper cooking of the must therefore represents the only way to obtain a good traditional balsamic vinegar.
Consequently, cavitation-assisted cooking could give excellent results because the heating of the liquid is homogeneous, as the liquid mass is not heated by heat sources such as flame or electrical resistance, but it is the same mass of liquid that heats up on its own, preventing localized caramelization formations.

10) Applied to desalination

Building a traditional desalination plant costs extremely important amount of money and need impressive quantities of energy in order to work. In addition, to build one requires careful planning and years of work.
Bringing cavitation equipment equipped for desalination directly when and were it is needed can solve many problems, especially during emergencies or in war operations.
Small structures, such as hotels, communities on islands or not reached by aqueduct services, will easily benefit from the use of cavitation devices equipped for desalination, especially if powered by thermo dynamic energy.

11) Applied to the oil

Recent scientific studies found that the high pressure and temperature increase provided by acoustic and hydrodynamic cavitation activate many processes and accelerate a number of chemical reactions.
Therefore, oil, even the heavy bituminous one, subjected to cavitation for about 15 minutes, could be transformed, practically, into another product as it improves the homogeneity, viscosity, gravity of the API (American Petroleum Institute) and other physical properties.
This happens because the formation of large molecular matrices, regular matrices and pseudo-polymer systems plays an important role in the oil extraction process, resulting in high surface tension and viscosity and non-Newtonian behavior.
Any disruption of these large molecular associations, particles, agglomerations or pseudo polymeric interactions leads to an alteration of the properties of the oil.
Lin and Yen (1993) cracked asphaltenes, which are refractory to FCC, and deactivated the catalysts even under mild conditions, using ultrasonic cavitation, sodium borohydride as a source of hydrogen and a surfactant to prevent recombination and the disproportion of asphaltene's radicals.
The hydrogen radicals ended the reactions of free radicals and saturated olefins. As a result, 35% of asphaltenes were converted into petrol and resins in 15 minutes. The conversion of asphaltenes into lighter hydrocarbons has increased 10-fold.
All this implies that oil, after being passed into the Empowering Device, acquires the most sought peculiarities and therefore could be offered for sale at higher prices.
It is now well established that the phenomenon of cavitation is more amplified in viscous fluids. If the flow of oil moves at high speed causing the absolute pressure of the oil to fall below the vapor pressure of hydrocarbons contained therein, cavitation occurs.
Cavitation separates the "liquid" phase (high boiling point hydrocarbons and their particles in

liquid hydrocarbons) from the gases present in the oil (trapped gases, water vapor and the hydrocarbon vapors involved).
In the refinery, on the other hand, it wll be a benefit from thermal cracking, catalytic cracking and hydrocracking. Likewise, all this can also be applied to biorefineries, petroleum gas oils and bio-based sources: by mixing water and diesel with controlled cavitation, it is obtained the so-called “white diesel”.

12) Applied to Fracking

Fracking, or hydraulic fracturing, consists of the current water pumping processes in the soil in order to promote yield and create the pressure required for horizontal drilling techniques. This practice requires millions of liters of water: for example shale wells require 3/7 million gallons per well (11 to 27 million liters).
In the vast majority of cases, this water must be brought to the wells by truck: 300 trucks can carry up to 4 million liters of water (about 1 million gallons). But already after the first use in the wells, the water recovered is highly corrosive because it has a high concentration of salt (from 7 to 10 times greater than sea water), other shale’s impurities plus the additives used for a variety of production reasons by oil companies. Beyond a certain threshold, water can no longer be re-used by further raising the costs of oil extraction due to the new supplies needed and the disposal of what has already been used.
Furthermore, environmental laws, which are increasingly restrictive, tend to pose more and more problems to the disposal of already saturated waters.
Cavitation can help avoiding the disposal of these waters as it can be treated directly on site, making them immediately suitable for re-use in the Fracking process. This can mean elimination of landfills and a 30 to 50% less use of new water for each well.

13) As part of ethanol production

The production starts from the mechanical grinding and then from the mixing with water of starchy grains. The resulting slurry is pumped inside the cavitator where each particle of the starchy bean structure is completely fractured, exposing additional starch molecules trapped inside the cellular structure and thus improving the enzymatic efficiency hydrolyzed in the “must”.
The smaller the particles, the greater the surfaces that interact allowing an increase in the ethanol yield, with the same initial matrix, from 1% to 2.5% and from 2% to 4% or more with no additional energy input and therefore with lower total raw material costs.
Applying cavitation before saccharification improves particle size and starch-sugar conversion

rate for subsequent fermentation in ethanol. Ethanol can therefore be generated more efficiently through fermentation and subsequent distillation.

14) Biodiesel

In the biorefineries, as in traditional refineries, thermal cracking, catalytic cracking, hydrocracking bring a big benefit. Therefore, mixing water and diesel from bio origins with controlled cavitation results in the so-called "white diesel".
The reaction times are reduced to a few seconds and, at the same time, cavitation allows to treat any matrix, even if of a lower quality, obtaining extremely flattering and better levels.
Biodiesel production begins by reacting the triglycerides with an alcohol and a catalyst. The products of this reaction are mainly biodiesel and glycerin.
Suffice it to say that the linked glycerin is less than 0.05% in biodiesel in two-stage systems.
Also in this case cavitation can be easily applied on existing plants in order to reduce costs and expand their production capacity or it can be the basis of totally innovative plants.
There are plants, especially in the United States, that have equipped themselves with this technology since 2005 and that use it with great profit despite the fact that the machines are those of the very first generations and therefore of the mono cavitation type without diffusion implementation for pressure recovery.
Using cavitation, production plants can use a greater quantity of matrices to be converted and with extremely higher values of free fats (FFAs). Therefore, used cooking oils, used oils from industrial processes, palm oils, beef tallow, poultry, etc. can be used as production matrices.
Furthermore, by speeding up the reactions, the quantities of catalysts to be used to complete the processes decrease accordingly.

15) In paper mills

In this sector, the production processes with traditional technology are continuously exposed to risks, such as the appearance of defects in the paper and production inefficiencies caused by the presence of lint of polymers or even agglomerates that form in low-flow areas, particularly when are combined cationic and anionic polymers. In extreme cases, bacterial formations can also appear.
Cavitation can be the optimal solution for all those needs of emulsion and homogenization of additives, inks or dispersed waxes as it is currently the most effective system for disintegrating and uniformly dispersing in the liquid bases both organic and inorganic pigments with even density above

50%.
Traditional systems for mixing and dosing are characterized by high costs of both implementation and management and, above all, maintenance as the deposit of sediments on different parts of the plant forces continuous interventions.
The consumption of water required to dilute the other fluids treated is also huge as this must be continuously introduced, also entailing the problem of increasing energy consumption by having to continuously stabilize the thermal levels of the matrices.
With cavitation, on the other hand, process water is used, completely eliminating, with the exception of the relative tanks, all external pre-treatment and filtration machinery.
Having an always constant flow of matrix being processed and there are no dead spots inside our apparatus, the possibility of encrustations or sediment deposits is also eliminated, thus reducing maintenance times to a minimum, guaranteeing perfect hygiene, better reactivity of the matrices introduced and, being the dimensions of the plant considerably reduced, any intervention, including dosage variations, will be practically immediate.
With experiments conducted using basic cavitators, it was found that the dosages of additives dropped by over 30% while retentives by over 25% with significant increases in the production capacity of the entire plant in general.

16) In tanneries

In tanneries, cavitation helps especially in breaking down the high concentrations of sulphides used for the processing of raw hides; the process times required to make the oxygen bubble in the tanks:

$$S + O_2 \text{ in } SO_4$$

Thanks to cavitation, pure oxygen can be easily replaced with much less expensive atmospheric air, the gas / liquid ratio is maximized thus obtaining a stable emulsion that allows a more intimate contact between the gases and the liquid with consequent reduction of the time required for the completion of the same operation, the necessary costs as well as streamlining all stages of the process. In a few minutes you will get the results previously obtained in weeks.

For further examples, please refer to our website:

www.ce.eco

EMPOWERING DEVICE

models	bio	test	standard
x mm	156	156	156
y mm	261	261	261
z mm	261	261	261
square meters	4,07	4,07	4,07
square feet	43,83	43,83	43,83
cubic meters	10,63	10,63	10,63
cubic yards	13,90	13,90	13,90
nominal flow rate m3 / h	60	40	60
liters / minute	*1.000*	*667*	*1.000*
liters / second	*16,67*	*11,11*	*16,67*
maximum m3 / day	1.440	320	1.440
minimum kW / m3	0,123 kWh	0,555 kWh	0,123 kWh
minimum ozone grams / m3	0,5	0,8	0,5
maximum ozone grams / m3	18,0	40,5	9,0
cost m3 from	0,049 €	0,345 €	0,059 €
cost m3 desalinated from	0,227 €	1,297 €	0,247 €
atex	X	X	X
ped	X	-	X
teflon	-	-	X
water	X	X	X
food liquids	X	X	X
leachate	-	X	X
edible oils	-	X	X
other oils	-	X	X
chemical industries	-	X	X
extractive industries	X	X	X
sludge	X	-	-

English - € 0,1809 /kWh

twin-set	twin-max	trio	sofron4	sofron8	sofron12	sofron16
261	261	261	261	290	310	340
261	261	261	340	340	340	340
261	261	261	300	300	300	300
6,81	6,81	6,81	8,87	9,86	10,54	11,56
73,32	73,32	73,32	95,52	106,13	113,45	124,43
17,78	17,78	17,78	26,62	29,58	31,62	34,68
23,25	23,25	23,25	34,82	38,69	41,36	45,36
60	120	180	240	480	720	960
1.000	*2.000*	*3.000*	*4.000*	*8.000*	*12.000*	*16.000*
16,67	*33,33*	*50,00*	*66,67*	*133,33*	*200,00*	*266,67*
1.440	2.880	4.320	5.760	11.520	17.280	23.040
0,247 kWh	0,123 kWh	0,123 kWh	0,106 kWh	0,103 kWh	0,102 kWh	0,101 kWh
1,0	0,5	0,5	0,5	0,5	0,5	0,5
18,0	9,0	9,0	9,0	9,0	9,0	9,0
0,099 €	0,049 €	0,056 €	0,046 €	0,044 €	0,043 €	0,042 €
0,417 €	0,227 €	0,240 €	0,159 €	0,142 €	0,137 €	0,134 €
also available in version:						
X	X	X	X	X	X	X
X	X	X	X	X	X	X
X	X	X	X	X	X	X
designed for:						
X	X	X	X	X	X	X
X	X	X	X	X	X	X
X	X	X	-	-	-	-
X	X	X	X	X	X	X
X	X	X	-	-	-	-
X	X	X	X	X	X	X
X	X	X	-	-	-	-
-	-	-	-	-	-	-

EMPOWERING DEVICE

STANDARD

model parameters	nominal flow rate m3 / h	60
	liters / minute	*1.000*
	liters / second	*16,67*
	liters internal circuit	150
	liters storage tank	0
	days of operation	364
	ozone grams / h	30
	annual maintenance *	*
rated power kW	engine	15,0
	main pump	5,5
	ozone system	0,5
	PLC & sensors	0,4
	UV system	*0,0*
	raise - optional	*0,0*
	other optional	*0,0*
	Actual kWh	10,1
system equipment	ozonators	1
	UV system	0
	graphene filter IN	0
	graphene filter OUT	0
	membrane	0
	insufflator	0
	dosing pump	0
	weir	0
	fridge	0
extra	atex	no
	ped	no
	teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	16,7	5,6	2,8	1,9	1,4	1,1	0,9
m3 / hour	60,0	20,0	10,0	6,7	5,0	4,0	3,3
m3 / hour - desalinated	30,0	10,0	5,0	3,3	2,5	2,0	1,7
m3 / day	1440,0	480,0	240,0	160,0	120,0	96,0	80,0
seconds per m3	60	180	360	540	720	900	1080
kW processing	0,025	0,076	0,151	0,227	0,303	0,378	0,454
kW / m3	0,168	0,505	1,009	1,514	2,018	2,523	3,027
ozone gr./ processing	0,075	0,225	0,45	0,675	0,9	1,125	1,35
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,123	0,370	0,740	1,110	1,480	1,850	2,220
2000,00 kW / m3	0,168	0,505	1,009	1,514	2,018	2,523	3,027
3000,00 kW / m3	0,357	1,070	2,140	3,210	4,280	5,350	6,420

x mm	156
y mm	261
z mm	261
square meters	4,07
square feet	43,83
cubic meters	10,63
cubic yards	13,90

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

BIO

model parameters	nominal flow rate m3 / h	60
	liters / minute	*1.000*
	liters / second	*16,67*
	liters internal circuit	240
	liters storage tank	0
	days of operation	364
	ozone grams / h	60
	annual maintenance *	*
rated power kW	engine	15,0
	main pump	5,5
	ozone system	1,0
	PLC & sensors	0,4
	UV system	*0,7*
	raise - optional	*4,0*
	other optional	*0,5*
	Actual kWh	13,9
system equipment	ozonators	2
	UV system	1
	graphene filter IN	0
	graphene filter OUT	1
	membrane	0
	insufflator	0
	dosing pump	1
	weir	0
	fridge	0
extra	atex	no
	ped	no
	teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	14,4	43,2	86,4	129,6	172,8	216	259,2
processes for now	250,0	83,3	41,7	27,8	20,8	16,7	13,9
liters per second	16,7	5,6	2,8	1,9	1,4	1,1	0,9
m3 / hour	60,0	20,0	10,0	6,7	5,0	4,0	3,3
m3 / hour - desalinated	30,0	10,0	5,0	3,3	2,5	2,0	1,7
m3 / day	1440,0	480,0	240,0	160,0	120,0	96,0	80,0
seconds per m3	60	180	360	540	720	900	1080
kW processing	0,056	0,167	0,333	0,500	0,667	0,833	1,000
kW / m3	0,232	0,695	1,389	2,084	2,778	3,473	4,167
ozone gr./ processing	0,24	0,72	1,44	2,16	2,88	3,6	4,32
ozone grams / m3	1,00	3,00	6,00	9,00	12,00	15,00	18,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,123	0,370	0,740	1,110	1,480	1,850	2,220
2000,00 kW / m3	0,168	0,505	1,009	1,514	2,018	2,523	3,027
3000,00 kW / m3	0,357	1,070	2,140	3,210	4,280	5,350	6,420

x mm	156
y mm	261
z mm	261
square meters	4,07
square feet	43,83
cubic meters	10,63
cubic yards	13,90

the set configuration offers

level of sterilization	*great*
targeted removal of pollutants	*great*
desalination	*to verify*
oil separation	*suitable*
food use	*to verify*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

TEST

model parameters	nominal flow rate m3 / h	40
	liters / minute	*667*
	liters / second	*11,11*
	liters internal circuit	150
	liters storage tank	300
	days of operation	364
	ozone grams / h	30
	annual maintenance *	*
rated power kW	engine	15,0
	main pump	5,5
	ozone system	0,5
	PLC & sensors	0,4
	UV system	*0,0*
	raise - optional	*0,0*
	other optional	*0,0*
	Actual kWh	10,1
system equipment	ozonators	1
	UV system	0
	graphene filter IN	0
	graphene filter OUT	0
	membrane	0
	insufflator	0
	dosing pump	0
	weir	0
	fridge	0
extra	atex	no
	ped	no
	teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	40,5	121,5	243	364,5	486	607,5	729
processes for now	88,9	29,6	14,8	9,9	7,4	5,9	4,9
liters per second	3,7	1,2	0,6	0,4	0,3	0,2	0,2
m3 / hour	13,3	4,4	2,2	1,5	1,1	0,9	0,7
m3 / hour - desalinated	6,7	2,2	1,1	0,7	0,6	0,4	0,4
m3 / day	320,0	106,7	53,3	35,6	26,7	21,3	17,8
seconds per m3	270	810	1620	2430	3240	4050	4860
kW processing	0,114	0,341	0,681	1,022	1,362	1,703	2,043
kW / m3	0,757	2,270	4,541	6,811	9,082	11,352	13,623
ozone gr./ processing	0,3375	1,0125	2,025	3,0375	4,05	5,0625	6,075
ozone grams / m3	2,25	6,75	13,50	20,25	27,00	33,75	40,50

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,555	1,665	3,330	4,995	6,660	8,325	9,990
2000,00 kW / m3	0,757	2,270	4,541	6,811	9,082	11,352	13,623
3000,00 kW / m3	1,605	4,815	9,630	14,445	19,260	24,075	28,890

x mm	156
y mm	261
z mm	261
square meters	4,07
square feet	43,83
cubic meters	10,63
cubic yards	13,90

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

TWIN-SET

model parameters	nominal flow rate m3 / h	60
	liters / minute	*1.000*
	liters / second	*16,67*
	liters internal circuit	300
	liters storage tank	0
	days of operation	364
	ozone grams / h	60
	annual maintenance *	*
rated power kW	engine	30,0
	main pump	11,0
	ozone system	1,0
	PLC & sensors	0,8
	UV system	*0,0*
	raise - optional	*0,0*
	other optional	*0,0*
	Actual kWh	24,4
system equipment	ozonators	2
	UV system	0
	graphene filter IN	0
	graphene filter OUT	0
	membrane	0
	insufflator	0
	dosing pump	0
	weir	0
	fridge	0
extra	atex	no
	ped	no
	teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	18	54	108	162	216	270	324
processes for now	200,0	66,7	33,3	22,2	16,7	13,3	11,1
liters per second	16,7	5,6	2,8	1,9	1,4	1,1	0,9
m3 / hour	60,0	20,0	10,0	6,7	5,0	4,0	3,3
m3 / hour - desalinated	30,0	10,0	5,0	3,3	2,5	2,0	1,7
m3 / day	1440,0	480,0	240,0	160,0	120,0	96,0	80,0
seconds per m3	60	180	360	540	720	900	1080
kW processing	0,122	0,365	0,731	1,096	1,461	1,827	2,192
kW / m3	0,406	1,218	2,436	3,654	4,872	6,089	7,307
ozone gr./ processing	0,3	0,9	1,8	2,7	3,6	4,5	5,4
ozone grams / m3	1,00	3,00	6,00	9,00	12,00	15,00	18,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,247	0,740	1,480	2,220	2,960	3,700	4,440
2000,00 kW / m3	0,406	1,218	2,436	3,654	4,872	6,089	7,307
3000,00 kW / m3	0,713	2,140	4,280	6,420	8,560	10,700	12,840

x mm	261
y mm	261
z mm	261
square meters	6,81
square feet	73,32
cubic meters	17,78
cubic yards	23,25

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

TWIN-MAX

model parameters	
nominal flow rate m3 / h	120
liters / minute	*2.000*
liters / second	*33,33*
liters internal circuit	300
liters storage tank	0
days of operation	364
ozone grams / h	60
annual maintenance *	*

rated power kW	
engine	30,0
main pump	11,0
ozone system	1,0
PLC & sensors	0,8
UV system	*0,0*
raise - optional	*0,0*
other optional	*0,0*
Actual kWh	24,4

system equipment	
ozonators	2
UV system	0
graphene filter IN	0
graphene filter OUT	0
membrane	0
insufflator	0
dosing pump	0
weir	0
fridge	0

extra	
atex	no
ped	no
teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	33,3	11,1	5,6	3,7	2,8	2,2	1,9
m3 / hour	120,0	40,0	20,0	13,3	10,0	8,0	6,7
m3 / hour - desalinated	60,0	20,0	10,0	6,7	5,0	4,0	3,3
m3 / day	2880,0	960,0	480,0	320,0	240,0	192,0	160,0
seconds per m3	30	90	180	270	360	450	540
kW processing	0,030	0,091	0,183	0,274	0,365	0,457	0,548
kW / m3	0,203	0,609	1,218	1,827	2,436	3,045	3,654
ozone gr./ processing	0,15	0,45	0,9	1,35	1,8	2,25	2,7
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,123	0,370	0,740	1,110	1,480	1,850	2,220
2000,00 kW / m3	0,203	0,609	1,218	1,827	2,436	3,045	3,654
3000,00 kW / m3	0,357	1,070	2,140	3,210	4,280	5,350	6,420

x mm	261
y mm	261
z mm	261
square meters	6,81
square feet	73,32
cubic meters	17,78
cubic yards	23,25

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

TRIO

model parameters	nominal flow rate m3 / h	180
	liters / minute	*3.000*
	liters / second	*50,00*
	liters internal circuit	450
	liters storage tank	0
	days of operation	364
	ozone grams / h	90
	annual maintenance *	*
rated power kW	engine	45,0
	main pump	16,5
	ozone system	1,5
	PLC & sensors	1,2
	UV system	*0,0*
	raise - optional	*0,0*
	other optional	*0,0*
	Actual kWh	38,6
system equipment	ozonators	3
	UV system	0
	graphene filter IN	0
	graphene filter OUT	0
	membrane	0
	insufflator	0
	dosing pump	0
	weir	0
	fridge	0
extra	atex	no
	ped	no
	teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	50,0	16,7	8,3	5,6	4,2	3,3	2,8
m3 / hour	180,0	60,0	30,0	20,0	15,0	12,0	10,0
m3 / hour - desalinated	90,0	30,0	15,0	10,0	7,5	6,0	5,0
m3 / day	4320,0	1440,0	720,0	480,0	360,0	288,0	240,0
seconds per m3	20	60	120	180	240	300	360
kW processing	0,032	0,097	0,193	0,290	0,386	0,483	0,579
kW / m3	0,215	0,644	1,287	1,931	2,575	3,219	3,862
ozone gr./ processing	0,225	0,675	1,35	2,025	2,7	3,375	4,05
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,123	0,370	0,740	1,110	1,480	1,850	2,220
2000,00 kW / m3	0,215	0,644	1,287	1,931	2,575	3,219	3,862
3000,00 kW / m3	0,357	1,070	2,140	3,210	4,280	5,350	6,420

x mm	261
y mm	261
z mm	261
square meters	6,81
square feet	73,32
cubic meters	17,78
cubic yards	23,25

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

SOFRON4

model parameters	
nominal flow rate m3 / h	240
liters / minute	*4.000*
liters / second	*66,67*
liters internal circuit	600
liters storage tank	0
days of operation	364
ozone grams / h	120
annual maintenance *	*

rated power kW	
engine	15,0
main pump	22,0
ozone system	2,0
PLC & sensors	1,6
UV system	*0,0*
raise - optional	*0,0*
other optional	*0,0*
Actual kWh	25,4

system equipment	
ozonators	4
UV system	0
graphene filter IN	0
graphene filter OUT	0
membrane	0
insufflator	0
dosing pump	0
weir	0
fridge	0

extra	
atex	no
ped	no
teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	66,7	22,2	11,1	7,4	5,6	4,4	3,7
m3 / hour	240,0	80,0	40,0	26,7	20,0	16,0	13,3
m3 / hour - desalinated	120,0	40,0	20,0	13,3	10,0	8,0	6,7
m3 / day	5760,0	1920,0	960,0	640,0	480,0	384,0	320,0
seconds per m3	15	45	90	135	180	225	270
kW processing	0,016	0,048	0,095	0,143	0,191	0,238	0,286
kW / m3	0,106	0,318	0,635	0,953	1,270	1,588	1,905
ozone gr./ processing	0,3	0,9	1,8	2,7	3,6	4,5	5,4
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,106	0,318	0,635	0,953	1,270	1,588	1,905
2000,00 kW / m3	0,106	0,318	0,635	0,953	1,270	1,588	1,905
3000,00 kW / m3	0,169	0,508	1,015	1,523	2,030	2,538	3,045

x mm	261
y mm	340
z mm	300
square meters	8,87
square feet	95,52
cubic meters	26,62
cubic yards	34,82

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

SOFRON8

model parameters	nominal flow rate m3 / h	480
	liters / minute	*8.000*
	liters / second	*133,33*
	liters internal circuit	1200
	liters storage tank	0
	days of operation	364
	ozone grams / h	240
	annual maintenance *	*
rated power kW	engine	15,0
	main pump	44,0
	ozone system	4,0
	PLC & sensors	3,2
	UV system	*0,0*
	raise - optional	*0,0*
	other optional	*0,0*
	Actual kWh	49,4
system equipment	ozonators	8
	UV system	0
	graphene filter IN	0
	graphene filter OUT	0
	membrane	0
	insufflator	0
	dosing pump	0
	weir	0
	fridge	0
extra	atex	no
	ped	no
	teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	133,3	44,4	22,2	14,8	11,1	8,9	7,4
m3 / hour	480,0	160,0	80,0	53,3	40,0	32,0	26,7
m3 / hour - desalinated	240,0	80,0	40,0	26,7	20,0	16,0	13,3
m3 / day	11520,0	3840,0	1920,0	1280,0	960,0	768,0	640,0
seconds per m3	7,5	22,5	45	67,5	90	112,5	135
kW processing	0,015	0,046	0,093	0,139	0,185	0,232	0,278
kW / m3	0,103	0,309	0,618	0,926	1,235	1,544	1,853
ozone gr./ processing	0,6	1,8	3,6	5,4	7,2	9	10,8
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,103	0,309	0,618	0,926	1,235	1,544	1,853
2000,00 kW / m3	0,103	0,309	0,618	0,926	1,235	1,544	1,853
3000,00 kW / m3	0,138	0,414	0,828	1,241	1,655	2,069	2,483

x mm	290
y mm	340
z mm	300
square meters	9,86
square feet	106,13
cubic meters	29,58
cubic yards	38,69

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

SOFRON12

model parameters	
nominal flow rate m3 / h	720
liters / minute	*12.000*
liters / second	*200,00*
liters internal circuit	1800
liters storage tank	0
days of operation	364
ozone grams / h	360
annual maintenance *	*

rated power kW	
engine	15,0
main pump	66,0
ozone system	6,0
PLC & sensors	4,8
UV system	*0,0*
raise - optional	*0,0*
other optional	*0,0*
Actual kWh	73,4

system equipment	
ozonators	12
UV system	0
graphene filter IN	0
graphene filter OUT	0
membrane	0
insufflator	0
dosing pump	0
weir	0
fridge	0

extra	
atex	no
ped	no
teflon	no

engine revolutions per minute: **2.000**

€ / kWh **0,18 €**

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	200,0	66,7	33,3	22,2	16,7	13,3	11,1
m3 / hour	720,0	240,0	120,0	80,0	60,0	48,0	40,0
m3 / hour - desalinated	360,0	120,0	60,0	40,0	30,0	24,0	20,0
m3 / day	17280,0	5760,0	2880,0	1920,0	1440,0	1152,0	960,0
seconds per m3	5	15	30	45	60	75	90
kW processing	0,015	0,046	0,092	0,138	0,184	0,229	0,275
kW / m3	0,102	0,306	0,612	0,918	1,223	1,529	1,835
ozone gr./ processing	0,9	2,7	5,4	8,1	10,8	13,5	16,2
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,102	0,306	0,612	0,918	1,223	1,529	1,835
2000,00 kW / m3	0,102	0,306	0,612	0,918	1,223	1,529	1,835
3000,00 kW / m3	0,128	0,383	0,765	1,148	1,530	1,913	2,295

x mm	310
y mm	340
z mm	300
square meters	10,54
square feet	113,45
cubic meters	31,62
cubic yards	41,36

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

EMPOWERING DEVICE

SOFRON16

model parameters	
nominal flow rate m3 / h	960
liters / minute	*16.000*
liters / second	*266,67*
liters internal circuit	2400
liters storage tank	0
days of operation	364
ozone grams / h	480
annual maintenance *	*

rated power kW	
engine	15,0
main pump	88,0
ozone system	8,0
PLC & sensors	6,4
UV system	*0,0*
raise - optional	*0,0*
other optional	*0,0*
Actual kWh	97,4

system equipment	
ozonators	16
UV system	0
graphene filter IN	0
graphene filter OUT	0
membrane	0
insufflator	0
dosing pump	0
weir	0
fridge	0

extra	
atex	no
ped	no
teflon	no

engine revolutions per minute: 2.000

€ / kWh 0,18 €

	continuous	short	medium	long	prolonged	accurate	scrupulous
processing cycles	1	3	6	9	12	15	18
required seconds	9	27	54	81	108	135	162
processes for now	400,0	133,3	66,7	44,4	33,3	26,7	22,2
liters per second	266,7	88,9	44,4	29,6	22,2	17,8	14,8
m3 / hour	960,0	320,0	160,0	106,7	80,0	64,0	53,3
m3 / hour - desalinated	480,0	160,0	80,0	53,3	40,0	32,0	26,7
m3 / day	23040,0	7680,0	3840,0	2560,0	1920,0	1536,0	1280,0
seconds per m3	3,75	11,25	22,5	33,75	45	56,25	67,5
kW processing	0,015	0,046	0,091	0,137	0,183	0,228	0,274
kW / m3	0,101	0,304	0,609	0,913	1,218	1,522	1,826
ozone gr./ processing	1,2	3,6	7,2	10,8	14,4	18	21,6
ozone grams / m3	0,50	1,50	3,00	4,50	6,00	7,50	9,00

**maintenance varies according to the accessories actually installed*

power consumption - basic equipment							
1000,00 kW / m3	0,101	0,304	0,609	0,913	1,218	1,522	1,826
2000,00 kW / m3	0,101	0,304	0,609	0,913	1,218	1,522	1,826
3000,00 kW / m3	0,122	0,367	0,734	1,101	1,468	1,834	2,201

x mm	340
y mm	340
z mm	300
square meters	11,56
square feet	124,43
cubic meters	34,68
cubic yards	45,36

the set configuration offers

level of sterilization	*good*
targeted removal of pollutants	*good*
desalination	*to verify*
oil separation	*to verify*
food use	*suitable*
use in hazardous and / or explosive environments	*to verify*

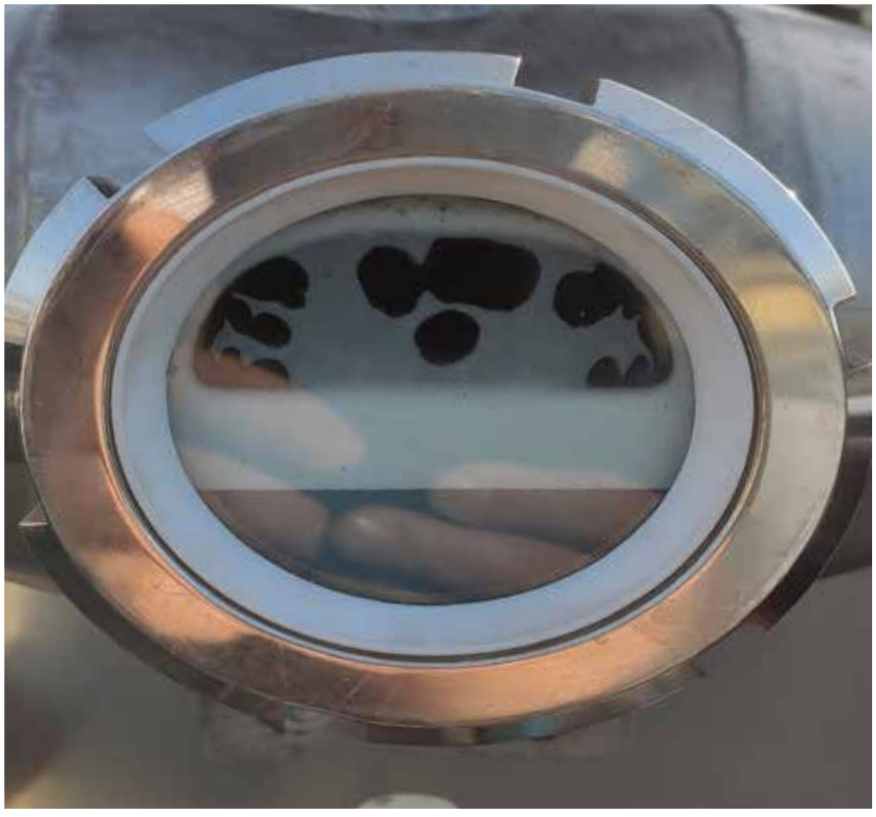
industrial waters

It is now known that cavitation allows excellent results to be obtained especially if applied in the presence of organic material as by demolishing the molecules it reduces both the COD and BOD values. This happens mainly due to the fact that the physical phenomenon of cavitation enhances, also multiplying exponentially, completely natural physical and chemical processes including oxidation.

While the tests conducted with the **EMPOWERING DEVICE** on organic-based liquids immediately returned decidedly positive results, **with percentage variations on respect to the AS IS sometimes even up to almost 4 figures and obtained in a very short time**, those conducted with industrial wastewater required a thoughtful and accurate set-up of the machinery in order to set the best process management dynamics and the related accessories to be applied in order to better complete the process itself.

All this it has become necessary because the tests on non-organic fluids had gone differently from expectations not due to the miss working of the machine but precisely due to its perfect functioning: the parameters of the liquid that were expected should be the first to undergo the action of the **EMPOWERING DEVICE**, given their inorganic nature, could not actually be treated until other values such as, by way of example, the total suspended solids had not been "normalized".

On industrial waters **EMPOWERING DEVICE** does not find its best application in addition to an already existing process but express its maximum when it itself forms the basis for a new, faster and more performing continuous processing process. In these applications, **EMPOWERING DEVICE** acts, depending on the case, as a flotator and as a micronizer of the particles, coagulating very small suspended solids, facilitating the following filtration, allowing the clarification of the wastewater and thus making subsequent chemical-physical treatments much easier. Just as it can best homogenize inhomogeneous wastewater, favoring the subsequent chemical attack through the same reagents also used for traditional industrial purification but consuming only a fraction of the energy required with traditional systems.



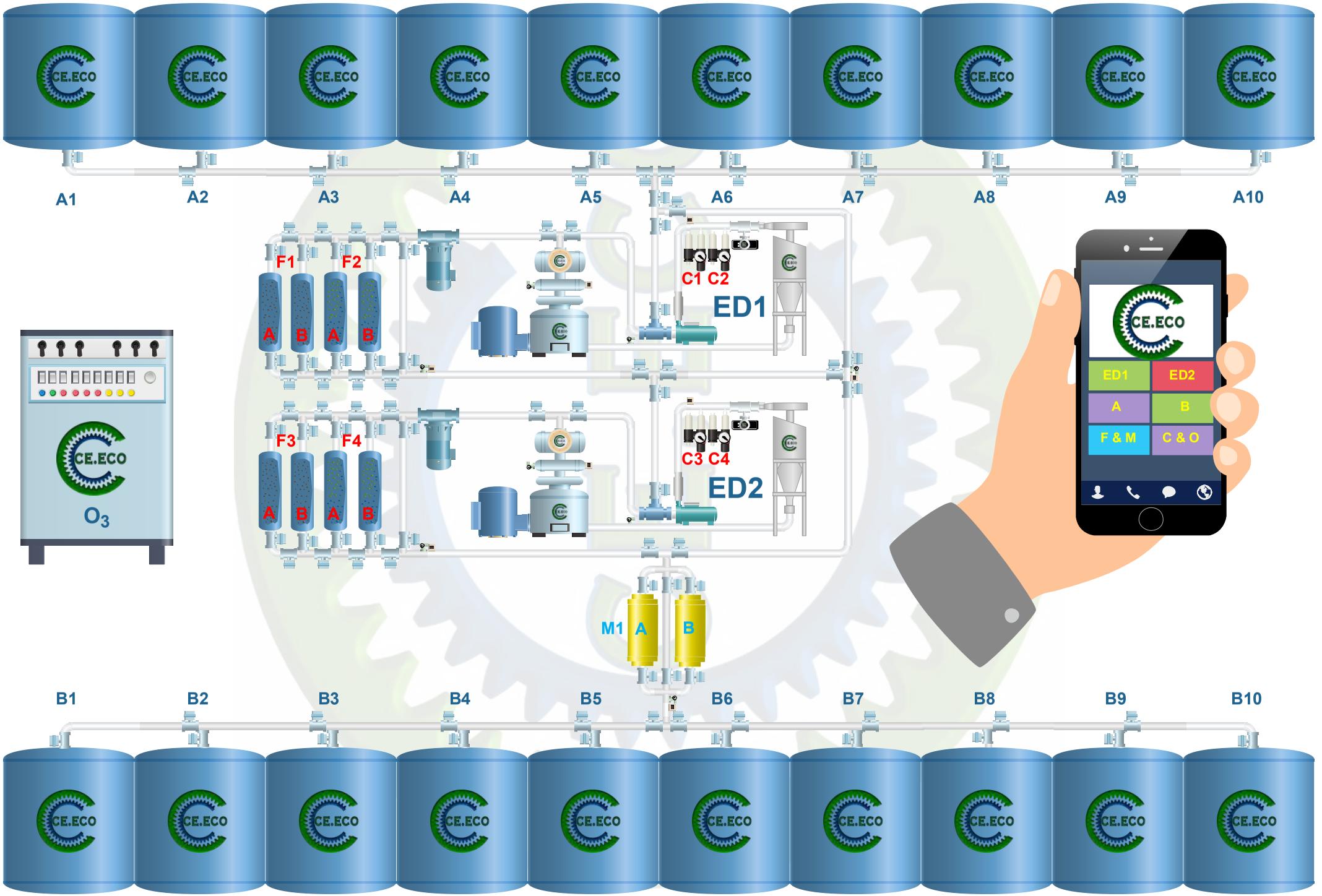
The construction geometry of the **EMPOWERING DEVICE** makes it not only a perfect pressure diffuser, thus reducing energy consumption, but also an excellent mixing system.

A further efficiency can be ensu-

red by the use of subsequent **EMPOWERING DEVICE**, as with 2 devices in series the liquid can undergo a first treatment at low revolutions, a filtration, an additive while it is treated at a high number of revolutions in the second device for then be further filtered thus obtaining, in most cases, a workflow without downtime.
The variety of traditional treatment of non-organic industrial waste is very wide, so the purification approach is almost always to be studied on a case-by-case basis. What all treatments have in common is that energy consumption, especially electricity, is very high, because these are subjected to numerous energy-intensive treatments, among which the main ones are:

- ➔ neutralization of ph;
- ➔ the separation of the precipitated salts;
- ➔ crystallization;
- ➔ the drying of the crystals;
- ➔ the separation of super-saturated crystals and suspended solids or those deriving from the chemical reaction of purification processes, often carried out with large centrifuges;
- ➔ the reaction with chemicals that lead to new less dangerous compounds and lower the costs of final disposal, when they do not allow a complete recovery of the wastewater;
- ➔ the recovery of industrial solvents, with the use of redistillation columns, from which however, in addition to the cleaned solvent, from the top, the residual substances come out, usually from the bottom, which must be conveniently disposed of.

Both in the pH neutralization plant units and in those of specific reactions with chemicals, the **EMPOWERING DEVICE** is capable to avoid large tanks and make the chemical process continuous and fluid, due to making possible to add the neutralizer online. Without the tanks that must be stirred continuously and for a long time in order not to be stratified and inhomogeneous, the pumps for sending to the neutralization or reaction reactor are also eliminated, as well as the pumps for relaunching the finished product, allowing considerable energy savings and compactness of the plant. The visual impact of the plant profile is thus drastically reduced, hiding from the eyes of the neighboring inhabitants who will therefore tend to complain less about the existence of the plant itself.
Knowing the characteristics of an incoming wastewater contained in a silos, even horizontal, through a PLC that can be controlled remotely according to the dictates of Industry 4.0, a set of solenoid valves and pumps will lead it through one, two, three or subsequent passages inside the cavitators and special filters designed to eliminate certain aspects of the wastewater to be treated and then add or not chemicals, ozone or whatever else is needed before being shipped to a storage silos of the treated where the wastewater, now processed and inertized, will then be ready to be disposed of.
On the basis of the “families” of origin of the wastewater, specific recipes are created in order to automate the process as much as possible.

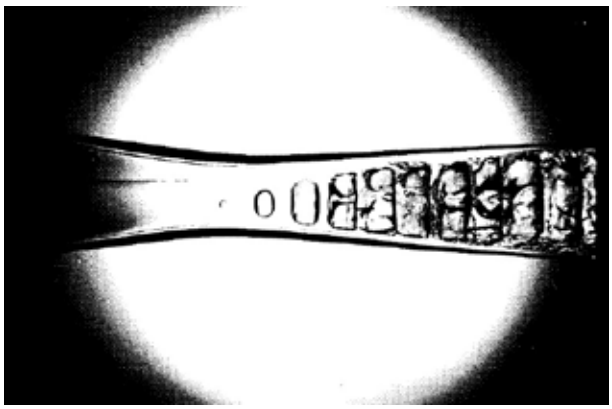

A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
F1
F2
A
B
A
B
C1 C2
ED1
F3
F4
A
B
A
B
C3 C4
ED2
M1
A
B
O_3
ED1
ED2
A
B
F & M
C & O
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10

industrial plant with ED

The previous page shows a water treatment plant developed around a couple of **EMPOWERING DEVICE**.
The water produced by the plant or brought to a treatment center equipped with our system, after having been withdrawn from the storage silos (**A1-A10**) undergoes a first cavitation treatment (**ED1**) with or without the addition of chemicals (**C1-C2**) and ozone (O_3).
Subsequently the fluid, relaunched if necessary with a pump, can be either filtered (**F1-F2**) or, through a bypass, continue its course.
Each filter can be duplicated in parallel (**A-B**) in such a way that if the sensors should notice a decrease in efficiency, the staff will immediately be notified to intervene on the cartridge to be regenerated or replaced.
Based on the needs, the fluid can undergo a subsequent cavitation in the second **EMPOWERING DEVICE** (**ED2**) which will be equipped exactly like the first: chemicals pumps (**C3-C4**), ozone (O_3), filters (**F3-F4**) duplicated in parallel (**A-B**), bypass and booster pump.
Similarly, for what happens at the exit of the first **EMPOWERING DEVICE** the fluid can at this point be sent back to the first or second cavitator to undergo further treatments or, if now considered purified, be sent directly or through osmotic membranes (**M1**) duplicated in parallel (**A-B**), towards the final storage silos (**B1-B10**). Even with membranes, should the sensors detect a decrease in efficiency, the staff will immediately be notified to intervene on the cartridge to be regenerated or replaced.
From the definitive storage silos, after sample analysis, following the provisions and limits of the law, the water will either be discharged into the sewer or into a ditch or even reused to water the surrounding fields.

EXAMPLE: neutralization of a dirty hydrochloric acid. It starts from a pH of 1-1.5. Caustic soda is added to bring the pH to 7 and be able to dispose of the final system, where salt (sodium chloride) and water are generated. With **EMPOWERING DEVICE** we avoid the agitated tank of dirty HCl and sending it to the reactor because the cavitator can take it directly from the tanks. The dirt immediately spreads throughout the mass thanks to the controlled cavitation, in the same cavitator the necessary NaOH is added online; the neutralized and homogenized wastewater by **EMPOWERING DEVICE** can pass directly to the self-cleaning desalination membranes, which are also favored by upstream cavitation as a cavitated wastewater is able to pass the membranes with less resistance and therefore using less energy.
The same happens for the centrifuges for the separation of supersaturated salts, or solid components resulting from purification processes through energy-intensive reactions: they are all fully replaceable with an **EMPOWERING DEVICE** equipped with membranes and / or filters.

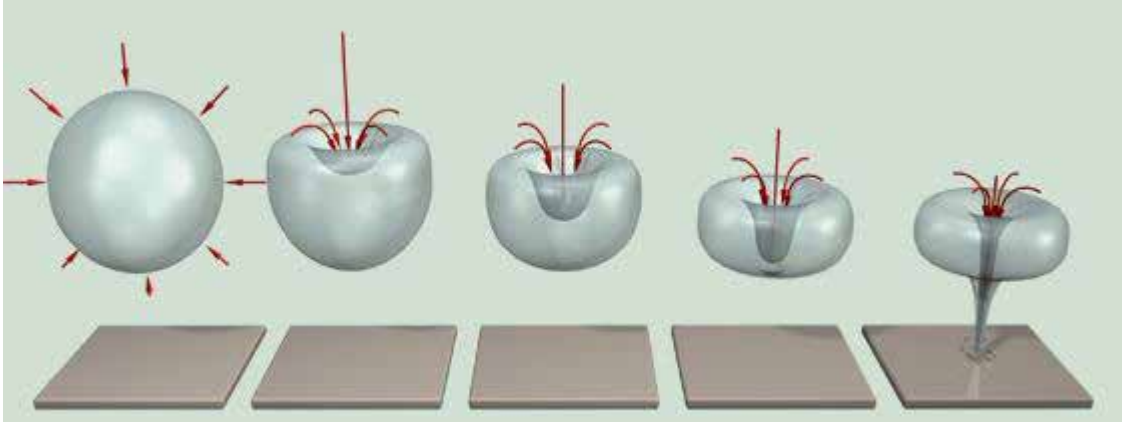
uncontrolled cavitation



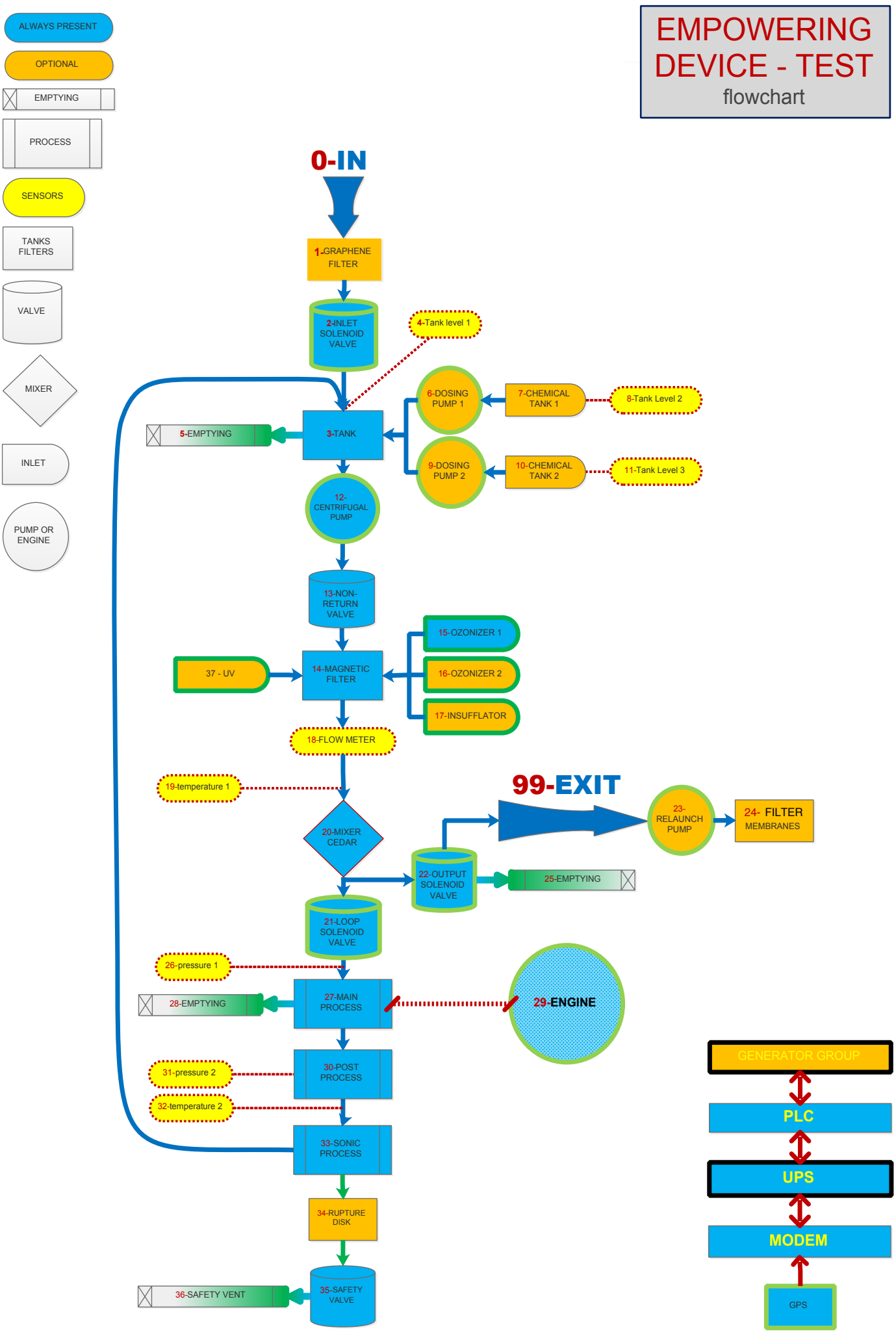
If in the liquid the absolute pressure becomes equal to or lower than the vapor pressure of the liquid at a certain temperature, in a few microseconds, microscopic vapor bubbles are formed. This is because liquids normally carry air dissolved in them and when there is a drop-in pressure down to the vapor pressure value, the air dissolved in the liquid is released and, therefore, the vaporization of the liquid itself is released also. The steam bubbles are then dragged by the current and when they arrive in areas with a pressure higher than the vapor pressure, then the collapse of the bubbles occurs.
The collapse and implosion phase releases a quantity of energy which, if not controlled, can cause:

- ➔ *a deterioration in the efficiency of the hydraulic system of at least 3%, due to the turbulence caused by cavitation.*
- ➔ *excessive vibration of the hydraulic system, causing noise.*
- ➔ *a severe deterioration of the internal components of the hydraulic system, due to the collapse of the bubbles near the wall of a component. In this case, a liquid jet (impinging jet) is generated which erodes the solid surface and forms what are called erosive pits. The area where this phenomenon occurs most frequently is at the impeller outlet, because in this section there is a temporary depressurization of the liquid, followed by a subsequent increase in pressure.*

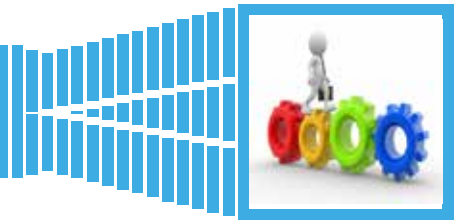
The erosion's degree is influenced by various factors, both related to the system's hydrodynamics and to the resistance behavior of the different materials.
The effects of condensation on the materials are mainly related to the surface hardness, the work hardening capacity and the grain size.
The cavitation erosion mechanism is very complex. In fact, in the literature, it is possible to find different theories on the causes of this process.



A first theory on the evolution of the erosive process provides that, when the single bubble implodes in a region of fluid away from the walls, its collapse occurs symmetrically. The surrounding fluid tends to quickly occupy the regions left free from the collapse of the bubble. This fluid movement induces a high intensity pressure wave that is transmitted quickly through the surrounding liquid. The high energy that is transmitted to the surrounding walls can lead to erosion of the material due to fatigue stress.
According to another hypothesis, however, when the bubble is near the sidewall, the collapse of the bubble occurs asymmetrically. The higher speed of condensation on the side opposite the wall induces the formation of a liquid jet at high speed which slits the vapor bubble and hits the wall itself. The energy transmitted following this impact can, over time, lead to erosion of the material due to fatigue stress.
The collapse of a vapor bubble acts as a trigger for the collapse of other bubbles.
In many devices it was observed that cavitation damage occurs in very localized areas, for example in a pump impeller. Often this is the result of the periodic collapse of a cloud of cavitation bubbles.
In nearly all of these cases, the consistent collapse of the cloud can cause much more intense noise and more prone to damage than a similar non-periodic flow. In this way the damage is more serious on the solid surface close to the location of the cloud explosion.
The question of whether cavitation damage is caused by micro jets or shock waves or both has been debated for many years. But even after the break caused by the micro-jet we find ourselves with a cloud of small residual bubbles that will continue to collapse collectively. Even if it is no longer a single bubble, this residual cloud will still have the same qualitative dynamic behavior as the possible production of a shock wave.


EMPOWERING DEVICE - TEST
flowchart
ALWAYS PRESENT
OPTIONAL
EMPTYING
PROCESS
SENSORS
TANKS FILTERS
VALVE
MIXER
INLET
PUMP OR ENGINE
0-IN
1-GRAPHENE FILTER
2-INLET SOLENOID VALVE
4-Tank level 1
3-TANK
5-EMPTYING
6-DOSING PUMP 1
7-CHEMICAL TANK 1
8-Tank Level 2
9-DOSING PUMP 2
10-CHEMICAL TANK 2
11-Tank Level 3
12-CENTRIFUGAL PUMP
13-NON-RETURN VALVE
14-MAGNETIC FILTER
37 - UV
15-OZONIZER 1
16-OZONIZER 2
17-INSUFFLATOR
18-FLOW METER
19-temperature 1
20-MIXER CEDAR
99-EXIT
23-RELAUNCH PUMP
24- FILTER MEMBRANES
22-OUTPUT SOLENOID VALVE
25-EMPTYING
21-LOOP SOLENOID VALVE
26-pressure 1
27-MAIN PROCESS
28-EMPTYING
29-ENGINE
31-pressure 2
30-POST PROCESS
32-temperature 2
33-SONIC PROCESS
34-RUPTURE DISK
36-SAFETY VENT
35-SAFETY VALVE
GENERATOR GROUP
PLC
UPS
MODEM
GPS

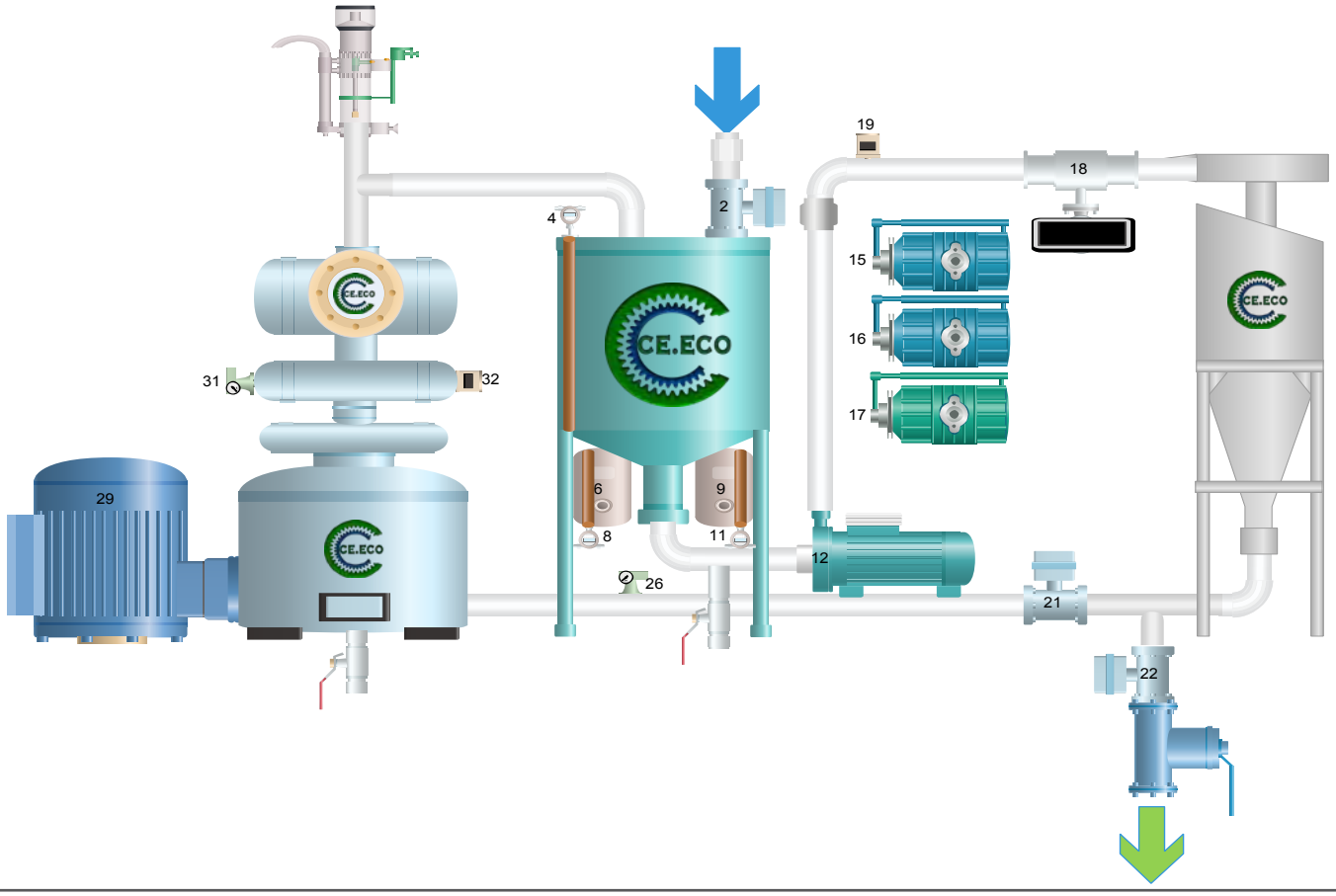
model: TEST



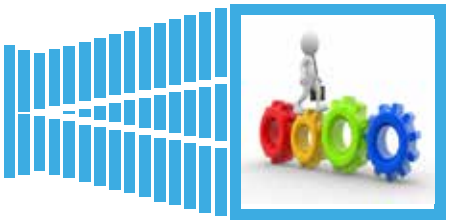
Example of a treatment for an organic liquid using an EMPOWERING DEVICE TEST model, which it is used to test the user 'smatrices on a stand-alone basis.
However, many of the processes we have developed are on-line kind: the machinery does not perform processing cycles but the liquid enters and exits without stopping, undergoing the treatments one after the other. In some cases we have provided for the presence of several cavitators one after the other to maximize the amount of liquid treated with the least use of electricity.
The fluid to be treated is introduced into the machinery through a flanged opening placed on the top (**0**). A graphene filter can optionally be positioned immediately before the flanged opening (**1**).
After the solenoid valve (**2**) which is placed immediately behind the inlet flange, a cannula guides the fluid towards the base of the tank (**3**) in such a way that the filling of the same takes place from the bottom upwards, exploiting the principle of communicating vessels, thus avoiding the formation of annoying turbulence that can trap air bubbles.
The inlet solenoid valve closes automatically when a preset level (**4**) for filling the tank is reached or upon manual command of the user or of the specific automatic processing program selected.
At the base of the tank there is a manual tap (**5**), accessible from the outside, to be used for taking samples and to facilitate complete emptying.
Optionally, up to two chemical tanks can be installed next to the loop tank, or one of double size, which can be filled from the outside equipped with level and dosing pump (**6**-**7**-**8** **&** **9**-**10**-**11**).
On the base of the tank, in a central position, a straight pipe leads to the centrifugal pump (**12**), and, immediately after, passes the non-return valve (**13**).
The pump re-launches the fluid towards the mixer also called **CEDAR** (**20**). In the piping between the mixer and the pump there are the magnetic filter (**14**), the flow meter (**18**), the first temperature sensor (**19**) as well as the inlet cannulas of the standard ozonator (**15**) of the second ozonizer (**16**) and an optional insufflator (**17**).
At the mixer outlet, the fluid can either continue the loop passing a special solenoid valve (**21**) or exit (**99**) from the machine passing another solenoid valve (**22**) beyond which one or more booster pumps (**23**) can be optionally placed as well as membrane filters (**24**). The outlet, being at the lowest point, is also used to empty the machinery (**25**) if it is necessary to clean it.
Beyond the valve that enters the loop, after the pressure control (**26**), the fluid enters the main process (**27**), which can be completely emptied by means of a special manual faucet (**28**) accessible from the outside, on which it is also connected the engine (**29**) of the device. At the outlet, the fluid passes into the post process (**30**) where both the temperature (**32**) and the pressure (**31**) are metered and from there into the sonic process (**33**) where the fluid undergoes the last treatments, observable through a porthole in glass, to then return to the tank.
Exactly as it happened at the inlet of the liquid, a cannula guides the fluid towards the base of the tank in such a way that the filling of the same takes place from the bottom upwards, exploiting the principle of communicating vessels, thus avoiding the formation of annoying turbulence that can trap air bubbles.

In case of too high pressures, if present as options, the safety valve (**35**) or the rupture disk (**34**) will operate and convey the excess fluid to the outside through a safety vent (**36**).
A fan system draws air from the basement of the device to eject it from the sides of the same: up to 400 cubic meters of air per hour eventful guarantee a correct parts as well as the reduction in temperature in about 5 cubic meters of all content space ' inside the protective hood. An optional UV lamp set is placed before the cedar (**37**).

The **EMPOWERING DEVICE** is controlled by a PLC connected to a webserver and interfaced to the CLOUD via a GSM modem, wired network or WI-FI or, optionally, satellite connection. A GPS will allow the device to be geolocated anywhere in the world. Optionally, especially indicated and recommended for transportable models, the use of a generator is foreseen.



noisiness



EMPOWERING DEVICE in order to be housed in a work environment it is equipped with an internal sound-absorbing and fireproof lining. The electrical panels are also isolated from the actual machinery by these panels.

The version we use, although derived from "musical" fields, lends itself well to the industrial sector for the attenuation of noise inside cabins for generators, engine compartments and systems of various kinds, where a reduction in noise must be obtained by limiting the thickness.

Products made of D30 Flame retardant guarantee higher results and performance as they are made with denser and microporous foam. The relationship between thickness and density of the material is discriminating for the result to be obtained, from the simple internal acoustic correction to the contribution towards external insulation.

The material is completely non-toxic, resistant to fungi and bacteria and complies with the fire reaction classification and approval requirements for fire prevention purposes.

Open cell polyurethane foam is the most widely used material in the field of acoustic correction as it offers excellent levels of absorption across a broad spectrum of frequencies, is flexible and elastic, lends itself to any processing, harmless to health, durable over time and with good fire resistance properties (in the self-extinguishing version).

The expanded polyurethane is made by means of a chemical reaction between molecules of di-isocyanates and polyols by means of suitable catalysts, and can therefore be based on polyether or polyester; they are expanded into very large blocks and are subsequently processed into panels, flat sheets, shaped, etc ... The result is a very EFFECTIVE, VERSATILE and LIGHT product, easy to apply in any context offering an excellent quality-price ratio.

Type: ashlar sound-absorbing panels
Composition: open cell polyurethane foam
Sound absorption coefficient: $\alpha \geq 0,5$ a 1000Hz
Thickness: 5cm (2+3)
Density: D30 Fireproof 30 kg /m³


ISOLATE BEFORE REMOVING COVER

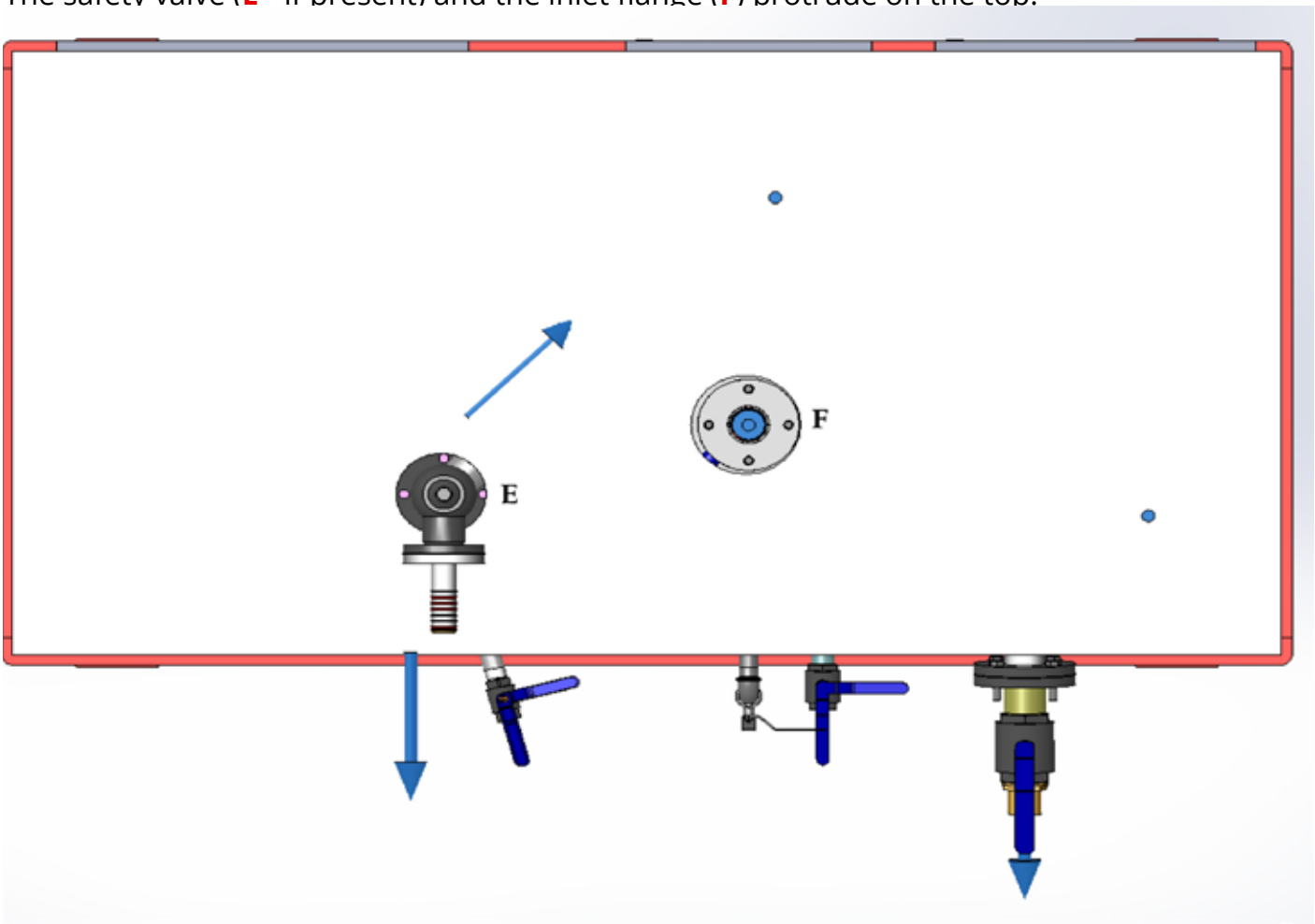
exterior & dimensions

The following description and images may vary according to the models, versions and costumes: the one presented is only an exemplary version of how an **EMPOWERING DEVICE** *can look and for this it should be understood.*

STANDARD EMPOWERING DEVICE externally it looks like a parallelepiped 240 cm high, with a long side of 235 cm and a short side of 126 cm.

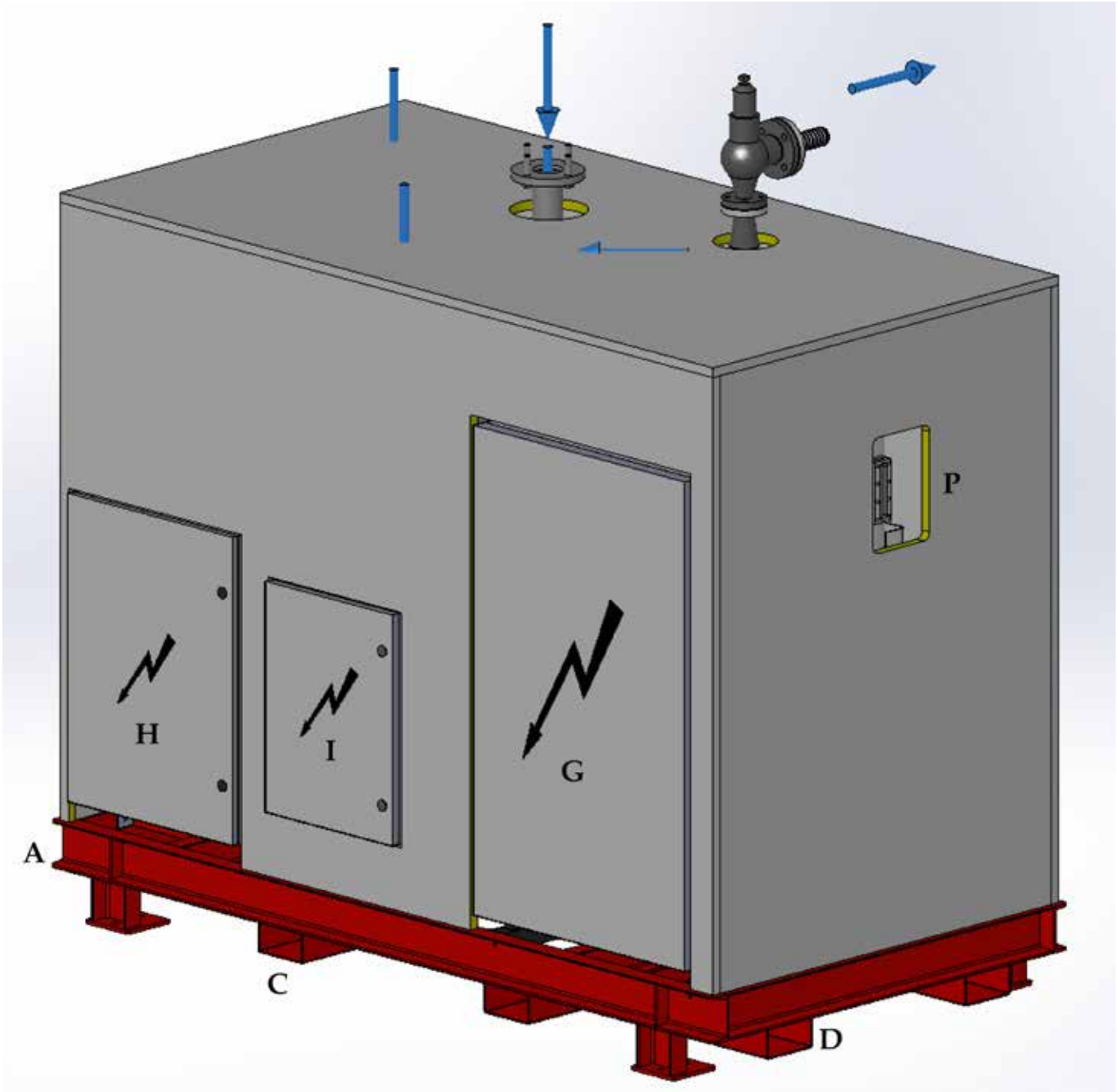
The metal basement (**A**) is 24 cm high and, thanks to a double system of overlapping and crossed mechanical guides (**C & D**) under the machine, it allows easy movement of the machine by forklift without any risk of accidental damage to the lower components. The air intake fans (**U, V & W**) are housed on the base.

The safety valve (**E** - if present) and the inlet flange (**F**) protrude on the top.

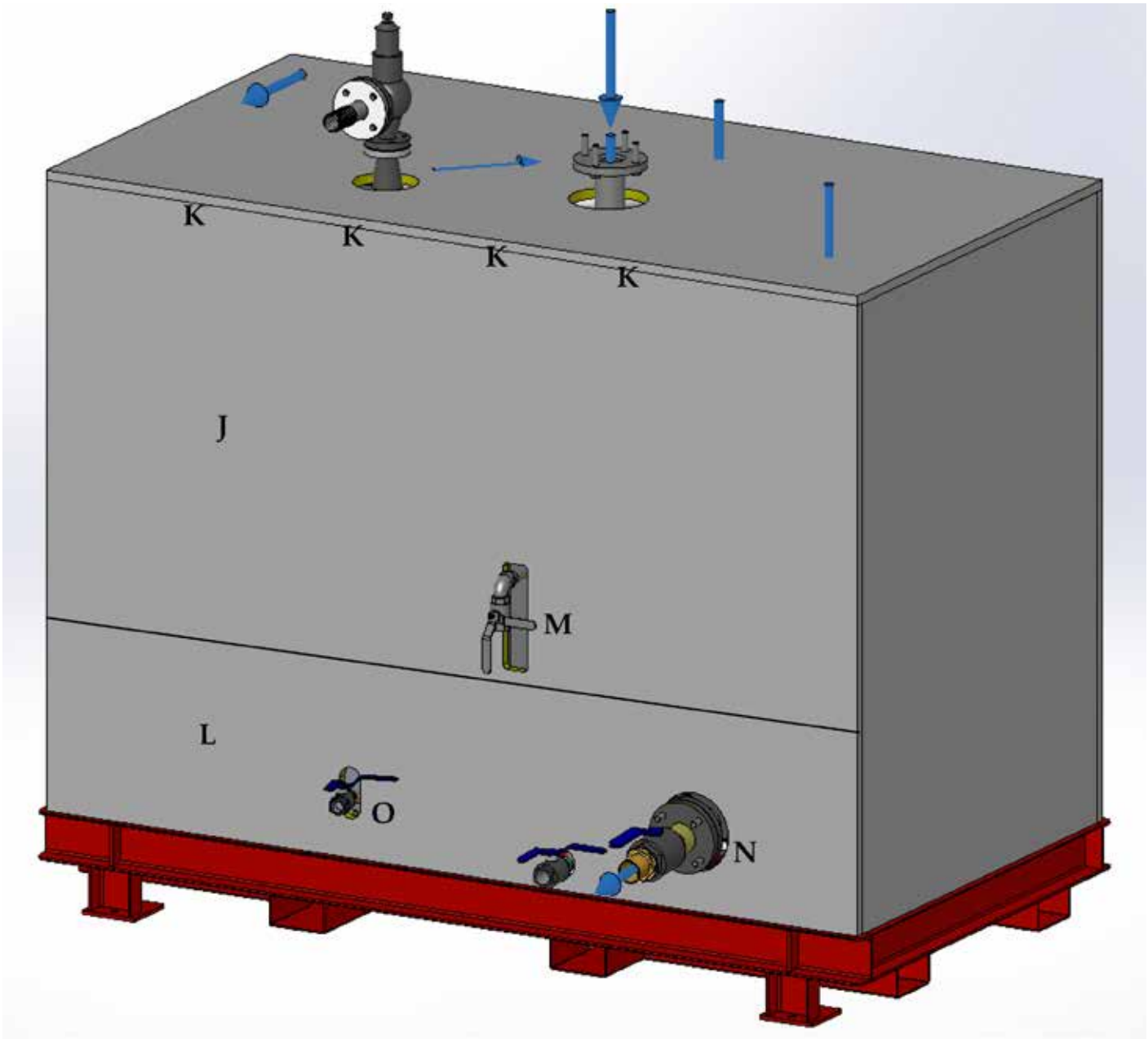


On the first long side there are 2 doors: the electrical panel (**G**) and the compartment that houses the ozonators and the insufflator (**H**); optionally there can be the compartment that houses the chemical tanks (**I**) and a second electrical panel dedicated to the inverters (**B**).

The second long side panel is split in half. The upper part (**J**) can be opened upwards thanks to



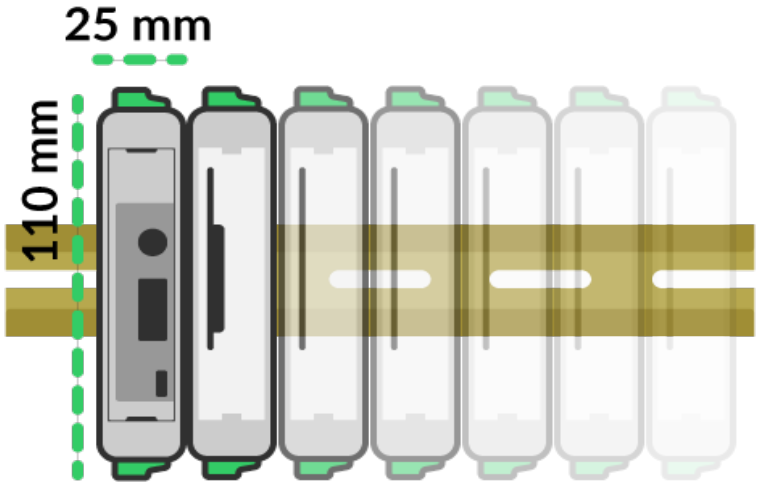
some hinges (**K**) while the lower part (**L**) is occupied by 3 hydraulic connections: a tap for direct withdrawals from the tank (**M**), an outlet flange from the treatment (**N**), optionally equipped with a manual tap, and an emptying tap (**O**) of the residual waste remaining inside the body of the machine. The opening allows for easy inspection and routine maintenance, for example the grease refill of the bearings.
A door (**P**) opens on the first short side containing the sealing liquid tank.



The second short side is entirely dedicated to the machine identification plate (**Q**).
On the external sides there are 3 ventilation grids (**R**, **S** & **T**) that allow the air to escape.
The hood is made externally in high-density polyethylene while internally it is fully lined with fireproof and sound-absorbing material.
The bonnet, covered with this fireproof material, combined with the presence of valves and engines of the ATEX category makes it possible to classify the entire machinery within this category.
By replacing the internal tank with a rounded one, it is possible to push the entire machine up to 16 BAR after PED certification.

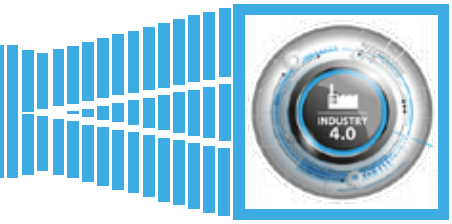
electrical system & PLC

Tensione esercizio/Supply voltage:	230 / 400 VAC
Tensione ausiliari/Aux. voltage:	230VAC/24VDC/12VDC
Frequenza/Frequency:	50–60 Hz
Corrente nominale/Nominal current:	35 Amp



EMPOWERING DEVICE adopts a PLC family designed entirely in Italy.
It is a product line of modular programmable controllers (PLCs) engineered in extremely compact enclosures and suitable for mounting on DIN EN60715 rail.
The CPUs use the latest generation processors.
All modules can be expanded through the I2C bus, guaranteeing a wide operating temperature and low energy consumption.
MID (Manufacturer ID) and DID (Device ID) protections can be implemented on all PLCs to protect the program from tampering.
Powered from 10 to 30Vdc with a consumption of only 1W, these devices are suitable for use in critical applications from an energy point of view.
With an operating temperature range from -20 to + 70 ° C, these devices are suitable for use in applications in environmentally critical environments.
EMPOWERING DEVICE can be equipped, on request, with motors, valves and electrical subsystems with ATEX certification and, therefore, the entire system can be ATEX certified.

general sale conditions



Without prejudice to what is established in the final offer, which also reports the economic values of the same,

Art. 1) **SALES DENOMINATION**: Each proposal is accepted by Chemical Empowering in compliance with all subsequent general conditions of sale, none excluded. Any condition entered by the buyer on the order, in contrast to the general conditions of sale of Chemical Empowering, is considered invalid. Any condition verbally agreed has no value unless Chemical Empowering writing confirmation.
Art. 2) **SUPPLY CONTRACT**: the contract is concluded only when Chemical Empowering sends the order confirmation to the buyer. Acceptance of the offer must in any case result from a written document. Any verbal or written commitment by the supplier's agents is not valid without express written confirmation of Chemical Empowering itself. Unless otherwise agreed, any costs for the transcription of the contract, if required, are borne by the buyer.
Art. 3) **DELIVERY**: Delivery times are always approximate and are never binding. In the event of outages, difficulties in the procurement of raw materials, breakdowns in the workshops used by Chemical Empowering, adverse weather conditions, pandemics and in any other case of force majeure, these terms are extended in proportion to the continuation of these events. Delivery terms start from the day on which the contract is finalized in all aspects, also formal, including the sending of the advance payments. Any suspension or delay caused by the buyer, even if it is of very short duration, is a reason for forfeiture of delivery terms. In this case, delivery will take place within the terms that will be re-established by the parties compatibly with the requirements of the Chemical Empowering production. The delay in deliveries does not allow the buyer to cancel the order or claim compensation, for any reason.
Art. 4) **PRICE**: Unless otherwise agreed, the price is intended for goods delivered ex-assembly workshop of Chemical Empowering, excluding costs of packaging, loading, transport, customs, unloading, installation. If in the period between the date of confirmation of the proposal by Chemical Empowering and the delivery of the goods, should occur changes in costs and currency, Chemical Empowering will have the right to revise the price according to the regulations in force.
Art. 5) **PAYMENT CONDITIONS**: Unless otherwise agreed, payments must be made in cash, net of a discount, directly to the Chemical Empowering accounts, in the terms indicated in the order confirmation. In case of late payment, the buyer will have to pay interest on arrears equal to the current Euribor rate + 2%. The payment of the individual installments cannot be deferred for any reason or for any exception. In particular, any disputes regarding the supply do not authorize the client to delay payments beyond the agreed terms, which are considered peremptory and essential. In the event of payment by installments, the non-payment of two installments, even if not consecutive, the contract must be considered terminated by law for default.
Art. 6) **PURCHASER CREDITWORTHINESS**: If there are changes in the corporate composition of the buyer or, in any case, news and facts which, according to the unquestionable judgment of Euribor, lead to a decrease in the solvency of the buyer, or other prejudicial factors such as protests, executions, etc., if the payment wasn't did fully in advance, Chemical Empowering will have the right to suspend the execution of the contract or to suspend the phase of the contract (EG. Feasibility Study, Basic, etc.), demand any guarantees or withdraw from the contract for just cause without obligation of any compensation. Any advances paid will be retained by Chemical Empowering as reimbursement of expenses, loss of earnings and compensation for damages, without prejudice to the greater.
Art. 7) **MANUFACTURING WARRANTY**: the device/plant built by Chemical Empowering is guaranteed by the same for 12 (twelve) months from the delivery date. Any defects must be reported within 8 (eight) days of discovery. The warranty refers to the correct use of the device/plant, in compliance with the instructions given by Chemical Empowering and the maintenance booklet. Chemical Empowering assumes no responsibility for damage resulting from inexperience and neglect of the buyer or his employees, from inadmissible overloads, inadequate means and materials of operation, from defects in the foundations and structures of the host property or from consequences due to chemical, electrochemical and electrical actions, unrelated to the operation to which the device/plant is used. In order to make repairs and replacements necessary for Chemical Empowering that are necessary as a result of the aforementioned guarantee, the customer must grant Chemical Empowering a suitable term and provide him free of charge upon his request with the help staff and any other necessary means. The parts of the supply removed or replaced are considered "under warranty" and become the property of Chemical Empowering only if they present defects or defects of origin and the transport costs for the parts to be replaced, replaced or repaired are the responsibility of the customer. At the request of the client, the repair can also be performed outside the Chemical Empowering office and travel, board and lodging expenses will be borne by the client. The aforementioned guarantee conditions always apply that the client has fulfilled

all the obligations deriving from the contract and the law and in particular those relating to payment and scheduled maintenance, and always that the assembly has been carried out by the technicians of the supplier. In the event that the buyer operates on the device/plant without the consent of Chemical Empowering, any warranty will cease.
Art. 8) **PERFORMANCE WARRANTY:** if required, Chemical Empowering can provide a specific warranty on the contractually agreed production levels on the regards of the device/plant. It will be of the same duration as the manufacturing warranty. Unless otherwise contractually agreed, the cost of this guarantee is borne by the customer.
Art. 9) **PROPERTY OF THE DEVICE/PLANT**: The ownership right on the device/plant provided remains with Chemical Empowering until full payment of the agreed price. In the absence of full payment, Chemical Empowering may withdraw, or not deliver, the device/plant by retaining the installments paid as compensation for the damage, without prejudice to the greater. In case of delivery before the full payment, the buyer undertakes to insure the device/plant at its own expense against damage resulting from fire and in any other fortuitous case and not to transfer possession of the device/plant, until the full payment, without the consent of Chemical Empowering. It is expressly agreed that the device/plant not fully paid will not be considered part of the property in which it is placed, or intended for the use of the property itself, and that, therefore, the ownership of the device/plant itself can also be claimed against of those who had already had, or who had subsequently purchased, any real right on the property of the buyer. Chemical Empowering has the right to waive the above agreed right in relation to the device/plant subject of the supply.
Art. 10) **CRIMINAL CLAUSE**: If the buyer withdraws from the proposal, indeed time, or from the contract, once the latter has been perfected, or refuses to receive the device/s or the plant/s covered by the contract itself, in addition to losing the advance amount as a deposit, it must pay to Chemical Empowering, as a penalty, an amount equal to 30% (thirty percent) of the agreed price for the purchase of the same device/s or the plant/s.
Art. 11) **WEIGHTS, DIMENSIONS, TECHNICAL DATA AND EXECUTED PROJECTS**: Projects, drawings, illustrations, weight data, dimensions, yields, consumption data, etc. communicated with the offer are only approximate. The data indicated in the proposal and the actual data of the materials cannot be the cause of complaints by the buyer. If experiences and/or processing needs ecommend it, Chemical Empowering may make slight changes to the details of the supply and to the data that are not the subject of a particular agreed commitment, without disputes being raised by the customer. All above except as explicitly stated in the purchase contract.
Art. 12) **ASSEMBLY**: Assembly or installation can be performed with the assistance of Chemical Empowering's specialized staff. The contract must state whether the assembly is included in the price of the machinery or whether it must be paid separately; failing that, assembly must be paid separately; in any case it remains established that it refers only to the performance of the labor of Chemical Empowering staff, therefore excluding travel, labor, porterage and transport and lifting equipment, scaffolding and masonry and foundation, joinery, carpentry etc. and in general all the ancillary works for the installation of the supplied machinery, Without explicit declaration of the supplier company, the fitter will not be able to carry out works other than those indicated on the assembly sheet. Chemical Empowering is only liable for the state-of-the-art assembly of the machinery supplied. The customer is required to sign the fitter's worksheet and with this signature will confirm the facts set out therein.
Art. 13) **ACCEPTANCE TEST**: In the absence of usage rules and regulations, referred to on the supply contract or on special agreements, the acceptance test will be carried out according to the rules established by Chemical Empowering. If the acceptance test is not possible or delayed for reasons not attributable to Chemical Empowering, the latter will communicate to the customer the chosen date for the execution (by certified mail or telegram or email certified by third parties), with 15 days' notice (fifteen); once the indicated day has elapsed, the device/plant must be considered tested. When installation is not agreed, the acceptance test of the device/plant supplied is carried out in the Chemical Empowering workshop before delivery.
Art. 14) **DISPUTES**: For all legal purposes, the client accepts, exclusively on any other, the application of Swiss law and the competence of the Swiss Judicial Authority, in particular of the Court of Zurich, even if the proposal or contract is stipulated elsewhere or through Brokers, Agents or Representatives and whatever the agreed means of payment. Except as otherwise contractually agreed during the purchase phase.
Art. 15) **TERMINATION OF THE CONTRACT**: If the buyer, after the refinement of the order should request, for any reason, the cancellation of the contract, this request must be considered legally equivalent to the termination of the contract due to the fact and fault of the client himself, with full safety of all Chemical Empowering rights also for a possible reintegration and / or maintenance action.

Chemical Empowering
AG
Alpenstrasse 16, 6300 Zug — Switzerland
SRL
Via La Louviere 4, 06034 Foligno — Italy

MAIN PARTNERS: