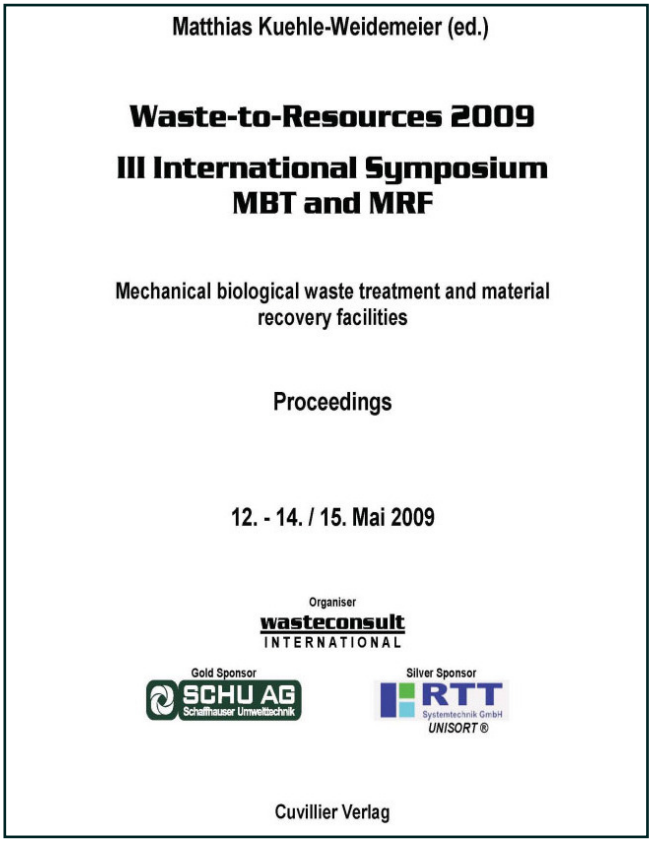
Matthias Kühle-Weidemeier (Herausgeber)

Waste-to-Resources 2009 III International Symposium MBT and MRF

Mechanical biological waste treatment and material recovery facilities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with different methods to determine the reduction of the biodegradables content in the waste (see section 3).

For the purpose of BMW diversion from landfill an MBT plant could simply compost all waste without any separation and landfill the residues. This might be a first stage of the development of a waste treatment system and would help to meet current legal requirements in terms of BMW diversion. It would be a straightforward solution which would not rely on markets for products from the process like RDF etc.

The more common approach is shown in figure 1 to combine the biological treatment with mechanical processing steps to separate products from the waste prior or/and after the biological treatment. The configuration can comprise a wide range of technologies and a wide range of products. This is reflected in the mass flow diagram which shows a fairly high range for the products that can be separated.

A common approach is the front-end separation of a RDF fraction which will be utilised in industrial processes like cement kilns, coal power plants, purpose built combustion facilities (e.g. to feed the energy to an industrial process) or in a mass burn incineration.

In case of a front end separation the material left after the separation stage is enriched with easily degradable components like kitchen waste and “dirty” paper, like tissues, which are not suitable for recycling. This material is then treated through an aerobic process (composting) where aerobic (oxygen breathing) bacteria and other micro-organisms digest organic wastes. In the process the bacteria grow and reproduce by using some of the energy and material in the organic matter. This process yields carbon dioxide and heat. The time taken for composting is usually determined by the rate at which the feed can be hydrolysed. Higher temperatures accelerate the hydrolysis stage, but the number of micro-organisms that can survive these higher temperatures is reduced.

The continuation of the composting process requires the addition of water. Water is needed to hydrolyse the feeds and progress the other biochemical reactions. The stabilised waste can then be landfilled. An alternative discussed in some countries in Europe is a compost like product that can be produced through a post-refinement stage. At this stage other material, like RDF or aggregates can be separated as well if a market is available and the process is economically viable.

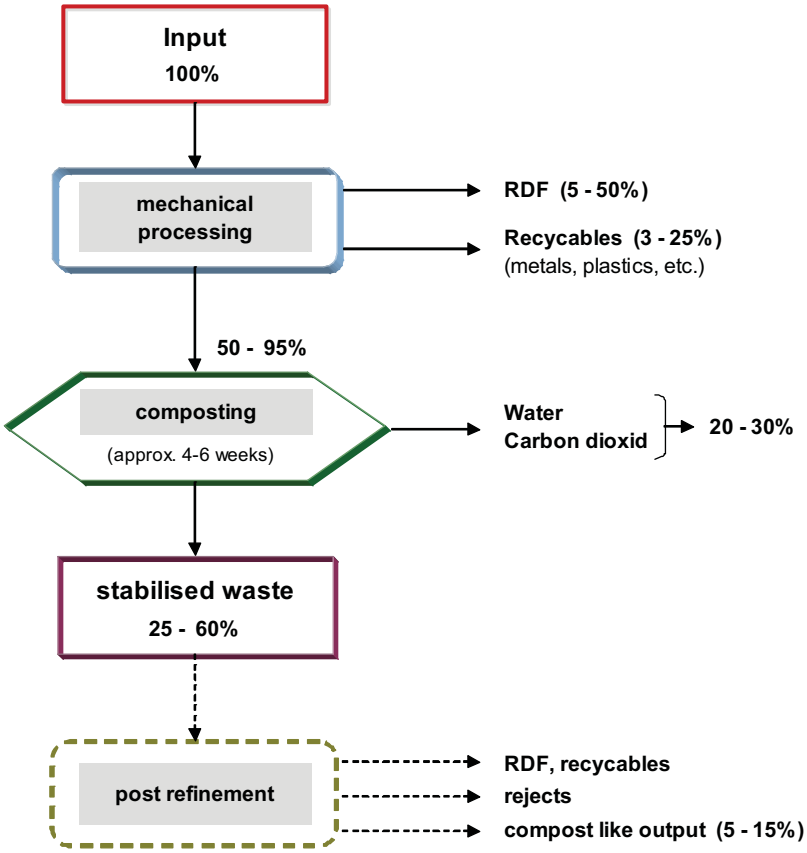

Figure 1: MBT for stabilisation

2.2 MBT with Anaerobic Digestion

Anaerobic Digestion is a biochemical process which takes place in a vessel in the absence of oxygen and results mainly in the formation of a carbon dioxide and methane gas mixture known as "biogas"

Anaerobic Digestion is very often referred to as a separate MBT approach. This might be justifiable for the aspect that renewable energy is produced. If looking at with respect to legal requirements for waste treatment AD is just one component of a MBT strategy. The most common approach where AD is involved is through the stabilisation approach. AD in such a context would then be used as the first stage of the biological treatment which focuses on the anaerobically easily degradable waste components. The "biogas" produced during digestion is used to provide internal electrical power generation and heating requirements. Surplus electrical power (and heat) can be sold as renewable energy.

The digestate is usually dewatered and treated aerobically (composted; often referred to as “maturation”). The purpose of the second stage is to further stabilise the waste, reduce the mass and reduce the odour of the material.

Figure 2 shows such an approach. The flow diagram looks very similar to the “stabilisation” approach. There is a significant impact in terms of process technology involved and the invest costs of such an approach are higher. On the other hand revenues from the biogas utilisation via CHP can be generated which might offset the higher investment costs.

An alternative to the approach of dewatering and further composting is the direct use of the digestate as a liquid fertiliser/soil conditioner. This is subject to meeting any legal requirements and conditions imposed. The key impact on the plant design will be in terms of achieving the sanitisation requirements imposed by the animal by-products legislation.

Figure 3 below shows the development of anaerobic digestion facilities in Europe for both biowaste (source separated kitchen and garden waste) and residual waste through MBT. It can be seen that anaerobic digestion of residual waste has rapidly increased over the last 5 – 7 years.

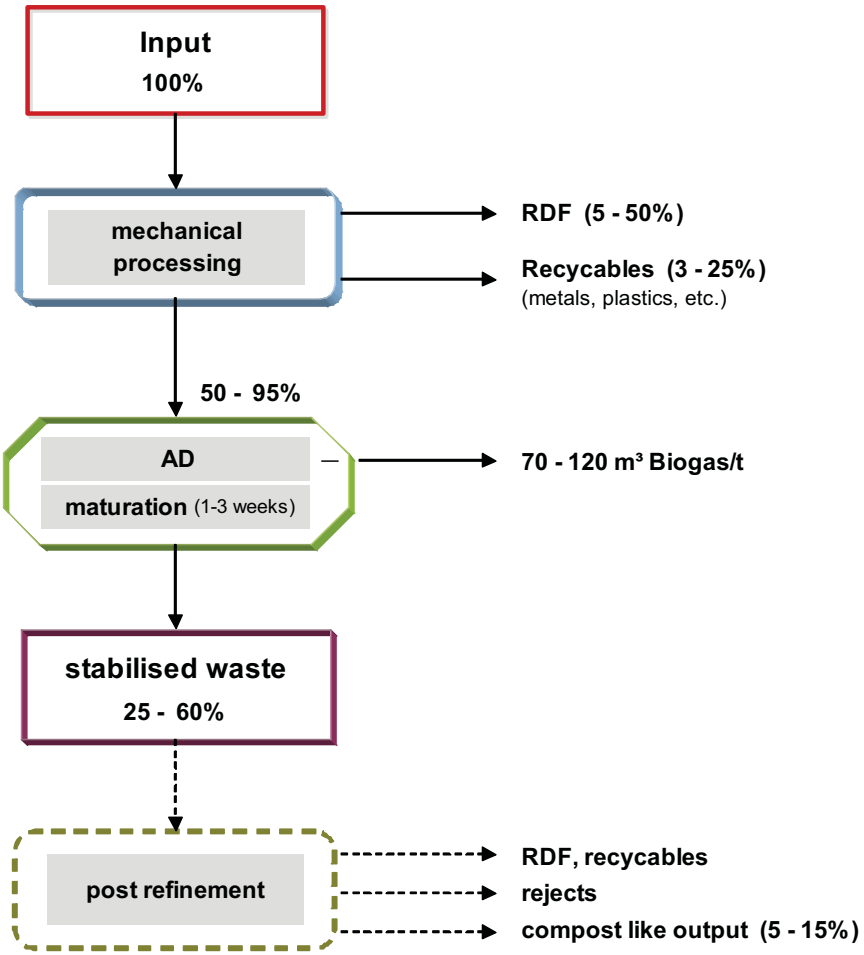

Figure 2: MBT with Anaerobic Digestion

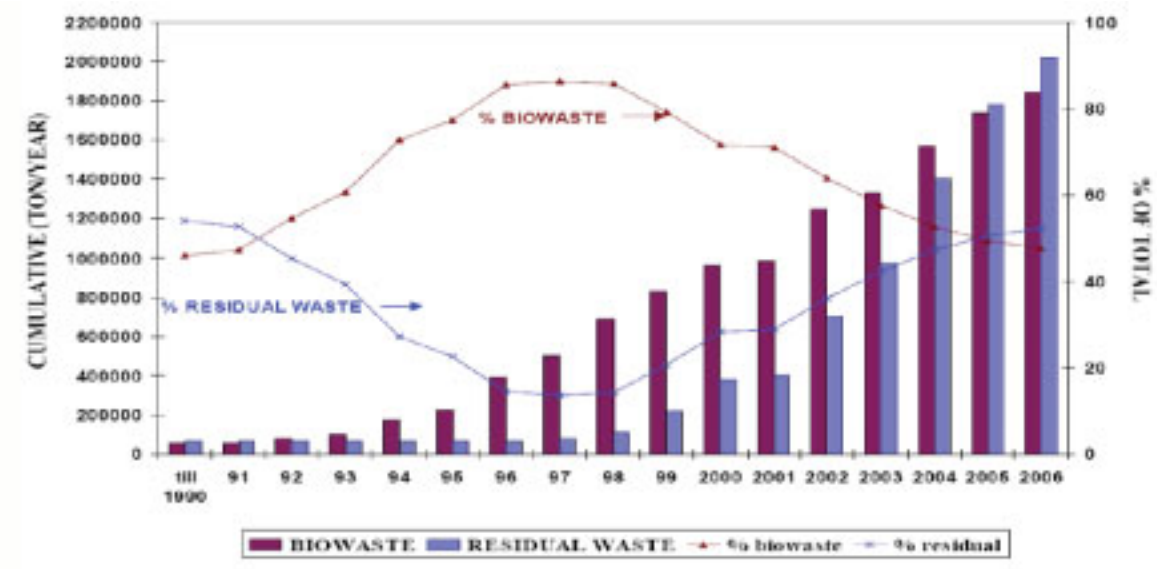

Figure 3: Development of MBT plants in Europe (deBare, 2007)

2.3 Biological Drying

"Biological Drying" is the other fundamentally different MBT approach. The scope of this approach is to make use of the energy content of the waste by means of the production of a (high quality) RDF which is the used for energy production.

The most well-known technology suppliers/developers of this approach are "Herhof" (Germany, now owned by the Greek civil construction company "Helector") and "Eco-deco (Italy)"

The main purpose of the biological part of the process is to produce the heat which is used to drive of the moisture from the waste in order to enable easier and more efficient mechanical separation. Hence the mechanical separation is performed after the biological treatment.

The waste is shredded and placed in enclosed bio-drying boxes for a pre determined period. Air is forced through the waste creating optimum conditions for microbial respiration, and hence drying of the waste. The warm air is extracted from the boxes and is passed over a heat exchanger. Air passed through the boxes is re-circulated, which is significantly reducing the volume of exhaust air.

Often associated with the biological drying approach is the production of a high quality RDF which can be burnt in industrial plants like cement kilns for a lower price than in a combustion facility or mass burn incineration. Another benefit of the drying of the waste is the increase of the calorific value of the material. There are also a few examples of existing facilities where no biological system is used for the drying process but a physical drying is used instead using gas or oil to produce the heat for evaporating the moisture from the waste.

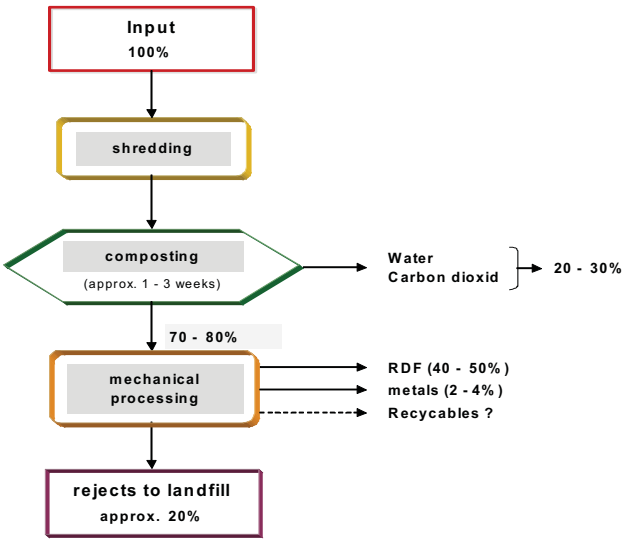

Figure 4: MBT – biological drying

3 Parameters to assess biodegradability

3.1 Background

The EU landfill directive requires a reduction of 65% in the amount of biodegradable waste which is landfilled (Art. 5). The main purpose of this requirement is a reduction in the adverse effect to the environment of the landfilling of untreated waste. The major problem with organic waste is that it degrades to the greenhouse gas methane in a landfill. Methane is a greenhouse gas that is 26 times more potent than Carbon Dioxide. Even with a state of the art landfill design incorporating methane capture, substantial amounts of methane will still escape to the atmosphere and contribute to global warming.

In Norway the government suggests the introduction of a threshold for biodegradable content in waste going to a landfill, defined by 10 % total organic carbon (TOC) or loss of ignition (LOI).

3.2 Parameters in different countries

While this general context is clear, the EU landfill directive does not give a clear guidance as to how to determine what is biodegradable. As methane is produced in landfills by a biological process, a suitable parameter to determine “organic waste” has to be established to measure it. In extensive research, predominantly in Germany, but also in Austria, Italy and other countries it has been demonstrated that several parameters may be used to determine the biodegradable content of waste. However, different biological tests measuring the aerobic (respiration) or anaerobic (gas formation) decomposition