

# EASILY ERECTABLE PREFABRICATED SOLID WASTE RECYCLING PROCESSING PLANTS (WRPP) WITH HIGH TEMPERATURE PYROLYSIS (HTP) TECHNOLOGY FOR SUB-SAHARAN AFRICA

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## 1. INTRODUCTION

Every State has the obligation to promote and maintain the welfare of its people and that all people have the right to live in a clean, healthy environment through sustainable and effective waste management<sup>1</sup>. The option for waste management that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the short term and long term, must be adopted to reduce the generation of waste and polluting substances at source. This means that the reduction, re-use and recycling of waste must be promoted<sup>2</sup>.

### 1.1. Situation Statements

- There are actually no proper integrated technical/technological systems for solid waste management on international standards for storage and processing of all types of solid wastes in most of the African countries;
- The existing municipal landfills/dumpsites are mostly not in accordance with the national and international environmental laws and therefore cannot operate further in this form;
- The electricity prices for the public and the industry in most of the African countries have increased dramatically in the past 15 years or so and there is need to put in place alternative and cheaper means of producing electricity.

### 1.2. Proposed Solution

New ecological technologies of waste processing of unsorted household and industrial solid waste are available whereby the solid waste is packed and sealed in airtight bags suitable for harmless long-term storage before processing to generate electricity. The packed solid waste is fed into special modular waste processing plants (Figure 1) with High Temperature Pyrolysis (HTP) in Thermo-Chemical Processors (TCP) that allow for 100% treatment of all types of unsorted waste (household, industrial, medical, construction, tires, etc.). The thermal energy produced by the reactors is then used to generate electricity without harmful emissions into the atmosphere. This is a relatively new technology, but worldwide, already some HTP WRPP plants are in operation.



**Figure 1: Some operational high-temperature pyrolysis technology plants (Energos)**

Currently, a total of 11 plants with high-temperature pyrolysis technology are in operation in Russia, Norway, Germany, Italy, Japan and the United Kingdom and other 9 plants are under construction in other countries. However, none of the facilities, which are in operation, under construction or currently in planning stage, consists of prefabricated, fast-erectable elements for solid waste processing.

## 2. Types of HTP WRPP

The existing HTP technologies in Norway, Great Britain and Russian differ primarily in the preparation of the waste before processing and in the HTP, TCR types.

There are two variants of waste preparation before processing:

- Unsorted solid waste is introduced into the TCP as a loose bulk;
- Unsorted solid waste will be compacted, packed into sealed envelopes of plastic sheeting (bales) before being introduced into the TCP.

There are two types of HTP TCP's:

- Horizontal HTP TCP;
- Vertical HTP TCP.

All facilities, which are in operation, under construction or currently in planning stage (Norway, United Kingdom, Germany, Russia), consists of individually planned and realized facilities with loose bulk waste introduction and horizontal HTP TCP for solid waste processing; but these are not usable for Africa.

### 3. Technical and Technological Requirements

This legally protected and patented new sustainable & environmentally friendly combined ecological technology for electricity generation from unsorted solid domestic and industrial waste in special modular WRPP with HTP in TCP allows 100% recycling of all types of unsorted solid waste in connection with prior significant volume reduction through effective compression for harmless short, medium & long-term storage before processing.

Depending on the population, a complete recycling of waste and garbage can be organized in a certain region, as well as production of electricity without harmful emissions into the atmosphere. The existing garbage in landfills, as well as the solid waste and garbage received daily, will be compacted, packed in sealed envelopes of polyethylene film (bales), as shown in Figure 2, and then stored in open space for any period up to 50 years or more (according to research result of the University of Lund, Sweden) before processing on special modular WRPP.



Figure 2: Waste Packaging and Bale Storage (Bala)

The treatment will be carried out in a vertical thermochemical reactor under high-temperature pyrolysis, as seen in Figure 3. The technology is protected by seven patents.



Figure 3: Vertical Thermo-chemical processor (Itlan)

The capacity of the single basic thermo-chemical processor is 100 tons of solid waste per day. The electricity output of the basic processor is 6 MW of electricity (for appr. 30,000 people).

The maximum capacity of one plant with TCP for recycling solid waste and garbage is not limited. The installation must be performed with a large number of processors.

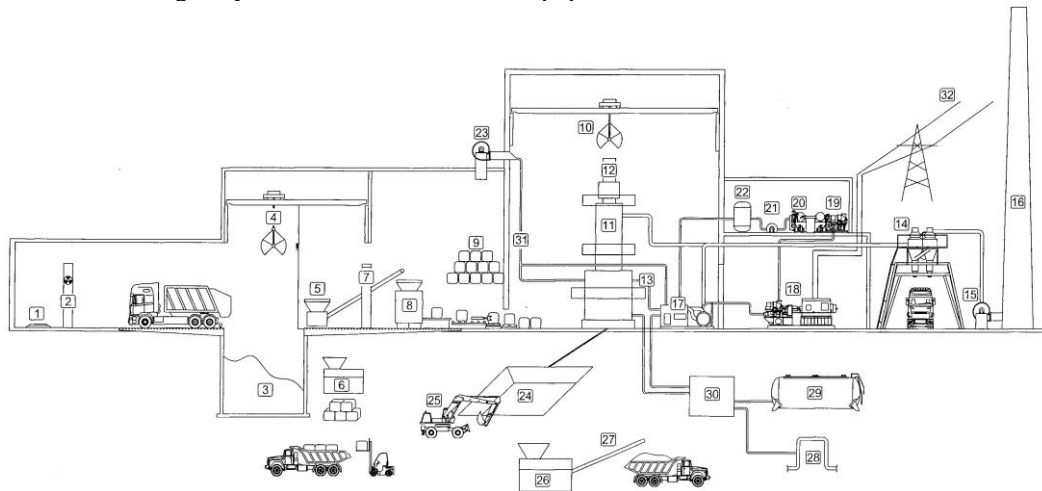
#### 4. Principle of the Technology of HTP:

- (i) Baled Municipal Solid Waste (MSW) heating up to 1650°C in a TCP with limited air access;
- (ii) Inorganic substances form a stable and eco-friendly slag melt (up to 20 tons/day) that can be used in road construction instead of gravel and crushed stone;
- (iii) Reactions occurring in the high-temperature zone with controlled air supply promote the formation of a pyrolysis gas, consisting essentially of the following elements: H<sub>2</sub>, CO, CO<sub>2</sub>, N<sub>2</sub>, CH<sub>4</sub>;
- (iv) Lack of air and existence of high temperatures preclude the formation of dangerous oxides of nitrogen, dioxins and persistent organic pollutants;
- (v) The technology also provides per single basic processor a significant amount (up to 6 tons/day) of ferrous metal in the form of scrap before baling (to be supplied to a metallurgical plant) and crashed slag (up to 20 tons/day) for road construction;

#### 5. Distinctive Features of this Technology from other Methods of Solid Waste Processing

- (i) Lack of air and existence of high temperatures of processing of MSW exclude environmentally harmful emissions into the environment in the form of nitrogen oxides, dioxins, furans and persistent organic pollutants;
- (ii) The result of waste processing is a product in demand in the national economy in the form of pyrolysis gas, electric and/or thermal energy, slag or the production of various chemical elements for the petrochemical industry;
- (iii) New polygons are not created and old territories are freed from previously created landfills for disposal of solid waste;
- (iv) The proportion of waste remaining for disposal is close to zero;
- (v) Atmosphere, soil, underground and surface water, as well as vegetation are not contaminated by waste;

- (vi) The level of ecologically caused diseases within the population is reduced.



**Figure 4: PRINCIPAL TECHNOLOGICAL SCHEME OF MPZ FACTORY (Itlan)**

### 6. Main Advantages of High Temperature Pyrolysis over Incineration

- (i) In principle no need for waste sorting before processing;
- (ii) The possibility of processing solid waste with a relatively high content of inorganic components;
- (iii) Resistance to high humidity of solid waste and variable morphological composition of waste;
- (iv) Can be used to dispose a wide class of waste, including persistent organic pollutants and waste, for which no other disposal methods exist;
- (v) Integration into existing waste treatment chains, including existing waste sorting and processing plants. This eliminates the need of polygons for landfilling.

### 7. Standard Design Project

A **Standard Design Project (SDP)** is an architectural design project which can be applied to a large number of objects and is used for implementation by many performers under different conditions.

The SDP for solid WRPP with HTP technology for Sub-Saharan Africa foresees a high level of prefabricated modules for easy erection of the whole plant. Traditional building work is reduced to a minimum. This avoids typical construction mistakes. All prefabricated modules will be ready delivered to the construction site and connected by cables and pipes. This considerably reduces the installation and trial operation time.

A special feature of this technology is that the plant is built directly on a landfill/dumpsite and usually requires no additional land. In addition, there is minimal material transportation. All elements of the plant must therefore take account of these special foundation conditions. This also opens up the possibility of complete short-term movement of the entire plant to another location.

### REFERENCES

- [1]. Constitution of the Republic of Namibia
- [2]. Act No 7 of 2007, Environmental Management Act, Namibia 2007 April 2018