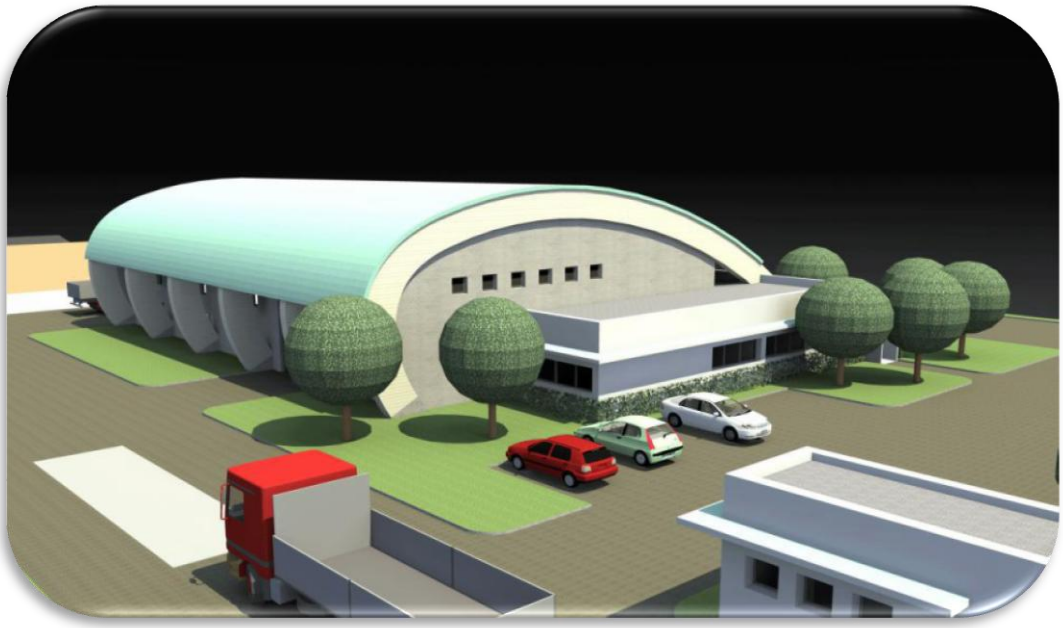


Energy From Waste
Pyrolysis System

3.6 MW

Disposal, valorization and recycling of waste
Total Energy Recovery

Zero Emission

Area 110.000 People

waste disposal with high energy recovery, zero pollution sources solid and gaseous
(zero emission and zero toxic waste)

Pyrolysis is a thermochemical decomposition of organic material at elevated temperatures without the participation of oxygen. It involves the simultaneous change of chemical composition and physical phase, and is irreversible. The word is coined from the Greek-derived elements *pyro* "fire" and *lysis* "separating".

Pyrolysis is a case of thermolysis, and is most commonly used for organic materials, being, therefore, one of the processes involved in charring. The pyrolysis of wood, which starts at 200–300 °C (390–570 °F),[1] occurs for example in fires where solid fuels are burning or when vegetation comes into contact with lava in volcanic eruptions. In general, pyrolysis of organic substances produces gas and liquid products and leaves a solid residue richer in carbon content, char. Extreme pyrolysis, which leaves mostly carbon as the residue, is called carbonization.

The process is used heavily in the chemical industry, for example, to produce charcoal, activated carbon, methanol, and other chemicals from wood, to convert ethylene dichloride into vinyl chloride to make PVC, to produce coke from coal, to convert biomass into syngas and biochar, to turn waste into safely disposable substances, and for transforming medium-weight hydrocarbons from oil into lighter ones like gasoline. These specialized uses of pyrolysis may be called various names, such as dry distillation, destructive distillation, or cracking.

Pyrolysis differs from other high-temperature processes like combustion and hydrolysis in that it usually does not involve reactions with oxygen, water, or any other reagents. In practice, it is not possible to achieve a completely oxygen-free atmosphere. Because some oxygen is present in any pyrolysis system, a small amount of oxidation occurs.

The term has also been applied to the decomposition of organic material in the presence of superheated water or steam (hydrous pyrolysis), for example, in the steam cracking of oil.

GREEN ENERGY AND ENVIRONMENT

Waste is one of the major challenges which modern world is facing today. Every year billions tones of waste are generated and these amounts are rising steadily.
Some major wastes which affect our environment are:

- Municipal Solid Waste (MSW)
- Different types of plastics
- Old tyres and rubber
- Auto Shredder Residue (ASR): plastics, rubber, fabrics, wires, etc.
- Organic waste: wood chips, saw waste, oil sludge, paper pulp sludge, poultry litter
- Medical waste from hospitals
- Electronic waste: computer boards, cables and wires

Wastes such as MSW, electronic waste, scrap tyres are currently either difficult to recycle or not 100% recyclable, while other waste such as medical waste is not recyclable and shall be disposed. Another typical example is goods packaging (e.g. food) when plastic attached to other materials (aluminum / polymer laminate). This laminate is inseparable from paper at the recycling facility. All these cases result in either incineration or landfilling.

On this website you will find the economically and ecologically viable industrial solutions of the different waste problems.
Brief summary of our core business:

- Waste-to-energy: pyrolysis as a source of bio fuel /green electricity
- Pyrolysis of toxic/medicine waste
- Pyrolysis of biomass and electricity production
- Pyrolysis of sewage/animal/paper sludge
- Pyrolysis: treatment of the decontaminated soil (oil, PCB, dioxin, mercury)

We perform turn-key projects (from a design phase to commissioning of the units) of the advanced proprietary waste-to-energy systems.

SUSTAINABLE ENERGY AND ENVIRONMENT

OUR GOALS: Practical implementation of the commercially proven environmental friendly and economically viable technologies:

- Stop polluting the environment
- Recover value from waste
- Decrease gas emissions
- Do not use food resources for energy production

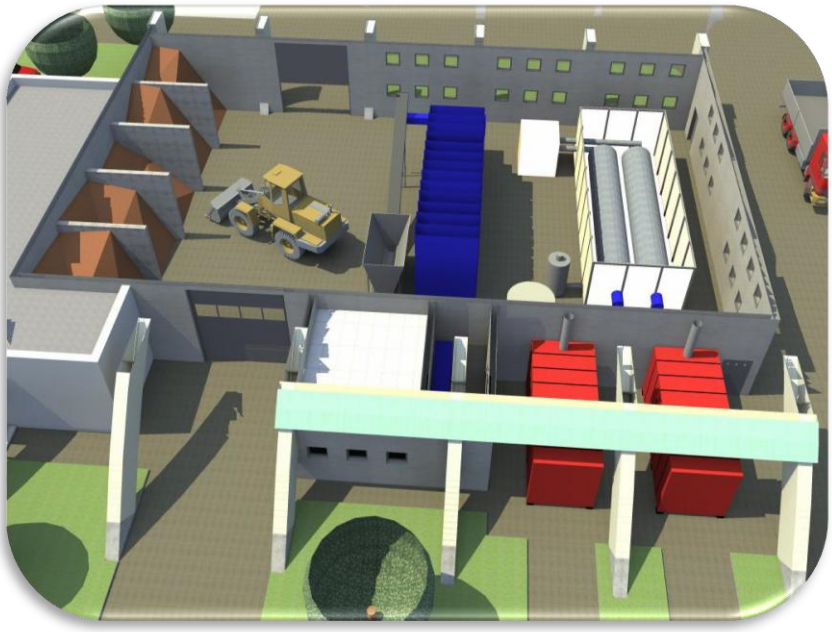
PYROLYSIS AS RECOVERING VALUE FROM WASTE

With an increase in population, urbanization and technology advancement, the amount and type of waste generated by various sectors is rapidly increased, causing negative impacts on health and the environment.
Pyrolysis is the thermal decomposition of waste into gas and solid phases in the absence of the external oxygen supply. The process takes place under the temperatures typically around 500 C. The gaseous product of pyrolysis can undergo the following transformations in downstream processes:

- cooling down followed by oil condensing; liquefaction is applicable for a limited number of feedstock, such as plastics or rubber
- cracking and cleaning in order to be used as fuel in a gas engine; pyrolysis gas conditioning is a complicated problem and additional drawback is that further treatment of the pyrolysis char will be performed at the high temperatures around 1500 C
- secondary combustion and generation steam in boiler, which consequently will be sent to steam turbine to generate electricity

Some of the advantages of pyrolysis are that the pyrolysis process is relatively insensitive to its input waste, combustion products associated with the burned solid waste are not generated, and dioxins formation can be efficiently prevented.

Application	Feedstock to pyrolysis system	Products of pyrolysis
Waste-to-Energy	• Municipal Solid Waste (MSW) • Waste plastics • Medical waste • Rubber and tyres • E-waste • Biomass /wood • Organic sludge (sewage /oil / paper sludge)	• Electrical energy • Steam • Black carbon • Oil • Non-oxidized metals
Carbonization	• Wooden chips • Organic sludge	• Solid fuel • Fertilizer
Soil remediation	Contaminated soil (dioxins, oil, mercury, organics)	Cleaned soil



CONTINUOUS PYROLYSIS

In Modular Pyrolysis Steam Cycle (MPSC) system waste is thermally degraded in a rotary kiln using an indirect, external source of heat, at temperatures of 400°–600°C in the absence of free oxygen supply.

The volatile portion of the feedstock is thermally decomposed, producing syngas which is sent into a boiler, producing steam for power generation, with the flue gas treated in an emission control sub-system. Char from pyrolysis kiln is further treated to generate extra syngas to be used in the process.

The pyrolysis plant consists of several functional modules such as pyrolysis, energy recovery, electrical energy generation, gas cleaning, etc. implementing pyrolysis process with coupled conventional steam-cycle.

The plant performance is related to the composition of feedstock input (calorific value and moisture content). Average mixed waste content in the input varies. Due to the built-in design features, the MPSC system successfully accommodates sudden fluctuations in the waste quality from its average value, which occur within the facility. Pyrolysis plants implementing oil recovery can also operate in continious mode

PYROLYSIS VS INCINERATION

Pyrolysis has a number of important advantages over incineration.

- The pyrolysis system for treatment of MSW and other wastes demonstrates excellent practical performance in controlling the emission of harmful substances such as dioxins with levels dramatically lower than regulation values.
- The pyrolysis facility is self-sustainable, i.e. fuel is required only for start-up operations. Steam and/or electricity generated during operation is further supplied outside of the facility to the customers.
- The pyrolysis plant does not produce waste water effluent from the gas cleaning system. Along with this obvious environmental advantage it also makes the system less expensive.
- Another environmental aspect is the reduction of the residuals to be sent for landfill disposal. Some remaining non-toxic ashes can also be used in the building industry.
- Recovered Metals are non-oxidized and can be further used.
- Can treat both low calorific and high calorofic waste.

PYROLYSIS OF MSW AND SEWAGE SLUDGE

Municipal solid and industrial waste, as well as sewage sludge are generated in large amounts.
MSW pyrolysis plant can treat

- fresh (unsorted) MSW
- sorted (high calorific) MSW
- MSW from landfill dumps (with soil)
- mixture of MSW with other waste, e.g. an industrial waste.

System performance depends on waste parameters: typical pyrolysis plant with the capacity 3.6 MWh (daily treatment of 120 tons) of unsorted MSW generates 75 MW of electricity for day (gross). The system can also be designed to generate heat for a district heating/hot water supply.
Sewage sludge generated by waste water treatment, occupies large areas when it is sent to landfilling. Usage of sludge as fertilizer is limited due to the potential contaminations with heavy metals, pathogens, parasites, seeds of weeds. There are also handling problems due to odour and high water content. Sludge volume decreasing by drying or incineration besides other issues require high fuel consumption. Pyrolysis of mechanically dewatered sludge eliminates problems of contamination with bio-substances and decreases volumes of sludge. Additionally energy is generated without external fuel supply to the process.

Example of treatment of 350 tpd of sewage sludge with moisture content 65- 70% after mechanical filtration: the remaining ash constitute ~ 15% of the dewatered sludge. This self-sustained facility will generate ~ 23 GW of electricity on annual basis.

OIL SLUDGE TREATMENT

Treatment of oil sludge represents a significant expense. Tens of thousands of tons of oil sludge are generated annually from oil production, storage, refining, and transportation. The oil sludge related problem is also caused by leakage at oil tankers and oil rigs, resulting in oil contaminated sand and water polluted with oil sludge.
Proper treatment of oil sludge is essential since these waste materials are hazardous to human and envronment.
The design specifications determine configuration of the pyrolysis system, i.e. whether to proceed with the oil sludge disposal and direct electricity generation or with oil condensing. Pyrolysis scheme with oil condensing may require further oil refinery.

Biomass

Wood waste, agricultural waste like straw, and other types of biomass represent renewable source of green energy.
Biomass is pyrolised, and then pyrolysis gas is used for direct electricity production.
Biochar recovered from non-contaminated biomass can be either further gasified in accordance with general MPSC scheme or to be used as soil improvement agent.
Amount of generated electricity depends on biomass type and its moisture:
- 1.25 t/h wooden chips (14 MJ/kg) with moisture content ~25% generate about 1,3 MWe.
- 4 t/h of poultry litter (~10 MJ/кg) generate ~2,3 MWe.
Moisture content in dried poultry liiter is in the range 10-30%, while calorofic value 10-16 MJ/kg. Ash content is 10-25% and depends on age of waste.

Plastic/ASR

Direct recycling of waste plastics not always possible, e.g. waste plastics can be contaminated; moreover, they often mixed with different sorts of materials such as paper, glass, metal, biowaste, etc. Food and beverage packaging is a typical example when plastic attached to other materials (aluminium/polymer laminate). It is impossible to separate this laminate from paper at the recycling facility.

Plastics pyrolysis can result in
a) energy generating
b) oil condensing
Pyrolysis oil can be used as heating oil or oil for diesel generators. Amount of generated electricity or codensed oil depends on composition of plastics mixture.

Automotive Shredded Residue (ASR) results from the reclamation process of recyclable ferrous and non-ferrous metals. The primary source of recyclable materials comes from automobiles, trucks, buses and common household appliances such as washers, dryers and refrigerators. According to estimates from the automotive industry only in the United States about 2 billion pounds of ASR are generated annually. ASR generally consists of a mixture of plastics, rubber, glass, wood products, cloth, paper, foam, dirt, and electrical wiring. The industrial ASR pyrolysis systems implement general MPSC scheme, producing pyrolysis followed by generation of electricity. Comparing with general case of MSW pyrolysis the ASR pyrolysis system is characterised by higher efficiency power generation, e.g. 9 t/h ASR with LHV = 21 MJ/kg and 20% moisture generates moer than 10 MWe

Medical Waste

Medical waste is a multi component hazardous waste. Main constituents of medical waste are plastics, textile and polyvinylchloride (PVC).Medical waste also includes needles, pathological wastes from surgery and autopsy, and pharmaceutical waste. Traditionally, hospitals burn medical waste in incinerators and then deposit it into waste landfill sites. When burned, PVC produces inter alia carbon monoxide, dioxins, and chlorinated furans. The California Environmental Protection Agency has banned the permitting of any new medical waste incinerators since 2001.

Pyrolysis is the efficient method of hazardous waste disposal and recovery of valuable materials. Output from medical waste pyrolysis depends on initial waste content: amount of waste and its composition determines whether to proceed with oil recovery scheme design or with a steam turbine configuration.

Tyres

Burning 1 ton of waste tyres produces about 450 kg toxic gases. The damage to the environment is obvious. Performing pyrolysis of scrap tyres saves the environment and gives yield to valuable materials.

Pyrolysis gas can be condensed recovering pyrolysis oil. The recovered oil usually has specific gravity about 0.91-0,94 kg/cm3, quite high sulphur content (0.6-1%) as well as the residual carbon content. This oil should be further refined prior to be used mainly as heating oil.

Another issue related to the scrap tyres pyrolysis is a pyrolysis carbon black (CBp). According to International Carbon Black Association this product should be rather called a black carbon. Carbon black is chemically and physically distinct black carbon. As expected CBp after further treatment could be used as filler e.g for asphalt or in low/medium grade technical rubber products.

In order to avoid additional investments to the pyrolysis oil refining and issues with further CBp treatment, its marketing and sales we recommend the pyrolysis of scrap tyres according to the waste-to-energy pyrolysis technology (MPSC) with generatin electricity. In this case certification of oil and CBp products will also not be required. At our waste-to-energy pyrolysis facility solid residuals can be further processed generating additional electricity.

Recommended minimum capacity of the pyrolysis facility is about 20 tpd, e.g. 800 kg/h will produce about 310-320 kg/h of oil, while 3 t/h will generate about 6,5 MW electricity.

ABOUT US

The Isotech srl Since 2004 is certified UNI EN ISO 9000, UNI EN ISO 14001, EMAS, SA 8000, is a company that operates primarily in the industrial sector, in particular in the field of design, construction, installation and commissioning of electrochemical plants machinery and advanced technology, which can be used in the recycling of process water and wastewater treatment with subsequent reuse in the production process operating in compliance with the environmental laws.
Isotech's professionals have worked in business, government and public international agencies, in different countries, and in diverse cultures. They possess a combination of diverse skills, knowledge, and experiences.
Main areas of expertise of ISOTECH are process technology and optimization of industrial processes, business development, project management. Our core business - implementation of environmental friendly treatment of waste (pyrolysis and gasification) as source of green energy.

PYROLYSIS PLANT

Municipal, industrial and bulky waste is delivered by waste collecting vehicles and discharged into the coarse waste storage bin. The waste is then picked up by a crane, discharged onto two alternative operated rotor cutters and then delivered into the fine storage bin. Some sewage sludge is also delivered there.

Crane mixes waste and sewagesludge in order to obtain a homogeneous mixture.The crane transfers the mixed waste into the feeding hoppers of the charging devices of the two rotary kilns.The conveyors transport the waste from the hoppers to the feeding chute, consisting of a gas-tight slide gate valve (prevents air access to the kilns) and a chute. A feeding screw arranged downstream the feeding chute conveys the waste into the pyrolysis kiln.

The pyrolysis of the waste materials takes place into two indirect heated rotary kilns. The kilns have heated lengths of about 20 meters and an inner diameter of about 2.2 meters. Each kiln has a capacity of 3 tons per hour. Waste is thermally degraded using an indirect external source of heat at ~500 C in the absence of free oxygen supply. Solid residuals of the pyrolysis process are removed via a wet discharger. The pyrolysis gas is sealed from the atmosphere by the water level in the discharger. Metals are extracted by an overhead magnetic separator discharged into a container for recycling.

The exhaust gas from the boiler is thoroughly cleaned in the emission control subsystem in order to achieve the full compliance with the emissions limits. The volatile portion of the feedstock produces syngas.