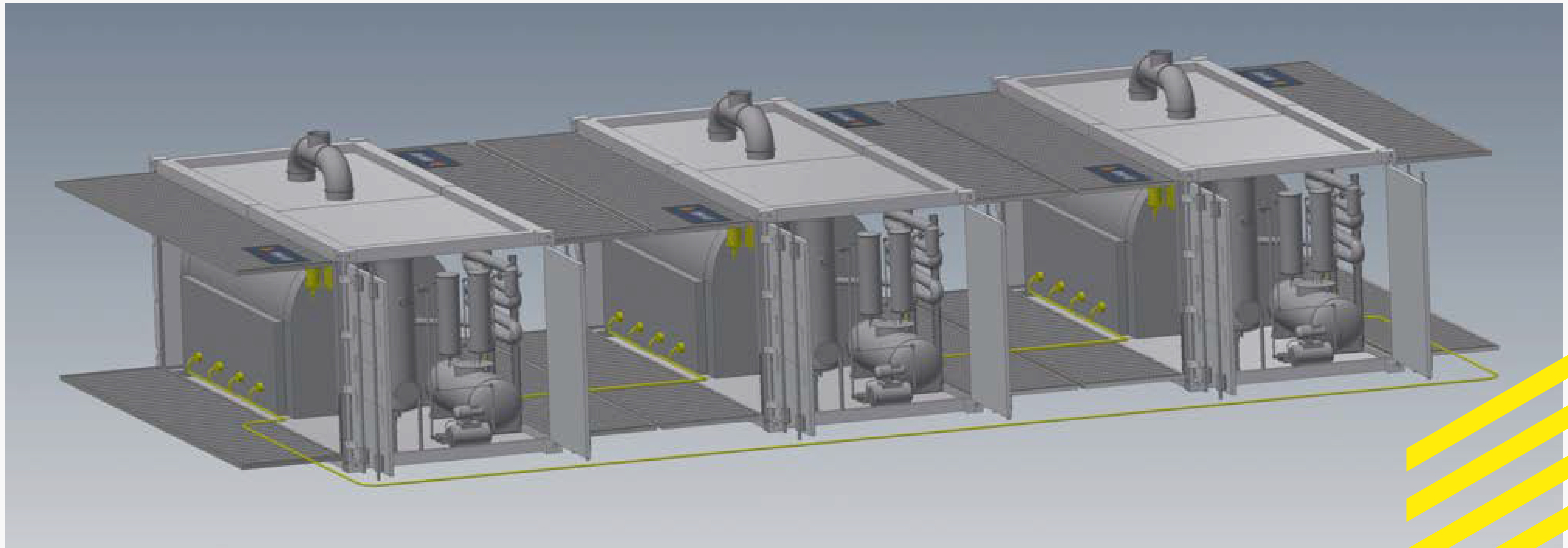
IDRO-05©

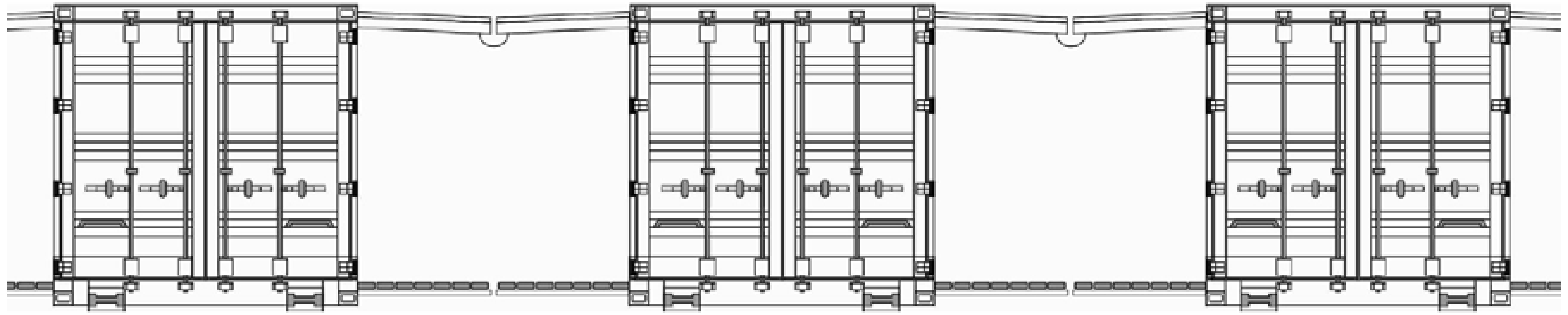
INSTALACJA DO RECYKLINGU OPON I ODPADÓW GUMOWYCH



Technical description

IDRO-05© Construction layout

The installation consists of at least six transport containers, type 20 and type 40. According to the project, the default version of the device includes seven containers with various functions. The core is three containers shown in picture 1. They accommodate reactors and other crucial components. Doors and sidewalls are openable - forming roofs, floors and connecting different installation elements. Containers four to seven, presented in picture 2. forming part of the complete mobile installation. The number of containers can vary. Customers can order personalized composition of modules of the IDRO-05© according to the specified needs. Possible functions of supplementing containers: separating carbonate from steel, carbonate storage, social, reactor cooling, liquid fraction storage and gas fraction storage.



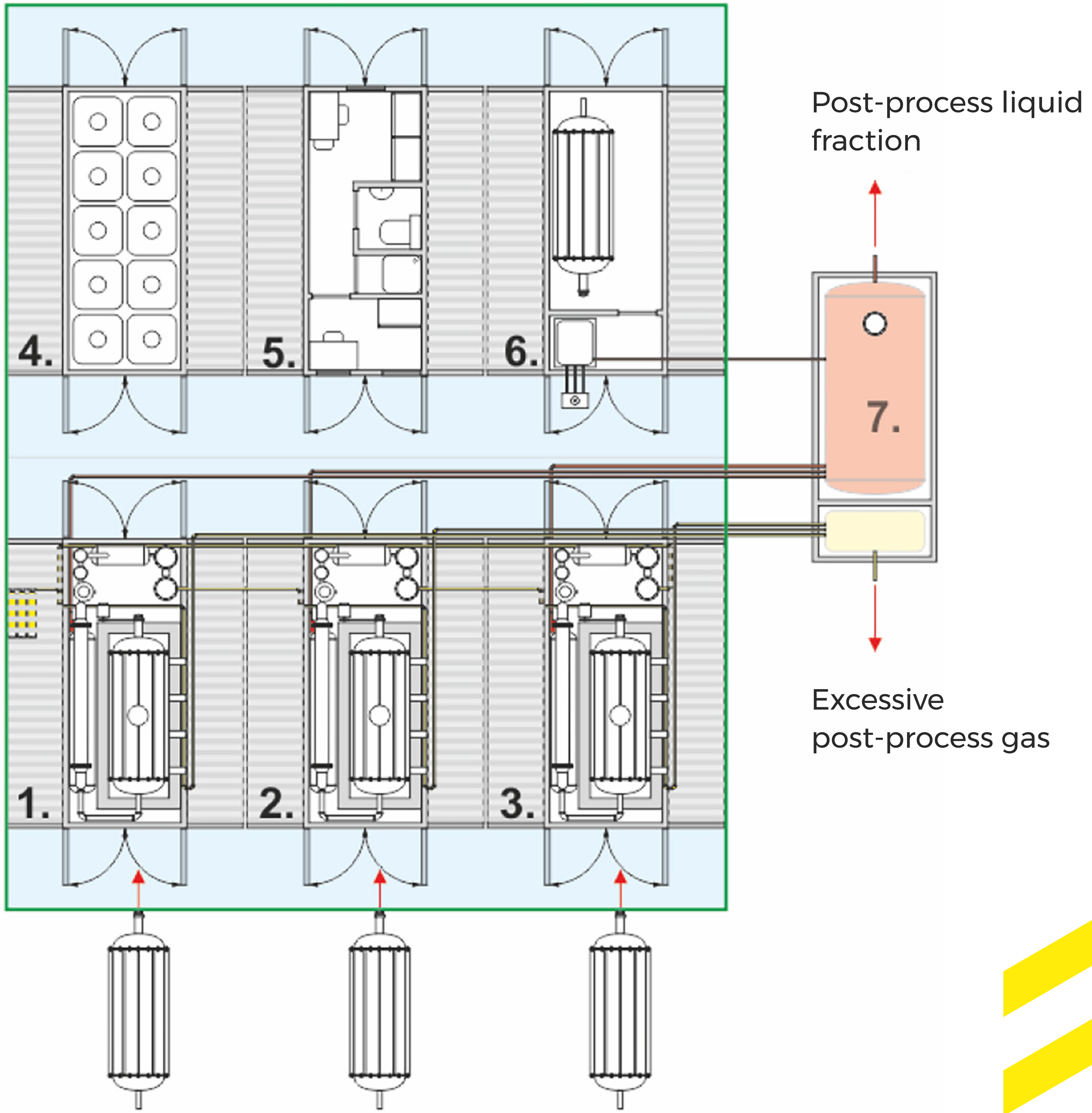
Pic 1. Containers with the side walls set up

Stationary tyre and rubber waste installation consists of three containers marked with numbers 1-3 on the illustration. Each of them equipped with:

a. Furnace with thermal isolation and a chimney;
b. Steam and gas mainline unit;
c. Horizontal rectification column with steam and gas cylinders;
d. Gas separator;
e. Initial and final gas cleaning filter;
f. Small gas compressor;
g. Gas tanks;
h. Power generator;
i. Gas burner;
j. Replaceable rotary reactors;
k. Other devices for processesing safer work and control.

In the default configuration, apart from the base set, mobile IDRO-05© installation consists of:

a. Container 4 – meant for dry post-process products storage;
b. Container 5 – office and social functions;
c. Container 6 – safe storage of exchangeable rotary reactors while they cool down to 40˚C temperature;
d. Container 7 – liquid and gas fractions storage. An excessive gas fraction fuels an electric power generator. Electricity powers up the container complex. The liquid fraction pump delivers it to a tank to pick up by the client.



Pic. 2. – Container layout

Installations important characteristics

IDRO-05© is a medium-size installation.

The patent office issued a notice number P.218771 for Prototype installation and work formula. Each installation station is built-in inside a mobile cargo container, adapted for delivery truck transport. It takes 10 hours to set it up again.

Low emissions, high efficiency and safety are due to replaceable hermetic reactors. There is no need for opening them until they fully cool down from thermolyzed content.

After setup, complete installation is a compact, module building and is perfect for the needs of a low-tonnage rubber waste recycling facility.

The design makes warranty checkups, repairs, modernization and development works easy, with no need for stopping any processes taking part in furnaces.

Only the initiation of the process requires an external gas source. The device uses products of the process to fuel the machinery in the next reactor. It can repeat continuously.

The amount of energy produced by the device allows for a sustainable source of power for furnaces and the electrical power generator used to control the process.

The cooling unit can reuse the energy from the reactor cooling process.

Installations important characteristics

Thermolysis is a thermal transformation of polymers to a liquid, gas and solid state that runs in a non-oxygen atmosphere. Processes purpose is not to recover energy from waste. Instead, the process recovers the substances of the batch.

The process requires an external source of gas for initiation, crucial for gaining the correct temperature from the reaction chamber. In further stages for the same purpose, the process uses post-process gas received in a furnace. The temperature of the process amounts from 350 up t o 380C.

Plastic and rubber production begins from oil distillation in a refinery. During the process, different boiling point ingredients exude. These are called fractions. Each fraction is a mixture of hydrocarbons in different chain-length or various particle structures. Plastic and rubber are composed of selected fractions in polymerization from smaller particles like ethylene or propylene. Various catalytic environments can cause differences between the created polymers. Polymers have different properties, structures and monomer particles.

The purpose of the thermolysis technological process is to depolymerize waste polyolefins from rubber and receive high-quality post-process products, demanded in a number of technical applications in the market. During the reversed process, depolymerization, long polymer chains snap in a statistically random way. Consequently, 1 ton of solid waste can produce the following fractions in variable proportions.

1. 1Up to 50% (350l) solid carbon residue. Calorific value ~29500 kJ/kg. Used as an add-on to low calorific value components with a possible way of manufacturing alternative fuel, for example, briquette or after processing a carbon black substitute used for secondary tyre, paint and lacquer dye production. After cleaning and granulation it could be a filter substitute.

2. Up to 35% (350l) thermolytic oil. Calorific value ~42000 kJ/kg. Derivative of heating oil, perfect for combustion in adequate furnaces or as a power generator fuel, intermediate for technical oil and lubricant, fuel production.

3. Up to 15% steel scrap from tyre, hose and gasket reinforcements.

4. Up to 150m3 of post-process gas. Calorific value ~ 48100 kJ/kg. Technologically used for sustaining the process, possibly some amount of that gas can be excessive.

The process emits no toxic polychlorinated dibenzodioxins, PCDD, PbrDD and polychlorinated dibenzofurans, PCDF, PbrDF. These dangerous chemicals cannot emerge because the whole process takes place in a non-oxygen atmosphere. Hermetically sealed reactors prevent oxygen-related reactions. Post-process gas emission assumptions base on self-conducted research with pilot installations and literature indicators. According to research, post-process gas composition is approximate to natural gas with differences in proportions. According to data coming from EPA (The Environmental Protection Agency), natural gas pollution emission indicators are:

1. Sulphur dioxide – 0,00215 [kg/m3]
2. Nitrogen oxides – 1,68 [kg/m3] (assumed Nox = NO2)
3. Carbon monoxide – 0,954 [kg/m3]
4. Dust – 0,09 [kg/m3] (assumed PM10=PM2,5=0,09 kg/m3)

Expected IDRO-05©'s post-process gas chemical composition

NAME

Gas fraction (post-process gas)

COMPOSITION	VALUE
Methane	2,5% - 35%
Ethane	1,5% - 20%
Propane	1,0% - 25%
Isobutane	1,0% - 5%
Butane	1,5% - 25%
Pentane	8,0% - 15%
Hydrogen	2,5%
Carbon mono/dioxide	<400 ppm

Prototype installations post-process gas chemical composition, researched by AGH Polska

NAME

Gas fraction (post-process gas)

COMPOSITION	VALUE
Methane	30%
Ethane	27%
Propane	20%
Other gases	23%

Gas fuels are considered ecological. Their combustion has a minor effect on air condition, especially regarding sulfur dioxide emission and dust pollution.

Exhaust gases from the combustion process discharge into the atmosphere with the existing infrastructure of each container, a chimney placed on the roof of each station.

Research regarding the emission of dangerous substances into the environment conducted in a prototype installation showed no negative comments from the Regional Inspectorate of Environmental Protection in Zielona Góra. The research includes benzene, toluene, ethylbenzene, m-xylene, p-xylene, o-xylene and affiliate hydrocarbons concentration in combusted post-process gas.

As a result, deduced values in exhaust gases probably match adequate emission standards for gas fuel combustion foreseen by polish law.

In-depth research concerning sulfur compounds volume in post-process gas needs to carry out. In case of over-emission of sulfur compounds, inventors plan using the relevant catalytic filters.

The installation will likely not have a negative impact on air quality even without using filters.

In case of not keeping up with emission parameters, monitoring systems will temporarily stop the installation, preventing excessive atmospheric em ission.

All of the data c ollected above refers to using tyres and non-vulcanized waste as a r esource.

IDRO-05© and mark et competitors DAGAS type installations t echnical parameters comparison

PARAMETER	DAGAS	IDRO-05©
External electrical energy usage	25kWh	0kWh
Installed devices power	50kW	10kW
Cooling and technolo-gical liquids utilized in installation	13m3	0m3
Liquids amount loss due to evaporation	Approx. 0,8m3/24h with need of constant refill	10kW
Necessary operators	2 per shift	3 per shift
Necessary thickness of con-crete screed under pyrolis / thermolysis reactor and distillation column	60cm	0cm
Installation work monitoring	constant	constant

PARAMETER	DAGAS	IDRO-05©
Frequency of external power usage	n/a	singular – only process initiation
CO2,CO, NOX, SOX ha-zardous gas emmision reduction	80%	95%
Capacity	5 ton/24h	9 ton/24h
Mobility	no	yes (10h montage time)
Energetic efficiency 20-25 Mg waste	Approx. 1 MW of electrical energy and 2-4 MW of heat	n/a
Process efficiency	An income stream from energy sale, the rubber-waste collection for utiliza-tion acquiring pro-duct fee and sell of post-process products	An income stream from the rubberwa-ste collection for uti-lization product fee and sale of high-qu-ality post-process products