Alcyon® BioThermic
Process for MSW Disposal

Waste: cesspool or goldmine ?

Alcyon®

Alcyon® BioThermic Process

Effective Municipal Solid Waste Treatment & Value-Added Conversion

Modern society faces a wide variety of environmental problems, one of which is the management of Municipal Solid Waste (MSW).

In addition to defacing the landscape, traditional dumping sites for untreated municipal solid waste pose a potential health hazard , not only in the immediate vicinity of the site , but also to the ground water. In the search for new solutions, city councils and communities worldwide are studying the problem and providing for the necessary funding.

ALCYON offers a wide range of technologies designed to solve the waste disposal problem in an efficient, economical, and environmental friendly way.

For Municipal Solid Waste (MSW) disposal, we have developed a new concept:

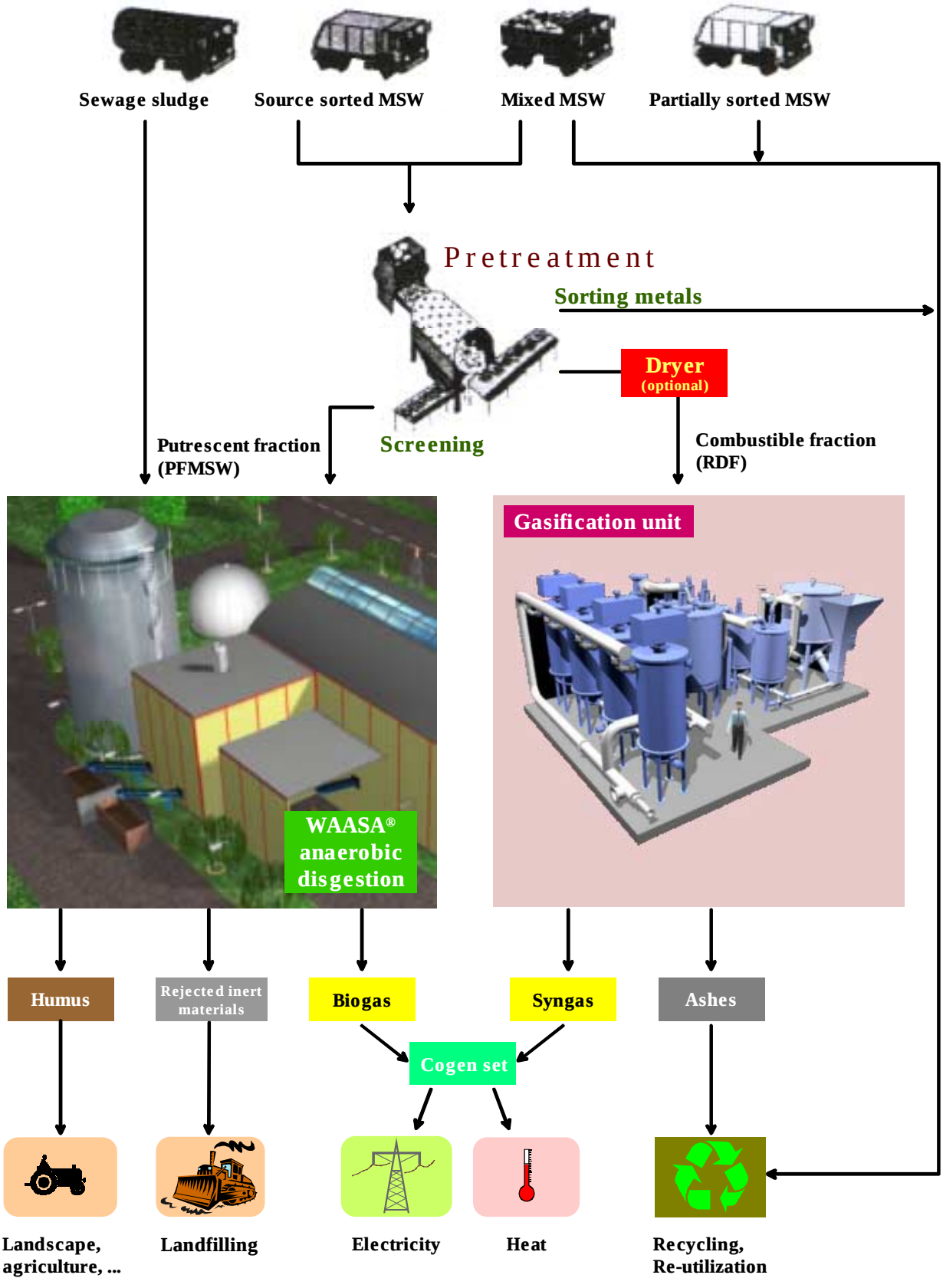
the *Alcyon® BioThermic* Process,

It is a differentiated waste disposal, where

- **the MSW Putrescent Fraction (PFMSW) is treated through a biological treatment, the WAASA® methanization process.**
- **The MSW combustible fraction, under the name of Refuse Derived Fuel (RDF), is treated through the THERMOGENICS gasification process.**

The biogas from the methanization process and the syngas from the gasification process are burnt both in a gas engine to produce electricity and heat.

BIOLOGICAL AND THERMAL TREATMENT OF MUNICIPAL SOLID WASTE



Alcyon® BioThermic Process

The Solution

The ***Alcyon® BioThermic* Process** combines:

- MSW pre-treatment (mechanical sorting)
- PFMSW methanization
- RDF gasification

MSW = Municipal Solid Waste
PFMSW = Putrescent Fraction of the Municipal Solid Waste
RDF = Refuse Derived Fuel = Combustible fraction of the Municipal Solid Waste)

This integrated process is a new and exciting solution for ensuring a high MSW recycling rate with effective MSW energy recovery.

The technology is based on extensive experiences in the process industry and on innovative planning concepts for modern waste disposal.

The process and its plant facilities meet the highest environmental standards. The plants are economical to use and safe to operate.

The *Alcyon® BioThermic* Process makes the construction of both large and small plants economical. Even very large regional waste disposal systems become feasible and economical when the *Alcyon® BioThermic* Process, with the option of a decentralized , modular approach, is utilized (see the chapter: Alcyon Integrated Municipal Waste Management).

MSW Pretreatment

A Good Start

In the MSW pre-treatment process described below, ALCYON will fit the needs of each community and will take into account any specific requirements.

First, the municipal solid waste is tipped onto the floor or into a receiving bunker from which the waste is conveyed to the primary trommel screening stage. Magnetic metals are separated from the waste before being fed into a secondary trommel screen, where the heavy fraction (inert materials and the putrescent organic fraction) and the light fraction (RDF) are separated.

The heavy fraction is then conveyed to the methanization plant for biological treatment. The RDF is conveyed directly to the gasifier, after shredding down to 50 x 50 mm lump size.

If required, the MSW pre-treatment plant can be supplied with an eddy current unit for the separation of non-ferrous metals.

The pretreatment plant includes:

1 a reception bunker

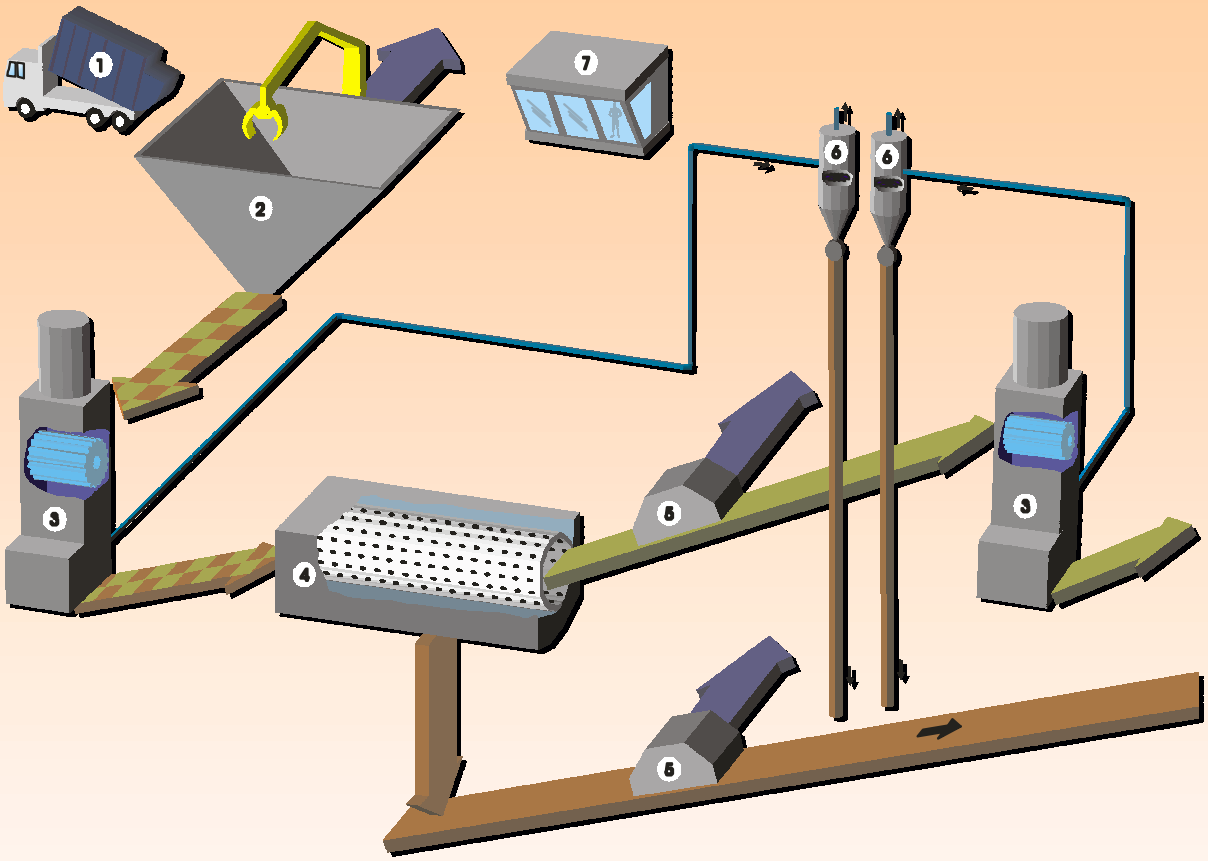
2 a primary trommel screen, for opening bags and for large pieces separation

3 conveyor belts with magnetic separator for ferrous metals separation

4 a secondary trommel screen for heavy fraction (inert materials, glass, putrescent fraction, etc.) and light fraction (RDF, mainly plastics, papers, cardboard, etc.) sorting

5 a conveyor belt with magnetic separation which takes the light fraction to a secondary shredder for size reduction down to 50 x 50 mm.

Pretreatment



1 Tipper
2 Hopper
3 Primary Trommel
4 Secondary Tromel
5 Magnetic separator
6 Dust collection system
7 Process control cabinet
8 Shredder

Municipal solid waste treatment

Methanization - the WAASA® Process

Natural Anaerobic Digestion

In landfills the degradation of organic matter takes many decades, with biogas emitted into the atmosphere, usually without any energy recovery. In a WAASA® plant the same process takes only two weeks and the biogas is utilized as fuel for energy production.

The other by-product, the humus, is fully stabilized, and suitable for use in landscaping and environmentally remedial works. Humus produced from source-sorted MSW is also suitable for use in agriculture and in horticulture.

Prior to the methanization of the substrate, solid impurities, such as glass and ceramics, aggregates (sand and gravel), cellular plastics, and cork, are removed by a patented feed preparation vessel (*Mixseparator*®).

The heart of the WAASA® plant is the patented bio-digestor (*TwinReactor*®), which operates in the thermophilic temperature range (55ºC). The process can also be applied in the mesophilic temperature range (35ºC). The choice between the two types of operation will depend solely on economical considerations .

A WAASA® plant normally consists of two or more parallel processing lines. The bio-digestors are stationary and installed upright. The size of one reactor can go up to 3,000 m^3. This will handle the waste generated by a population of approximately 200,000 people. For larger waste quantities two or more parallel reactors are required.

Depending on the size, the bio-digestors are made either of steel or of reinforced concrete. The reactors can also be built inside bedrock.

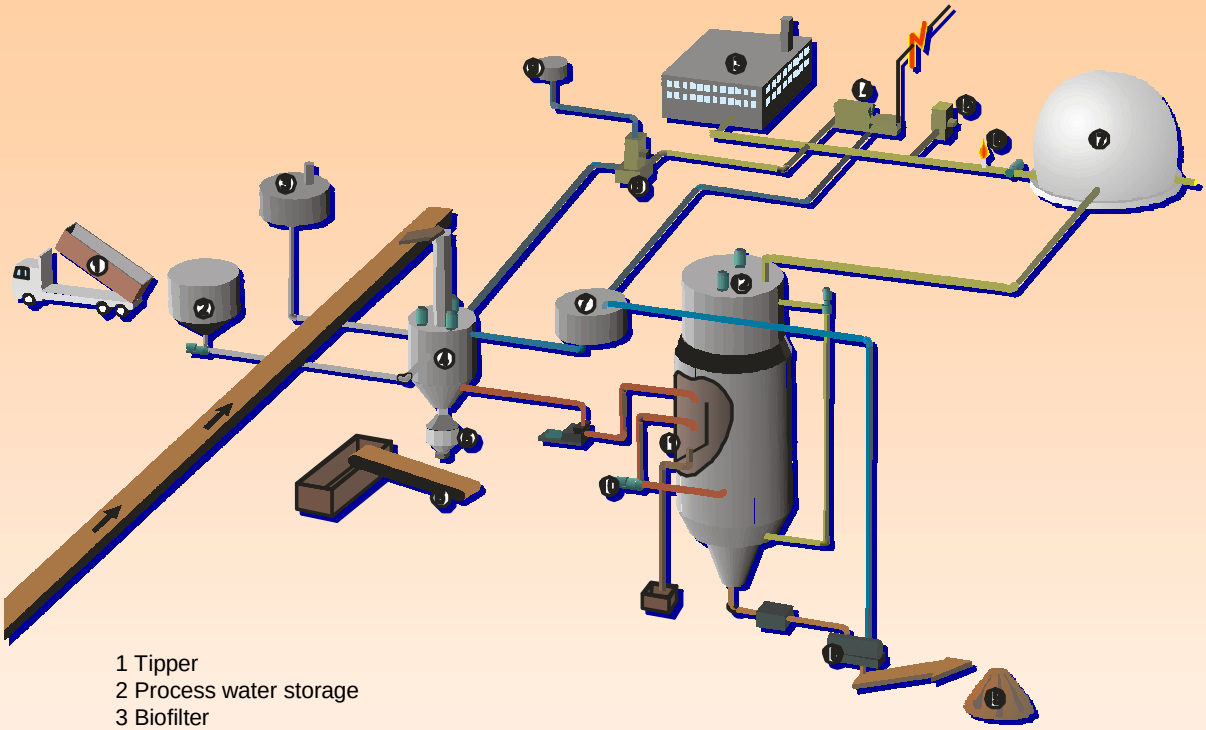
The degrading of organic matter takes place in the bio-digestors where methanogenic bacteria convert organic substances into biogas and humus matter. The retention time of material in the process is 15-20 days. The bio-reactor substrate is effectively mixed by means of a bubble column created by the circulated biogas and by mechanical devices.

For the mesophilic process the digested slurry is pasteurized in order to ensure hygienic safety. The pasteurization takes place in closed vessels, in which the slurry is kept at a temperature of 70ºC for 30 minutes. For the thermophilic process pasteurization is not necessary.

After pasteurization the slurry is mechanically dried to a total solid content down to 35% to 45% of the original volume. At a later stage, storing properties, aesthetic appearance, and usability of humus can be improved by post-aeration and by screening.

The humus by-product is fully processed and stabilized and is thus suitable for landscaping, gardening and agriculture.

Biological Treatment through the WAASA® Process



1 Tipper
2 Process water storage
3 Biofilter
4 Mixseparator®
5 Heavy fraction separator
6 Belt conveyor
7 Process water storage & heating
8 Biogas cleaner
9 Biofilter
10 Bacteria injection system
11 Biodigestor prechamber
12 Twin Reactor®
13 Building
14 Cogeneration unit
15 Biogas dryer
16 Flare
17 Biogas storage
18 Dewatering unit
19 Humus

Putrescent Fraction of Municipal Solid Waste Treatment through Methanization

Methanization & Composting Processes Combined

Combining methanization and composting technologies on the same site could provide key-benefits:

- Methanization will treat wet waste, e.g. the putrescent fraction of the municipal solid waste, wet garden trimmings, etc.
- Composting will treat dry waste, e.g. ligneous biomass waste, bark residues, etc.

Key-Benefits

- green waste management improved: no anaerobic digestion during the composting, no compost compaction, better compost aeration
- lower composting station operational costs
- no local nuisance (no odor, no leachates)
- methanization/composting equipment optimization
- complementary technologies: methanization excess water will be used for compost watering. After methanization, humus needs 10 days for maturation. It will be mixed to the compost flow. This improves the quality of the compost, resulting in improved fertilizer quality (better C/N ratio).

Waasa Plant

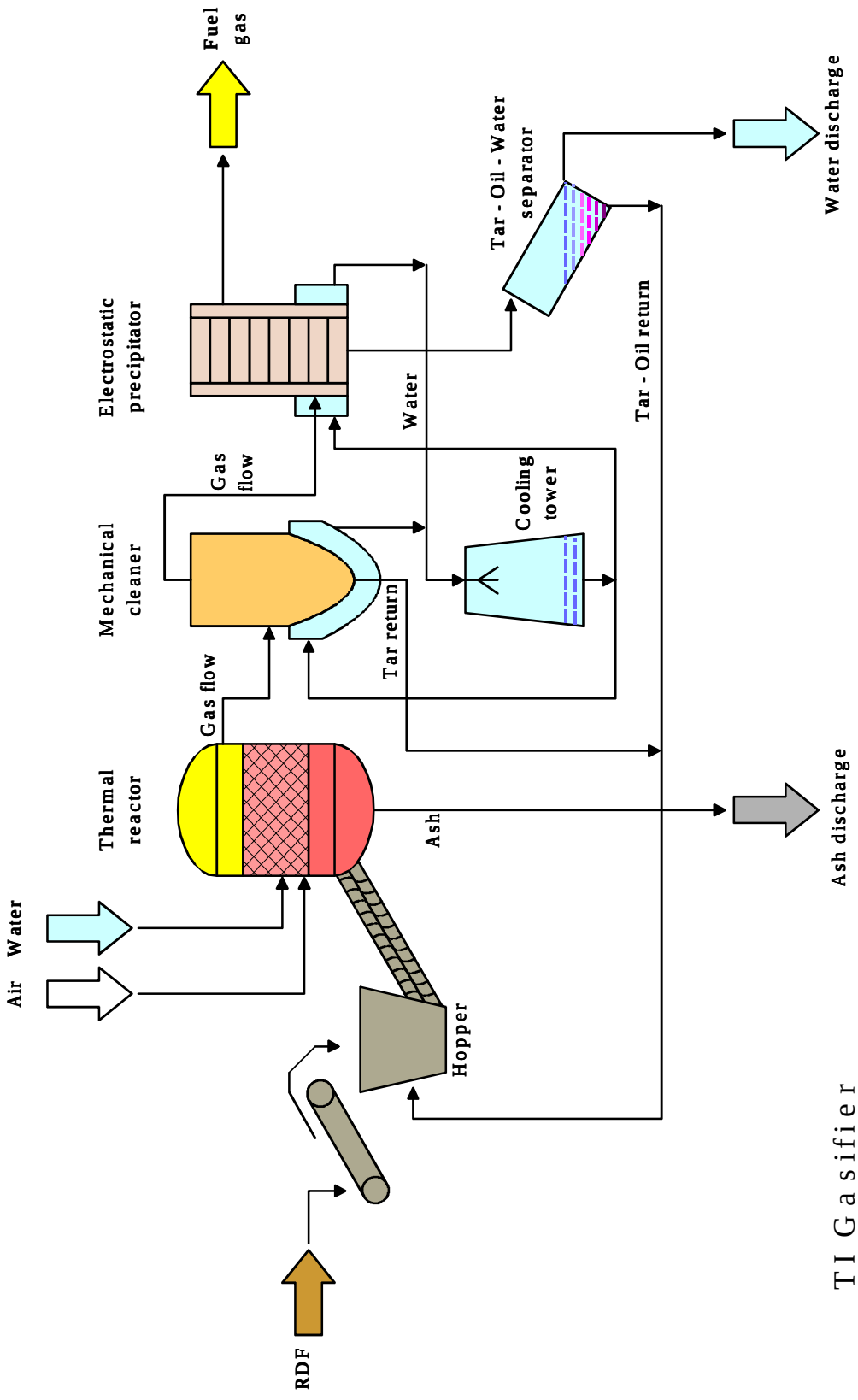
Capacity : 60’000 t/y MSW

RDF Gasification

The Environmental Friendly Way for RDF Treatment & Value-Added Conversion

The RDF is homogenized during the pre-treatment process, and has a high thermal value, with a low moisture content, compared to untreated MSW.

The RDF gasification will produce fuel gas (SYNGAS), which will be used to produce energy.



TI Gasifier

Principle of Gasification

THERMOGENICS Gasification Process Key-Benefits

- **Accepts wide range of feed stock materials**

  Flexibility in terms of waste materials available at various times of the year or with changes in market conditions - combustion-based systems are restricted to specific materials with certain physical characteristics.

- **Ability to operate at less than 100% of capacity**

  Can vary operation with availability of waste and energy demand - other systems must operate at design capacity - less flexibility.

- **No air emissions from the gasifier**

  The gasifier does not require a "smokestack" as its emissions are the combustible gas used to produce electrical power. The only emissions are those from the engines, boilers or gas turbines. Environmental permitting is simplified and less costly.

- **Continuously Operation**

  Better suited for operations where operations are not required for seven days per week and 24 hours per day.

- **Operates at low pressures and temperatures**

  Reduced original cost. Simplified and longer cost maintenance requirements. Less stringent requirements for operating permits.

- **Fully Automated Operating System**

  Does not require a full-time operator. Complete system diagnostics built in to computer controlled operating system.

Alcyon® BioThermic Process Key-Benefits

The *Alcyon® BioThermic* Process represents an unique combination of state-of-the-art techniques, in which science and modern processes technology work hand-in-hand. All sub-processes are designed for treating, not producing waste. Therefore the quantity of waste to be landfilled after treatment is lower than in competing methods. The *Alcyon® BioThermic* MSW Treatment Plant generates, per ton of municipal waste received ,about 10% to 15% of inert material for landfilling, which is much less than with MSW mass burn incineration.

Due to effective water re-circulation. the quantity of waste water is greatly reduced. Prior to disposal, effluents are treated in accordance with the regulations of the controlling authority.

Flexibility

- Capacities from 100 tons per day up to 2,000 tons per day.
- Centralized or decentralized plant implementation.
- Easy adaptation to possible future changes in waste quantity and quality.
- Step by step construction for large areas.
- Possible co-digestion of sewage sludge.

Ecological Aspects

- Closed processing eliminates local nuisances such as odors, birds, rats, etc.
- Low emissions into air, land and water.
- High recycling rate.
- Fully processed by products.
- Minimum plant waste.

Reliability

- Proven technologies.
- Expert and advanced engineering.
- Efficient process control and automation.

Economical Aspects

- Higher net energy production when compared to mass burn incineration or other waste disposal systems; increased revenue from sale of energy.
- Lower investment costs.
- Lower operational costs resulting from high automation (reduced need for man-power), and from moderate consumption of process chemicals and of energy.,
- Excellent return on investment.

Competitiveness

- The need for landfill space is only 1/10 of that used by simply dumping into landfills, and 1/3 of what mass burn incineration method requires.
- The whole process takes only two weeks as compared with the 3 - 6 months required by an aerobic composting plant. In landfills the biodegradation takes over 20 years and biogas is emitted in an uncontrolled way into the atmosphere.
- Energy production is high compared with mass burn incineration and other conventional combustion processes. In the future, most reusable materials like paper and plastic will be recycled and not incinerated. Removing them will reduce the heat content of municipal solid waste. For mass burn incineration this means that some additional fuel will have to be used in order to burn the waste effectively. This does not apply to the *Alcyon® BioThermic* waste disposal. The total amount of RDF will decrease. but the RDF calorific value will not change, so the thermal process will not be affected.
- Investment and operational costs are competitive compared to mass burn incineration and other conventional combustion processes.
- Co-digestion of sewage sludge with PFMSW is possible, and increases profits.
- Decentralized *Alcyon® BioThermic* waste disposal plants make possible considerable savings in transportation costs as compared with centralized systems.
- Processing the MSW putrescent organic fraction into humus increases the recycling rate to meet national requirements.

Alcyon® Integrated MSW Management Program

A Decentralized Method for MSW Management

Basic Principle # 1

Differentiated Municipal Solid Waste Disposal

An *Alcyon® BioThermic* plant consists of:

- 1x Pretreatment plant, for MSW mechanical sorting.
- 1x Methanization plant, for PFMSW treatment.
- 1x Optional pelletizing plant, for RDF densification.
- 1x Gasification plant for RDF treatment.
- 1x Cogen Set for energy production.

It will be a much more environmental friendly way and cheaper way to treat MSW.

Basic Principle # 2

MSW Decentralized Plants Implementation

Costly MSW transportation requires a decentralized approach of MSW management. It is also true that a step by step implementation program will be more realistic for solving the problem. Three basic modules will be available:

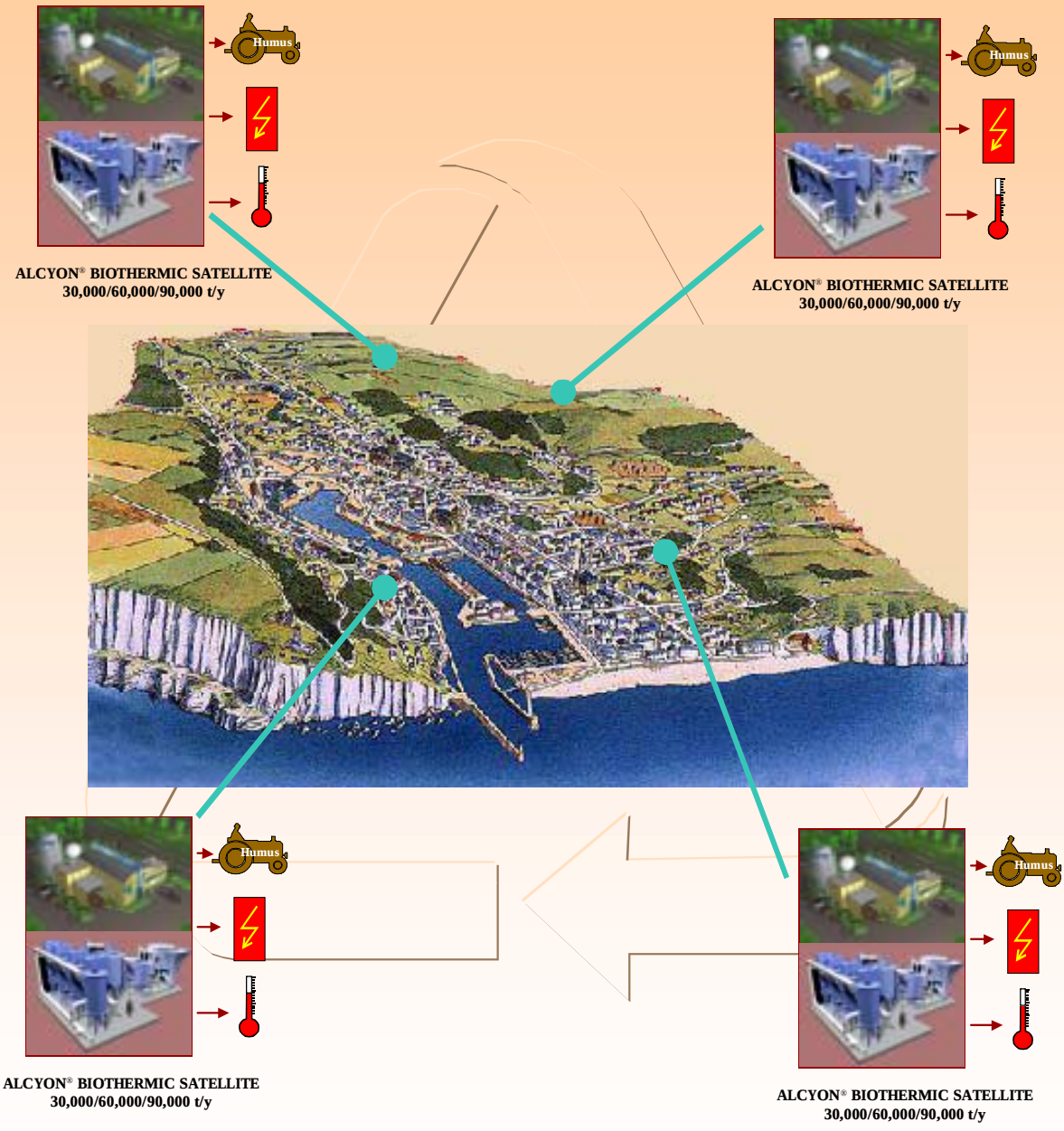
- 30'000 metric tons per year
- 60'000 metric tons per year
- 90'000 metric tons per year

The plants localization and their capacities could be optimized by the Alcyon® Integrated MSW Management Program.

Key-Benefits :

- lower MSW management costs
- step by step MSW management
- lower investment & operational costs
- Environmental friendly way MSW treatment

"ALCYON® BioThermic"
Decentralized MSW Management



Remarks:

- **On the same site, satellite capacity can be doubled, tripled, etc.**
- **The satellites localization and their capacities could be optimized by the WAIMS Program.**

Municipal Solid Waste Questionnaire

Please fill and fax to Alcyon S.A., +41-26-469 03 14

Company / Community Name : .....

First Name : ..... Last Name : .....

Address : .....

P. N. (ZIP) : ..... City : .....

State : ..... Country : .....

Phone : ..... Fax : .....

Waste characteristics

Annual volume : ..... m^3

Annual weight : ..... m.t

Average composition:
(% of total weight)

Type		
Organics, Putrescibles		%
Wood, Grass		%
Paper, Cardboard		%
Plastic, Rubber		%
Textile, Leather		%
Glass, Sand, Stones		%
Metals		%
Inerts, misc. waste		%

Value-added Conversion

Local needs for:	Yes	No	Sales price	
Electricity				USD/kWh
Fresh water (bottles)				USD/m3
Water treatment				
Cooling				
Heating				
Steam production				USD/kWh
Organic fertilizer				USD/t

Geographical situation of the projected MSW Treatment Plant

Distance to the city: ..... km

	Yes	No
Roads available		
Facilities available		
Water available		
Electricity available		

Date : .....

Alcyon S.A.
Chantemerle 39 P.O. Box 301 • CH-1701 Fribourg (Switzerland)
Tél : +41 26 469 03 10 Fax : +41 26 469 03 14
www.alcyon.ch E-Mail: desk@alcyon.ch