WASTE REFINERY FOR URBAN MINING

by IPAS nv • 2019

IPAS
urban mining - waste refining

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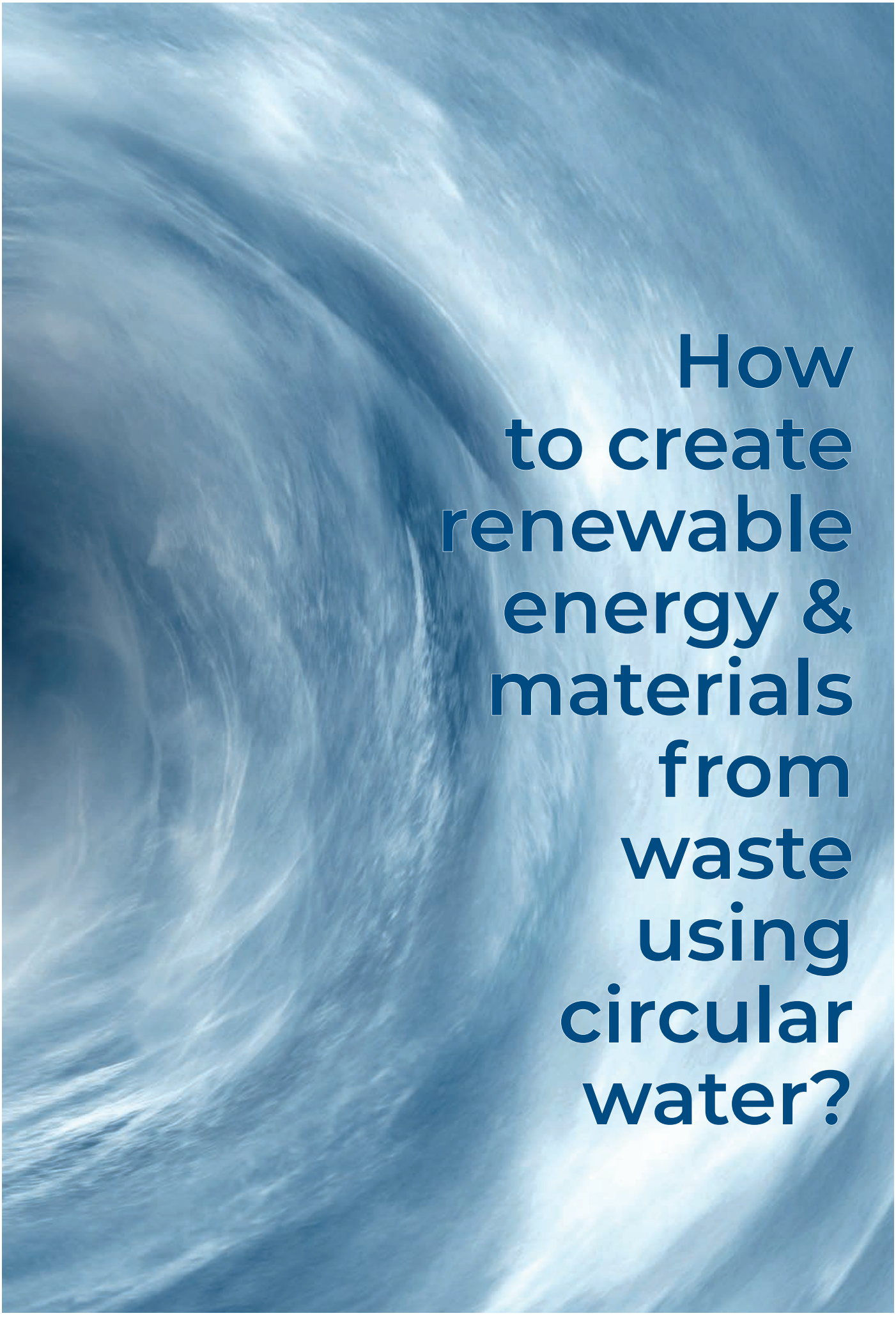


How to create renewable energy & materials from waste using circular water?

about

INTRO

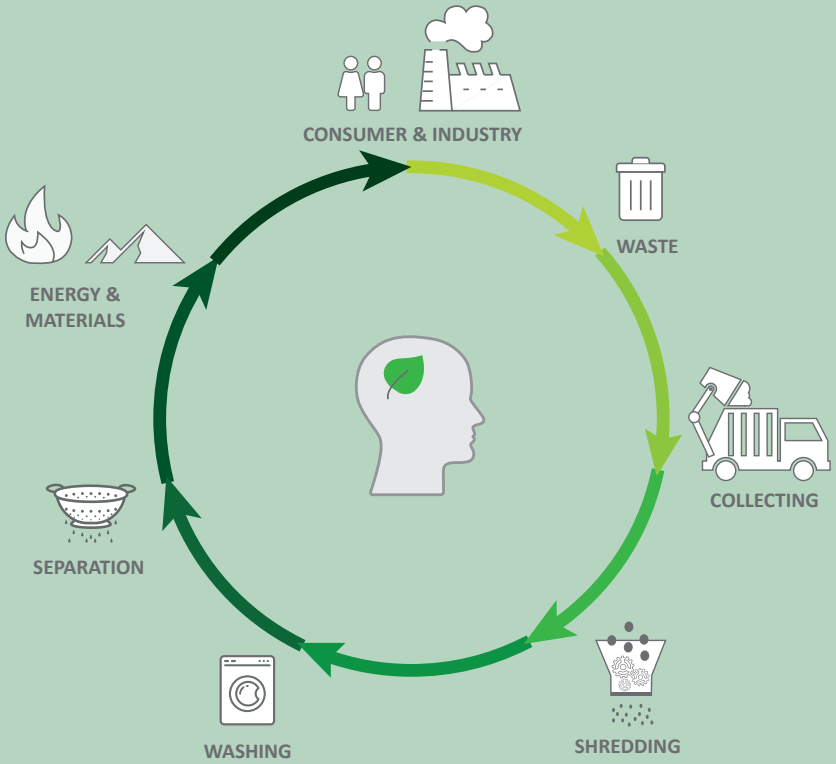
Scope of work:
to create a greener world!

- IPAS is creating a completely new installation for the **total valorisation of the rest-materials**: WASTE REFINERY©.
- The solution to the waste problem is: to **recycle every piece** of trash we produce !
- The WASTE REFINERY© is a patented **wet separation process** that is built from worldwide **proven technology** from the raw materials sector. IPAS, the (re-)start-up company and promotor of this innovation, has over 40 years hands-on experience in design, building and start-up of separation systems.
- WASTE REFINERY© separates the mixed waste into different fractions for raw materials and in a calorific fraction for energy generation. The moisture content in the waste (up to 1/3 of the mass) will be used as process water and cleaned before re-use in a closed loop.
- WASTE REFINERY© is developed since 2013 and is now **ready for industrial implementation**.
- The business-plan foresees a **very interesting return on investment** (over 15%) while it brings a future proof solution for municipalities by guaranteeing a fixed long term low cost for waste management for the people they serve.
- WASTE REFINERY© is proposed in a unique **DBFMO formula**. IPAS will DESIGN, BUILD, FINANCE, MAINTAIN and OPERATE. Installations will be developed at no investment cost for the local community. Of course local authorites are welcome to co-invest. If you are convinced about the future of URBAN MINING, then WASTE REFINERY© is the right way to go.
- IPAS, the (re-)start-up company sees a **worldwide market**, as WASTE REFINERY© is low cost and high gain, for both investors and local people.
- And of course, WASTE REFINERY©, is the real pragmatic answer and stepping stone towards the **circular economy** as waste is no longer trash, but a **re-source for society** and human kind.

This business proposal for WASTE REFINERY© offers a unique opportunity for those who want to **COMBINE INNOVATION, GREEN SOLUTIONS AND NEW BUSINESS**.

VALUE PROPOSITION

- WASTE REFINERY© offers a **patented solution** for who is willing to invest in future proof valorisation of Municipal Solid Waste.
- WASTE REFINERY© in the unique DBFMO formula meets **the need of local communities** throughout the world to find affordable and sustainable solutions and offers considerable **return of investment** to investors.
- Unlike existing systems (waste incineration and landfill) WASTE REFINERY© is completely compliant with the future needs of society: **recycle materials to 100 %** !
- **The market is worldwide**, without any limits !



about

COMPANY

IPAS, a start-up with experience

IPAS is a '**re-start business**' that takes along over **40 years of experience** and today is teaching the technology to a younger generation.
IPAS, as the driving force behind WASTE REFINERY©, is the ideal company for this world breaking novelty, because it has a big experience in the industrial treatment of raw materials and it masters all existing and proven technologies. IPAS created the concept for WASTE REFINERY© together with the development company 'transit_LAB' that specialises in 'transition-scenarios' and 'redevelopment of mining regions'.

...Vision

IPAS endorses the '**Sustainable development goals**' (SDGS), as adopted at the United Nations in 2015 .
The Sustainable Development Goals will be the starting point and criteria in each project:

- Every project is 'future proof' and contributes to the growth of the sustainable community.
- IPAS explicitly presents itself as **promoter of the 'circular economy, also the new economy'**.
- This is translated into the pursuit of equilibrium in the E^3:
  Economics / Ecology / Emotion
- Applied to the company mission and task, that translates into
  - Mining - worldwide: Yes, but residual flows get a useful application and do not end up on landfills.
  - Manufacturing - worldwide: Yes, but waste also becomes an end product. If not production shall be avoided.
  - Consumption - worldwide: Yes, but without dumping or incinerating waste.

IPAS

urban mining - waste refining

...Mission

- Designing, engineering and building of tailor-made processing plants for raw materials / waste in the broadest sense of the word and worldwide.
- To be the supporting structure for the implementation of WASTE REFINERY©, worldwide.

...Goal

URBAN MINING for future generations !
To transform waste into new raw materials.
Our urban environment and human consumption are becoming an increasingly important source of a new and more sustainable economy. All waste streams hold valuable commodities for nowadays society and even more for future generations. WASTE REFINERY© will put cities and regions on the right track : to valorise what is already there. The maximum and efficient recovery of raw materials is now realistic.

...Pioneering partners

ETIENNE SCHOUTERDEN

Etienne Schouterden (1947) has vast experience in the technical processes of treatment of raw materials, coal and waste streams. He developed a whole range of technical processes to recover coal tips, sludge basins, demolition wastes, contaminated soils,... but also the application of renewable energy techniques. Often he combines these technologies. Etienne Schouterden is specialized in industrial separation and raw materials enrichment techniques. He worked worldwide in the sector of coal, industrial chemistry and valorization of materials. Etienne is founder of IPAS.

THEO MITROVOLTSIS

Theo Mitrovoltsis (1964) has over 30 years of entrepreneurial experience in the following sectors: building sector, integration of technologies, project management, business planning. He worked not only in Belgium, but has international experience in Greece, Rumania, Cuba. Theo Mitrovoltsis is the CEO of IPAS.

PAUL BOUTSEN

Paul Boutsen (1962) is experienced in hands-on regeneration practice and strategy development. He has worked closely with municipalities, reconversion companies, private investors and other planning structures in Belgium and international networks, mainly with as task to generate creative scenario's in economic development. Paul Boutsen is founder of transit_LAB the development cooperative for transition scenario's. www.transit-lab.be. He acts as networker / prospector for WASTE REFINERY©.

...IPAS & building partners

- IPAS has an international network of experienced partners for subcontracting.
- **Moreover, IPAS wants to maximize local involvement in the projects by buying and sourcing local suppliers.**

WASTE REFINERY©

The technology for real urban mining

'WASTE REFINERY©' is an **industrial and fully mechanised WET separation process** for mixed Municipal Solid Waste, pre-sorted or non-pre-sorted. It brings the material in an installation of carefully sequenced treatment steps:

- Shredding.
- Washing in a DYNAMIC environment, making use of the moisture content of the waste itself.
- Separating based on density: inert fractions, calorific fractions.
- Drying (if needed) to create a fuel or a raw material for chemical valorisation.

From here on, materials find their new way into the economy, as raw materials or as basis for energy generation.

The secret and the novelty: a wet process !

The technological process consists mainly of a WET separation line. Wet technology has the following main advantages:

- the end products are **clean** and therefore have a higher market value and give less leaching.
- the energy need is low: **no energy is wasted** by evaporation of water or heating of inert materials.
- a **maximum amount** of metals can be **recycled** as little oxidation occurs[1] .
- the capacity of the installation can be adjusted as desired.
- the dust problem is under control.

The main criteria for the creation of a performant separation system are:

- **Dynamics.** The process must bring the shredded MSW in a constant movement in order to get an effective separation based on density of the material.
- **Speed**. The process must go as fast as possible, to avoid digestion, oxidation and leaching.
- **Capacity**. The process must be able to perform at any given time.

1 Since no combustion of the material takes place, only little oxidation of e.g. metal parts and metal foils occurs. This has 2 consequences: (1) a higher fraction of the metals in the MSW can be recycled as metal (with much higher value than metal oxides); (2) some metals dissolve less than their oxides or salts, so that lower metal leaching of the resulting products occurs than for combustion ashes.

IPAS urban mining

PORTFOLIO

40 years of experience

01

WASTE REFINERY FOR BOTTOM ASH TREATMENT

IPAS designed and built **a world premier installation** in the year 2000 to clean and separate the bottom ash from the INDAVER waste incinerators in Antwerp, Belgium. This installation runs ever since without any technical defects and still is a reference in the sector of Waste Management.

In the ash treatment unit, ashes from the household incineration facilities are washed, sieved and purified. The end product is a valuable secondary material that can be used for several applications. Ferrous and non-ferrous metals are carefully removed in various cut, sieve and wash units. Some of those recuperated metals will be used in industry. Inert ashes remaining after incineration are converted into granulates. These can be used as secondary materials in the construction industry, in accordance with the relevant environmental regulations.

TOP REFERENCES

Reference of a world premier installation
INDAVER (2000 / Belgium): total realisation for separating and upgrading of rest materials after waste incinerator. After burning of waste remains 25 to 30% of the total mass. This 30 % is reduced to 3% of rest material. 27 % of the ash mass is revalorised through the IPAS process.
See also: http://www.indaver.be/en/installations-processes/material-recovery/ash-treatment/

OTHER REFERENCES

AZN (2005 / the Netherlands / TSC); Machiels (2005 / Belgium / TSC)

02

SOIL WASHING/REMEDIATION/SANITATION

IPAS developed installations for SOIL WASHING. Highly contaminated soils are cleaned in high volumes and until a 100 % recyclability of the materials.




TOP REFERENCES

Grondreinigingscentrum Limburg / Carmans NV (2007 to 2015, Belgium / TSC). This installation runs 90 t / hour of highly contaminated soil. IPAS is currently building an similar installation to process 250 t/hour.
Moreover, the whole plant runs on renewable energy.
As final step, IPAS is developing an added on installation to valorise the last 20 % fraction of the contaminated sludge: 17 % of fine materials will be turned in to a new product, capturing and stabilizing the contaminants and 3 % organics will go to energetic valorisation.
So this plant will soon reach a 100 % recycling of contaminated soils.

OTHER REFERENCES

NMB (1991 / the Netherlands / TSC for road construction); Gyproc nv (1991 / Poland / combustion plant in Gypsum industry); Basse Sambre (1991 / Belgium / TSC sand recovery); SET nv (1991 / Belgium / TSC); Hogeschool Delft (1996 / the Netherlands / TSC); Watco RSW nv (1999 / Belgium / TSC); Rens (2000 / Belgium / TSC);

03

COAL SLUDGE RECOVERY

In the environment of working and closed coalmines most often exist PONDS, that can be very big. They are used to store in a temporary or permanent way the SLUDGE from the coal washing process. Very often these ponds are still rich in fine coal to very fine fractions of usable coal. IPAS is a top specialist in recovery of coal from these ponds, as IPAS masters the wet process technology. IPAS has designed and built several POND WASHING INSTALLATIONS to recover coal from sludge mass. IPAS installations run profitable for coal ponds from 40 % coal content.
The recovery and sanitation of coal ponds is, a necessity when the mining activity stops.

REFERENCES

IPAS references in coalmine sludge recovery. The projects are situated in run of mine environment or in sanitation contexts or pit recovery operations.
Fechner (1988 / Germany / Total Separation Concept -TSC-); Sewater (1989 / Belgium / TSC); Solichar (1989 / Belgium / TSC); Haisy (1990 / USA / TSC); Hansen Coal Gmbh (1990 / Germany / TSC); Issabel (1990 / USA / TSC); Kempense Steenkoolmijnen (1990 / Belgium / TSC); IPAS Polska (2010 – 2013 / Poland / contaminated Coal Tips and Sludge Ponds – studies).

AVAILABLE TECHNIQUES @ IPAS

- Coal crushing
- Screening WET / DRY till 350 mm
- Separating: Dens medium, Jigging, Cycloning, Spirals, Flotation
- Thickening: Deepcone, Normal thickener
- Dewatering: Centrifuges (Decanter, Shub centrifuges, Pusher centrifuge), Vacuum filtration (Drum, Disc, Belt), Multiroll filter, Chamber filter press
- Drying: mechanical and thermal drying

04

GLASS RECYCLING

The collection of used glass (bottles, jars, ...) from households is a common practise in Europe. Glass represents an important inert fraction in the Municipal Waste stream. IPAS has developed a fully automatic recycling line that processes up to 25 tons per hour.

Different steps in the glass recycling process:

- Separation of the course fraction to prepare colour separation on complete bottles
- Separation of granulates
- Separation of non-ferrous fraction
- Separation of stones and porcelain.

REFERENCES
GRV (1992 / Belgium / TSC); VLAR (1994 / Belgium / Engineering); GRL (1997 : Belgium / TSC); GRL (2009 / Belgium / CHP installation)

05

COALWASHING

IPAS has built several 'total separation concepts' for the coalmining industry.

- 'Run of Mine' COAL: design and build of installations of all possible capacities.
- 'TIP washing': design and build of profitable installations from a coal content of 10 %.

REFERENCES

SSM Terneuzen (1990 / Netherlands / TSC - total separation concept [1]); Anscoal nv (1991, Belgium / TSC); Terval (1991 / Belgium / PWT - process water treatment [2]); Stadtwerke Saarbrücken (1993 / Germany / TSC – research); Knurow (1995 / Poland / machinery); Slask (1995 / Poland / machinery); Czech coalmines (1996 / Czech Republik / chemicals); Techno Agrar (1996 / Germany / chemicals); Jankowice (1997 / Poland / machinery); Tr International Ltd (1998 / USA / TSC – research); Donbass coalmines (1998 / Ukraine / chemicals); APM (2000 / Indonesia / TSC research); Mekol (2000 / Belgium / process water treatment); China Coalmines (2000 / China / chemicals); Dzerdzhinsko – Energosurs (2001 / Ukraine / TSC); Gorenenrgo (2002 / Ukraine / TSC); ROA/Adcoal (2003 / Belgium / TSC); SE Ecotekh (2003 / Ukraine / TSC); ABT (2005 / Belgium / process water treatment); CoalminesMarcel, Jankowice, Anna, Jasmos, Knurow (1991 – 2007 / Poland / chemicals); Techexpertise (2010 / Ukraine / separation plant in partnership);

1 TSC or 'Total Separation Concepts' means: complete analysis, design and build of industrial solution to separate and upgrade materials.

2 PWT or 'Process Water Treatment' means: analysis, design and build of industrial treatment installation for water / process water.

06

WATER PURIFICATION & TREATMENT OF ORGANICS IN THE FOOD INDUSTRY

In the food industry IPAS has built several projects based on DAF technologies (Dissolved air flotation). This is a water treatment process that clarifies wastewaters by the removal of suspended matter such as oil or solids. The removal is achieved by dissolving air in the wastewater under pressure and then releasing the air at atmospheric pressure in a flotation tank or basin. The released air forms tiny bubbles which adhere to the suspended matter causing the suspended matter to float to the surface of the water where it then is removed by skimming.

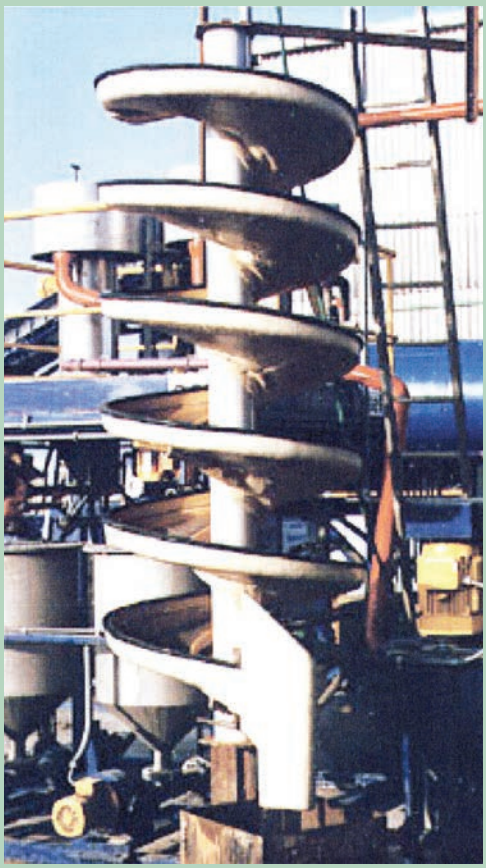
REFERENCES

Clarebout nv (1991 / Belgium / PWT);Organic Waste System (1992 / Belgium / TSC); Noliko Vegetables (1992 / Belgium / PWT); Van Reusel Snacks (1993 / Belgium / BAK reactor); Vanlommel Slachthuis nv (1994 / Belgium / PWT research meat industry); Krikro (1994 / Belgium / PWT – potato industry); Decoster bvba (1996 / Belgium / PWT potato industry); Van Reusel Snacks (1996 / Belgium / consultancy on process); Van Reusel Snacks (1998 / Belgium / process optimisation); Van Reusel Snacks (2000 / Belgium / PWT); Equinox (2000 / Belgium / consulting); Bravi nv (2002 / Belgium : PWT potato industry);

07

SLUDGE & WATER TREATMENT IN THE CONCRETE INDUSTRY & BRICKWORKS

IPAS developed and implemented in the concrete sector a very performant system for recuperation of process water. The payback time for these investments was everywhere less than 6 months, because of the reuse of water streams and the fact that no longer contaminated water needs to be discharged in to the environment or in the public wastewater systems or that no longer sludge needs to be put in the landfills.



REFERENCES

De Nieuwe Zandegroeven (1992 L/ Belgium / TSC); ECHO (1994 / Belgium / PWT – development of new concept); Varenberg nv (1994 / Belgium / PWT – research gravel recovery); Winters (1994 / Belgium / PWT – research gravel recovery); Goudezeune (1996 & 1997 & 1998 &1999 / Belgium / PWT 4 installations); Ropa bvba (1996 / Belgium / PWT meat industry); Vos Vleeswaren (1996 / Belgium / PWT meat industry); Heylen (1997 / Belgium / PWT – ceramics); Betonson (Kampen) (1997 / Belgium / PWT); Trilco (1997 / Belgium / PWT); Vasco (1997 / Belgium / PWT process optimization in heating system); Ergon (1998 / Belgium / PWT); Kerkstoel (1998 / Belgium / PWT); Carrières du Hainaut (1998 / Belgium / PWT stone quarry); Damman nv (1999 / Belgium / TSC – brick works); Martens Beton nv (1999 / Belgium / PWT); Carrières du Boulonnais (1999 / France / PWT research – stone quarry); Agref (2000 / Belgium / PWT); Ebema (2000 / Belgium / PWT); Marlux (2000 / Belgium / PWT); Sander-Pebüso (2000 / Belgium / PWT); Tripan (2000 / Belgium / PWT); Carrières du Hainaut (1998 / Belgium / PWT stone quarry); Boskalis (2001 / the Netherlands / TSC research sieve sand); De Vijfhoek (2001 / the Netherlands / TSC research sieve sand); SVK (2001 / Belgium / PWT); De Meteoor (2001 / the Netherlands / PWT research); Heembeton (2001 / the Netherlands / PWT); Klaps Beton (2001 / Belgium / PWT); Seveton nv (2001 / Belgium / PWT research); EWI nv (2001 / Belgium / PWT); Mostone (2001 / Poland / PWT research stone quarry); Marlux (2001 / Belgium / chemicals); Seveton (2002 / Belgium / PWT – adjustment); BDI Ambés (2002 / France / PWT); BDI Grigny (2002 / France / PWT); Den Boer Beton (2002 / Belgium / PWT adjustment); MBI (2002 / Belgium / PWT); Heembeton (2002 / the Netherlands / chemicals); BMI (2003 / France / PWT); Lithobeton (2003 / Belgium / PWT); C&G (2003 / UK / PWT); C&G (2004 / UK / PWT); BDI Pujaut (2004 / France / PWT); Den Boer Beton (2005 / the Netherlands / PWT)

IPAS has more relevant references in sectors, usefull for the new concept WASTE REFINERY & GENCOAL.

OTHER RELEVANT REFERENCES OF IPAS:

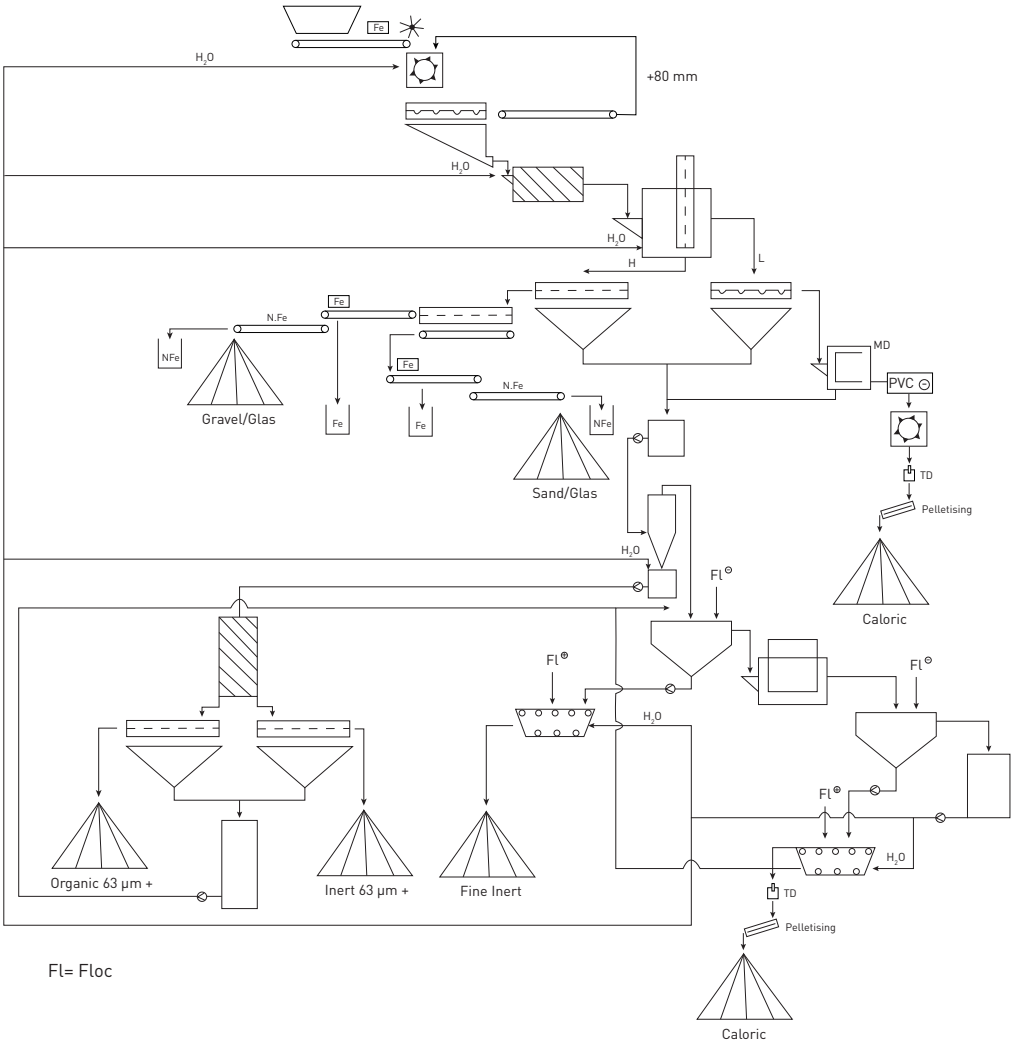
Booy CleanBelgium (1994 / Belgium / TSC schredder in waste management); Mathys nv (1994 / Belgium / PWT / research – paint industry); Mireille (1996 / Belgium / PWT dry cleaning industry); DSM (1996 / Belgium / PWT plastics industry); Watco (1998 / Belgium / TSC waste management); SK-Eng & Const (2001 / Korea / TSC research waste management); Londonwaste (2002 / UK / TSC research waste management); Galloometal (2007 / Belgium / Metal – Non Ferro separation study).

production

PROCESS

Waste Refinery©

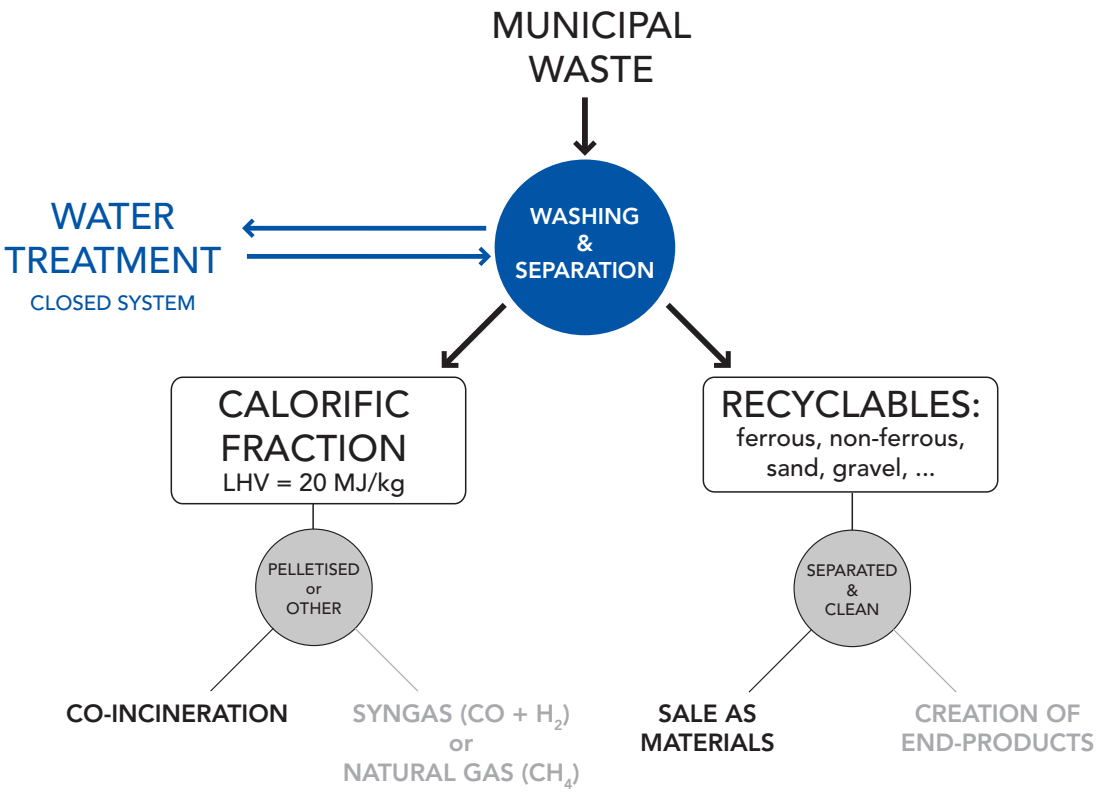
PROCESS FLOW DIAGRAM



Fl= Floc

WASTE REFINERY© is a patented process, using proven technologies as components.

THE TRANSFORMATION PROCESS IN ONE GLANCE



The final goal is to achieve end products in as high an added value as possible Materials will be sold in the market or be the raw material for new products. The energetic fraction will be sold as fuel or serve as material for new energetic processes. The calorific fraction can serve for co-combustion in existing power stations (electricity or heating) or as source for the creation of syngas. IPAS is developing strategic partnerships so that everywhere in the world, the most advanced and realistic scenario can be proposed.

WASTE REFINERY©
A REAL ALTERNATIVE

WASTE REFINERY© is developed especially as alternative for landfill and for incineration, as they both destroy valuable materials. But also compared with DRY separation processes WASTE REFINERY© has important advantages.

LANDFILL DESTROYS AND CREATES PROBLEMS.

- Landfills are the source of many problems in this world. They are the symbols of the past and the painful scars of human consumption. Many countries in the world want to stop with this practice, but see no alternative as many technologies are too expensive.
- Landfill destroys materials through oxidation of metals and fermentation of organics, contributing to harmful emissions and diseases. Even if landfill is controlled and optimised with gas extraction, it remains an out-fading practice. Eventually societies will have to clean up the mess from the past.

INCINERATION DESTROYS AND IS EXPENSIVE.

- With an average working cost of € 110 / $ 120 per ton and an investment cost that is ten times higher than WASTE REFINERY©, incineration (even with recuperation of heat) is an expensive solution for MSW.
- Moreover, incineration destroys valuable materials and only makes the waste quantity smaller as an average of 25 to 30 % of the initial mass remains after treatment in the form of ashes. If not neutralised by a washing process, these ashes are a real threat for the environment.
- In the incinerators the waste has first to dry by evaporation of the water, which necessitates a lot of energy before the waste ignites, whereas in WASTE REFINERY© no unnecessary water evaporation is needed. Therefore more energy can be recovered.

DRY SEPARATION IS NOT EFFECTIVE AND EXPENSIVE

Compared to dry technology (eg MBT) to separate and recycle/recover MSW, WASTE REFINERY© has the following advantages:

- The end products are cleaner, as wet cleaning dissolves all sorts of impurities that stick to the material with dry technology. Therefore, the market value of the products is higher (metals) and the materials (inerts) will show reduced leaching and will therefore more easily comply with the regulations for recycling as construction materials;
- Wet technology uses the water (= 30 %) of the MSW in the process, rather than having to evaporate it, which is accompanied by loss of energy;
- The capacity of a wet installation can easily be adjusted;
- In a wet technology there are much less problems with dust.
- Automated dry separation has a much higher cost, as the calorific end product is still a problematic fraction that needs to be sent to an incinerator.

THE HEART OF THE TECHNOLOGY

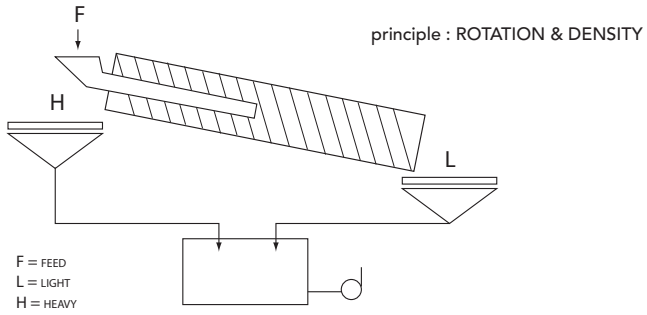
WASTE REFINERY© is built upon components that all are proven and worldwide available technologies. In the technology market there are two different systems that are qualified for **a performant dynamic process**: autogenous dense medium and pulsation dense medium.

THE AUTOGENOUS PROCESS uses a turning barrel, tailor-made, that when injected with process water forces the material to split into different fractions based on its inherent absolute density.

THE PULSATION PROCESS uses a 'JIG', a tailor made bath in which the material is brought to create an 'apparent density' and in interaction with compressed air the material is split based on its inherent density.

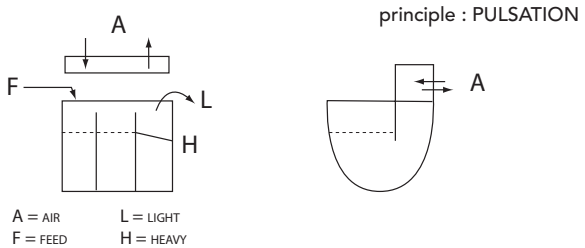
AUTOGENOUS DENSE MEDIUM (ADM) + DENS MEDIUM WITH OTHER MATERIALS LIKE Fe, Al, ...

This wet separation process uses rotation in a drum to separate the fractions based on their own density.



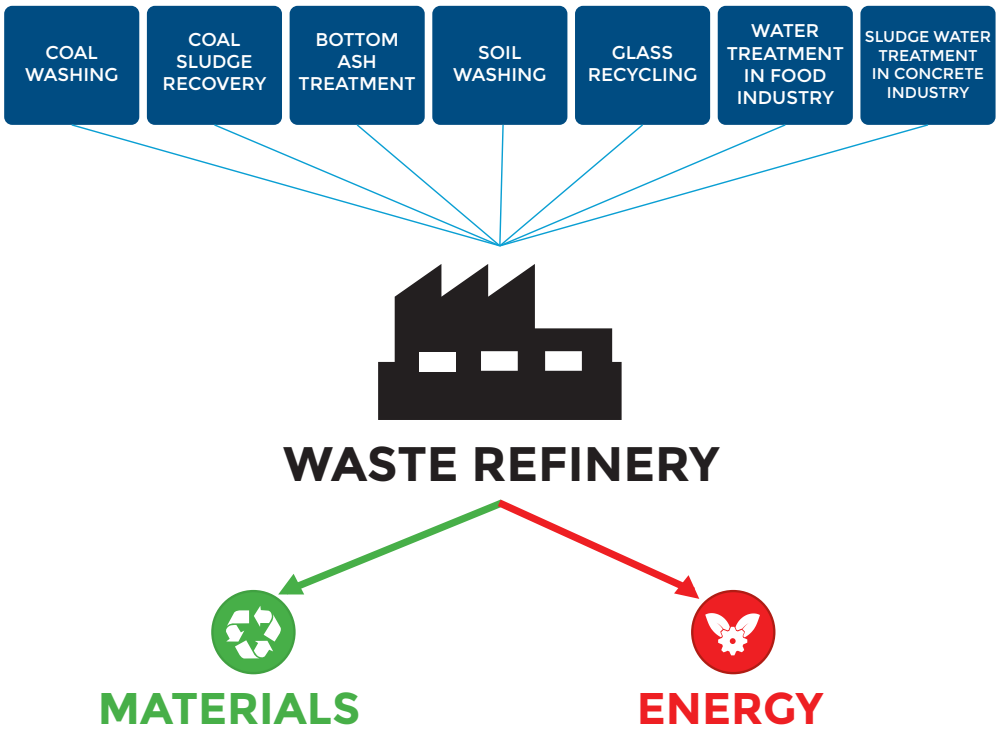
DYNAMIC APPARENT DENSITY WITH PULSATION TECHNOLOGY

This wet separation process uses pulsation of compressed air to separate the fractions based on their own density



THE COMBINATION OF TECHNOLOGIES CREATES THE PROCESS

The WASTE REFINERY is in fact a compilation of existing technologies from different industrial sectors: mining, raw materials, environmental techniques for soil and water remediation and recycling of materials like metal, glass food, ...



In the WASTE REFINERY an industrial separation and refining process is created in order to separate all relevant fractions from the mixed household waste. The process is built up in general following these main steps:

A. FEED AND PRE-TREATMENT
B. COURSE WASHING
C. FINE WASHING
D. WATER TREATMENT
E. PELLETIZING

A. FEED AND PRE-TREATMENT

The first step in the process is feed and pre-treatment. It is important that the MSW is homogenized and prepared for a wet treatment, the washing process:
1/ the rough material goes through a de-ironing installation, basically a magnetic field to take out the Ferro parts.
2/ then 'shredding' is important, to create a material that is between 0 and 200 mm maximum.
3/ A sieve at 200 mm is installed to control this factor.
4/ particles bigger that 200 mm will be sent back to the shredder.

A choice can be made to install a double feed and pre-treatment line to have no defects in the functioning of the installation: 2 X 10 t/h versus 20 t/h single line.

B. COARSE WASHING, FOR MATERIAL OVER 14 MM

The bigger parts will be sent through a course washing installation, where the material is split in to inert and calorific (light) material. The inert will be separated in Fe, NFe and other inert. The calorific fraction will also be sent through a Ferro, Non Ferro and PVC separators, so that will remain the first calorific fraction, coming from the bigger fractions. This will be fed through a drying installation and a shredder to be sized to maximum 20 mm.

The drying installation in fact is a combination of mechanical dewatering (1 or 2 pieces) and a thermal dryer.

- The mechanical dewatering can be centrifuges and/or multi-roll-filter (press) (or others) to bring the material to 20 % of moisture.
- The thermal dryer brings the material to 10 % moisture.

C. FINE WASHING, FOR MATERIAL UNDER 14 MM

The smaller parts will be sent through a similar washing process to treat the material up to 14 mm.
From the fine washing will be separated: the energetic and the inert fraction on the one hand and the water on the other hand. At this point the water still contains the contamination and the sludge.

The energetic fraction from the smaller fraction will be dried (mechanical and thermal drying) in the same installation as in step B.

D. WATER TREATMENT

In the water treatment it is important to see that:

- The water has a physical chemical and a biological (bio rotor) treatment.
- The sludge that remains is being dewatered to a semi-solid (stiff) condition so that this rest material can be sent to the landfill or to a special treatment/ valorisation plant.
- The treated water is sent back in to the installation as process water.

E. PELLETIZING

The final product will be made transportable. The analysis of the fuel proved that there is a quite high volatile flammable in the sample. It is suitable to process the material into pellets. To make the calorific fraction most transportable and handlable as a solid fuel or as basis for further valorisation.

VALORISATION OF THE ENERGETIC FRACTION

The use of the energetic fraction of the treated waste streams in co-combustion in existing heating or electricity boilers for many regions in the world seems to be the most appropriate way to valorise it, as in many places power generation systems use solid fuels. IPAS believes that this is a valuable way to go nowadays, in the age of transition towards the more sustainable future. Furnaces are mostly well equipped with exhaust cleaning systems (desulphurisation, ...) Moreover, industrial tests show even an non measurable effect in co-combustion operations.

But in the same time the development for better and future proof valorisation systems is imperative. IPAS invests, together with partners, in this scenario. Gasification and the creation of hydrogen as an energy carrier and as a renewable raw material for the chemical sector are the new tracks that are currently being developed by IPAS. This has high priority !

development MILESTONES

Waste Refinery©

The development of WASTE REFINERY© did not happen overnight. It is the fruit of thorough analysis, hands on tests, confrontation with scientific research institutes, gaining peer reviews. A Belgian - Czech partnersship between IPAS and DEPOS, the intermunicipal waste management company in the Karvina region (CZ), was the basis for development works.

In brief the history of the creation process

	MILESTONES	EXTERNAL PARTNERS INVOLVED
2012	· Visit of Czech delegation to Belgian waste management installations and policies in the frame of Interreg, European exchange of Mining regions	· SMOOK, local towns of Karvina · EURACOM, network of mining regions in Europe, the PROSPECTS-project
2013	· Field research trips to Karvina, · Taking of sample of fresh waste for laboratory test and analysis · Analysis of energetic fraction at Ostrava University	· Transit_LAB, B · RIKKA, CZ, consulting partner · DEPOS, waste management · VŠB – Technická univerzita Ostrava
2014	· Development of concept of wet separation for MSW · Description of concept · registration at BENELUX office for intellectual property · certification of energitic fraction as alternative fuel	· VVUU Radvanice, certification
2015 - 2016	· Testing of concept through peer review · Market research and internal discussions at Karvina level	· Prof C Vandecasteele KUL & C. Block (2C ecosolutions) · Albi Mining University (F)
2017 - 2018	· Application of governmental funding in CZ for semi industrial test · Semi-industrial test for the creation of 7 t of energetic material · controlled combustion test in city heating system of Ostrava-Karvina at Veolia heating station · Assessment of possible implementation and market entrance of the solid alternative fuel made of mixed municipal waste	· Czech Ministry of Industry & Trade · Veolia Ostrava · Bee Partner consultants · ZUOVA (Institute of Public Health) · AWT Rekultivace
2019	· Refining of the concept · Commercial scenario · Description of international Patent	· Patent bureau Bockstael (B)


MINISTRY OF
INDUSTRY AND TRADE


RIKKA


IMT Mines Albi-Carmaux
École Mines-Télécom


Ostrava - Radvanice
VVUÚ, a.s.


PROSPECTS
TO PROMOTE ENTREPRENEURSHIP AND NEW SMES


ZDRAVOTNÍ ÚSTAV SE SÍDLEM V OSTRAVĚ


2C
ECOSOLUTIONS


BP


transit_LAB


Centrum
ENET


DEPOS
Horní Suchá a.s.


INTERREG IVC
INNOVATION & ENVIRONMENT
REGIONS OF EUROPE SHARING SOLUTIONS


AmpluServis


VEOLIA


AWT
ADVANCED
WORLD
TRANSPORT

LABORATORY TEST STARTING POINT IN '13-'14

On July 3, 2013 a sample was taken from the DEPOS dump site in Horny Sucha, Karvina Region, Czech Republic.

- DEPOS dumped 5 trucks of fresh municipal waste from 4 different municipalities **(Karvina, Havirov, Petrvald and Doubrava**) on top of the dump site;
- The MSW was mixed and compacted using of a front wheel loader;
- A 20 kg sample of MSW was manually taken and transported to Belgium

DEPOS landfill on July 3, 2013

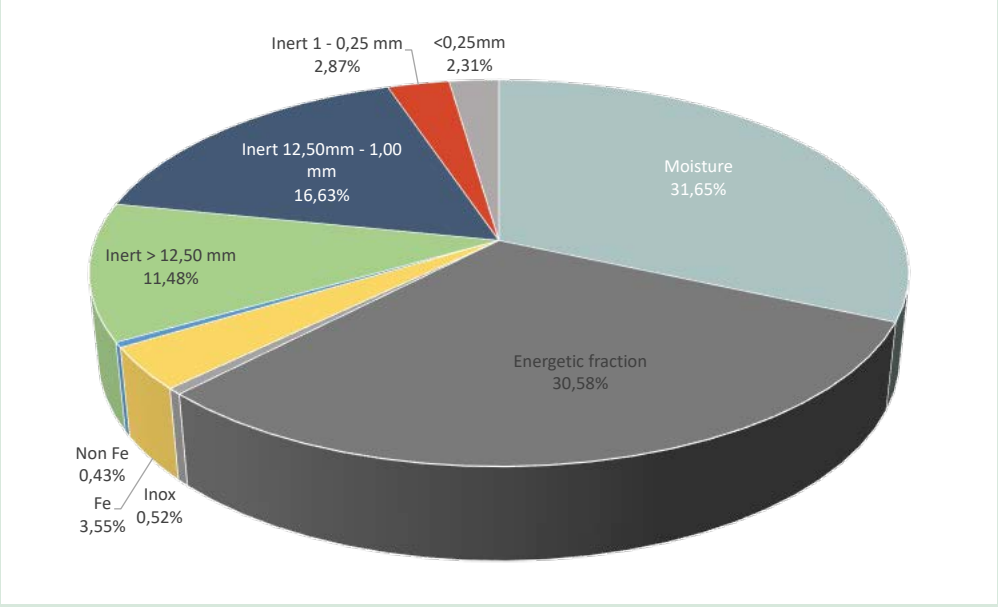
In Belgium the following steps were taken:

- screening;
- picking;
- density separation in water of different fractions;
- drying first in open air (summer conditions), then in a covered space;
- milling in different steps.

Seperated fractions from DEPOS sample

SEPARATION RESULTS FROM SAMPLE

DRY + MOIST Date July 31, 2013		
	Weight, g	**% of total**
Moisture	6,370.50	31.65%
RDF	6,155.00	30.58%
SS	105.00	0.52%
Fe	714.20	3.55%
Non Fe	85.70	0.43%
Inert > 12.50 mm / stone	2,310.00	11.48%
Inert 1.00 mm – 12.50mm / gravel	3,348.00	16.63%
Inert 0.25 mm – 1.00 mm / sand	577.00	2.87%
<0,25mm	464.00	2.31%
TOTAL	**20,129.40**	**100.00%**



Conclusion:

the result is comparable to analyses obtained in other regions internationally

- 1/3 of MSW = moisture or water.
- 1/3 of MSW = organic & RDF
- 1/3 of MSW = inert material

RESULTS FROM THE 'ASH TEST' AT TECHNICAL UNIVERSITY OSTRAVA

Main conclusion: calorific value of GENCOAL is comparable to coal.

VŠB – Technická univerzita Ostrava
Laboratoře Institutu geologického inženýrství
Helena.raclavska@vsb.cz

ANALYSIS OF THE GENCOAL (RDF)

Protocol No.1/01/2013 dated on 11.12.2013

RDF – Depos Mr.Ceslav Valosek		Mixed sample	Used method
Water dry up (W_{ex})	%		ČSN 441377 Tuhá paliva – Stanovení obsahu vody
Water rest (W_h)	%		ČSN 441377 Tuhá paliva – Stanovení obsahu vody
Water in total (W_t)	%		ČSN 441377 Tuhá paliva – Stanovení obsahu vody
Water at the sample	%	3,24	ČSN ISO 11722 Tuhá paliva – Černá uhlí – Stanovení vody v analytickém vzorku sušením v N_2
Humidity	%		ČSN ISO 562 Černá uhlí a koks – Stanovení prchavé hořlaviny
Ash in dry matter	%	20,87	ČSN ISO 602 Stanovení obsahu popelovin
Volatile flammable in dry matter	%	74,27	ČSN ISO 562 Černá uhlí a koks – Stanovení prchavé hořlaviny ČSN ISO 5071-1 Hnědá uhlí a lignity - Stanovení prchavé hořlaviny v analytickém vzorku
Fixed Carbon	%	4,86	
Heat of combustion in dry matter	J/g	23013	ČSN ISO 1928 Stanovení spalného tepla kalorimetrickou metodou v tlakové nádobě a výpočet výhřevnosti
Caloric value in dry matter	J/g	19835	
Caloric value in the sample	J/g	18985	
C in dry matter	%	47,526	ČSN P ISO TS/ 12902 Tuhá paliva – Stanovení veškerého uhlíku, vodíku a dusíku – Instrumentální metody
H in dry matter	%	15,426	
N in dry matter	%	0,769	
0 in dry matter (calculation)	%	15,409	
S in dry matter	%	<0,010	

Values calculated as average from 6 samples

Rightness due by
Mrs. Prof.Ing.H.Raclavská,CSc.

ASH MEASUREMENT

Temperature for ash melting ČSN ISO 540

- DT (deformation temperature) : 1093 - 1132
- ST (sphere temperature): 1198 - 1211
- HT (hemisphere temperature): 1209 - 1230
- FT (flow temperature): 1222 - 1257

X-RAY FLUORESCENCE ANALYSIS

Indicative results from mobile X-ray unit (X-ray fluorescence analysis). Ag, Ba, Cd, Co, Hg, Se, Sn were under detection limit

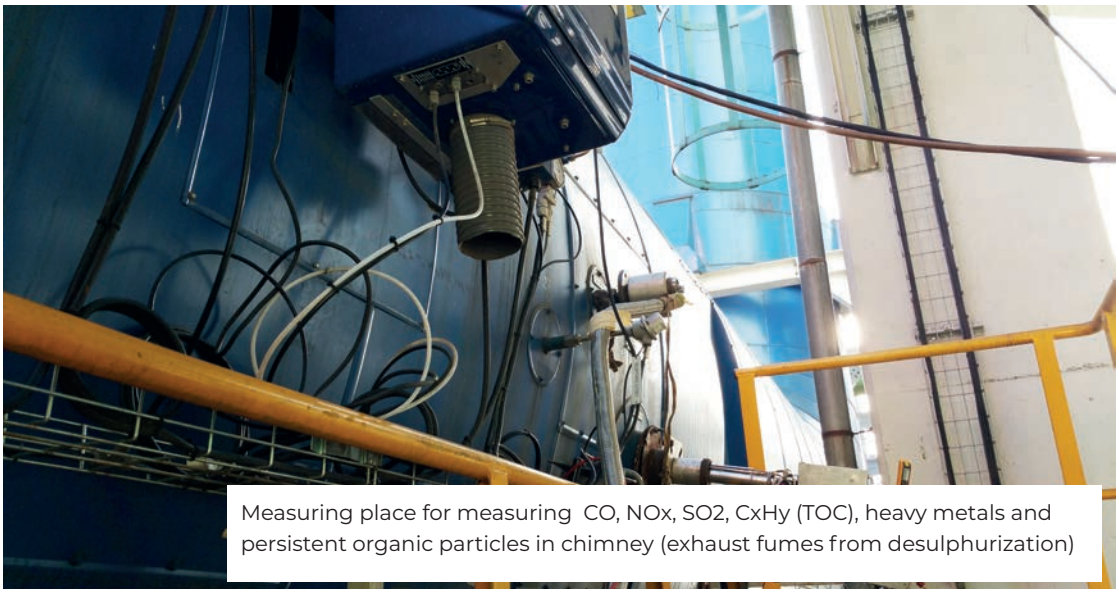
Element	mg/kg dry matter
Ca	38457
V	31
Cr	101
Mn	221
Ti	2690
Fe	5421
Ni	51
Cu	16
Zn	677
As	11
Rb	10
Sr	119
Zr	43
Mo	31
Sb	112
Pb	38
Bi	7

THE INDUSTRIAL TEST 2018

As the main concern of the partner DEPOS was to find proof on the energetic value and the usability of the energetic fraction in existing heating stations, locally in the Karvina region, in 2016 was decided that IPAS should perform a semi-industrial test on the separation of the energetic fraction from the MSW.
An agreement was made to set up the test together with:

- VEOLIA Karvina for co-combustion of the fraction in the existing heating station
- VSB Technical University for analysis of the energetic fraction and measurements during the combustion test
- Laboratory ZUOVA for analysis of the water fraction
- Bee Partner for the desk research on possible local market for the energetic fraction and feasibility scenario for setting up the industrial installation at DEPOS, Horni Sucha.

In June 2018 a full report was delivered by Ing. Jana Szczukovà: 'An assessment of possible implementation and market entrance of the solid alternative fuel GENCOAL made of mixed municipal waste".



Measuring place for measuring CO, NOx, SO2, CxHy (TOC), heavy metals and persistent organic particles in chimney (exhaust fumes from desulphurization)

Measuring place for HCl and HF

SPECIFICATION OF THE FUEL, FOLLOWING ENVIRONMENTAL LAWS OF CZECH REPUBLIC IN 2018

The final product is intended as an additive to solid fossil fuels as combusted at middle and large energetic facilities. The conditions for using this product at specific energetic facilities are defined in the Act n° 102/2001 (General product safety act) and Act n° 201/2012 (Air protection act) and, in accordance to the Air protection act, are subject of approval of respective public authority for specific energy source.

Technical specification of the GENCOAL, solid alternative fuel, according to the producer is defined by the certificate for solid alternative fuel GENCOAL for energy use; certificate authority: VVUÚ Radvanice; ID: 202/H/2014 of July 31, 2014.

Waste usable for the GENCOAL production

Combustible	**ID**
Mixed municipal waste	20 03 01

Fuel technical requirements

Water content (ar)	max. 15,0 [%]
Ash content (d)	max. 25,0 [%]
Calorific value (ar)	min. 17,0 [MJ/kg]
Calorific value (d)	min. 17,0 [MJ/kg]
Chloride content (d)	max. 0,6 [%]
Fluorine content (d)	max. 0,02 [%]
Antimony content (d)	max. 120 [mg/kg]
Arsenic content (d)	max. 20 [mg/kg]
Cadmium content (d)	max. 7,5 [mg/kg]
Chromium content (d)	max. 500 [mg/kg]
Cobalt content (d)	max. 10 [mg/kg]
Copper content (d)	max. 1300 [mg/kg]
Lead content (d)	max. 200 [mg/kg]
Manganese content (d)	max. 250 [mg/kg]
Mercury content (d)	max. 0,4 [mg/kg]
Nickel content (d)	max. 500 [mg/kg]
Thallium content (d)	max. 2,0 [mg/kg]
Vanadium content (d)	max. 50 [mg/kg]
Barium content (d)	max. 200 [mg/kg]
Sum of polychlorinated biphenyl (PCB)	max. 0,4 [mg/kg]

The final product GENCOAL is comparable with coal in terms of energetic value. The product is intended as an additive into solid fossil fuels. Complying with defined legal conditions it is enabled to combust it in heating plants or power plants.

COMBUSTION TEST AT VEOLIA HEATING STATION

For the combustion test at Veolia heating plant in Karvina was transported 8,3 tonnes of GENCOAL.
The combustion test was carried out in alignment with the project elaborated in Technical University Ostrava (VŠB-TU) as well as with the Decision of Regional Authority – Moravian-Silesian region (case ID: MSK 45866/2017; March 4, 2017). The test was realized in March 3-4, 2018.

Conclusions made of combustion test results:

1. During the whole time of the test, all the emissions limits valid in Karvina heating plant were observed at the exhaust outlet from desulphurization.
   Concentration of gas pollutants SO2 was around 209 mg.m-3R.
   Concentration of gas pollutants NOx was around 326 mg.m-3R.
   Concentration of gas pollutants CO was around 94 mg.m-3R.
   Concentration of gas pollutants CxHy was around 2 mg.m-3R.
   Concentration of gas pollutants HCl was around 67 mg.m-3R.
   Concentration of gas pollutants HF was around 0,7 mg.m-3R.
   Concentration of gas pollutants TZL was around 12,4 mg.m-3R.
   Concentration of gas pollutants PCDD/F - ITEQ was around 0,0033 ng.m-3R.
   Concentration of heavy metals Cd + Tl 0,0165 mg.m-3R.
   Concentration of heavy metals Hg 0,0026 mg.m-3R.
   Concentration of heavy metals As + Co + Cr + Cu + Mn + Pb+ Sb + V + Ni 0,2355 mg.m-3R.
   These figures correspond to standard results as combusting mixture of hard coals and coal sludge.
2. Mixing of certified fuel mixture GENCOAL with hard coal was carried out at outer coal storage in Karvina heating plant. Wheel loader VOLVO was used to mix it. This technology can be admitted for one-time test, however, it would be necessary to build a mixing technology for permanent operation.
3. Coal mills could fuel milling without any obvious increase of milling works and lengthening the milling time.
4. Proportion of the certified fuel mixture GENCOAL was chosen in alignment with the project, namely in weight ratio around 3 to 5% to hard coal. Based on the band weight data, the real balance ratio was 2,5%. During coaling, the proportion of the certified fuel GENCOAL could reach the weight ratio of up to 5%, because balanced ratio is not possible to reach with a wheel loader. The proportion is determined based on other tests in order to not endanger milling facility. Measuring of temperatures and CO and O2 concentration in the coal dust tank proved that milling of fine-grained certified fuel GENCOAL does not nor cause temperature increase or CO concentration increase in the coal dust tank.
5. Side products – ash and slag - were not influenced, because, in comparison to ash in coal, the proportion of solid inert phase in the certified fuel mixture GENCOAL is negligible.
6. Exhaust delay time in the combustion chamber at temperature above 850 °C considerably exceeds the minimal time of 2 seconds. At average temperature (1200° C) of exhausts in the combustion chamber, the delay time is 5,03 seconds.
7. Chloride content in the certified fuel GENCOAL is similar to a mixture of coal and coal sludge (see the Table n°1). Hard coal, especially from Poland, contains chloride. The most HCl gases are caught at desulphurization.

Results and evaluation of combustion test emissions regarding integrated permission for boilers K1-K4 in Karvina heating plant.

Emissions	Limits in the integrated permission	Measured figures
Solid pollutants [mg.m-3R¬]	60	12.4
NOx ¬¬[mg.m-3R¬]	450	326
CO [mg.m-3R¬]	250	94
SO¬¬2 [mg.m-3R¬]	1700	209

In the integrated permission the figures are relevant for solid fuels combustion in Karvina heating plant. If GENCOAL is used as a fuel, all the limits given by integrated permission are complied.

Results and evaluation of combustion test regarding integrated permission and Regulation 414/2012 for 100-300 MW sources combusting mixture of waste and fuel.

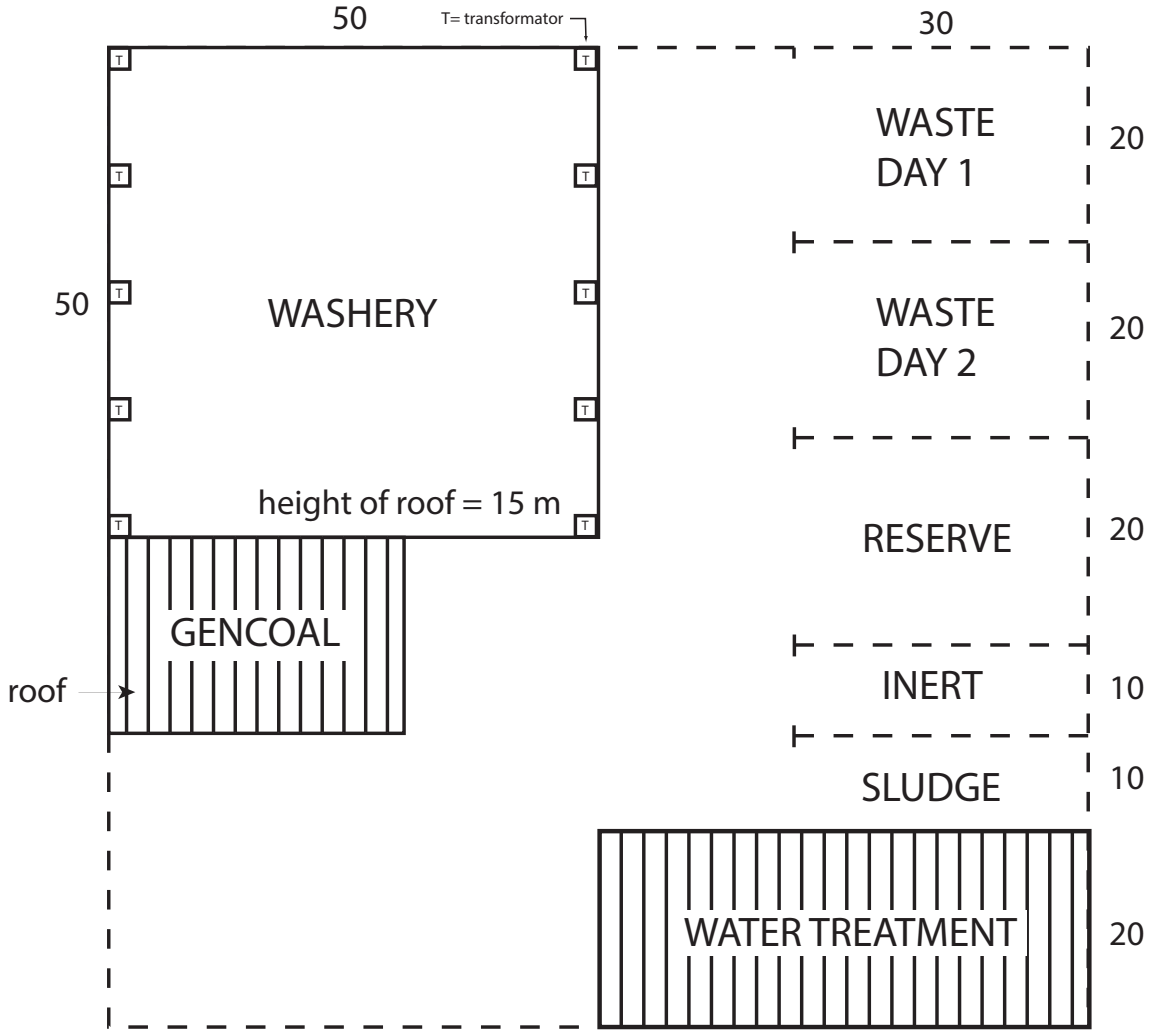
Emissions	Limit for incineration plants	Limit for coal	Mixed limit	Measured figures
Solid pollutants [mg.m-3R¬]	10	25	24,9	12,4
NOx ¬¬[mg.m-3R¬]	200	200	200	326
SO¬¬2 [mg.m-3R¬]	50	200	199	209
CO [mg.m-3R¬]	50	250	249	94
TOC (CxHy)[mg.m-3R¬]	10	not defined	not defined	2
HCl [mg.m-3R¬]	10	50	49,9	67
HF [mg.m-3R¬]	1	not defined	1	0,7
PCDD/F [ng.m-3R¬]	not defined	not defined	not defined	0,0033
Heavy metals Cd + Tl [mg.m-3R¬]	not defined	not defined	not defined	0,0165
Hg [mg.m-3R¬]	not defined	not defined	not defined	0,0026
As+Co+Cr+Cu+Mn+Pb+Sb+V+Ni	not defined	not defined	not defined	0,2355

If the certified fuel GENCOAL is assessed as a waste, emission limit for NOx, SO2 and HCl was not complied. These figures are highlighted in red. Limits figures exceeding for NOx, SO2 and HCl was not caused by combustion of certified fuel GENCOAL. NOx concentration is a result of denitrification device operation and reagent injection. To lower SO2 and HCl emissions, it is necessary to increase lime sorbent dosage.

scheme for

LAY-OUT

of Waste Refinery©



analysis
SWOT

Strengths

- WASTE REFINERY© is an innovative process using proven technologies
- Low investment per installation
- Very cost-effective project
- Experienced management team
- Patented innovative product

Weaknesses

- New market entrant
- WASTE REFINERY© will need a lot of marketing and networking
- Knowhow on urban mining and circular economy is still underdeveloped worldwide

Opportunities

- Worldwide market
- Pragmatic step to circular
- economy
- Public Private Partnerships
- Chance for communities

Threats

- Existing waste market players are not waiting for radical innovators

business proposal
CONCLUSIONS

WASTE REFINERY© is completely compliant with the IPAS vision on a more sustainable society: E³ ecology – economy - emotion
WASTE REFINERY© is a real alternative for existing waste management methods for the following reasons:

ECOLOGY

- There is almost no negative impact to the environment, as the whole production process is controlled from long standing proven technologies, in what IPAS has many years of hands on experience.
- The method is completely future orientated, because it combines the best possible ratio in recycling between materials recuperation (materials economy) and energy recovery (energy economy).
- There is a big reduction in landfill gas emissions and a much smaller claim on land because the installations are relatively small (compared to landfills).
- Useable materials are stopped from being destroyed in incinerators and landfills.
- Moreover WASTE REFINERY© shows very interesting perspectives towards the shift from co-incineration towards chemical processing of municipal waste and towards a complete renewable process of energy generation. IPAS has this aspect under development.

ECONOMY

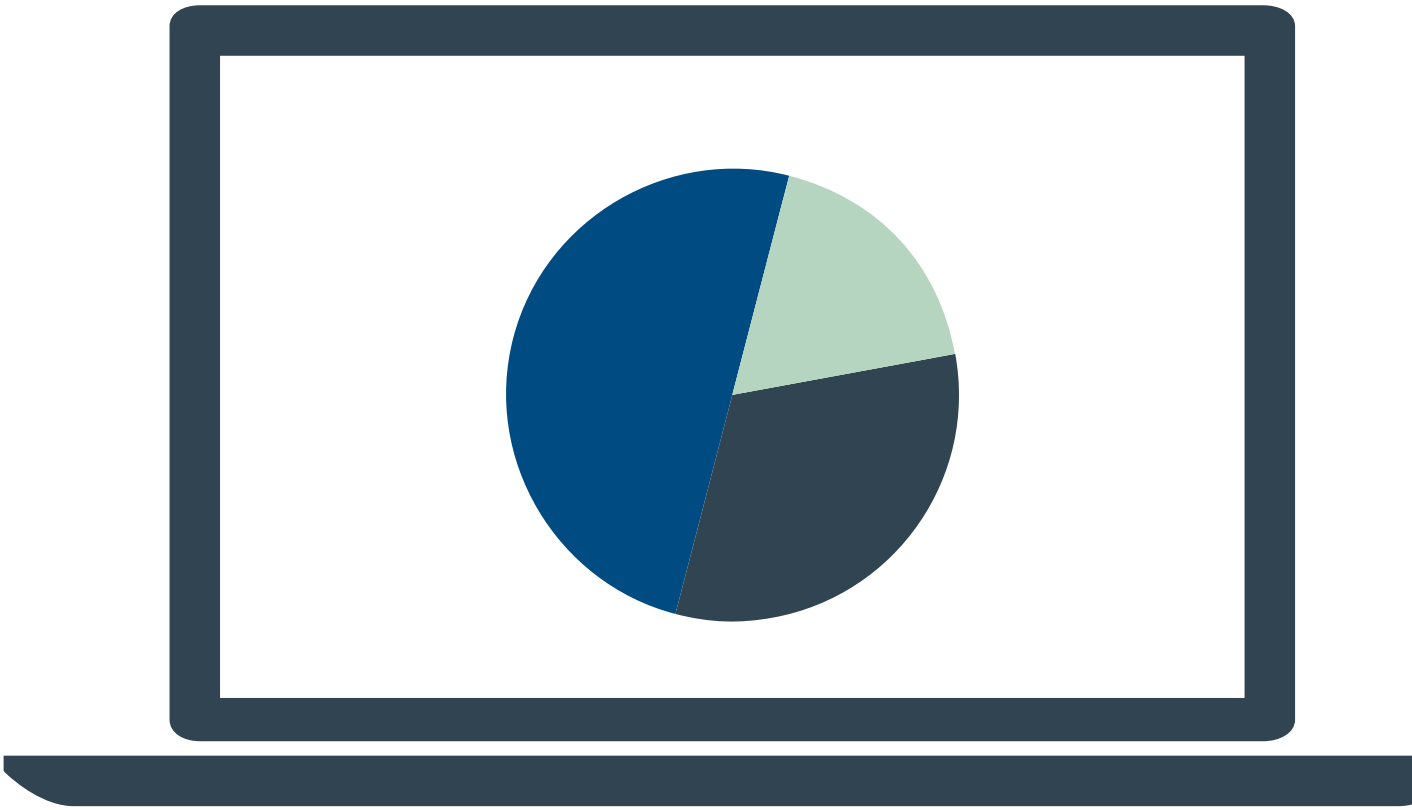
- The method is cheap, compared to the Western European standard of waste incineration.
- The business plan shows that managing waste in this industrial separation method is seriously profitable.
- WASTE REFINERY©reduces the use of fossil fuels.
- WASTE REFINERY© creates high value (clean) end products that can go directly in the production circle.

EMOTION

- WASTE REFINERY© is a realistic and pragmatic step towards the circular economy, because it shows that waste is an asset for society. Moreover WASTE REFINERY©-installations can be used for landfill mining.
- To work in partnership with local communities is a true option. 'Public Private Partnership' proposals are ready for implementation, showing a profitable operation for both the public partners and the private investors.
- Implementing WASTE REFINERY© installations will not destroy existing jobs, but create new ones.
- Risks for people with dry separation methods are eliminated by the wet separation process: no dust, no asbestos, no ignition-risk.

working scenarios

BUSINESS APPROACH



The successfully tested concept WASTE REFINERY allowed IPAS to develop a business proposal adapted to each city or region. The (adaptable) calculation tools are available at IPAS.

The economic efficiency assessment is based on standard analysis of costs and benefits to verify and assess the eligibility and financing needs of the project , to verify the financial sustainability of the project and to evaluate the economic benefits.

IPAS can offer several scenarios:

- Turn-key delivery of a complete installation
- DBFMO-formule: Design, Build, Finance, Maintain and Operate
- PPP-formule: Public Private Partnership
- Operational co-operation with local suppliers

Production on an annual basis in tonne

45.000 - 115.000

Production per hour in tonne

20 T

Working days a year

247

Internal employees

Technicians

Managing director

External employees

/

Administative staff

/

Summary of the key information:

- The amount of processed waste is 45 000 - 115 000 t annually, there are 247 working days at 20 Ton/hour.
- The gate fee for waste treatment is stable for a long term period.

Length of reference period

The length of the reference period is set at 17 years. The length was chosen in relation to the lifetime of the key part of the investment, which is the technological part. The investment will be realized over 2 years and will be calculated with a 15-year operation.

annex 1

ANALYSIS OF THE CALORIFIC FRACTION 2018

AmpluServis, a.s.
Elektrárenská ul.5558, 709 74 Ostrava
Department of chemical services; Phone:596 904 532

PROTOCOL OF ANALYSIS Nr. P 18-436

Analysis of fuel

Customer: VŠB - TUO, doc. Dr. Ing. Čech Bohumír

Name of the sample: **Heating plant Karviná - coal, solid recovered fuel, fly ash, slag**

Date of accepting of the sample: 5/04/2018

Results of the analysis:

Analysis methods:		SOP Nr.P 01 (ČSN 44 1377)	SOP Nr.P 06 (ASTM D 7582)	SOP Nr.P 06 (ASTM D 7582)	SOP Nr.P 05 (ČSN ISO 1928)	SOP Nr.P 05 (ČSN ISO 1928)	SOP Nr.P 03 (ČSN ISO 562)
Number of the sample:	Sample Identification N°	W_t^r (%) Total moisture original basis	A^r (%) Ash original basis	A^d (%) Ash dry basis	Q_s^{daf} (MJ/kg) Calorific value in combustible	Q_i^r (MJ/kg) Calorific capacity	V^{daf} (%) Volatile matters
18/2127	raw black coal with solid recovered fuel	6,20	25,92	27,63	35,09	22,94	28,0
Measurement uncertainty :		2% rel.	1% rel.	1% rel.	0,5% rel.	3,5% rel.	1% rel.

Analysis methods:		SOP Nr.P 07 (ČSN ISO 19579)	SOP Nr.P 07 (ČSN ISO 19579)	SOP Nr.P 12 (ČSN ISO 29541)	SOP Nr.P 12 (ČSN ISO 29541)	SOP Nr.P 12 (ČSN ISO 29541)	SOP Nr.P 12 (ČSN ISO 29541)
Number of the sample:	Sample Identification N°	S^r (%) Sulfur original basis	S^{daf} (%) Sulfur in combustible	C^r (%) Carbon original basis	C^{daf} (%) Carbon in combustible	H^r (%) Hydrogen original basis	H^{daf} (%) Hydrogen in combustible
18/2127	raw black coal with solid recovered fuel	0,43	0,63	58,310	85,895	3,359	4,948
Measurement uncertainty :		3% rel.	3% rel.	0,5% rel.	0,5% rel.	2% rel.	2% rel.

Analysis methods:		SOP Nr.P 12 (ČSN ISO 29541)	SOP Nr.P 12 (ČSN ISO 29541)	Calculation	Calculation	SOP Nr.A 38 (ČSN ISO 587)	SOP Nr.A 38 (ČSN ISO 587)
Number of the sample:	Sample Identification N°	N^r (%) Nitrogen original basis	N^{daf} (%) Nitrogen in combustible	O_d^r (%) Oxygen original basis	O_d^{daf} (%) Oxygen in combustible	Cl^r (%) Chlorine original basis	Cl^{daf} (%) Chlorine in combustible
18/2127	raw black coal with solid recovered fuel	1,095	1,613	4,693	6,914	0,110	0,125
Measurement uncertainty :		3% rel.	3% rel.	-	-	15% rel.	15% rel.

Analysis methods:		SOP Nr.P 01 (ČSN P CEN/TS 15414-2)	SOP Nr..P 02 (ČSN EN 15403)	SOP Nr.P 02 (ČSN EN 15403)	SOP Nr.P 05 (ČSN EN 15400)	SOP Nr.P 05 (ČSN EN 15400)	SOP Nr.P 03 (ČSN EN 15402)
Number of the sample:	Sample Identification N°	W_t^r (%) Total moisture original basis	A^r (%) Ash original basis	A^d (%) Ash dry basis	Q_s^{daf} (MJ/kg) Calorific value in combustible	Q_i^r (MJ/kg) Calorific capacity	V^{daf} (%) Volatile matters
18/2126	solid recovered fuel	57,20	13,03	30,44	26,85	6,12	80,7
Measurement uncertainty :		2% rel.	1% rel.	1% rel.	0,5% rel.	3,5% rel.	1% rel.

Analysis methods:		SOP Nr.P 07 (ČSN ISO 19579)	SOP Nr.P 07 (ČSN ISO 19579)	SOP Nr.P 12 (ČSN EN 15407)	SOP Nr.P 12 (ČSN EN 15407)	SOP Nr.P 12 (ČSN EN 15407)	SOP Nr.P 12 (ČSN EN 15407)
Number of the sample:	Sample Identification N°	S^r (%) Sulfur original basis	S^{daf} (%) Sulfur in combustible	C^r (%) Carbon original basis	C^{daf} (%) Carbon in combustible	H^r (%) Hydrogen original basis	H^{daf} (%) Hydrogen in combustible
18/2126	solid recovered fuel	0,12	0,41	18,286	61,426	2,173	7,299
Measurement uncertainty :		3% rel.	3% rel.	0,5% rel.	0,5% rel.	2% rel.	2% rel.

Analysis methods:		SOP Nr.P 12 (ČSN EN 15407)	SOP Nr.P 12 (ČSN EN 15407)	Calculation	Calculation	SOP Nr.A 38 (ČSN ISO 587)	SOP Nr.A 38 (ČSN ISO 587)
Number of the sample:	Sample Identification N°	N^r (%) Nitrogen original basis	N^{daf} (%) Nitrogen in combustible	O_d^r (%) Oxygen original basis	O_d^{daf} (%) Oxygen in combustible	Cl^r (%) Chlorine original basis	Cl^{daf} (%) Chlorine in combustible

18/2126	solid recovered fuel	0,550	1,847	8,639	29,019	0,136	0,761
Measurement uncertainty :		3% rel.	3% rel.	-	-	15% rel.	15% rel.

Analysis methods:		SOP Nr.P 10
Number of the sample:	Sample Identification N°	* combustibles (%)
18/U/918	fly ash K1	14,49
18/U/919	fly ash K2	10,89
18/U/920	slag K1	0,08
18/U/921	slag K2	0,97
Measurement uncertainty :		2% rel.

* Non-accredited analysis

The laboratory is qualified to implement the updated standards identifying the methods used.

Measurement uncertainty is expressed as dilated uncertainty, which is the multiplication result of standard measurement uncertainty and dilation coefficient k=2, corresponding to reliability level approximately 95%. It does not take into consideration the influence of sampling.

Date of performance of analysis: 5.-17.4.2018

Date of issue of report: 17/04/2018

Protocol issued by: Bilejová Soňa

Protocol approved by: Arabaszová Zdeňka-chief testing laboratory

Stamp and signature of the approving person:

ANNEX #45

annex 2

ASSESSMENT REPORT OF CALORIFIC FRACTION AS ALTERNATIVE FUEL UNDER CZECH REPUBLIC LAW

VVUÚ, a.s.
Certification Body for Products
Pikartská 1337/7, 716 07 Ostrava – Radvanice
Czech Republic

ASSESSMENT REPORT

No. VVUÚ – 017216/2014

Manufacturer: **RNDr. Česlav Valošek**
Karola Śliwky 149/17
733 01 Karviná – Fryštát
Czech Republic
(business name, name, address)

Product: **GENCOAL, solid recovered fuel according to manufacturer's specification**
(name, type, nominal values, etc.)

Assessment performed by: Ing. Přemysl Kanclíř
COV Expert

The date of Assessment Report issuance: 31. 7. 2014

No. VVUÚ – 017216/2014

1 Product Specification

GENCOAL is a solid recovered fuel produced according to manufacturer's specification" (see Figure 1) The fuel is produced from crushed and sorted out municipal waste from which individual fractions are mechanically separated and subsequently modified for purpose of energetic use.

Product classification according to the waste catalogue

Waste code number	Waste classification
20 03 01	Mixed municipal waste

The fuel is intended for use as an additive in solid fossil fuels in combustion process in medium and large energy facilities. The conditions for fuel utilization in particular energy facilities shall complain requirements of actual legal requirements and conditions given in permission of relevant state authority.

Figure 1

2 Assessment of the Certified Product Type with the Appropriate Regulations

2.1 Introduction

The certification proceedings for the product „GENCOAL, solid recovered fuel according to manufacturer's specification" (hereinafter fuel) was commenced based on the certification application No. 017216 from January 16, 2014, registered by the Certification Body for Products on January 27, 2014. The certification procedure was performed based on submitted technical documentation, test reports and performed inspections.

The list of used documentation and test reports is stated in Point 6 herein.

The manufacturer selected the following certification scheme:

Scheme number	Sampling	Evaluation	Certification document	Supervision
1A	Supply of the sample by manufacturer	Determination of characteristics by tests or evaluation	Certificate with limited validity	Supervision not performed

2.2 Indicators of Significant Properties and Examination Methods

Basic Requirement	Requirement regulation / documentation	Test procedure
Technical parameters of fuel	Technical specification	Control, test
Quality requirements for fuel, classification of fuel	The Act No. 201/2012 Coll. Technical specification	Control, test
User Instructions	The Act No. 102/2001 Coll. Technical specification	Control

2.3 Sample Collection

Product sample for testing was supplied on January 27, 2014.

2.4 Place and Date of Tests and Controls

The tests were performed in the Testing Laboratory in Zdravotní ústav se sídlem v Ostravě, from February 2, 2014 to April 30, 2014, in the Testing Laboratory in AmpluServis, a.s., from April 25, 2014 to April 29, 2014 and in the Testing Laboratory in VÍTKOVICE TESTING CENTER s.r.o., on February 13, 2014.

2.5 The Test and Controls Results

The controls and test results were performed in the extent specified in the chapter 2.2 of this Report. The product sample test results are the subject of Test Reports No. 8162/2014 from March 3, 2014, No. 22661/2014, from May 13, 2014, issued by Zdravotní ústav se sídlem v Ostravě, Test Report No. 2014/0157 from February 14, 2014, issued by VÍTKOVICE TESTING CENTER s.r.o., Test Report No. P 14-563 from May 13, 2014, issued by AmpluServis, a.s.

The performed controls are included in the Control Protocol No. 017216/2014 from July 31, 2014.

2.6 Comparison of the Certified Product Properties with Appropriate Regulations

Product parameter	Requirement value *(Technical specification)*	Detected value	Assessment
Water content (ar)	max. 15,0 [%]	4,2 [%]	Comply
Ash content (d)	max. 25,0 [%]	24,2 [%]	Comply
Net calorific value (ar)	min. 17,0 [MJ/kg]	22,10 [MJ/kg]	Comply

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Product parameter	Requirement value *(Technical specification)*	Detected value	Assessment
Net calorific value (d)	min. 17,0 [MJ/kg]	21,70 [MJ/kg]	Comply
Chlorine content (d)	max. 0,6 [%]	0,2 [%]	Comply
Fluorine content (d)	max. 0,02 [%]	0,008 [%]	Comply
Antimony content (d)	max. 120 [mg/kg]	10,8 [mg/kg]	Comply
Arsenic content (d)	max. 20 [mg/kg]	11,9 [mg/kg]	Comply
Cadmium content (d)	max. 7,5 [mg/kg]	1,93 [mg/kg]	Comply
Chromium content (d)	max. 500 [mg/kg]	49,1 [mg/kg]	Comply
Cobalt content (d)	max. 10 [mg/kg]	2,82 [mg/kg]	Comply
Copper content (d)	max. 1300 [mg/kg]	15,8 [mg/kg]	Comply
Lead content (d)	max. 200 [mg/kg]	30,4 [mg/kg]	Comply
Manganese content (d)	max. 250 [mg/kg]	143 [mg/kg]	Comply
Mercury content (d)	max. 0,4 [mg/kg]	0,136 [mg/kg]	Comply
Nickel content (d)	max. 500 [mg/kg]	44,3 [mg/kg]	Comply
Thallium content (d)	max. 2,0 [mg/kg]	< 2 [mg/kg]	Comply
Vanadium content (d)	max. 50 [mg/kg]	14,4 [mg/kg]	Comply
Barium content (d)	max. 200 [mg/kg]	158 [mg/kg]	Comply
PCB content – sum	max. 0,4 [mg/kg]	0,19 [mg/kg]	Comply

Notes:
(d) dry basis
(ar) as received

Technical documentation assessment

Name of document	Finding	Assessment
Technical specification – GENCOAL, solid recovered fuel according to manufacturer's specification	Technical documentation fulfills requirements of the Act No. 102/2001 Coll., as amended.	Comply

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3 Prerequisites for Continuous Adherence to the Certified Product Quality

The certificate is applied to volume of 30 tons provided that the production is carried out according to manufacturer's technical specification.

4 Conclusion

The certified product „GENCOAL, solid recovered fuel according to manufacturer's specification", made by the manufacturer RNDr. Česlav Valošek, Karola Śliwky 149/17, 733 01 Karviná – Fryštát, Czech Republic

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the requirements:

- of the Act No. 102/2001 Coll., on General Product Safety, as amended,
- of the Act No. 201/2012 Coll., on Air Protection,
- of the Technical specification – GENCOAL, solid recovered fuel according to the manufacturer's specification, from July 29, 2014.

Validity of the certificate is limited by the test volume of 30 tons of fuel.

5 Supervision

Supervisions of the certified product are not performed – see the certification scheme.

6 The List of documents for the Issuance of Certificate

- Certification application No. 017216, from January 16, 2014, registered on January 27, 2014;
- Technical specification – GENCOAL, solid recovered fuel according to manufacturer's specification, from 2 July 9, 2014;
- Test Report No. 8162/14, from March 3, 2014, issued by Zdravotní ústav se sídlem v Ostravě;
- Test Report No. 22661/14, from May 13, 2014, issued by Zdravotní ústav se sídlem v Ostravě;
- Test Report No. 2014/0157, from February 14, 2014, issued by VÍTKOVICE TESTING CENTER a.s.;
- Test Report No. P 14-563, from May 13, 2014, issued by AmpluServis, a.s.;
- Control Protocol No. 017216/2014, from 31. 7. 2014, issued by Certification Body for Products, VVUÚ, a.s.

In Ostrava - Radvanice on July 31, 2014

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