CLEAN
AIR, WATER, FOOD
and ENERGY

Innovations and Patent Publications
by
Dr. Hannu L. Suominen, 1987 - 2026

In perfect harmony with the world

INTRODUCTION

Pure air, water, food and energy are essential commodities for all of us. Free access to them, anywhere, should be a privilege for everybody. But, most of the people do not have this privilege, yet, or any more. Our goal is to develop methods and products, by which clean air, water, food and energy will be available for everybody – indefinitely.

Our Zero Emission Methods and Products follow the principle of photosynthesis and biological oxidation – principles of natural cycles. This is why they are in perfect harmony with a sustainable world.

To enhance the practical applications of these principles, I established companies to develop, manufacture and market the patented methods and products. Our product development is carried out with a team of some of the brightest scientist, engineers, technologists and like-minded entrepreneurs from many fields to make our ideas a reality.

Using Zero Emission Technology for recycling industrial material and producing energy is a new, but an imperative principle for the well-being of people. Otherwise, the harmful effects of the industrial and agricultural activities will accumulate to unsolvable levels.

The establishment of my companies has been driven by my hobbies and interests in clean nature and my driving force to focus into natural sciences during my university career. The strong theoretical background helped me to observe and understand the consequences of ‘industrialized’ world’s destructive behavior towards the environment and nature in general.

The concern of the deteriorating environment encouraged me to develop holistic scientific solutions, which could re-establish and restore the natural balance and maintain it in a sustainable way, so that the living standard and health of people will improve.

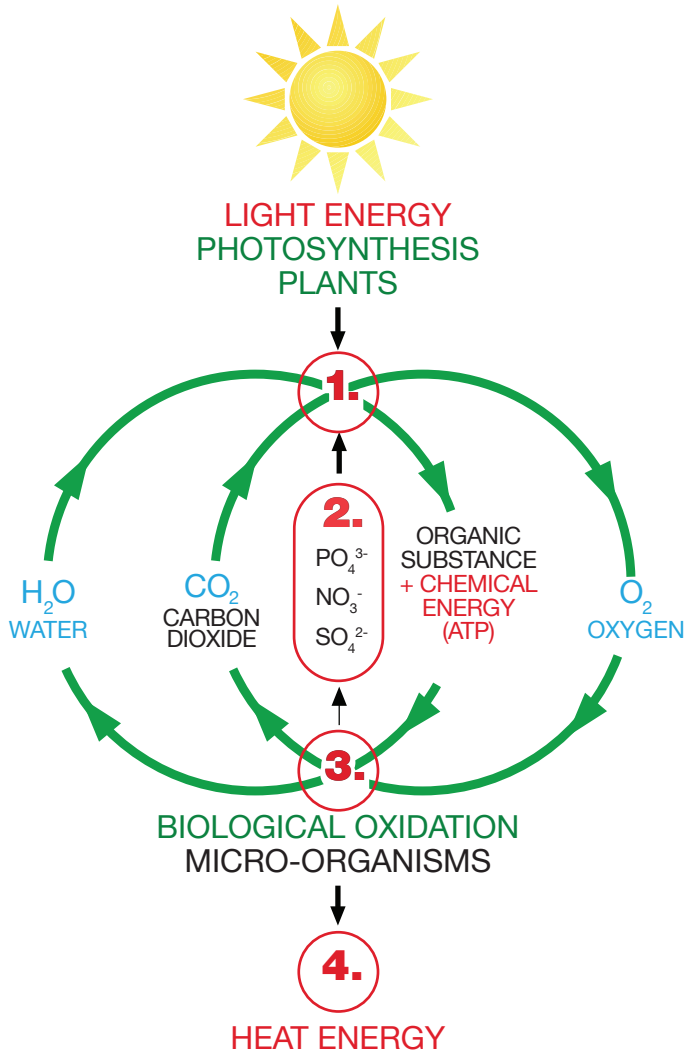
Over the last 40 years I have led companies gaining the extensive experience in international, industrial business for the conservation of nature. During these years and about this subject, I have applied 50 original patent applications, which have led to 153 issued Letter of Patents and more than 350 patent related documents.

For this presentation I have collected a comprehensive list of my innovations and patent publications, which have had an essential role in developing and commercializing the Zero Emission Technology.

The Greek philosopher and scientist Aristotle (384 – 322 BCE.) identified the four key “elements” of life being: earth, water, air and fire (energy). This presentation of my innovations is being divided into these four categories.

January 2026, Hannu L. Suominen, PhD in Marine Microbiology

THE ZERO EMISSION PROCESS OF NATURE



Photosynthesis and biological oxidation sustain the balance of organic substance, carbon dioxide and oxygen. In nature, the sustainable balance is based on clean air and clean water. In nature, waste material never accumulates and disturbs the sensitive balance.

1. The first basic process of life is photosynthesis: Plants produce sugar (glucose) with high energy content from clean water and atmospheric carbon dioxide. At the same time plants release clean oxygen to the atmosphere. For this process, plants need light energy from the sun. Light energy binds into organic substance as chemical binding energy (in Adenosine Tri Phospnate molecules, ATP).

2. For the production of organic substance, for their growth, plants also need oxidized, water soluble nutrients, such as phosphate (PO_4^{3-}), nitrate (NO_3^-) and sulfate (SO_4^{2-}) from the soil.

3. The second basic process of life is biological oxidation: The cells of human beings and all the other living organisms oxidize the organic substance, to water and carbon dioxide. For this process, cells need oxygen from clean air. At the same time, the bound chemical energy (ATP) and the nutrients are released for the use of organisms. The unused nutrients or the biological waste is left to feed the microorganisms.

4. Finally, the microorganisms oxidize the biological waste with atmospheric oxygen mainly into water and carbon dioxide. At the same time, they oxidize the essential chemical elements into their water-soluble forms (e.g. PO_4^{3-}, NO_3^- and SO_4^{2-}). The biological oxidation process is odorless and it does not release toxic compounds into the environment. At the end of the biological oxidation process, the light energy of the sun, bound into the organic substance, is released as heat energy.

CLEAR AIR, WATER, FOOD and ENERGY

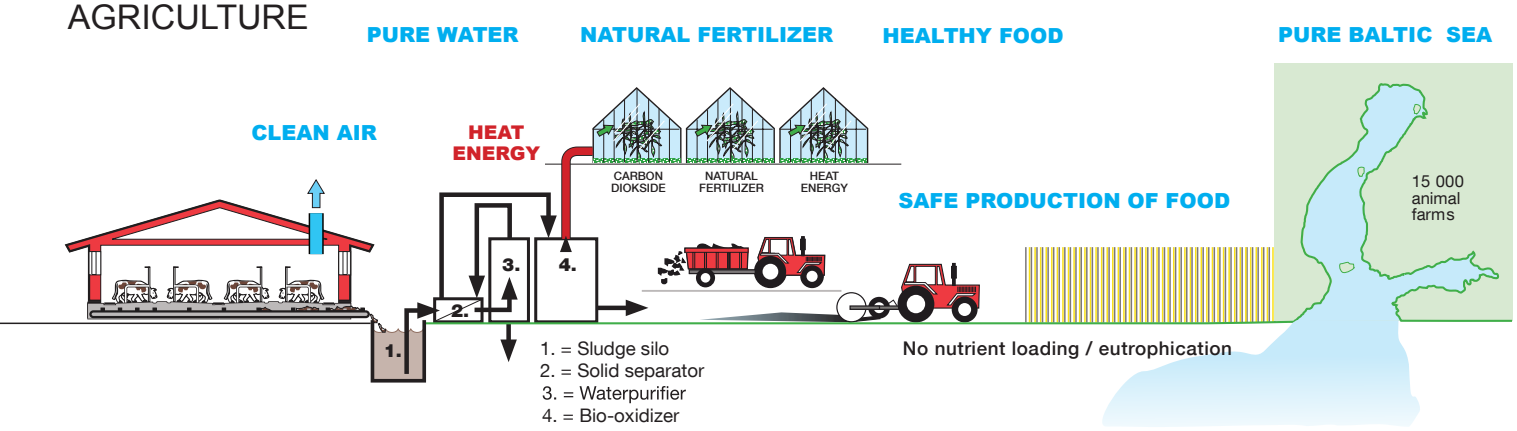
In perfect harmony with the world

Zero Emission technologies

Our Zero Emission Methods, Technologies and Products follow the principle of photosynthesis and biological oxidation – principles of natural cycles.
This is why they are in perfect harmony with the sustainable world.

The patented technologies for ecological and sustainable development

AGRICULTURE



NANOGAS®

Singlet Oxygen Generator purifies gas emission from agriculture and industry

MUST®

Electrochemical water purifier seprates pure water and odorless solids from liquid manure. The solids will be oxidized to natural fertilizer.

CHEMOSTOR®

Microbes will convert organic material to natural fertilizer in the Bio-oxidizer. Pure bio-energy will be released and recovered at the same time.

BIOFILM®

The biodegradable cover film increases the yield without chemical weed killers.

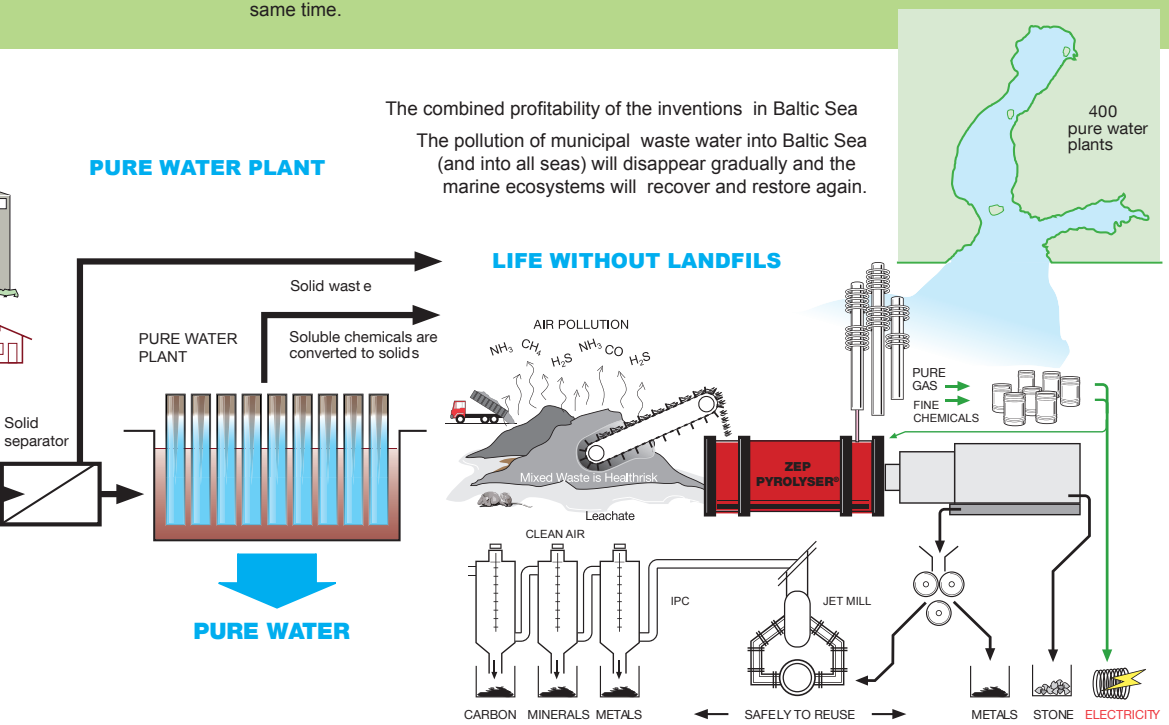
THE COMBINED EFFECT OF THE INVENTIONS IN AGRICULTURE

These new technologies will improve profitability, the quality of food and prevent emissions to air, soil and water.

THE COMBINED EFFECT OF THE INVENTIONS IN WATER SHEDS

The emissions from agri-culture will disappear gradually and water eco-systems will restore.

MUNICIPALITIES



The combined profitability of the inventions in Baltic Sea

The pollution of municipal waste water into Baltic Sea (and into all seas) will disappear gradually and the marine ecosystems will recover and restore again.

DRYCLO®

Waterless sewage saves water and prevents pollution of drinking water.

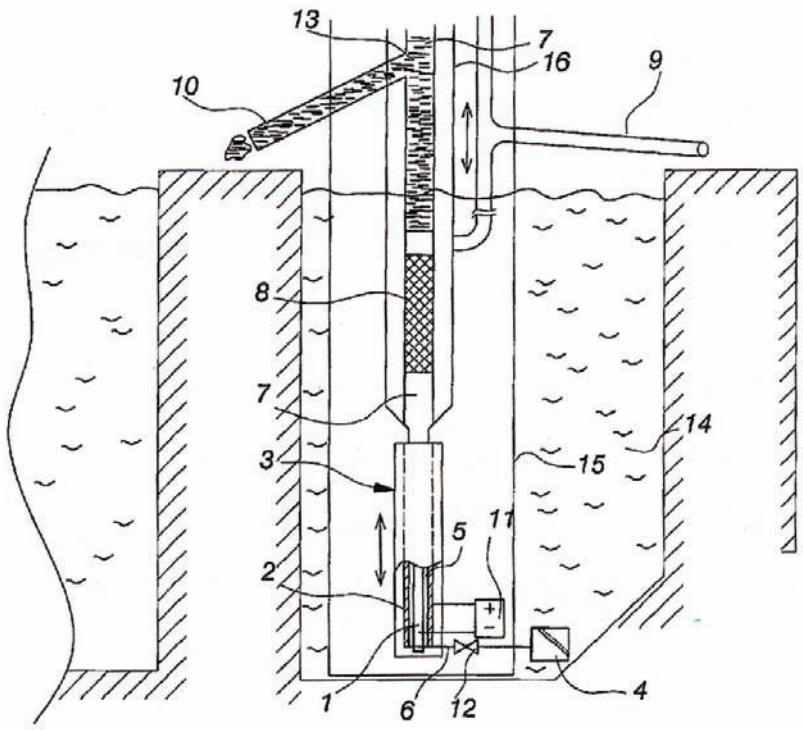
MUST®

The electrochemical water purifier removes nitrogen and phospho-rous nutrients, and sulfur compounds from waste water and des-troys hormones, medicines, viruses, bacteria and parasites perma-nently, hygienically and economically.Pure Water Plant will convert all solid and soluble impurities in the waste water to solid material which in Zero Emission Pyrolysis produce pure energy and elements for reuse.

ZEP PYROLYSER®

The Zero Emission Pyrolysis converts all chemical compounds in high temperature and without oxygen,into pure minerals and elements. Simultaneously it releases the energy, which is bound into waste, as heat and hydrogen gas, which will be recovered and used to produce electricity – landfills are not needed any more. AIR, SOIL AND WATERS WILL STAY CLEAN.

MUST® – An electro-chemical water purifier in which a molecular sieve eliminates all pollutants from waste water



Patent no: FI 20095877,
Method and apparatus for
purification of waste water (2009)

The initial objectives of the innovation

- Develop a water purifying system that eliminates all pollutants from any type of waste water without exception.
- Recycle clean purified water without fears of contamination.
- Isolate all bio-solids and contaminants from the waste water in dry solid so that they can be processed further.

How it works

MUST (abbreviation for Molecular Unique Separation Technology) is an electrolytic process whereby very tight molecular sieve is produced so that the hydrogen gas, produced at the same time, will lift the sieve through the waste water capturing and separating all impurities from the waste water. For this process MUST uses the most stable elementary isotope in the universe – Iron (^{56}Fe) and the dissociation of the most dependable molecule of life – Water (H_2O), which create the net of the tight metal hydroxide.

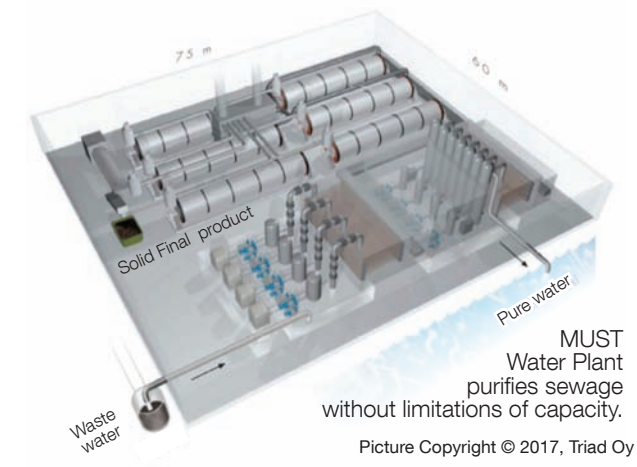
The process is fully automated and remotely controlled. No precipitating chemicals are needed. Instead, the process uses sacrificing metallic electrodes, which need to be changed when worn out.

The footprint of the modular MUST water purifying plant is less than 10 % of a conventional CBT plant of the same capacity. Capital expenses and daily operating expenses are significantly lower than of the CBT plants for the safe quality of purified water.

MUST combined with a CHEMOSTOR, Quartz Oxidizer and an Activated Carbon Filter, can convert any type of waste water in to clean, fresh potable drinking water. In the case of slightly polluted groundwater and surface water, Quartz Oxidizer and Activated Carbon Filter will do the job alone.

MUST is particularly effective on heavily contaminated waste streams, and unlike the CBT technologies, it does not produce any bio-sludge but dry solids from solid and soluble pollutants present in the waste stream.

The small MUST Water Purifier produces drinking water even from cow manure at a capacity of 44 000 m^3/year.



MUST
Water Plant
purifies sewage
without limitations of capacity.

Drinking water from Quartz Oxidizer

The cells of the MUST-reactor

Benefits of MUST

- Eliminates all contaminants from the waste water.
- Produces clean, fresh potable drinking water.
- Produces dry solids for easy and affordable reuse.
- Low power consumption.
- No precipitating chemicals, resulting in low operating costs.
- No disposable filters.
- Small footprint, less than 10 % of the CBT plant's footprint.
- Purification takes place in real time, therefore no need for large storage ponds.
- Modular design enables unlimited capacity.

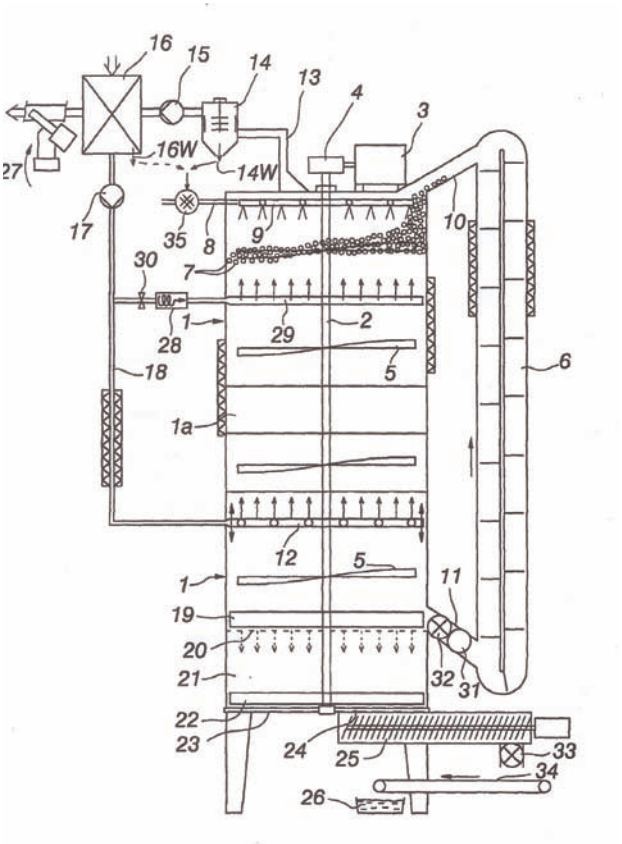
Conventional technologies and reasons to replace them

- Water Closet and Chemical Biological Waste Water Treatment (CBT) has been in use over 100 years.
- However, over 60 % of all waste waters of the developed countries are still introduced to rivers, lakes and seas without any treatment at all.
- Sewer waste of most small communities, even in the USA, flow through precipitating ponds only.
- CBT technology has been adapted globally only in most of the largest cities, and overflow to the oceans seems to be a general practice.
- CBT removes trash, sand and suspended solids, but not the most harmful soluble chemicals, such as nitrogen and sulfur compounds, hormones, medicines, viruses, and bacteria, which will stay in the treated water and flow to the recipient natural waters.
- CBT creates anaerobic microbial cell mass, which cannot be utilized, but is dumped into landfills, burned or used for biogas with heavy emissions.
- The MUST technology will avoid all these problems and produce potable water and reusable safe solids by ZEP without any emissions.

Future innovation objectives

- Since the scarcity of drinking water will depress living conditions in our societies, the key objective for the MUST water purifying system, at this stage, is to gain commercial traction and successfully deploy this technology throughout the world.
- Supply the entire world with unlimited high quality drinking water.
- Desalinate seawater and use the Novel Gravity Pumping system using gravity force and hydrostatic pressure, to supply fresh water to the mainland over mountains.

CHEMOSTOR® – A bio-oxidization reactor that converts organic waste into Natural Fertilizer and Heat Energy by High Temperature Mold



Patent no: FI 115628
Method and apparatus for oxidizing organic material (2005)

The initial objectives of the innovation

- to convert organic cow and pig manure into a high quality, stable Natural Fertilizer product that releases the nutrients, only on demand.
- to develop a process that is hygienic and eliminates bad odors and gas that are released from the organic waste.
- to extract the heat that is released during the bio-oxidization process and make it available as a resource for alternative purposes i. e. direct heating or electricity.

How it works

Organic waste is broken down by micro-organisms whilst traveling through a continuous rotating chamber until the nutrients are consumed. Ultimately all nutrients made available through this accurately controlled process are encapsulated (at 80 degrees Celsius) into the spores of High Temperature Mold, known as *Thermo Achtinomyceatea* sp.

For the growth and propagation the microbes need organic nutrients and plenty of oxygen. Organic waste provides the nutritents and oxygen from the outside air is blown into the reactor.

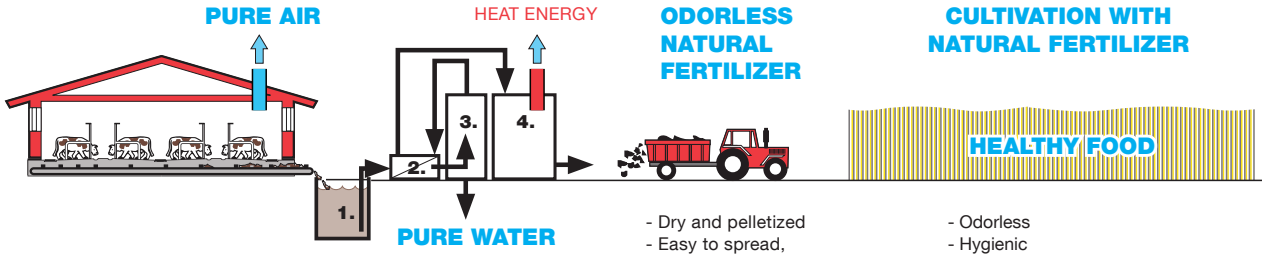
The bio-oxidizing process creates hot water vapor and carbon dioxide, which will be sucked out for recovery of heat energy. When the temperature cools down the microbes sporulate and encapsulate the oxidized nutrients into them.

The resulting product is odorless, hygienic and stable, and since it is not soluble into rain water, it does not pollute the environment.

The roots of the plants can actively take the nutrients from the spores as and when the plant needs them. The Natural Fertilizer greatly enhances the yields of all cultivated plants and there are no limitations in the amounts of nutrients in the Natural Fertilizer.

One Chemostor bio-oxidizer can be operated in the horizontal position (CCM 150 m^3) or in vertical position at a capacity of 3 000 tn/y. The process is hygienic and odorless. Nanogas air cleaner is assembled in the output end of the reactor for 30 000 m^3/h.

The large organic farms, which produce meat, milk and natural fertilizer, do not pollute air, water or soil.



Example:

1 800 000 l milk/y
6 000 tn liquid manure/y,
from which 5 000 m^3 of pure water, 480 tn of natural fertilizer

1. FEED TANK (2 m^3)
2. SOLID SEPARATOR (2 m^3/h)
3. WATER PURIFIER (1000 l/h)
4. BIO-OXIDIZER (300 kg/h)

- Dry and pelletized
- Easy to spread, 5 tn/ha (480 tn/y)
- Hygienic, stable, insoluble, no pathogens
- No limitations to spread
- Frees labor in high season

- Odorless
- Hygienic
- No loss of nutrients
- No chemical fertilizers
- No ground water pollution
- No diseases
- Improves the quality of soil
- Increases the yield
- Decreases the production cost

Benefits of CHEMOSTOR

- Eliminates organic solid waste without emissions.
- Produces high quality Natural Fertilizer without seeds of weeds.
- Natural Fertilizer is not soluble in water, therefore eliminating pollution.
- The process and products are odorless.
- The final product is hygienic and pathogen free.
- The combined use of Natural Fertilizer with BIOFILM significantly enhances crop/pasture yields.

Conventional technologies and reasons to replace them

- Spreading of untreated smelling animal manure and synthetic fertilizers have already spoiled agricultural land and ground water.
- Methane (CH_4) production or anaerobic rotting for “bio-gas” from manure for “renewable energy alternative” results in devastating emissions to the environment. It releases toxic NH_3 and H_2S gas into the air, nitrogen enriched water into waterways when bio gas sludge is used as fertilizer, it leads to compaction of the soils thereby compromising yields. One problem of stinking manure has created 3 more serious problems!
- To eliminate the emissions from bio-gas will be extremely expensive and has not been done properly so far.
- Bio-gas production is not a waste elimination process, but a waste transformation process.
- The energy and material balances are negative.
- Composting in wind rows under open sky is a commonly used process in which a variety of worms and micro-organisms propagate one after another emitting stinking gas and creating concentrated waste waters, which as untreated, pollute ground water.
- To avoid all those drawbacks and expenses, I developed the closed, accurately controlled vertical Bio-oxidizer that provides a distinct alternative to produce valuable Natural Fertilizer also in very large scale.

Future innovation objectives

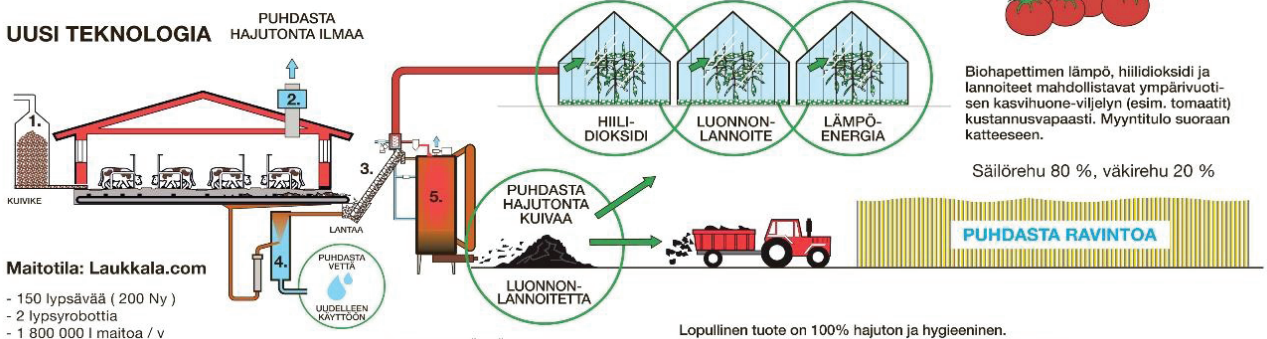
- The next generation CHEMOSTOR will be vertical, producing natural fertilizer for organic/natural farmers ranging from small to industrial scale without pollution and having a cutting edge payback period.
- All green and animal waste can be converted to Natural Fertilizer for replacing synthetic fertilizers. (PCT/EP2024/072468)

AzoFertti

Maatalousjätteen käsittelyvertailu

PUHDASVESIMENETELMÄ

UUSI TEKNOLOGIA



Biohapettimen lämpö, hiilidioksidi ja lannoiteet mahdollistavat ympärivuotisen kasvihuone-viljelyn (esim. tomaatit) kustannusvapaasti. Myyntitulo suoraan katteeseen.

Säilörehu 80 %, väkirehu 20 %

Maitotila: Laukkala.com

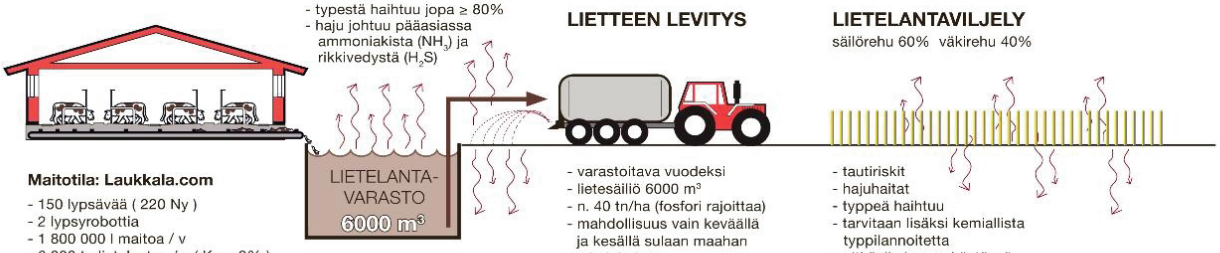
- 150 lypsävää (200 Ny)
- 2 lypsyrobottia
- 1 800 000 l maitoa / v
- 6 000 tn lietelantaa / v (Ka ~ 9%)
- 160 ha säilörehutuotannossa
- ruokinnassa 60% säilörehua, 40% väkirehua

1. KUIVIKESÄILIÖ (2 m³)
2. ILMANPUHDISTIN
3. KIINTOAINE-EROTIN (2 m³ / h)
4. VEDENPUHDISTIN (1000 l / h)
5. GRAVISTOR BIO-HAPETIN (300 kg / h)

Lopullinen tuote on 100% hajuton ja hygieeninen. Rakeinen kuiva luonnonlannoite palauttaa kaikki ravinteet peltoon. Liukenematon, hygieninen lannoite ei saastuta pohjavesiä. Vain mikrobit pystyvät murtautumaan rakeen sisukseen hyödyntääkseen tarvitsemansa ravinteet.

LIETELANTAMENETELMÄ Käytössä oleva menetelmä => ympäristö pilaantuu satotaso laskee

NYT KÄYTÖSSÄ



RAVINNETAPPIOT

- typestä haihtuu jopa ≥ 80%
- haju johtuu pääasiassa ammoniakista (NH_3) ja rikkivedystä (H_2S)

LIETTEEN LEVITYS

LIETELANTAVILJELY

säilörehu 60% väkirehu 40%

Maitotila: Laukkala.com

- 150 lypsävää (220 Ny)
- 2 lypsyrobottia
- 1 800 000 l maitoa / v
- 6 000 tn lietelantaa / v (Ka ~ 9%)
- 170 ha säilörehutuotannossa
- ruokinnassa 60% säilörehua, 40% väkirehua

- varastoitava vuodeksi
- lietesäiliö 6000 m³
- n. 40 tn/ha (fosfori rajoittaa)
- mahdollisuus vain keväällä ja kesällä sulaan maahan

=> hajuhaitta
=> valuu vesiin
=> taudit leviävät
=> sitoo työvoimaa huippusesongissa

- tautiriskit
- hajuhaitat
- typpeä haihtuu
- tarvitaan lisäksi kemiallista typpilannoitetta
- pitkäaikaisessa käytössä

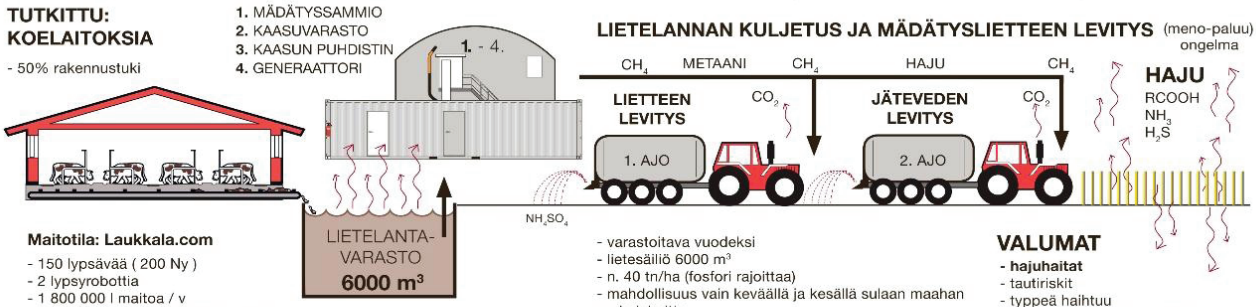
=> satotaso laskee
=> pohjavesi pilaantuu

MÄDÄTYSMENETELMÄ BIOKAASU-menetelmä => tuottaa yhdestä ongelmasta kolme uutta: myrkyllinen kaasuseos, anaerobi-liete ja erittäin vaikeasti puhdistettava jätevesi. Käytännössä saatujen kokemusten mukaan Biokaasun tuotanto onympäristön kannalta tuhoisaa ja täysin kannattamatonta

TUTKITTU: KOELAITOKSIA

- 50% rakennustuki

1. MÄDÄTYSSAMMIO
2. KAASUVARASTO
3. KAASUN PUHDISTIN
4. GENERAATTORI



Maitotila: Laukkala.com

- 150 lypsävää (200 Ny)
- 2 lypsyrobottia
- 1 800 000 l maitoa / v
- 6 000 tn lietelantaa / v (Ka ~ 9%)
- 160 ha säilörehutuotannossa
- ruokinnassa 60% säilörehua, 40% väkirehua

RAVINNETAPPIOT

- typestä haihtuu jopa ≥ 80%
- haju johtuu pääasiassa ammoniakista (NH_3) ja rikkivedystä (H_2S)

- varastoitava vuodeksi
- lietesäiliö 6000 m³
- n. 40 tn/ha (fosfori rajoittaa)
- mahdollisuus vain keväällä ja kesällä sulaan maahan

=> hajuhaitta
=> valuu vesiin
=> taudit leviävät
=> sitoo työvoimaa huippusesongissa

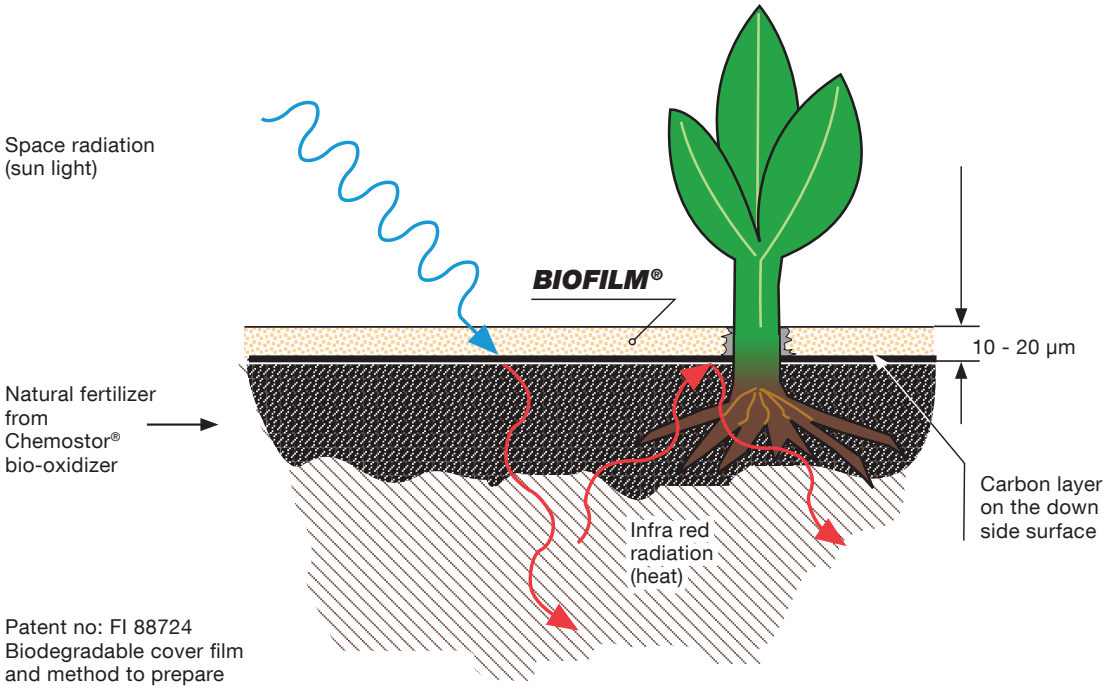
- typpipitoinen jätevesi on erittäin kallista puhdistaa
- valuu pelloilta vesistöihin

VALUMAT

- hajuhaitat
- tautiriskit
- typpeä haihtuu
- tarvitaan lisäksi kemiallista typpilannoitetta
- pitkäaikaisessa käytössä

=> maan rakenne tiivistyy
=> **satotaso laskee**
=> **pohjavesi pilaantuu**

BIOFILM® – A biodegradable, transparent, carbon coated plastic film, used for cover cultivation



Patent no: FI 88724
Biodegradable cover film
and method to prepare
the same, (1989)

The initial objectives of the innovation:

- to cultivate crops without the use of herbicides (weed killers)
- to increase yield by increasing soil temperatures and preventing evaporation
- heating soil and enabling crops to be sown earlier than normal, thereby greatly assisting areas in the world with naturally short growing seasons
- to develop and use biologically degradable carbon coated thin film for plant cultivation

How it works

When energy in the short waves of space radiation and sunlight penetrates the transparent BIOFILM, the carbon coated down side of BIOFILM converts the light into long wave Infra-Red (IR) radiation. Simultaneously BIOFILM reflects IR or heat energy back into soil from the upper side of the transparent layer. The area of soil, where the roots of the plants are, will stay warm and wet.

This effect of IR decreases the temperature gradient in the soil under BIOFILM and prevents the evaporation and condensation of water, keeping warm moisture in the roots of the cultivated plants.

The automatic sowing machine prepares the seed bed, wraps the BIOFILM over it, and punches small holes through it. Seeds are planted through the small holes in the BIOFILM allowing access of light only for the cultivated vegetation. The BIOFILM prevents the growth of weeds so that chemical weed killers are not needed.

Benefits of BIOFILM

- No herbicides are needed, since no weeds will be able to grow.
- BIOFILM in combination with the use of the Natural Fertilizer, produced by the CHEMOSTOR®, significantly increases plant production up to 300% with e.g. potato, corn, sunflower and peanuts.
- BIOFILM warms up the soil thereby enabling earlier sowing or planting of crops and extension of the growing period.
- The use of BIOFILM combined with the Natural Fertilizer, produced by the CHEMOSTOR®, results in stronger and healthier crops.
- BIOFILM fully disappeared in time for the sowing of the consecutive crop.
- Reduces growing costs

The automatic sowing machine prepares the bench, fixes biofilm on top of it, punches holes through it and sows the seeds through the small holes.

The seeds germinate under the film in warm wet soil and will grow through the holes. Weeds are not growing, because carbon coated film does not penetrate light.

Sun flower produces early high yield by the Biofilm cultivation on the fields located over 65 degrees of the Northern latitude.

Biofilm and natural fertilizer increase the yield in field cultivation over 300 % compared to the chemical cultivation.

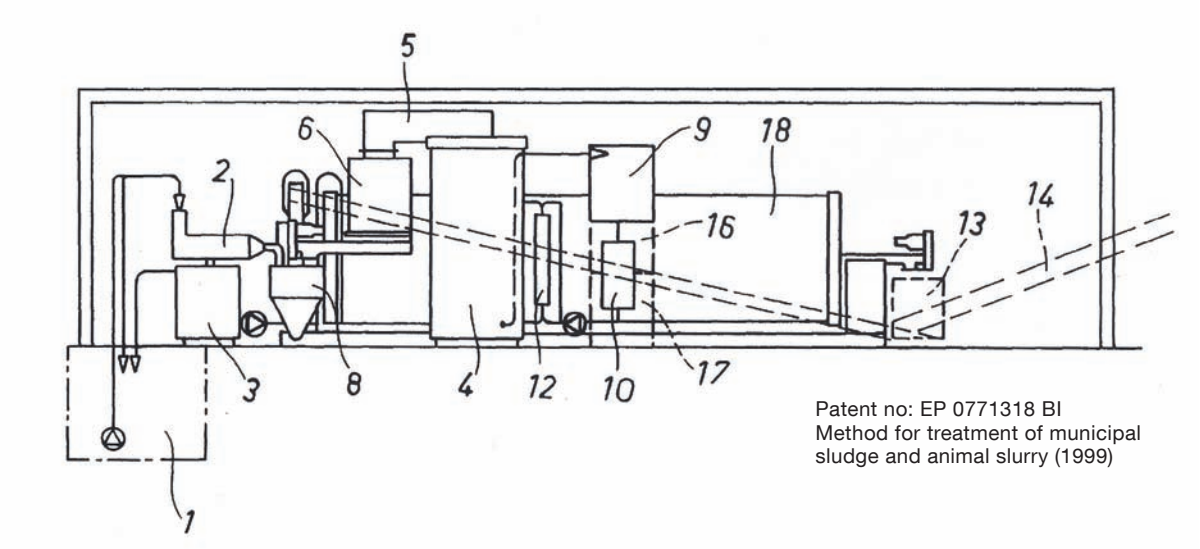
Conventional technologies and reasons to replace them

- The present field cultivation of food products is based on the use of synthetic fertilizers, herbicides and pesticides.
- The use of these chemicals secures the yield, but compromises the quality of food, the environment and the public health.
- Extensive use of chemicals destroys many species of beneficial microbes, insects and some animal species resulting in reduced biodiversity and shakes the natural balance.
- Over use of chemicals also causes build-up of multi-resistant microbes, thereby creating even more diseases and pests.
- Non biodegradable plastic, used as a mulching film, adds the severe burden of plastic residues in the nature.
- The BIOFILM technology was developed up to an industrial scale and with the organic farming it will replace the current chemical practices and prevents the adverse effects of them.

Future innovation objectives

- Replacing cellulose production from trees with glucose polymer production by photosynthetic Cyanobacteria sp., will fix carbon dioxide from atmosphere and water from ocean or lake by sunlight.
- This will in time restore the clear cut old Northern Forests and Southern Rain Forests and re-establish the biodiversity.
- Developing the next generation BIOFILM by using “microbial cellulose”, which is a strong and long, twisted glucose fiber, will replace the tree based cellulose used in paper, board and plastic manufacturing.
- The next generation BIOFILM can be as durable as Kevlar-plastic or totally water soluble and biodegradable, but still as thin as 10 micron.
- The same microbes can make BIOFILM directly in any form and therefore any shapes of three-dimensional bio-polymer moldings are possible without the conventional 3D-printer.

DRYCLO® – A collector, separator and eliminator of solid and liquid fecal waste



Patent no: EP 0771318 BI
Method for treatment of municipal sludge and animal slurry (1999)

The initial objectives of the innovation

- To create a waterless sewer for private homes and cities.
- To create energy independent homes all year round.

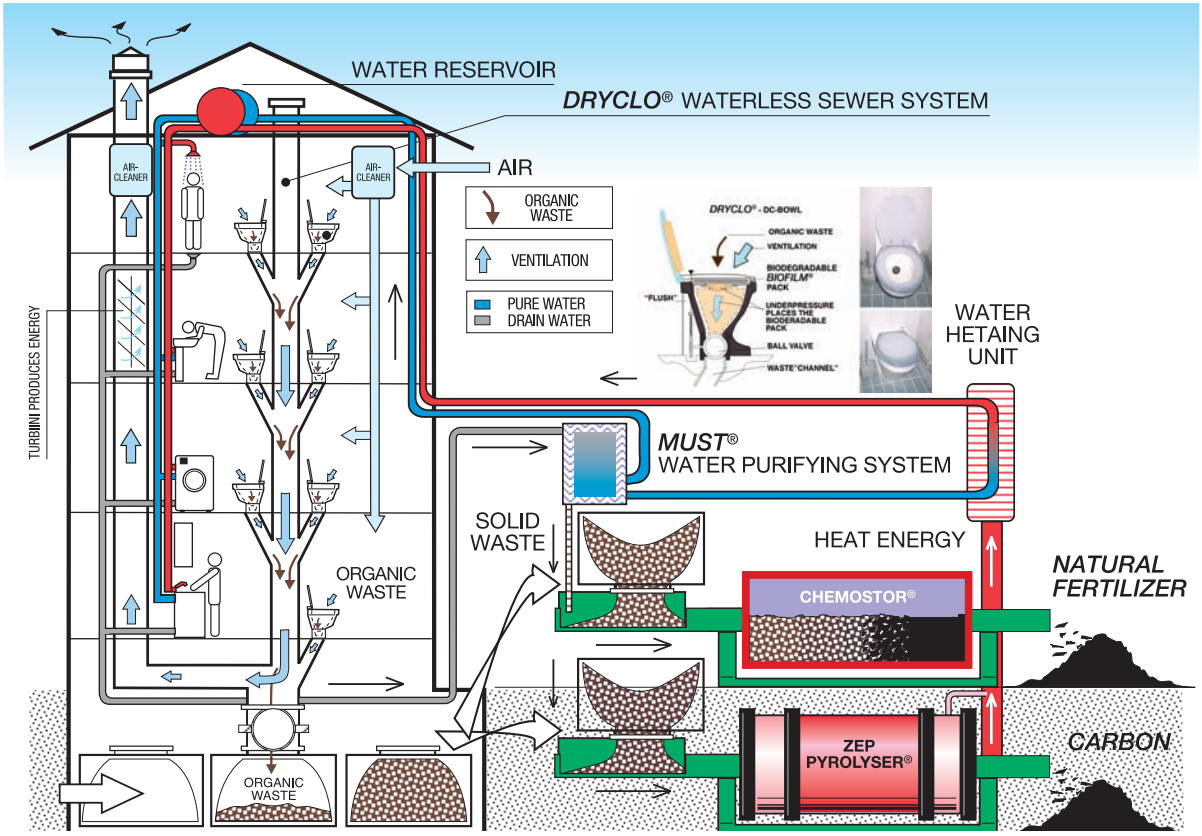
How it works

DRYCLO separates and collects solid and liquid components from fecal waste without flushing water into the sewer pipelines. The separated solid fecal waste, as septic sludge, is then bio-oxidized in a CHEMOSTOR with source separated household waste for elimination of the hygienic problems. The released heat energy will be used for heating houses and for producing electricity. (video)

The fertilizer produced from the CHEMOSTOR can be used for landscaping parks and flowerbeds, and also in forestry. This application is feasible only for small communities who maintain accurate garbage separation.

For large municipalities, due to the harmful pollutants, the collected dry human waste can be processed in the ZEP-PYROLYZER instead of CHEMOSTOR or landfills.
The liquid waste separated by the DRYCLO will be processed by Molecular Unique Separation Technology or MUST, which will be discussed later, and not at standard Waste Water Treatment Plants using a Chemical Biological Treatment process (CBT).

- The solid fecal waste will not be transferred along sewage pipelines with pure drinking water, but as “dry material” directly without delay to elimination process.
- Sewage waste water will be purifed electrochemically and the separated solids introduced directly into Zero Emission Pyrolyzer for elimination.
- The products are: solid, pure carbon and heat- and electric energy.
- Washing water will be introduced directly into MUST-water purifer.
- The purifed water will be used primarily as washing water, but can be further purifed up to drinking water by quarts oxidizer.
- The organic source separated household waste will be converted to fertilizer
- The mixed waste will be eliminated and converted to solid carbon and heat and electric energy by pyrolysis.



Benefits of DRYCLO

- Preserves water, thereby reducing the need to use good quality drinking water as a carrier of fecal waste along the sewage pipe lines.
- DRYCLO will be extremely feasible in areas where there is a shortage of water.
- The amount of waste water decreases.
- DRYCLO prevents the pollution of drinking water, because all solid and liquid waste will be purified immediately in point of creation to useful final products.
- As a results there will be natural fertilizer for food production or/and active carbon for water purification.
- At the same time when the waste are utilized, bio-energy as heat and electricity is produced. Bio-energy will replace fossil fuels and decrease the need for nuclear energy as well.
- The energy independence is continuous 24/7 in any weather condition
- There is no need to burn anything which decreases air pollution.

Conventional technologies and reasons to replace them

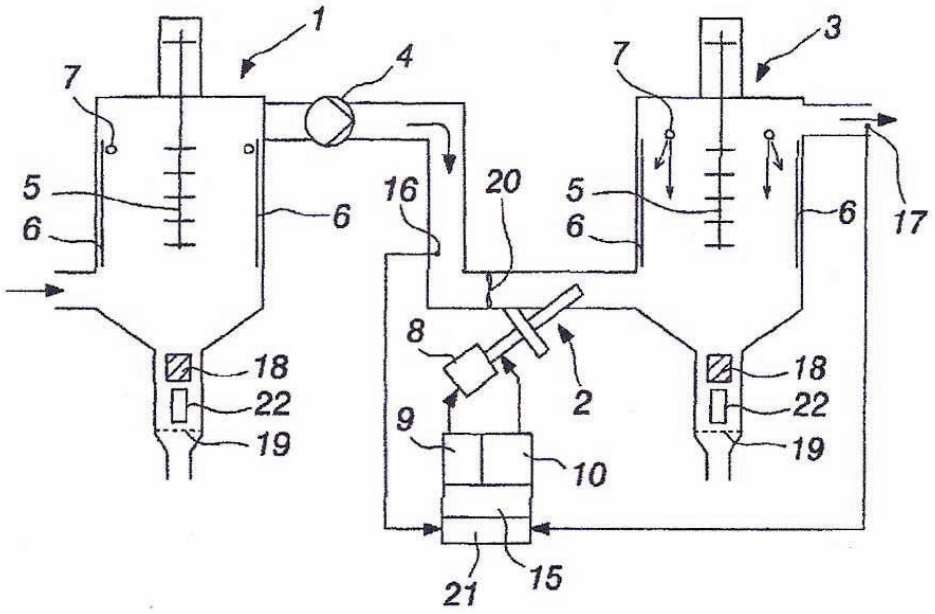
- The water closet and CBT will stay in place for years to come.
- The CBT process leaves many chemical pollutants untreated, and once the treated water is released back into the water ways, it is causing many biohazards, including a build-up of water-borne diseases and eutrophication of the fishing grounds.
- The CBT plants also precipitate microbial sludge, which is predominantly dumped as a harmful pollutant into landfills causing toxic leachate and air pollution.
- Therefore, it is important that the damages have to be dramatically minimized by Zero Emission Technologies such as DRYCLO with the CHEMOSTOR, MUST- and ZEP- technologies.
- Due to these technologies pure fresh water reservoirs stay unpolluted and more water resources will be available to households.

Future innovation objectives

- The novel practices for waterless waste elimination are imperative.
- The old buildings can be converted so that waste can be collected without sewer pipe lines.
- The new buildings can be designed so that the gray water is recycling in every single apartment without conventional sewage.
- The immediate processing of waste in point of creation provides access to heat and electricity and therefore decreasing to burn fossil fuels, air pollution and adverse impact to atmosphere.

The combined DRYCLO technology of the next generation should provide all means for building energy-independent private homes and large cities without burning or carrying garbage to the landfills. This will happen without mixing drinking water into fecal waste, and with purifying all water for recycling without any pollution.

SINGLET OXYGEN GENERATOR® – An air purification system that purifies toxic and strong smelling air by producing singlet oxygen radicals that will instantly oxidize organic molecules, resulting in fresh air



Patent no: FI 117852,
Method and device and singlet oxygen generator for gas purification (2002)

The initial objectives of the innovation

- To eliminate the bad odor from dairy farms and industry.
- To produce pure air from CHEMOSTOR bio-oxidizer and ZEP-Pyrolyzer after particle removal

How it works

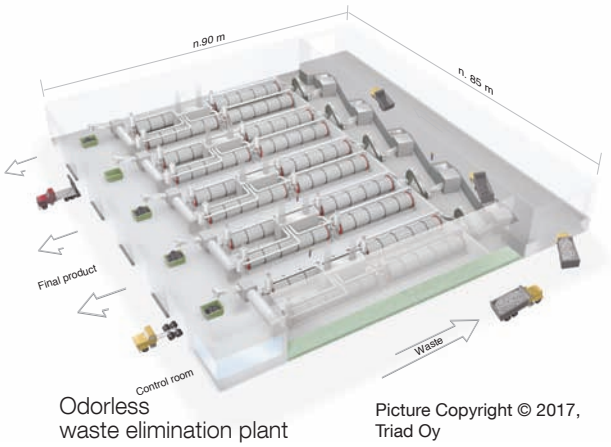
The SINGLET OXYGEN GENERATOR (SOG) technology is based on a radio frequency oscillation between the outer coil electrode and the rod electrode inside a glass tube. The polluted air flows through the outer insulation tube into which the energy is released from the coil. By adjusting the voltage and frequency, one can create the exact energy, which splits the oxygen molecule into 2 oxygen atom radicals.

To avoid ozone release, which could be a side effect if the power is too high related to the impurities in the dirty air, a marker gas with feedback loop is used to secure ozone free pure air.

If dirty air contains particles, they are first removed by ION PARTICLE CLASSIFIER or by a simpler Ion Blast method, for facilitating the effectiveness of SOG. Singlet oxygen is very active and powerful towards any organic molecules and it will oxidize them instantly.

Benefits of SINGLET OXYGEN GENERATOR

- Eliminates all bad odors from any toxic and/or strong smelling air.
- No ozone is produced.
- Nano size particles are removed by oxidation.
- SOG applies for purification of all flu gas, but it's best solution is in oxidation and elimination of the toxic, stinging organic compounds.



Odorless
waste elimination plant

Manufacturing of the odorless dust-free Natural Fertilizer (2000 ton/year).

Every bio-oxidizer is equipped with the air cleaner (30 000 m^3/h).

Conventional technologies and reasons to replace them

- Burning of waste material or any fuel will potentially produce toxic gas emissions.
- Anaerobic rotting of organic waste produces stinging, toxic gas mixture.
- The use of ozone is a general method for eliminating smelling gas.
- Ozone is a toxic gas and ozone generators are leaking it into the air.
- Activated carbon is generally used to eliminate toxic ozone in some extent.
- SOG will have no ozone emission and therefore does not need an activated carbon filter.

Future innovation objectives

- It is important to understand that the burning of any material will compromise the air quality by emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, heavy metals and nano particles, which cause acid rain and severe atmospheric pollution, polluting waters, too.
- SOG eliminates stinging problems of animal husbandry to its employees and environment.
- The elimination of toxic and smelling gas does not eliminate the environmental pollution of energy production by burning.
- The combination of Ion Blast, ION PARTICLE CLASSIFIER (IPC) and SINGLET OXYGEN GENERATOR will provide all the essential means to purify any air stream from any apparatus and from any industrial process.
- The SOG-technology does not eliminate radioisotopes from the emissions of the nuclear power plants.

GRADIPLATE®

TEMPERATURE - GRADIENT INCUBATOR

GRADIPLATE IS A TEMPERATURE GRADIENT INCUBATOR

GRADIPLATE is a plate type temperature-gradient incubator. It was originally developed for determination of the limiting growth temperatures of microbial cultures, but it can also be used for studying other temperature-dependent biological, chemical or physical phenomena. In all applications high capacity is provided by two identical incubation chambers on both sides of the gradient plate. In the standard microbiological applications microbes are cultivated in or on culture media in specially designed Gradicuvettes, resembling rectangular Petri dishes, which are placed on the gradient plate.

PRINCIPLE OF OPERATION

The core of GRADIPLATE is a rectangular metal plate whose opposite edges are kept at different temperatures by circulation of constant temperature liquids through two channel system. The difference in temperature induces a continuous, linear temperature gradient in the metal plate. The same gradient is induced in the samples placed on the plate. The isotherms of the temperature field are straight and parallel to the longest dimension of the chamber. The slope of the temperature gradient is linear and perpendicular to the isotherms. The actual temperatures prevailing on the gradient are monitored at two points with high-class electronic temperature sensors attached to the metal plate. The temperatures at other parts of the gradient are obtained from the readings T_L (low) and T_H (high) through a linear equation.

STANDARD ASSEMBLY

1. GRADIPLATE, the core unit or the incubator proper.
2. GRADITEMP, the temperature control unit with a continuous digital display of the low and high temperature, equipped with a recorder receptacle.
3. GRADICUVETTE, an autoclavable incubation dish, 8 cuvettes included (size 97 mm x 70 mm x 12 mm).
4. CRYOSTATS, the liquid units with two high-duty adjustable circulating cryostats.

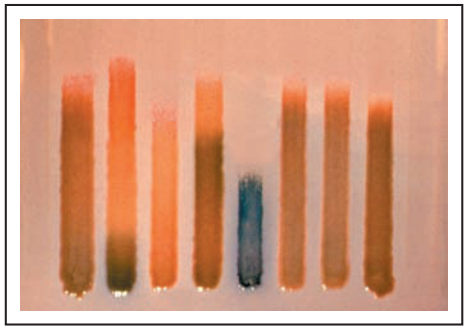
SPECIFICATIONS

- Operating temperature range: -2°C to +95°C
- Operating gradient range: Operating temperature difference can be set from 1 to 20°C which gives a gradient range of 0.01 to 0.2°C/mm.
- Temperature stability: ± 0.01°C with specified cryostats.
- Maximum capacity: 80 cultures at a time with GRADIFILT system.

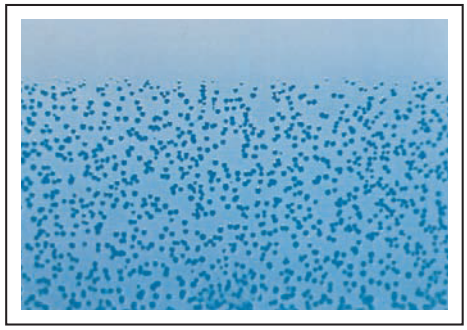
APPLICATIONS

- Determining the maximum, the optimum and the minimum growth temperatures of cell cultures
- Determining the optimum temperature of a metabolite (e.g. enzyme) production.
- Development of temperature-dependent selective methods.
- Basic research on temperature-dependent biological activities.
- Research on biological, chemical or physical reactions or phenomena.
- A variety of the GRADIPLATE accessories are available for different applications.

GRADIFILT, an autoclavable filter assembly for filtering ten test suspensions in parallel lanes.

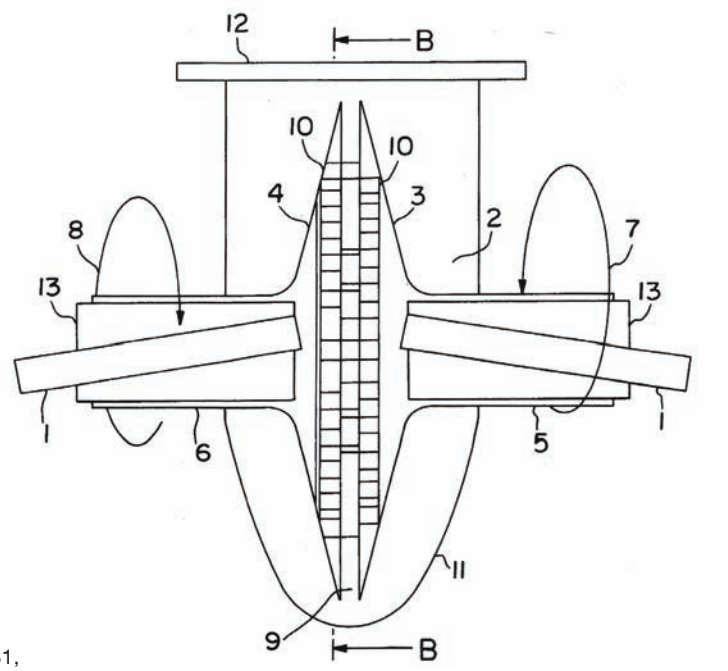


Parallel growth lines of different ***Coliform*** species filtered by GRADIFILT and grown on mFC agar in the gradient.



Growth limit of a ***Coliform bacterium*** inoculated by flooding and grown on mFC agar in the gradient.

JET MILL – An autogenous opposed jet mill technology for pulverizing grinded materials down to sub micron particles



Patent no: US 6,230,995 B1,
Micronizing device and method for micronizing solid particles (2001)

The initial objectives of the innovation

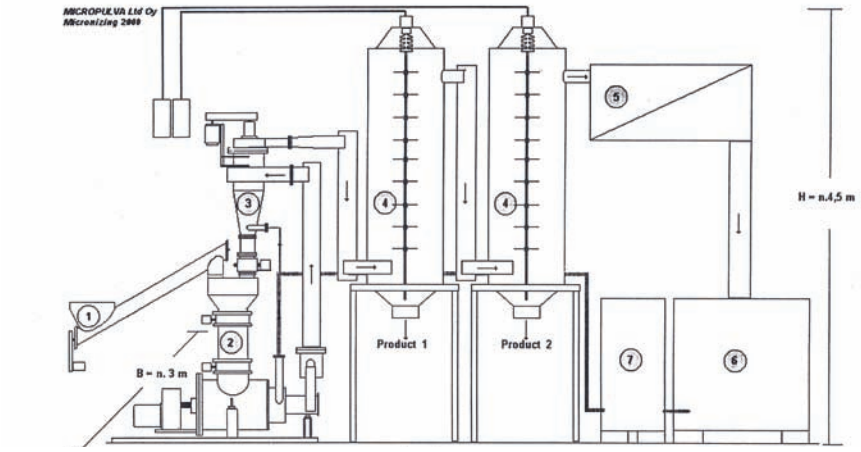
- Further development of Micropulva Jet Mill to increase the performance by high speed accelerator.
- Break down sub micron particles to make nano particles for IPC to collect separated pure elements and minerals
- To decrease the milling energy of the new jet mill

How it Works

In the autogenous jet milling the pre-grinded solid material (less than one millimeter) will be mixed into air and the pressurized air will be accelerated to high speed (800 m/s, 7 bar, temperature exceeding the due point). Two high-speed air streams, in which fine particles of millimeter size are mixed, are colliding through jet nozzles. The particles disintegrate themselves down to sub-micron size. Part of the particles pass by and have to be recycled to the air stream for new colliding. The original Jet Mill had a centrifugal classifier, which was designed to recycle the course particles (over 100 microns) back to Jet Milling and into the mechanical classifier. From the classifier the finest particles of nanometer size are collected as a powdered product. In the Ion Particle Classifier (IPC) this “primary product” is further introduced through a series of the IPC chambers for separation of the different powdered materials. The high speed accelerator and IPC were essential improvements to Jet Mill.

Benefits of Jet Mill

- The autogenous jet milling saves energy up to 70 % comparing to conventional grinding and recovering technologies.
- Jet Mill produces so small particles that many minerals and elements can be separated from the side stone.
- The physical characteristics of many materials such as sugar, milk powder and minerals such as Ilmenite, will be changed dramatically when the particle size is decreased.

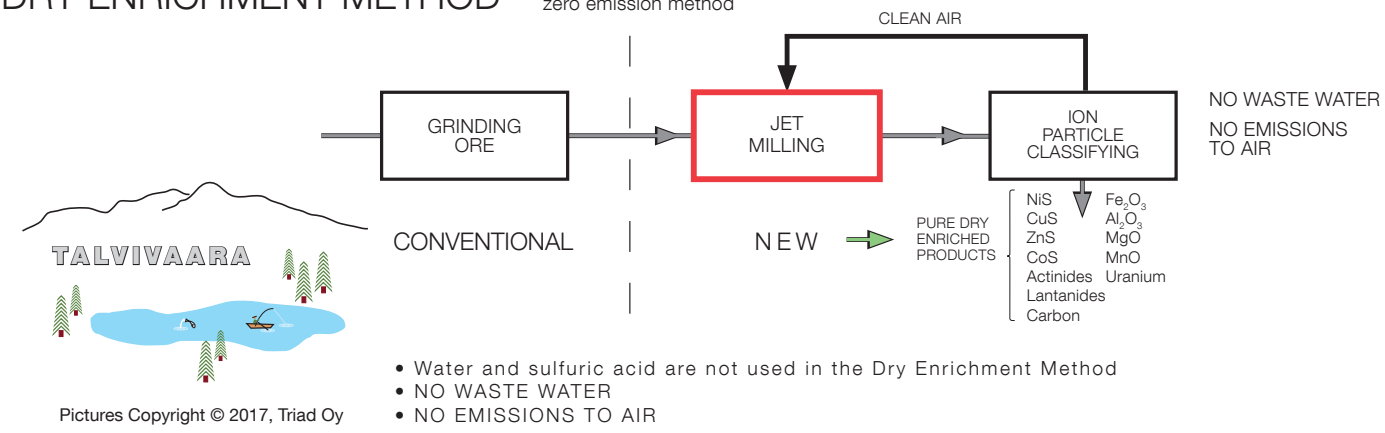


Opposed Jet Mill with Ion Particle Classifier

Opposed Jet Mill with mechanical classifier in Pyhäsalmi Mine

DRY ENRICHMENT METHOD

zero emission method



- Water and sulfuric acid are not used in the Dry Enrichment Method
- NO WASTE WATER
- NO EMISSIONS TO AIR

Opposed Jet Mill and Ion Particle Classifier in Dry Enrichment process of mine

- Mixing of different materials of nano size of particles decrease the energy consumption up to 80 % (i.e. in chocolate production)
- Ilmenite mineral ($FeTiO_2$), which as grinded by conventional way, is wearing, crystal like, bristle material, but in sub-micron powder behaves as soft lubricant and is an ideal weighing agent in cutting liquid in sub-sea oil drilling. (Titania A/S, Norway)
- Jet Mill and IPC together make it possible to use Dry Enrichment Technology in the mining process, in which the conventional water usage is not any more needed.
- Jet Mill and IPC together make profitable pyrolysis process, which will be presented next.

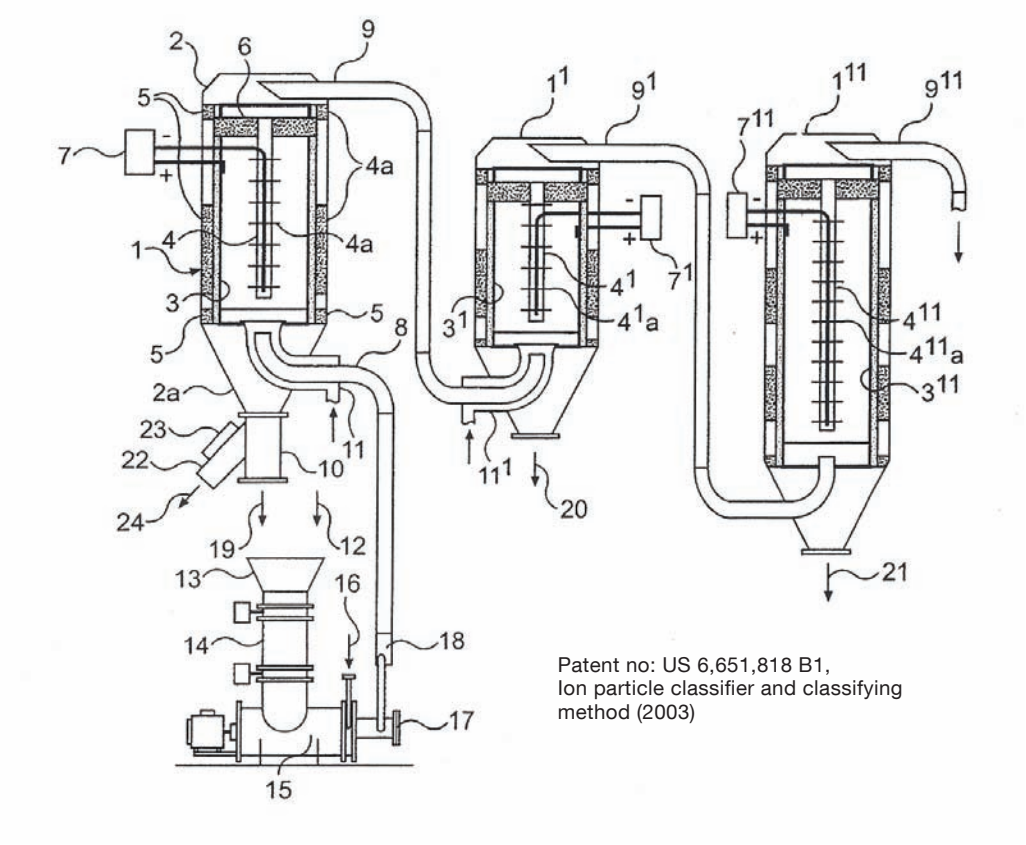
Conventional technologies and a reason to replace them

The improvements to the existing Opposed Jet Mill do not replace the unique technology of Micropulva Ltd Oy, but make it high performance apparatus by extending its applications.

Future innovation objectives

- The small particles which are accelerated and collided by high speed air flow to create nano size dust will provide new era and opportunities for material technology.
- The energy of powderization will decrease substantially.
- New opportunities will be opened for the mining industry when water is no needed and the mining operations do not destroy environment.

ION PARTICLE CLASSIFIER® – An air purification system that removes and classifies sub-micron particles from air by charging them in a high voltage electric field



Patent no: US 6,651,818 B1,
Ion particle classifier and classifying method (2003)

The initial objectives of the innovation

- For making BIOFILM, sub-micron particles i. e. particles with a size from 100 nano meter to 10 nano meter, were needed, all of which had to be captured.
- At the time there was no filtration system capable of doing this, which created the motive for the invention.

How it works

This technology was developed by a team of inventors, who had a pioneering background in Autogenous Jet Milling, Ion Blast Air Purification and BIOFILM Assisted Agriculture.

The original Jet Mill had a centrifugal classifier, which was designed to recycle the course particles (over 100 microns) back to Jet Milling and into the mechanical classifier.

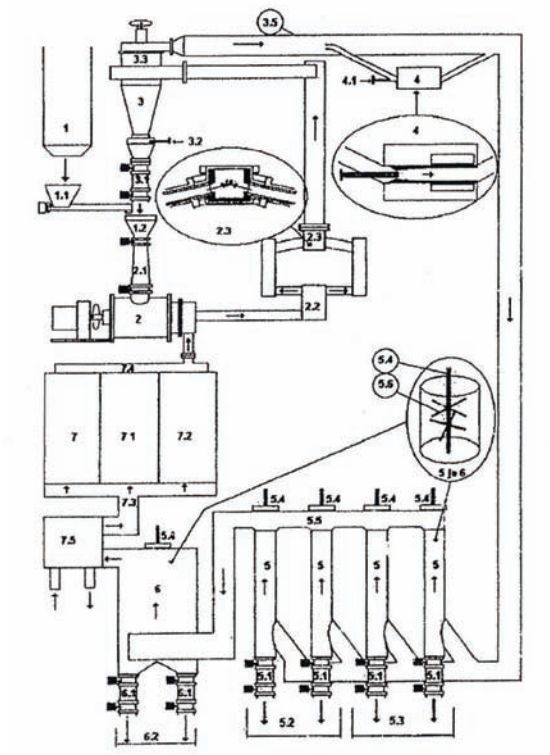
The ION PARTICLE CLASSIFIER (IPC) was an essential addition to the Jet Mill. In the autogenous jet milling two high-speed air streams, in which fine particles of millimeter size are mixed, are colliding through jet nozzles (800 m/s). The particles disintegrate down to sub-micron size.

Part of the particles pass by and have to be recycled to the air stream for new colliding. From the classifier, the finest particles are collected as a powdered product. In the IPC this “primary product” is introduced through a series of the IPC chambers.

The high voltage DC power supply (up to 150 kV) creates a jet stream of positive ions (ca. 3 mA) across the IPC chamber and enforces the positive charge onto the particles. The negative wall of the chamber collects the positively charged particles for recovery.

The serial arrangement of the IPC chambers with different characteristics will classify and recover the particles based on the size, specific gravity and charge. This makes it possible to separate also elements and minerals from each other with very high purity.

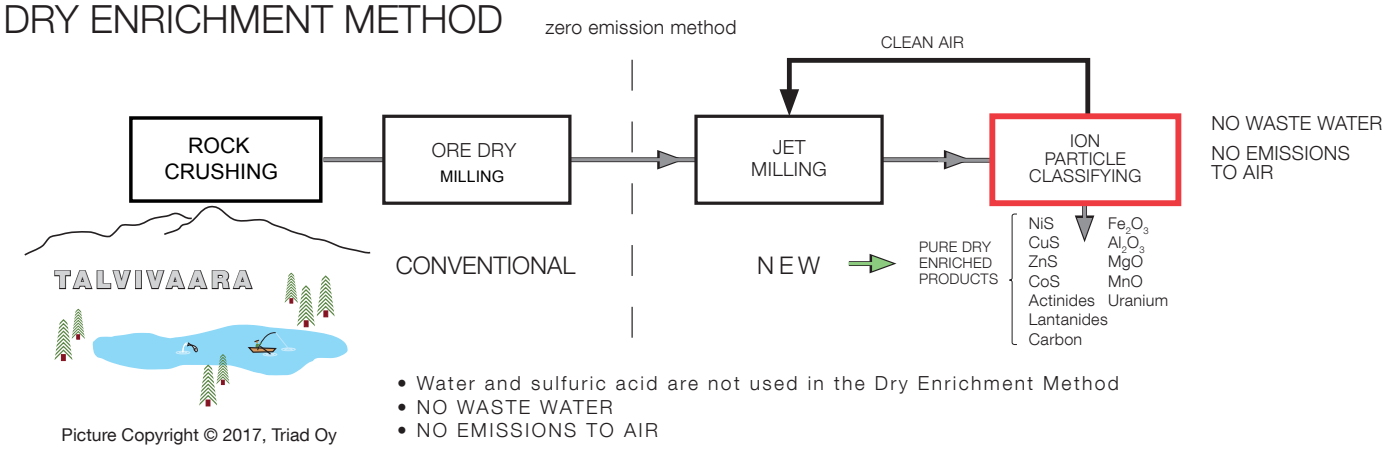
As extreme applications the Jet Mill and the IPC technologies provide the means for making BIOFILM as well as the dry enrichment of minerals in the mining industry, preventing all water and air pollution.



Opposed Jet Mill and Ion Particle Classifier separate minerals in the pilot facility (One milligram of Platinum form 1000 kg of iron ore).

Opposed Jet Mill with air purifier and Ion Particle Classifier (WO 98/36840, 1998)

DRY ENRICHMENT METHOD



- Water and sulfuric acid are not used in the Dry Enrichment Method
- NO WASTE WATER
- NO EMISSIONS TO AIR

Opposed Jet Mill and **Ion Particle Classifier** in the Dry Enrichment process of mine

Benefits of ION PARTICLE CLASSIFIER

- Purifies air from any type of air polluting industry.
- Avoids the need for toxic pollution of water used in the mining industry by extracting all side minerals through dry enrichment, leading to high profit margins.

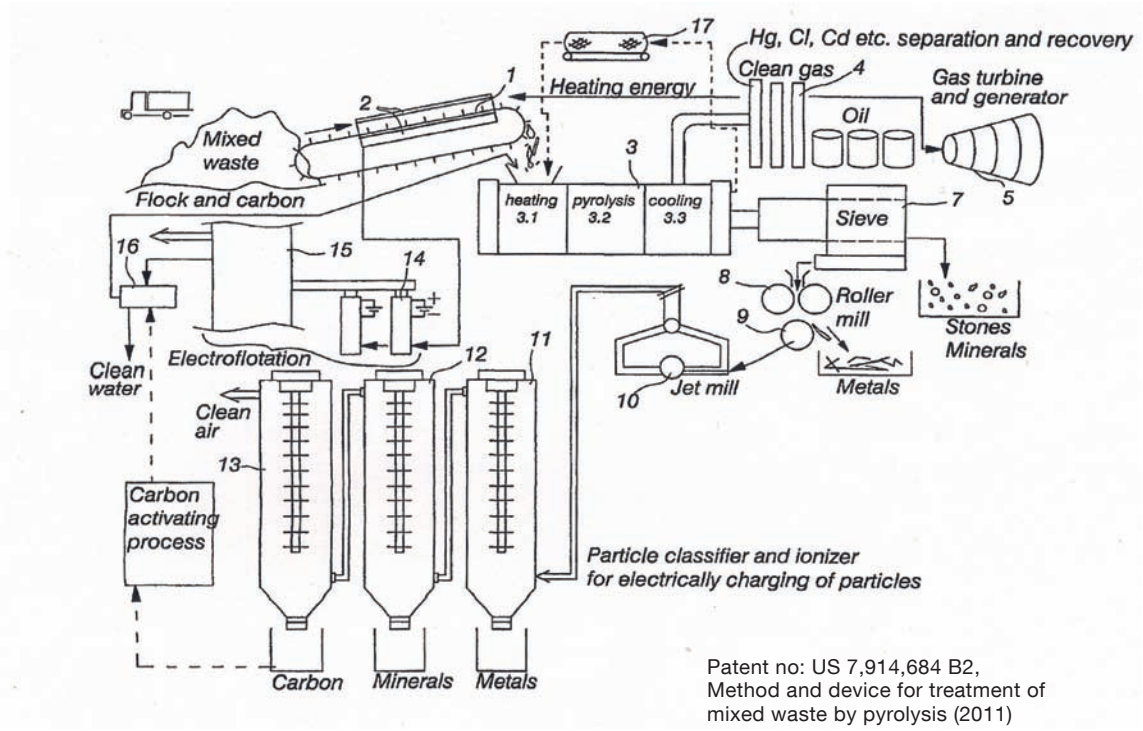
Conventional technologies and a reason to replace them

- Mechanical filters create vast waste problem of disposable filter media.
- Sub-micron and nano particles are not captured by mechanical filters.
- IPC does not create disposable waste having no filter media.
- IPC captures all particles down to nano meter size.

Future innovation objectives

The lack of pure air and clear sky will depress living conditions in our societies, where energy production is dependent on burning fossil fuels. At this stage the key objective for the ION PARTICLE CLASSIFIER is to gain commercial traction and successfully deploy this technology throughout the world and especially in the energy and mining industries.

ZEP-PYROLYZER® – An anaerobic thermo-chemical cracker that processes organic waste through enforced convection thereby recovering pure carbon black and heat energy



Patent no: US 7,914,684 B2,
Method and device for treatment of mixed waste by pyrolysis (2011)

The initial objectives of the innovation

- To develop alternative solutions for waste processing with the aim to avoid the use of landfills.
- To break down all organic waste to solid carbon, and separate and recover it with other pure elements
- To eliminate waste with positive material and energy balance

How it works

The ZEP-PYROLYZER is a processor in which thermo-chemical decomposition of organic material at elevated temperatures takes place in the absence of any air. It involves the simultaneous change of chemical composition and physical phase, and is irreversible.
Providing the material and energy balances are positive, the ZEP-PYROLYZER is a feasible solution for the elimination of landfills and the production of carbon and other pure elements and energy.

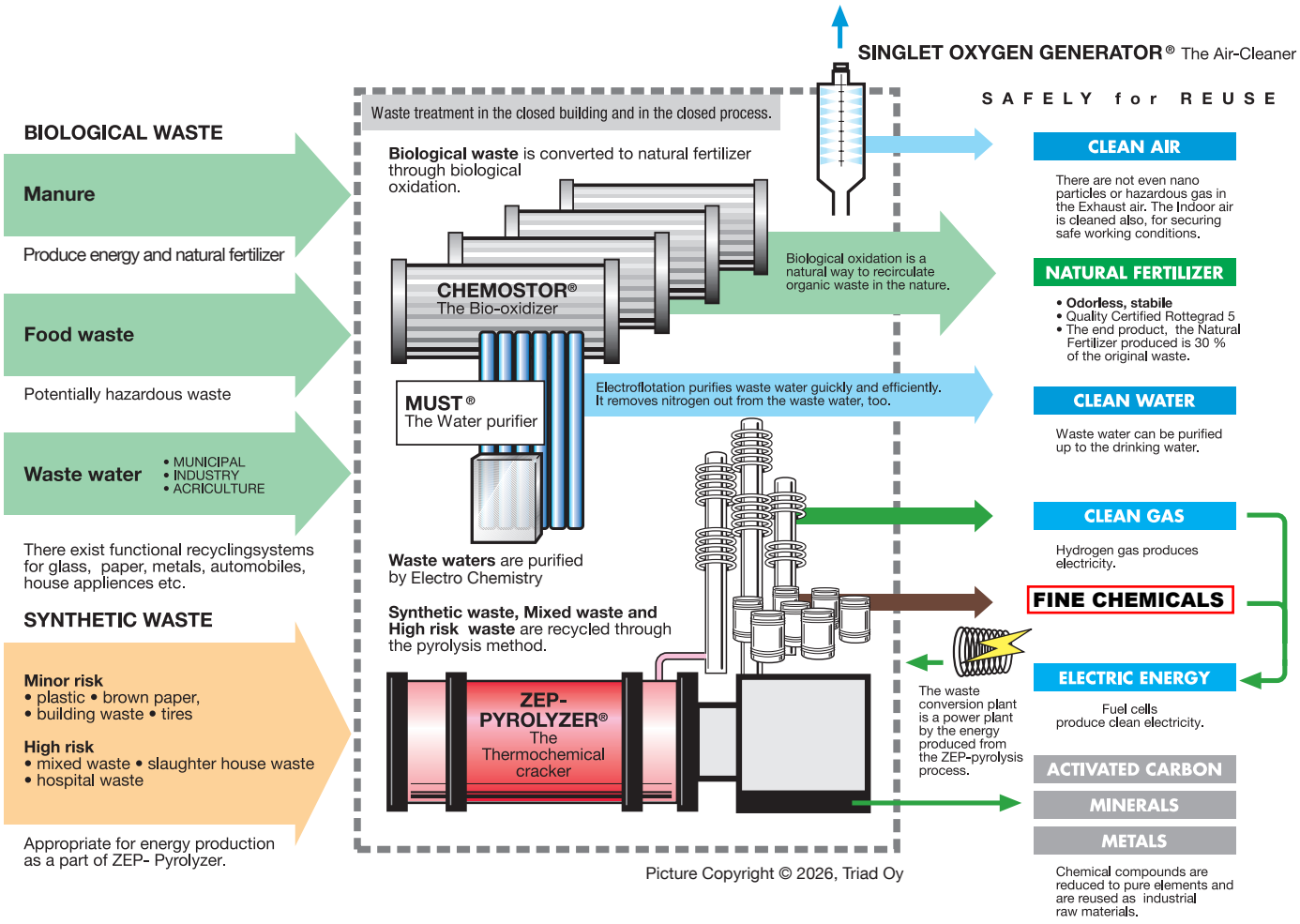
This means that the waste material introduced into the ZEP-PYROLYZER has to be dry and free of oxygen. The recovered carbon has to be in elementary form and not be converted during the process into carbogenous compounds containing carbon polymers. This is achieved by the enforced convection method.

The combination of Jet Milling, ION PARTICLE CLASSIFIER and MUST- technologies are needed for the pyrolysis process.

The produced pure elementary carbon can be used as a valuable raw material for tire manufacturing or as activated carbon for purifying drinking water and air. To do this, the impurities from pyro-gas and pyro-carbon have to be extracted as pure elements or minerals, and pure pyro-gas recycled back through forced convection. The energy content of the produced and recovered pyro-gas is higher than the energy needed to release it from the organic material. The material and energy balances are positive.

As a consequence, ZEP PYROLYZER is a waste power plant, which will convert all waste material to energy and to valuable commercial commodities.
When there are no landfills, there are no emissions to air and no toxic landfill leachate into ground water.

Hope for the future – LIFE WITHOUT LANDFILLS



Benefits for ZERO - EMISSION - PYROLYZER:

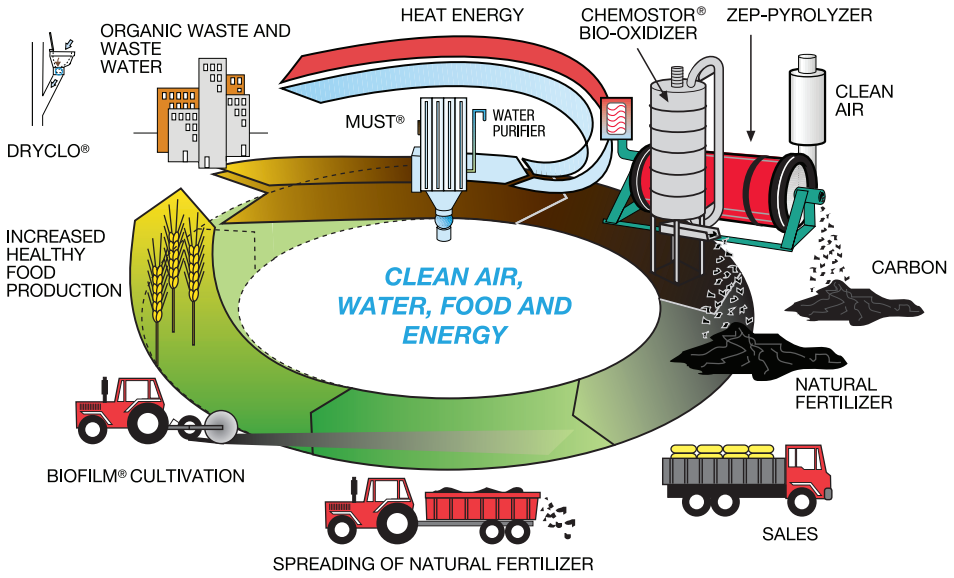
- All waste is converted into energy and valuable commercial commodities without any emissions to air, water or land.
- Produces pure elements and minerals for continuous recycling.
- Fixes carbon in solid form for reuse. Since carbon dioxide, sulfur dioxide and nitrogen oxides are not released to the atmosphere, ZEP is an odor free and hygienic process.
- Decreases mining of the virgin elements.

Conventional technologies and reasons to replace them

- Addition of carbon dioxide, sulfur dioxide and nitrogen oxides, (causing acid rain), the flue gas emissions from waste incinerators and especially from coal power plants also includes arsenic and mercury. These toxic elements will accumulate and enrich in the aquatic food chains compromising marine food source.
- Initially arsenic poisoning will cause skin disease (arsenic toxification is known in China since 5000 years) and mercury (high concentrations in Montana coal) eventually results in osteoporosis.
- Mercury is a calcium analog, and by replacing it, will cause collapse of the bones and finally total destruction of human beings. (Refer to Minamata disease, due to a release of mercury chloride ($HgCl_2$) from a pulp mill in Japan, in 1956.)
- ZEP PYROLYZER will capture all these and many other toxic but valuable elements for reuse while producing clean electric and heat energy.

Future innovation objectives

- With the technology in place, the first and foremost task is to scale up and create commercial interest for the application and replace waste power plants by the ZEP technology.
- The emissions free, material and energy positive technology should be realized with the reduction of wasted raw materials and energy to save and improve the living conditions.
- ZEP will have, hopefully, a dramatic impact for decreasing the human role in climate change by reducing green-house gas emissions.



Conclusion

The referred materials provided in this document prove, that we have during the 30 years of intense research and development, produced an impressive suite of environmental technologies, that can be adopted to solve most, if not all, of the current environmental problems involving clean air, clean water, clean environment and healthy food.

The research and development work is well supported with the data that has been collected from extensive trial work conducted over more than three decades with diverse industries in three continents.

The intense focus on the fundamental research required to ensure that the technologies will produce sustainable results, has taken priority over the commercialization of these technologies.

Now when the new products have been developed and new patents are in place, we have committed to the commercialization of the listed innovations through our companies. I have called a group of specialist and sub-contractors with whom our company will deliver the various products to the market. At the time of compiling this document, commercial MUST units are being manufactured and designs are being finalized for the next generation bio-oxidizer.

The new materials such as microbial photosynthetic bio-polymers will preserve the clear-cut Northern Forest and Southern Rain Forest and retain the biodiversity. The polluted waters, rivers, lakes and oceans will be restored for aquatic life. The access to drinking water will be secured by the electrochemical MUST-technology.

Bio-oxidization and cover cultivation by bio-polymer will provide unlimited access to natural healthy food. The use of the planetary gravity forces with solar power will replace fossil deposits as a power source. This together with bio-polymers, which will fix carbon dioxide from the atmosphere, will slow down the climate change and return clear skies for everyone, including China and India. In summary, commercialization of all these innovations is very much at the early adopter stage. The need to replace the poor and expensive performance of the conventional materials and technologies is urgent and continuously requests Zero Emission Technologies for clean and high performing material and sustainable energy production.

The benefits from these innovations - clean air, clean water, natural soils, healthy food and ample renewable energy - will be enjoyed for generations to come.

You are welcome to join our venture for developing sustainable and secured future.

Espoo, Finland, January 2026

Dr. Hannu L. Suominen with his partners and global representatives

Attachment no 1: Dr. Hannu L. Suominen's patent applications for Zero Emission Technologies in 1987 - 2026

Patent appl. No:	Priority Date	Title
1. Innovation: BIOFILM®, the Biodegradable Plastic Film for Plant Cultivation		
1.1. FI 881965	27.04.1988	"Biologically decomposable composition"
2.2. FI 891905	21.04.1989	"Procedure and means for attaching film used in covered cultivation"
3.3. FI 891906	21.04.1989	"Planting film used in covered cultivation and micro greenhouse"
4.4. FI 894735	05.10.1989	"Biologically degradable combination film and method of preparing the same"
5.5. FI 894736	05.10.1989	"Biologically degradable film and method of preparing the same"
6.6. FI 894734	05.11.1989	"Biologically degradable cover film and method of preparing the same"
7.7. FI 902373	11.05.1990	"Biologically degradable cover film and method of preparing the same"
8.8. US 592 616	04.10.1990	"Production of biologically degradable films"
9.9. US 592 953	04.10.1990	"Biologically degradable combination film and method preparing the same"
10.10. US 592 617	04.10.1990	"Biologically degradable plant cover film and method preparing the same"
11.11. FI 905155	18.10.1990	"Procedure for attaching film used in covered cultivation"
12.12. FI 91114	06.03.1991	"Method for preparing biologically degradable film"
13.13. FI 911628	04.04.1991	"Method for preparing biologically degradable film"
14.14. US 732 412	13.07.1991	"Method for preparing biologically degradable film
15.15. US 952 760	19.07.1991	"Biologically degradable cover film and method of preparing the same"
16.16. US 998 913	30.12.1992	"Biologically degradable films comprising enzyme-coated bio-degradable polymer particles"
2. Innovation: Chemostor®, the Bio-Oxidizer for Natural Fertilizer		
17.1. FI 901854	12.04.1990	"Compostor"
18.2. FI 925276	20.11.1992	"Process and device for composting organic waste"
19.3. FI 940842	23.02.1994	"Feeding and mixing arm for a drum compostor"
20.4. FI953923	22.08.1995	"Device for rotating drum composter with slow speed"
21.5. US 980141	23.03.1998	"Device for rotating drum composter with slow speed"
22.6. FI 20020169	30.01.2002	"Method and device for oxidizing organic mass"
23.7. FI 20021727	27.09.2002	"Method and device for oxidizing organic matter"
3. Innovation: Dryclo®, Waterless sewer system		
24.1. FI 963209	16.02.1995	"Method for treatment of municipal waste sludge or animal slurry"
4. Innovation: MUST®, the Molecular Unique Separation Technology for water purification		
25.1. FI 932288	19.05.1993	"Flock separating apparatus"
26.2. FI 940174	16.02.1994	"Method for purification of piggery slurry"
27.3. FI 945268	09.11.1994	"Electrolytic cell"
28.5. US 836,849	19.05.1997	"Flock separating apparatus"
29.6. US 280,140	26.03.1999	"Flock separating apparatus"
30.7. FI 20020159	25.01.2002	"A method and apparatus for removal of nitrogen from waste water"
31.8. FI 20025064	18.02.2002	"Method and apparatus for removing impurities from waste water by electro flotation"
32.9. FI 20095845	14.08.2009	"Method and apparatus for the purification of hydrogen sulfide containing aqueous solutions"
33.10. FI 20095846	14.08.2009	"Method for dewatering a fiber and particle suspension in the manufacturing of pulp, paper or board"
34.11. FI 20095877	26.08.2009	"Method and apparatus for the purification of waste water"
35.12. FI 20145319	02.04.2014	"Method for removal of sulfate from aqueous solutions"
36.13. EP/2024/067123	19.06.2024	"Method and a water purification apparatus for purifying acidic wastewater from a mining.....
37.14. EP/2024/072468	08.08.2024	"Method and a system for removing nutrients from wet animal manure, a fertilizer product
5. Innovation: SOG®, Singlet Oxygen Generator for gas purification		
38.1. FI 20020304	15.02.2002	"Method and equipment and singlet oxygen generator for purification of gas"
39.2. FI 20030056	04.02.2004	"Method and apparatus for cleaning the exhaust gases of bio-oxidizer"
6. Innovation: Opposed Jet Mill for micronization of solid particles		
40.1. FI 1999273	20.12.1999	"Method and equipment for feeding a counter jet mill"
41.2. FI 970733	22.08.1998	"Equipment and method for producing ultra fine dry powders by means of high-energy power gas"
42.3. PCT/FI00/00910	19.10.2000	"Micronizing device and method for micronizing solid particles"
7. Innovation: IPC®, the Ion Particle Classifier Technology for air purification		
43.1. PCT/FI00/00918	24.10.2000	"Ion Particle Classifier and classifying method"
8. Innovation: ZEP®, the Zero Emission technology for waste elimination		
44.1. PCT/F100/1048	30.11.1999	"Method and equipment for pyrolytic treatment of organic material"
45.2. PCT/FI01/00302	02.04.2001	"Method for treating possibly contaminated biological material prior to a pyrolysis process"
46.3. PCT/F102/00993	06.12.2001	"Method and equipment for pre-treatment of used tyres before a pyrolysis process"
47.4. PCT/F103/00070	30.01.2002	"Method and apparatus for treating mixed waste by pyrolysis"
9. Innovation: Temperature Gradient incubator		
48.1. FI 77055	15.05.1987	"Thermal-Gradient Incubator" Inventor Seppo Niemelä / Limitek Oy
49.2. FI 891050	06.03.1989	"Temperature-Gradient Incubator for studying Temperature Dependent Phenomena". Inventor Alpo Lähetkangas / Biodata Oy
50.3. FI 895476	16.11.1989	"Substrate container to be used in Temperature-Gradient Incubator". Inventor Hannu L. Suominen / Biodata Oy

Summary:
Most of the patent literature can be found from the patent registers of: www.prh.fi, and www.escpacenet.com and other international patent registers. However, the list of the patent publications is not complete and the patent registers have still some errors and missing data.
Based on the above patent applications, there are over 153 Letters of Patents issued in my name and more than 350 patent related documents issued in many countries such as in the People's Republic of China, Japan, South Korea, Argentina, Brazil, Australia, USA, Canada, USSR, Norway, and in many EU countries.
The subject related patents have expired after 20 years from the priority date or before. All of the publications are in the files of the inventor.
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Mr. Lauri H. Suominen, tel: + 1 612 978 4505, email: lauri.suominen@hls-electro.fi

Attachment no 2:

Dr. Suominen has delivered over 300 projects to 45 countries by his companies since 1979

CLIENT/PARTNER	PLACE	COUNTRY	RESEARCH PROJECT (TP), TECHNOLOGY, MATERIAL OR PRODUCT DELIVERY (LT)	COMP/NDA	YEAR STARTED
AGRICULTURE AND FOOD PRODUCTION:					
Finnish Co-operat. Dairies Assoc.	Helsinki	FI	Temperature gradient incubator/sour milk, LT	B/3	1986
University of Helsinki	Helsinki	FI	Temperature gradient incubator/basic research, LT	B/1	1986
Biocon Biochemicals Ldt	Cork	IR	Bacillus strain for Amylaze production, LT	B/3	1986
Neste Oyj	Porvoo	FI	Polyethylene produc. and degradation analysis, TP	B/2	1987
Amerplast Oy	Tampere	FI	Polyethylene degradation trials, LT	B/2	1987
T. K. Ruti	Porvoo	FI	Biofilm masterbatch production, TP, LT	B/2	1987
Rosenlew Oy/Teno AB	Norrköping	SE	Biofilm masterbatch production, TP, LT	B/2	1988
Rosenlew Oy	Pori, Merikarvia	FI	Biofilm production, TP/ LT	B/2	1988
Mäntyniemi Farm	Kesälahti	FI	Biofilm field trials in 7 farms,TP, LT	B/2	1989
Ministry of Agriculture	Peking	CN	Chemical free agricultural technology, TP, LT	B/3	1989
Agriculture Development Center	Peking	CN	Biofilm delivery and field trials, TP, LT	B/3	1989
College of Veterinary Medicine	Helsinki Univer.	FI	Temperature gradient deliveries/pathogens, 2 x LT	B/1	1989
Valio Oy, Finnish Co-operat. Dairies	Helsinki	FI	Temperature gradient incubator/milk, 2 x LT	B/3	1989
National Veterinary Institute	Helsinki	FI	Temperature gradient incubator/Listeria, LT	B/1	1989
Lindström pig farm	Sipoo	FI	Water purification of pig slurry, TP, LT	B/2	1989
Meat Technology Institute	Helsinki Univer.	FI	Temperature gradient incubator/meat, LT	B/1	1989
MP. Madam Deng Nang	Peking	CN	Biofilm cultivation in Finland and in PRC, TP	B/3	1990
National Public Health Institute	Kuopio	FI	Temperature gradient incubator/pathogens, LT	B/1	1990
Burns Philip Pty Ltd	North Ryde NSW	AU	Temperature gradient incubator/beer, yeast, LT	B/3	1990
Wipak Gryspeert S.A.S.	Bousbecque	FR	Biofilm production, TP, LT	B/2	1990
Japan Steel Works Ltd	Tokyo	JP	Biofilm production, TP, LT	B/2	1990
Technical University of Helsinki	Espoo	FI	Temperature gradient incubator/chemistry, LT	B/1	1990
Ilmajoen Osuusmeijeri YTJ	Ilmajoki	FI	From whey to cheese by electrochemistry, TP	B/2	1991
Valio Oy	Riihimäki	FI	Temperature gradient incubator/cheese, LT	B/2	1991
Univer. Degli Studi di Brescia	Brescia	IT	Temperature gradient incubator/ research, LT	B/1	1991
Kirvelä Stable	Mynämäki	FI	Bio-fertilizer from horse manure, LT	BB/1	1991
Riuttaskorpi Dairy Farm	Loimaa	FI	Bio-fertilizer from cow manure, LT	BB/1	1991
Lahti Farm	Kisko	FI	Fertilizer from active sludge, LT	BB/1	1991
Juva Dairy Farm	Uusikaupunki	FI	Bio-fertilizer from cow manure, LT	BB/1	1991
Aura Chemicals	NSW	AU	Fertilizer from slaughter waste, LT	BB/1	1991
Sulin Stable Farm	Kangasala	FI	Bio-fertilizer from horse manure, LT	BB/1	1991
Pirhonen Dairy Farm	Kitee	FI	Bio-fertilizer from cow manure, LT	BB/1	1991
Silpola Pig Farm	Lammi	FI	Bio-fertilizer from pig manure, LT	BB/1	1991
Toukovirta Dairy Farm	Hikiä	FI	Bio-fertilizer from cow manure, LT	BB/1	1991
Sanox AB	Umeå	SE	Experimental Quantor- reactor, LT	BB/1	1991
Agricultural school	Jämsä	FI	Bio-fertilizer from pig manure, LT	BB/1	1991
Lyttbacka Dairy Farm	Kronoby	FI	Bio-fertilizer from cow manure, LT	BB/1	1991
Unilever Research	Bedford	UK	Temperature gradient incubator/ food research, LT	B/3	1992
State Research Center	Espoo	FI	Temperature gradient incubator/ food research, LT	B/1	1992
Vasala Stable Farm	Oulu	FI	Bio-fertilizer from horse manure, LT	BB/1	1992
Ketonen Stable Farm	Läyliäinen	FI	Bio-fertilizer from horse manure, LT	BB/1	1992
VTT Laboratory	Jyväskylä	FI	Elimination of contaminated soil, LT	BB/1	1992
Kuusikko Stable	Kuusjärvi	FI	Bio-fertilizer from horse manure, LT	BB/1	1992
Rasila Chicken Farm	Somero	FI	Bio-fertilizer from chicken manure, LT	BB/1	1992
Björkö Fisk	Åland	FI	Bio-fertilizer from fish waste, LT	BB/1	1992
University of Eastern Finland	Liperi	FI	Bio-oxidizer for animal husbandry research, TP, LT	B/1	1993
Board of Environment and Waters	Helsinki	FI	Temperature gradient incubator/ water research, LT	B/1	1993
University of Eastern Finland	Joensuu	FI	Temperature gradient incubator/research, LT	B/1	1993
B. Damkjaer	Copenhagen	DK	Purification trials of pig slurry, TP	B/2	1993
Nabuurs Farm	Braband	NL	Water Purifier for Dairy and Pig Farm, LT	A+C+D/2	1997
Pirteä Porsas Oy	Vehmaa	FI	Purification of pig slurry, TP	D/2	2002
Bundesforsch. für Ernährung	Karlsruhe	DE	Temperature gradient incubator/ food research, LT	D/2	2003
Biovakka Oy	Vehmaa	FI	Purification of cow manure, TP	D/2	2003
Saaristomeren kala Oy	Uusikaupunki	FI	Elimination of viruses from fishery, TP	D/2	2003
Arla Foods AB	Stockholm	SE	Purification of wastewater from Dairy Plant, TP	D/2	2004
J.R. Simplot Company	Boise, ID	USA	Fertilizer from cattle manure by bio-oxidizer, TP	H/2	2004
Al Rawabi Dairy CO.	Dubai	UAE	Pure water and fertilizer from Dairy Farm, TP, LT	D/3	2004
Dubay Ingredients LLC	Stratford, WI	USA	Purification of wastewater from Cheese Plant, TP, LT	H/3	2005

Dubay Ingredients LLC	Stratford, WI	USA	Purification of wastewater from Ethanol Plant, TP, LT	H/3	2005
Jepuan peruna Oy	Jepua	FI	Purification of potato process water, TP, LT	D/2	2005
United Dairymen of Arizona	Tempe, AZ	USA	Purification of wastewater from Dairy Plant, TP	D/2	2005
Smithfield Beef Group Inc.	Green Bay, WI	USA	Purification of slaughterhouse wastewater, TP	H/3	2005
Foremost Dairy Inc.	Sparta, WI	USA	Purification of wastewater from cheese process , TP	H/3	2005
ConAgra Foods Inc.	Omaha, NE	USA	Wastewater of Hermisto Potato Plant , TP	H/3	2005
ConAgra Foods Inc.	Park Rapids,MN	USA	Wastewater of tomato plant, TP	H/3	2005
Emerald Dairy Inc.	Emerald, WI	USA	Purification of wastewater from Dairy Process, TP	H/2	2005
Golden Cheese Company	Corona, CA	USA	Purific. of wastewater of ethanol production, TP	H/2	2005
Kraft Inc.	Melros, MN	USA	Purific. of wastewater of ethanol production, TP	H/2	2005
Wholesome Dairy Farm	Chilton, WI	USA	Purification of biogas sludge of dairy farm, TP	H/2	2005
Sebesta Blomberg @ Associates	Roseville, MN	USA	Treatment of biosolids, TP	H/2	2005
Alfalfa America Inc.	Belle Plaine, MN	USA	Purification of alfalfa process water, TP	H/2	2006
Rahulan Rehu OY	Mikkeli	FI	Elimination of smell from of pet food factory, TP, LT	H/2	2006
Laukkala Farm	Kiuruvesi	FI	Pure water and fertilizer from cow manure, TP, LT	I/2	2006
Valio Oy	Lapinlahti	FI	Purification of cheese process waste water, TP	D/2	2006
Al Rawabi Dairy CO.	Dubai	UAE	Pure water and fertilizer from Dairy Farm, TP, LT	D/3	2006
Tabree Denmark ApS	Daugård	DK	Purification of pig slurry, TP	D/2	2008
DuPont	Paris	FR	Purification of water from soy process, TP	D/3	2012
NOAH Water Solutions BV	Asper	BE	Water Purifier for pilot research, TP, LT	D/2	2013
Open Country Dairy Ltd	Waharoa	NZ	Purification of dairy waste water, TP	D/3	2014
Food & Energy Campus GmbH	Frankfurt	DE	Purification of biogas slurry, TP	D/3	2014
Wedex Finland Oy	Tornio	FI	Pure Water and Natural Fertilizer from cow manure	J/3	2017
Al Rawabi Dairy CO.	Dubai	UAE	Pure water and fertilizer from Dairy Farm, TP, LT	J/3	2018

MUNICIPALITIES:

Prokisto OY	Kankaanpää	FI	Bio-oxidizer for wastewater treatment plant, LT	A+D/2	1993
Metropolitan Council, YTV	Helsinki	FI	Oxidization of organic household waste, TP, LT	D/1	1994
Karmöy county	Karmöy	NO	Purification of leachate from landfill, TP	D/1	1996
Metropolitan Council, YTV	Espoo	FI	Purification of leachate from Ämmässuo landfill, TP	D/1	1998
Secure Recycler LLC	San Francisc, CA	USA	Pyrolysis of used tires, TP, LT	F+G/2	1999
Lofoten Avfallsselkap AS	Lekenes	NO	Bio-oxidizer for household waste, septic sludge, LT	D/1	1999
Lofoten Avfallsselkap AS	Lekenes	NO	Air purifiers for bio-oxidizers, LT	D/1	2000
City of Espoo	Espoo	FI	Elimination of Ämmässuo Landfill, TP	D/1	2000
WWTP of Suomenoja	Espoo	FI	Purification of wastewater, TP	D/1	2002
Kuusakoski Oy	Heinola	FI	Purification of leachate from industrial landfill, TP,LT	D/3	2002
Ministry of Environment	Borj Chekir	TU	Elimination of organic waste from landfill, TP	D/1	2003
Vision 2015 Gambia	Jufureh	GM	Clean water from the Gambia River, TP, LT	D/1	2005
City of Heinola	Heinola	FI	Purification of wastewater, TP	D/1	2005
Hyvinkään Vesi Oy	Hyvinkää	FI	Elimination of wastewater sludge, TP	D/1	2005
Kotkan Vesi Oy	Kotka	FI	Purification of wastewater, TP	D/1	2005
Oy Silja Line AB	Helsinki	FI	Purification of wastewater from Silja Serenade, TP	D/2	2005
Vihti County	Vihti	FI	Purification of wastewater, TP, LT	D/1	2006
Maple Lake development	Maple Lake, MN	USA	Purification of wastewater, TP	H/2	2006
Annadale development	Annadale, MN	USA	Purification of wastewater, TP	H/2	2006
City of Lohja	Lohja	FI	Purification of leachate from landfill, TP	D/1	2006
USPure, LLC	Sausalito, CA	USA	Purification of wastewater, TP	H/2	2006
Europol SA	Athens	GR	Oxidation of municipal sludge, TP	D/2	2006
City of Francis	Francis, UT	USA	Purification of wastewater, TP, LT	D/2	2009
ASER AS	Skibotten	NO	Purification of leachate from landfill, LT	D/1	2009
City of Kuusamo	Kuusamo	FI	Purification of wastewater, TP	D/1	2010
Sato Energy Holdings (Pty) Ltd	Cape Town	RSA	Purification of wastewater, TP	D/2	2013
Timpanogos Special Services	Americ. Fork, UT	USA	Purification of wastewater, TP, LT	D/2	2014
The City of Inkom	Inkom, ID	USA	Purification of wastewater, TP	D/2	2014
City of Logan	Logan, UT	USA	Purification of wastewater, TP	D/2	2014
Jiangsu Yiyang Water Ind. Co.	Xixing	CN	Purification of wastewater, TP, LT	D/2	2015
SPARCL Ltd.	Feilding	NZ	Purification of wastewater, TP, LT	C/2	2015
Horowhenua District Council	Foxton	NZ	Purification of leachate from landfill, TP	C/2	2015
H.G. Leach & Co	Paeroa	NZ	Purification of leachate from landfill, TP	C/2	2015
H.G. Leach & Co	Tirohia	NZ	Purification of leachate from landfill, TP	C/2	2015
Bonny Glenn	Marton	NZ	Purification of leachate from landfill, TP	C/2	2015
Hamton Downs	Hamilton	NZ	Purification of leachate from landfill, TP	C/2	2015
IMOG	Harelbeke	BE	Purification of leachate from landfill, TP	C/2	2015
Makel Electro Mechanic Eng.	Ankara	TR	Drinking water from river, TP	C/2	2016
Palmerston North	Horizon region	NZ	Purification of wastewater, TP	J/3	2018

FOREST INDUSTRY:

Enso Gutzeit Oyj	Lappeenranta	FI	Prevention of slime in Paper Mill, TP, LT	B/2	1989
United Paper Mills	Valkeakoski	FI	Prevention of slime in Paper Mill, TP	B/3	1990
United Paper Mills	Valkeakoski	FI	Prevent. of degradat. of sack and cable paper, TP, LT	B/3	1990
Oy Metsä Botnia AB	Joutseno	FI	Prevention of slime in Paper Mill, TP	D/3	2005
Myllykoski Oyj	Myllykoski	FI	Purification of wastewater of paper process, TP	D/2	2005
Stora Enso, Packaging Boards	Imatra	FI	Purification of wastewater of paper process, TP	D/2	2005
Mreal Oyj	Kirkniemi	FI	Purification of wastewater of paper process, TP, LT	D/2	2005
Mreal Oyj	Joutseno	FI/USA	Purification of BCTMP wastewater, TP, LT	H/3	2007
Sonoco Alcore Oy	Karhula	FI	Purification of board process water, TP	D/2	2009
Andritz Oy	Kotka	AU	Purification of pulp process water, TP	D/2	2011
Zubialde Paper Mill	Aizarnazabal	ES	Purification of TMP process water, TP	D/2	2012
South African Pulp and Paper	Lohja	FI	Purification of pulp process water, TP	D/3	2012
South African Pulp and Paper	Lohja	FI	Purification of pulp process water, TP	D/3	2012
Asian Pulp and Paper, Co.	Suzhou	CN	Purification of paper process water, TP	D/2	2012
UPM Oyj	Fray Bentos	UY	Purification of eucapulp process water, TP	D/3	2013
UPM Oyj	Kaukas	FI	Purification of bleaching process water, TP	D/3	2013
UPM Oyj	Jämsänkoski	FI	Purification of TMP process water, TP	D/3	2013
Stora Enso, Fluiting Mill	Heinola	FI	Purification of fluting process water, TP	D/3	2013
Corenso United Oy Ltd	Pori	FI	Purification of board process water, TP	D/2	2013
Vida Paper	Lessebo	SE	Purification of paper process water, TP	D/2	2013
Metsäboard Oyj	Espoo	FI	Purification of board process water, TP	D/2	2013
P&P Project GmBh	Winterthur	CH	Purification of paper process water, TP	D/2	2013
APP Gold Huasheng Paper Co.	Suzhou	CN	Purification of paper process water, TP	D/3	2013
Egypt Uniboard	Cairo	EG	Purification of paper process water, TP	D/2	2013
Jiangsu Yiyang Water Ind. Co.	Xixing	CN	Purification of paper/pulp process water, TP, LT	D/3	2015

MINING INDUSTRY:

Titania AS	Hauge i Dalene	NO	Jet Mill to Ilmenite Mine, LT	E+D/2	1998
Riddarhyttan Resources AB	Kittilä	FI	Cyanide destruction in gold mine, TP	D/2	2003
Phelps Dodge Inc.	Phoenix, AZ	USA	Purification of Sierrita Mine waters, TP, LT	H/2	2007
Phelps Dodge Inc.	Phoenix, AZ	USA	Purification of Bisbee Mine waters, TP, LT	H/2	2007
Outotec Oyj	Espoo	FI	Purification of Mine waters, TP, LT	D/2	2009
Dragon Mining Sweden AB	Svartliden	SE	Purification of Gold Mine waters, TP	D/2	2011
Talvivaara Oyj	Sotkamo	FI	Purification of Nickel Mine waters, TP, LT	D/1	2012
Eesti Energia AS	Tallinna	EE	Purification of Shale Oil Mine waters, TP, LT	D/2	2012
Agnico Eagle Finland Oy	Kittilä	FI	Purification of Gold Mine waters, TP, LT	D/3	2013
Agnico Eagle Finland Oy	Kittilä	FI	Purification of Gold Mine sulfate waters, TP, LT	D/3	2014
LKAB	Kiruna	SE	RFP for removal of uranium, TP	K/3	2019
LKAB/Vattenfall	Kiruna	SE	Separation of uranium from mine water, TP, LT	K/3	2020
LKAB	Kiruna	SE	Proposal for removal of uranium, TP, LT	K/3	2021
Fortum Water Solutions	Hitura Mine	FI	Purification of jarosite water from cobalt mine, TP, LT	K/3	2022

GAS-, OIL- AND COAL PRODUCTION:

Norsk Hydro ASA	Oslo	NO	Purification of oil production water, TP	D/3	1999
Statoil ASA	Bergen	NO	Purification of oil production water, TP, LT	D/3	1999
Aramco	Riad	KSA	Purification of oil production water, TP	D/3	2004
British Petroleum America Inc.	Warrenville, IL	USA	Purification of oil production water, TP	D/3	2006
Vest Tank AS	Slovåg	NO	Purification of oil production water, TP	D/3	2006
USDOE/Wall Creek	Casper,WY	USA	Purification of oil field production water, TP	H/2	2006
RMOTC	MO	USA	Purification of oil field production water, TP	H/2	2006
Anadarko Petroleum Corporation	Houston, TX	USA	Purification of oil field production water, TP	H/2	2006
Encana Oil & Gas, Inc.	Mesa Verde, AZ	USA	Purification of gas production water, TP	H/2	2007
Encana Oil & Gas, Inc.	Edmonton	CA	Purification of oil-sand production water, TP	H/2	2007
Occidental Petroleum Corporation	NM	USA	Purification of gas and oil production water, TP, LT	H/3	2008
BCDE Group LLC	Minneapolis, MN	USA	Sale of US patent for water purification, TP, LT	D/2	2008
Eesti Energia AS	Tallinn	EE	Purification of phenol water from shale oil, TP, LT	D/2	2013
Aquatera	Grande Prairie	CA	Purification of oil-sand production water, TP, LT	D/2	2013
Jiangsu Yiyang Water Ind. Co.	Xixing	CN	Purification of coal gasification wastewater, LT	D/3	2014
Peace Field Limited	Hong Kong	CN	Purification of oil production water, LT	D/3	2014
Enpro Oil	Midvale, UT	USA	Purification of oil production water, TP	D/3	2015
Baotou City	Inner Mongolia	CN	Purification of coal mine production water, TP	C/3	2015
Alma Plus S LLP	Almaty	KZ	Purification of oil production water, TP	C/3	2016

POWER PLANTS:

Arizona Public Service Co.	Wintersburg, AZ	USA	Purification of water from Nuclear Power Plant, TP	H/2	2005
E.ON Finland Oyj	Espoo	FI	Purification of water from Coal Power Plant, TP	D/2	2006
Vantaan Energia Oy	Vantaa	FI	Purific. flugas condens. of waste power plant, TP, LT	D/2	2014

CHEMICAL and PHARMACEUTICAL INDUSTRY:

Fermion Oy	Hanko	FI	Penicillin- and glucose analyzers, TP, LT	J/3	1977
Bactomatic Inc.	Princeton, NJ	USA	Manufacturing of Microbe analyzer, TP	J/3	1980
Orion Diagnostica Oy	Espoo	FI	Electrochemical changes in culture media, TP	J/3	1981

Mother Load Plastics Inc.	Sonora, CA	USA	Manufacturing of Microbe Analyzer, TP	J/3	1982
Finnish Sugar Oyj	Hanko	FI	Optimization of production of starch enzymes, TP	J/3	1983
Nabisco Brands Inc.	CT	USA	Transfer of enzyme production to Finland, TP, LT	J/3	1984
Viiskulman Hammashoitola Oy	Kuopio	FI	Portable Microbe Enrichment Unit of Finnoflag, LT	D/3	2005
Jiangsu Yiyang Water Ind. Co.	Xixing	CN	Purification of water of Chemical Factory, TP, LT	D/3	2014
DuPont	Pass Christian	USA	Purification of wastewater from Delisle Plant, TP	D/3	2015

COMPANIES:
The Companies established by Dr. Hannu L. Suominen by which the above mentioned projects were delivered:

A:	BCDE Invest Oy,	FI, 1971 - 2008,	Majority owner,	CEO 1985 - 2008
B:	Biodata Oy,	FI, 1979 -1994,	Majority owner,	CEO 1979 - 1993
BB:	Bioteräs Oy,	FI, 1985 – 1992,	Partner owner,	CEO 1991 - 1992
C:	HLS-Elektroautomatiikka Oy,	FI, 1993 - present,	Majority owner,	CEO present
D:	BCDE Group Waste Management Ltd Oy,	FI, 1994 - 2015,	Majority owner,	CEO 1994 - 2015
E:	Micropulva Oy,	FI, 1996 - present,	Majority owner,	CEO 1996 - 1997
F:	BCDE GROUP Colorado LLC,	USA, 1999 - 2008,	Majority owner,	CEO 1999 - 2008
G:	Universal Environmental Technologies Inc.,	USA, 1999 - 2008,	Majority owner,	CEO 1999 - 2008
H:	BCDE GROUP LLC,	USA, 2003 - present,	Majority owner,	CEO 2003 -2008
I:	Geniva Oy,	FI, 2006 - present,	Majority owner,	CEO present
J:	Personal contribution,	Biotechnology specialist		1977- present
K:	Applied Physics Instruments API Oy	FI, 2014 - present,	Majority owner	CEO 2019 - present

NDA: The availability of the results from the above mentioned projects:
1: Public results, no NDA
2: Results available under NDA
3: Results currently client classified confidential

SUMMARY:
The most important research projects, requests for proposals and deliveries, have been involved with purification of wastewater and drinking water. In the case of wastewater purification in the agriculture and forest industries, the impurities that are separated from manure and process waters can be converted to fertilizer, returned into the products or converted to energy, respectfully.
For almost all other applications, additional treatment methods had to be developed to eliminate the harmful or even toxic impurities that were separated during the purification process, such as heavy metals, gasses, pharmaceuticals, hormones, PFAS etc. to avoid air, water, and soil or food pollution.

This resulted in the development of the Zero Emission Technology and its related products that over time have provided us with an extensive databank of test results from a wide range of industrial applications.

A Finnish pioneer, the late Mr. Ville Kangas, established the company Bioteräs Oy in 1985 and started the production of bio-oxidizers for animal husbandry farms. He had experience in bio-gas production, and when it failed, he changed to bio-oxidation. When I joined his company as partner and CEO in 1991, I named the bio-oxidizer as Quantor Compostor. The Quantors had oxidized dry manure to bio-fertilizer from 1985 to 1990. Bio-oxidizers were further developed by our companies and 68 installations totally were delivered up to 1998. From 1990 onwards larger farms and wet manure based practices forced us to develop the MUST Water Purifier for separation and purification of liquid fraction from wet manure as pure water. This led to the development of Azofertti, the farm based fertilizer factory. Bad odour, typically related to animal husbandry, is eliminated by the MUST Pure Water Technology and the Chemostor Bio-Oxidizer for production of high quality Pure Water, Natural Fertilizers, Heat- and Electric Energy. The Azofertti installation improve the profitability of animal husbandry and eliminates all environmental issues.

The results confirm that the current deteriorating environmental and living conditions can be reversed back to a healthy environment with clean air, water, soil and food, by using our suite of Zero Emission Technologies. From my 50 original inventions, there are 153 internationally issued Letter of Patents in my name, in 2025.

Many thanks to all our customers, representatives and distributors, with whom we have delivered over 300 projects to 45 countries. We will further develop and offer our profitable methods and products for the benefit of all.

Espoo, January, 2026
Dr. Hannu L. Suominen, PhD in Marine Microbiology, interested in High Energy Physics and Electronics
Chairman of the HLS-Electro Group of New Companies, dedicated to produce Fresh Air, Water, Healthy Food and Zero Emission Energy.

International patents