

## **SophSys BV - Dutch pyrolysis specialists**

Pyrolysis is the general name for a technology that enables the recycling of various waste products into energy and/or re-usable materials with minimum emissions.

Pyrolysis is a Level-C chemical Recycling technology and is considered to be the Best Available Technology (BAT) in the industry for processing waste materials that can not be recovered or re-used.

Short explanation Pyrolysis:

Pyrolysis is the general term for a technology that processes waste into gas without the presence of oxygen. Pyrolysis can be used to process waste into gas, gas/oil and/or char.

<https://en.wikipedia.org/wiki/Pyrolysis>

Due to the fact that pyrolysis operates without the presence of oxygen, a real (or open) fire inside the processing reactor is simply not possible.

Real fire – needed in incineration - is the cause of high emissions. This is the reason that pyrolysis is a much cleaner technology for processing waste in comparison to incineration.

Within the pyrolysis technology setting, several specific types of pyrolysis systems have been developed and implemented over the past years around the world.

**SophSys has obtained representations for technologies to recycle the following waste products:**

### **Landfill waste**



Depending on the mixture and on-site situation of the landfill, SophSys can process the landfill waste as follows:

Step 1 - separating and removing of organic materials (compost materials)

Step 2 - drying of remaining waste composition

Step 3 - sorting of waste to recover valuable materials

Step 4 - pyrolyze remaining waste into gas

Step 5 - converting gas into energy (electricity)

## Household waste



Depending on the mixture of the waste, SophSys can process the household waste as follows:

Step 1 - separating and removing of organic materials (compost materials)

Step 2 - drying of remaining waste composition

Step 3 - sorting of waste to recover valuable materials

Step 4 - pyrolyze remaining waste into gas

Step 5 - converting gas into energy (electricity)

## Industrial waste



Depending on the mixture of the waste, SophSys can process the industrial waste as follows:

Step 1 - separating and removing of organic materials (compost materials)

Step 2 - drying of remaining waste composition

Step 3 - sorting of waste to recover valuable materials

Step 4 - pyrolyze remaining waste into gas

Step 5 - converting gas into energy (electricity)

## End-Of-Life Plastics



Depending on the mixture of the plastics, SophSys can process the plastic waste as follows:

Step 1 - pyrolyze plastic waste into gas

Step 2 - converting gas into energy (electricity)

Or:

Step 1 - pyrolyze waste into oil

Step 2 - purification of oil (extraction of unwanted components to enhance quality of oil)

## Medical waste



Depending on the mixture of the waste, SophSys can process the medical/chemical waste as follows:

Step 1 - controlled and isolated drying of materials

Step 2 - controlled and isolated pyrolyzing of waste into gas

Step 3 - converting gas into energy (electricity)

**Please note** that for medical and chemical waste processing, strict rules and regulations on health and safety apply.

Additional gas-cleaning technology is required to ensure a safe and controlled processing of produced gasses. For more detailed information, please contact our specialists.

## Car and Truck Tires



Depending on the type of tires, SophSys can process the tires as follows:

Step 1 - specialized shredding technology

Step 2 - extraction of valuable materials such as Kevlar and metals

Step 3 - pyrolyze remaining waste into gas

Step 4 - converting gas into energy (electricity)

Or:

Step 3 - pyrolyze remaining materials into oil and char (Carbon)

## Wind Turbine Blades



SophSys can process the wind turbine blades as follows:

Step 1 - On-site shredding technology with minimum environmental impact

Step 2 - Pyrolyze shredded blades into clean reusable fibers and gas

Step 3 - Converting gas into energy (electricity)

**Note:** Fibers obtained from pyrolysis can be used to produce new plastics and products.

## Sewage Sludge



SophSys can process the sewage sludge as follows:  
 Step 1 - drying of sludge material (using heat from pyrolysis unit)  
 Step 2 - pyrolyze dried material into powder for disposal

**Notes:**

- In certain circumstances, the dried pyrolyzed powder can be used as a filler. This depends on the composition and polluting elements within the sludge.
  - Due to the very low caloric value of sewage sludge, it is advised to combine this process with a household-waste installation to obtain gas for operating the sewage sludge installation.
- Please ask our specialists for detailed advise on this product and setting.

**More waste processing options are available including woodchips. Please ask our specialists for the best solution for your waste material.**

**Available systems and settings**

Several pyrolysis-equipment manufacturers have developed their own technology for a specific type of waste.

Depending on the waste type, the best technology is selected and deployed for best result.

The systems offered by SophSys are all 24/7 operated systems.

All offered systems are field-tested, proven technologies.

**Capacity**

Landfill waste:	model 1: 8.000 ton per year	model 2: 25.000 ton per year
Household waste:	model 1: 8.000 ton per year	model 2: 25.000 ton per year
Industrial waste:	model 1: 8.000 ton per year	model 2: 25.000 ton per year
End of life plastics:	model 1: 8.000 ton per year	model 2: 25.000 ton per year
Medical and chemical:	model 1: 8.000 ton per year	
Car and truck tires:	model 1: 8.000 ton per year	
Wind turbine blades:	model 1: 4.000 ton per year	
Sewage sludge:	model 1: 4.000 ton per year	

Above models can be interconnected to allow for larger waste volume processing.

### **Integrated solution provider**

SophSys has a team of experts and specialists to enable a fully integrated project development. SophSys is a pyrolysis specialist, but to develop a full and successful project, additional specialists are needed on gas-to-energy conversion, grid connection, design and calculations, permits and construction.

SophSys can provide all required services to its clients and in some cases even assist in obtaining EU funding for projects.

To know more about the SophSys team and the capabilities of the team, please see attached team introduction.

### **Pre-sorting and recovery**

Waste often contains valuable and recoverable materials. The EU waste system requires the implementation of recovery for valuable and reusable materials. SophSys has a long-term partnership with several waste-sorting technology providers. Retrieving valuable materials from your waste could enhance your project ROI and increase the revenues from the process. Non-recoverable material is sent to the pyrolysis unit whilst recovered valuable materials can be sold to third parties to be reused in various processes.

### **Gas to electricity**

Alongside the pyrolysis units, SophSys is able to provide high-end gas generator units for converting pyrolysis gasses (syn-gas, similar to LPG) into electricity.

The generator unit capacity is between 0.4 to 1MWh per unit and are all containerized and sound-proof installed.

### **Waste analysis**

Knowing the real composition of your household and industrial waste is essential for understanding the required process and potential outcome models on product and finance.

SophSys offers waste analysis to businesses and governments, both on and off-site using the latest in available technology and research and works with European laboratories for validation and quality control.

### **Future developments**

#### **Hydrogen (H<sub>2</sub>)**

The pyrolysis industry is on a continuous journey to improve the systems and results.

As part of our strategy, SophSys is involved in a new development for extracting Hydrogen (H<sub>2</sub>) from the syngas. This new development is expected to be ready late 2023.

#### **Bio-fuel**

Some waste materials can be converted into oil. To allow this oil to be used as a Bio Fuel, this oil requires upgrading and extraction of Chlorides and Sulphur. SophSys is leading and funding a new development for extracting Chlorine and Sulphur from the pyrolysis oil to allow a 50/50 mixing rate with raw oils used for producing fuel. With this new development, fuel companies are able to add oils from waste to their intake materials into the steam cracker and produce high quality fuels for cars, trucks and ships with the required % of bio fuel composition, as demanded by the EU.

The Bio Fuel development is expected to be finished mid-2023.

**Pyrolysis explained (general process).**

Pyrolysis is a process of chemically decomposing materials at elevated temperatures in the absence of oxygen. The process occurs at temperatures above 200°C and up to about 1.000°C in slight under-pressure condition. It simultaneously involves the change of physical phase and chemical composition and is an irreversible process. It makes it possible to obtain a carbonaceous solid, oil and a gas, and depending on the temperature, the proportion of the three resulting compounds is different.

The processes shown below represent one operational unit.

Before processing waste materials, certain types of waste require a drying process to reduce the moisture content of the waste (affects the yield of the system if too wet). The heat required for drying waste can be obtained from the pyrolysis process.

Waste is shredded into a specific size and stored into a special design holding container (fireproof system). From this holding container, the waste is sent into the reactor unit (pyrolysis unit).

Inside the reactor, the waste materials are converted into ashes and gas.

If the pyrolysis process is cut short, it is possible to retrieve oils and gas from this process.

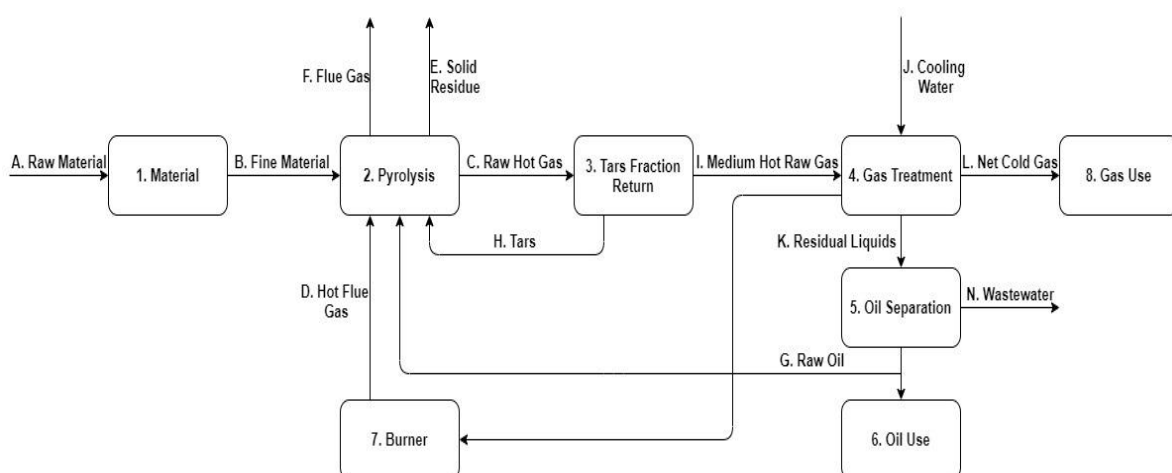
(Please note that producing oil requires extensive knowledge to avoid production of chemical waste.)

An internal loop is used to process tar fractions into 100% gas.

20% of produced gasses is used for external heating of the reactor unit (parasitic load). Remaining 80% gas is available for converting into energy (electricity)

Alongside the gasses, ashes are produced. These ashes can contain valuable materials such as metals and minerals.

The basic process flow diagram shown below describes the technology as performed by PGE, Waste4ME and various other system developers.



Pyrolysis is a Type-C chemical waste recycling process under EU law. The technology is identified under EU law and within the ‘Ladder van Lansink’ as part of the stricter Dutch/EU legislation on

waste disposal and emission reduction. As such, pyrolysis is a better and more sustainable solution in comparison to gasification, incineration and landfill.



Pyrolysis (Type-C) is seen as ‘best available technique’ (B.A.T.) for disposal of remaining (reject or end-of-life) waste streams after separation and re-use of waste (class A to B). The pyrolysis installations presented in this brochure are recognized, approved and supported by Dutch and British government as green technology and in-line with EU waste legislation and EU directive.

Emissions

Pyrolysis is a technology that operates *without* the presence of *oxygen* in the system, the basic principle of pyrolysis. As such, the formation of toxic gasses - such as dioxins and furans - is avoided. The pyrolysis installation operates at temperatures between 200 and 1.000 degrees Centigrade and can therefore accept all components inside the waste that can occur in household, SRF, RDF and landfill waste. The indicated types of waste and their composition, versus the used technology and absence of oxygen make it impossible to produce toxic gasses. The closed system includes a high-end tested and proven gas-washing installation to purify the produced gas for conversion through the LPG-operated generator set.

The installation encounters two positions for emission: one on the exhaust of the pyrolysis heating system, and one on the exhaust of the gas-operated generator sets for converting the LPG to electricity.

Exhaust pyrolysis heating system

The emission on the heating system of the pyrolysis installation is classed under EU law and emissions are within EU legislation for indicated technology and method of recycling. As such, the technology complies with EU emission regulations and the emission is significantly lower than other methods of final disposal of waste.

*Emission data calculated to standard 11% oxygen level*

<b>Emission</b>	<b>Pyrolysis emissions</b>	<b>Maximum allowed level</b>
NOx as NO <sub>2</sub>	68,5 mg/Nm <sup>3</sup>	180 mg/Nm <sup>3</sup>
SO <sub>2</sub>	14,7 mg/Nm <sup>3</sup>	40 mg/Nm <sup>3</sup>
C <sub>x</sub> H <sub>y</sub> and C*	< 0,2%**	10 mg/Nm <sup>3</sup>
CO	< 1,25 mg/Nm <sup>3</sup> **	30 mg/Nm <sup>3</sup>
HCl	< 1,0 mg/Nm <sup>3</sup> **	8 mg/Nm <sup>3</sup>



### Exhaust emission gas-operated generator set

The LPG-operated gas generators are certified as a Tier 5 installation under EU law for emissions on LPG-operated engines. As such, the generators are within EU legislation for emissions and comply with national and local legislation. Several KVT generator installations are already operating on this pyrolysis LPG gas worldwide, i.e. in The Netherlands, African countries and United Kingdom. The KVT generator sets are equipped with top of the range DeNox units for final cleaning of exhaust gases as required by Dutch/EU law.

Want to know more about the pyrolysis technology and what that could do for your situation, please contact our us via [Martijn@sophsys.nl](mailto:Martijn@sophsys.nl) or call 0031-6-288-47-131.



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