WasteServ Malta Ltd

Integrated Pollution and Prevention Control Consolidated Application

Malta North Waste Treatment Plant (IP007/13)

Operation of a Mechanical Treatment Plant with Anaerobic Digester & a Biogas Plant for Animal Manure

Supporting Information

May 2015

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Disclaimer

The information provided in this document is not based on the conceptual design as received at tendering stage. The design is dependent on the technology proposal submitted by the eventual selected bidder. Furthermore, once the winning bid is selected and eventually awarded, the conceptual design submitted at tendering stage has yet to be refined, finalised and approved by the Client. Only then would the supporting information be valid, hence this document accompanying the present IPPC application is still subject change.

B1.2 NON-TECHNICAL DESCRIPTION

Please provide a non-technical description of the proposed installation activities.

The current application is for an integrated pollution prevention and control (IPPC) permit related to the operation of the Malta North Waste Treatment Plant (the facility) in Ghallis L/O Naxxar.

The facility, which shall be operated by WasteServ Malta Limited, shall consist of two main elements which may operate independently:

- A Mechanical Treatment Plant (MTP) coupled with an Anaerobic Digester (AD) able to process either municipal solid waste (MSW) or at source separated biowaste in a series of mechanical and biological treatment steps with a capacity of 100,000 tonnes of waste per annum. The facility will also include a sorting facility for bulky waste with a capacity of 47,000 tonnes per annum.
- A biogas plant for the receipt and treatment of manure with a capacity of 39,000 tonnes of manure per annum.

Similar to other WasteServ facilities, a quality management system (QMS) and environmental management system (EMS) shall be developed; the latter will ensure the continuous improvement of the environmental performance of the facility.

An environmental monitoring programme covering air, land, water and noise is currently being implemented for the neighbouring landfill facilities; this shall be pursued and adapted to include monitoring of parameters relevant to the operation of the new facility.

B.1.4.1 Site Report

A site report, providing a history of the site (including current and past uses) and describing the condition of the site of that part of the installation in respect of which you are applying for a permit, and, in particular, identifying any substance in, on or under the land which may constitute a pollution risk. A baseline report assessing the state of the groundwater and land may also be required by the Authority.

Site Description

The site is located within a complex of existing facilities that includes the former Maghtab landfill, as well as new and proposed waste management facilities in various stages of development including the Ghallis and Ta' Zwejra engineered landfills, a hazardous waste storage facility and a civic amenity site.

It is located on the northern coast of the Maltese Islands. Overall the site is relatively flat lying. Apart from the land that has in the past been landfilled, the majority of the site was used for agricultural purposes. The area was not intensively farmed and a number of areas were unused. Parts of the site, particularly along the northern and western boundaries were used by trappers. Degraded garigue is located along the northern and eastern boundaries of the site.

Further information on the current and past uses and condition of the site may be found in section 4 of the Environmental Impact Assessment prepared in connection with the development of the facility. A copy is being included with this application.

Further detail can also be referred to in the Section Land and Ground Water Risk Assessment at the end of this annex.

B2.1 ENVIRONMENTAL MANAGEMENT SYSTEM

Provide details of your proposed management techniques and environmental management system (EMS). An EMS can take the form of a standardised system (e.g. EN ISO 14001:1996; EMAS) or a non-standardised ("customised") system, provided that is properly designed and implemented.

WasteServ is currently in the process of implementing ISO9001 and ISO14001 for its facilities which are already in operation. Eventually the system will be extended to include this facility. The way the environmental management system (EMS) is planned will ensure the continuous improvement of the environmental performance of the facility. The planning, development and implementation of ISO14001 shall start 6 months from the operation of the facility.

The implementation of the EMS will focus the attention of the operator on the environmental performance of the installation. In particular the maintenance of and compliance with clear operating procedures for both normal and abnormal situations and the associated lines of responsibility should ensure that the facilities permit conditions and other environmental targets and objectives are met at all times.

It will be a standardised EMS, to give higher credibility, that will contain the following components:

- definition of an environmental policy
- planning and establishing objectives and targets
- implementation and operation of procedures
- checking and corrective action
- management review
- validation by certification body

A) DEFINITION OF AN ENVIRONMENTAL POLICY

Top management will be responsible for defining an environmental policy for a facility and ensuring that it:

- is appropriate to the nature, scale and environmental impacts of the activities
- includes a commitment to pollution prevention and control
- includes a commitment to comply with all relevant applicable environmental legislation and regulations, and with other requirements to which the organisation subscribes
- provides the framework for setting and reviewing environmental objectives and targets
- is documented and communicated to all employees
- is available to the public and all interested parties

B) PLANNING

- procedures to identify the environmental aspects of the facility, in order to determine those activities which have or can have significant impacts on the environment, and to keep this information up-to-date.

- procedures to identify and have access to legal and other requirements to which the organisation subscribes and that are applicable to the environmental aspects of its activities.

- establishing and reviewing documented environmental objectives and targets, taking into consideration the legal and other requirements and the views of interested parties establishing and regularly updating an environmental management programme.

- including designation of responsibility for achieving objectives and targets at each relevant function and level as well as the means and timeframe by which they are to be achieved.

C) IMPLEMENTATION AND OPERATION OF PROCEDURES

It will be important to have systems in place to ensure that procedures are known, understood and complied with, therefore effective environmental management includes:

I. *Structure and responsibility:* defining, documenting and communicating roles, responsibilities and authorities, which includes appointing one specific management representative; providing resources essential to the implementation and control of the environmental management system, including human resources and specialised skills, technology and financial resources.

II. *Training, awareness and competence:* identifying training needs to ensure that all personnel whose work may significantly affect the environmental impacts of the activity have received appropriate training.

III. *Communication:* establishing and maintaining procedures for internal communication between the various levels and functions of the facility, as well as procedures that foster a dialogue with external interested parties and procedures for receiving, documenting and, where reasonable, responding to relevant communication from external interested parties.

IV. *Employee involvement:* involving employees in the process aimed at achieving a high level of environmental performance by applying appropriate forms of participation such as the suggestion book system or project-based group works or environmental committees.

V. *Documentation:* establishing and maintaining up-to-date information, in paper or electronic form, to describe the core elements of the management system and their interaction and to provide direction to related documentation.

VI. Efficient process control:

- adequate control of processes under all modes of operation, i.e. preparation, startup, routine operation, shutdown and abnormal conditions.
- identifying the key performance indicators and methods for measuring and controlling these parameters (e.g. flow, pressure, temperature, composition and quantity).
- documenting and analysing abnormal operating conditions to identify the root causes and then addressing these to ensure that events do not recur (this can be facilitated by a 'no-blame' culture where the identification of causes is more important than apportioning blame to individuals).

VII. Maintenance programme

- establishing a structured programme for maintenance based on technical descriptions of the equipment, norms etc. as well as any equipment failures and consequences.
- supporting the maintenance programme by appropriate record keeping systems and diagnostic testing.
- clearly allocating responsibility for the planning and execution of maintenance.

VIII. *Emergency preparedness and response:* establishing and maintaining procedures to identify the potential for and response to accidents and emergency situations, and for preventing and mitigating the environmental impacts or human health impacts that may be associated with them.

D) CHECKING AND CORRECTIVE ACTION

I. Monitoring and measurement

– establishing and maintaining documented procedures to monitor and measure, on a regular basis, the key characteristics of operations and activities that can have a significant impact on the environment, including the recording of information for tracking performance, relevant operational controls and conformance with the facilty's environmental objectives and targets.

- establishing and maintaining a documented procedure for periodically evaluating compliance with relevant environmental legislation and regulations.
- Establishing and maintaining a documented procedure to monitor any adverse impacts on human health especially with regards to air emissions, noise etc.

II. Corrective and preventive action: establishing and maintaining procedures for defining responsibility and authority for handling and investigating non-conformance with permit conditions, other legal requirements as well as objectives and targets, taking action to mitigate any impacts caused and for initiating and completing corrective and preventive action that are appropriate to the magnitude of the problem and commensurate with the environmental impact encountered.

III. Records: establishing and maintaining procedures for the identification, maintenance and disposition of legible, identifiable and traceable environmental records, including training records and the results of audits and reviews.

IV. Audit

- establishing and maintaining programme(s) and procedures for periodic environmental management system audits that include discussions with personnel, inspection of operating conditions and equipment and reviewing of records and documentation and that results in a written report, to be carried out impartially and objectively by employees (internal audits) or external parties (external audits), covering the audit scope, frequency and methodologies, as well as the responsibilities and requirements for conducting audits and reporting results, in order to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained.

- completing the audit or audit cycle, as appropriate, at intervals of no longer than three years, depending on the nature, scale and complexity of the activities, the significance of associated environmental impacts, the importance and urgency of the problems detected by previous audits and the history of environmental problems – more complex activities with a more significant environmental impact are audited more frequently.

- having appropriate mechanisms in place to ensure that the audit results are followed up.

V. Periodic evaluation of legal compliance

- reviewing compliance with the applicable environmental legislation and the
- conditions of the environmental permit(s) held by the facility
- documentation of the evaluation.

E) MANAGEMENT REVIEW:

- reviewing, by top management, at intervals that it determines, the environmental management system, to ensure its continuing suitability, adequacy and effectiveness
- ensuring that the necessary information is collected to allow management to carry out this
- evaluation
- documentation of the review

B2.2 PROPOSED ACTIVITIES

B2.2.1 Describe the proposed installation activities

Mechanical and Biological Treatment Plant

The plant will process 147,000 tonnes per annum of feed stock derived from residual municipal waste arising from Malta, based on the following:

- 100,000 tonnes per annum of mixed municipal wastes
- 47,000 tonnes per annum of bulky waste

Oversize rejected materials that can not be handled by the process plant (such as concrete blocks, car engines or other big disturbing or dangerous parts) will be removed after visual control by crane or wheel loader before they enter the MBT process.

This part of the project comprises mechanical and biological processes (MBT), including anaerobic digestion (AD). The plant has been designed to recover recyclables (e.g. metals), produce RDF materials, recover energy from the CHP plant fuelled by the biogas and produce a refined digestate for end use.

A biogas CHP plant is included to maximise energy recovery. Electricity shall be exported to the grid whilst waste heat from the exhaust systems will be used within the process.

The MBT plant will be built at two different locations. The dry and wet pre-treatment facility will be installed on the initial MBT site which is located in the central area of the Maghtab Complex. The facility for the biological treatment will be built on the same site where the biogas plant (BGP) for animal manure shall be erected.

Social Buildings and Offices

This facility will be erected in the west of the reception hall and will have a dedicated road entrance with associated parking for personnel. Entry to the Social Building will be via ground floor reception. The building shall contain welfare facilities and offices.

Waste Reception Hall

The Reception Hall has been designed to house approx. 1-2 days collection of municipal waste and bulky waste. The entrance to the reception hall will be through automatic doors protected by air curtains to minimise the release of odours from the facility. This will be considered as part of the overall air strategy.

The waste reception hall has been designed to accommodate a 16.8 m articulated vehicle. The Waste Reception Hall will be built as a fire compartment and rainwater from the roof will be linked to the rainwater harvesting system.

Fast roller doors will be used for entrances to Mechanical Treatment Reception Hall (for Bulky Waste and MSW admission) and in AD Manure Reception Hall.)

Process Hall

The Process hall shall be directly linked to the Waste Reception Hall by the conveyor systems (penetrations through the fire protection wall). The Process hall shall contain the mechanical pre-treatment and wet pre-treatment technology. No manual sorting is envisaged. Big disturbing parts and non suitable wastes which have been identified by visual control shall be removed by wheel loader operation.

The roof will be linked to the rainwater harvesting system. Integrated into the process hall structure will be the control room. The recovered recycled material will be collected in containers. The design includes for the use of 6 tonne, 12 tonne and 15 tonne containers. The RDF outlet, baling and storage are located on the south side of the process hall under a porch roof.

Anaerobic Digestion Facility

The Anaerobic Digestion Facility for the organic fraction recovered from MSW shall be installed at the site of the Biogas Plant. The waste suspension shall be pumped from the MBT site to the AD Facility. Process water which is needed to produce the waste suspension will be pumped from the AD Facility to the MBT site. Biogas production and utilization as well as digestate handling will occur at the same location at the BGP site

Central Utilities

The project includes for the installation of the site wide utilities distribution including electricity, gas, site lighting, CCTV, drainage, distributing to/from the site boundary.

Traffic Flow and Weighbridges

The road infrastructure is designed to accommodate the vehicle volumes and incorporates holding zones, that allow control and movement throughout the site.

Acoustics

The project has been designed in line with the relevant standards.

Odour and Dust Control

Delivery and handling of untreated waste as well as the dry mechanical treatment of waste form the most significant sources of odour and dust releases.

All areas of the MBT-plant, in which malodorous process air is envisaged, are designed to include an air collection system to remove such odours by means of forced extraction. The most significant area where odour is released is the Reception Hall. The entrance to the Reception Hall will be through automatic doors protected by air curtains to minimise the release of odours and dust from the waste reception area.

Exhaust air collected from the Reception Hall and source segregated air from the mechanical pre-treatment items will pass through a dust filter system. Afterwards the air will be treated in an acid scrubber and a biofilter. Waste air from the machines within the wet pre-treatment hall will be directly sucked off to the scrubber.

The exhaust air concept shall be optimised to reduce the air flow from the process to a minimum. Emission monitoring shall be conducted by the analysis of a discrete sample from the measuring point at the biofilter. The measured odour will be less than 2,000 O/U. Specific samples will be measured and tested within the agreed protocols.

Dust shall be removed by the dust filter and will be less than 20 milligrams /m3. The exhaust air treatment for the AD process can be reduced to a chemical scrubber system. Most of the tanks shall be connected to the biogas system which shall have only defined emission points.

Process Description

The MBT facility is designed to accept and process 147,000 tonnes of Municipal Solid Waste (household and bulky waste) per annum. The split of incoming feedstock will be as follows:

- 100,000 tpa of household residue waste
- 47,000 tpa of bulky waste

This technical description introduces the process engineering concept of a MBT plant with wet-AD treatment.

The refused derived fuel (RDF) separated from waste input shall be landfilled until alternative treatment is available.

The biogas that shall be produced during anaerobic digestion shall be converted into power. The excess power shall be fed into the national grid.

General Plant Concept

The mechanical - biological waste treatment plant described is a combination of mechanical sorting and a wet anaerobic digestion as shown in Figure 2.1.

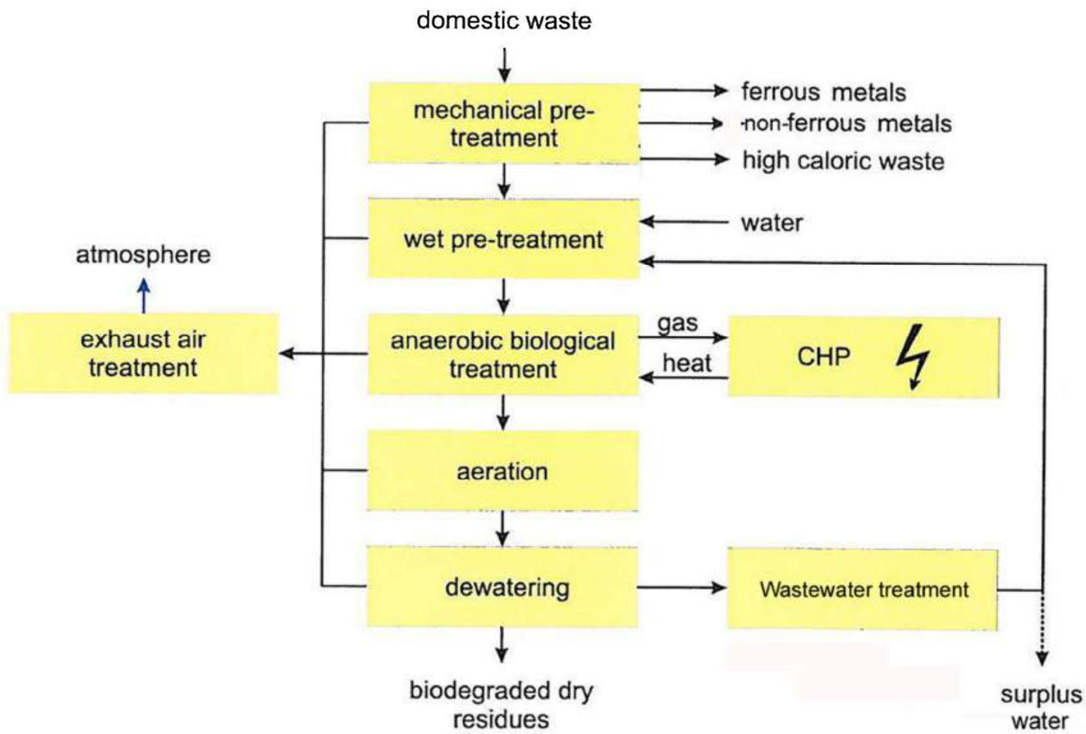


Figure 1: Block diagram of the MBT plant

In the mechanical pre-treatment plant the waste will be separated in several waste streams to enable specific recycling or disposal. By separating metals and high calorific waste, a substantial amount of residual waste shall be used for material recovery and energy production. In this stage, the organic fine fraction for the anaerobic digestion stage will also be separated from the incoming household waste stream. By the integration of a digestion stage, emissions will be minimised and in addition biogas will be produced. This biogas will be transformed into electrical energy and heat via a CHP. The digestion products still have a considerable calorific value, which is why they are called low calorific value fuel.

Process water resulting from the dewatering process of the digestion product, shall be used for slurrying the organic waste fraction before digestion takes place. Surplus water will be treated together with the liquor from digested manure to meet the discharge limits. The exhaust air is cleaned by means of acid scrubbing and biofilter systems which provide odour control.

The MBT plant shall be erected at two separate sites. Waste reception as well as mechanical and wet pre-treatment shall be located at the MBT site. The biological treatment process shall be located at the planned site for the BGP to optimize the use of biogas and the digestate handling as well as waste water treatment.

Plant Components

Mechanical Pre-Treatment

Municipal Solid Waste

- Removing of any unacceptable oversize or otherwise un-processable items
- Opening of refuse bags
- Separation of ferrous and non-ferrous (mainly aluminium) metals for further recycling
- Separation of high calorific value fraction (RDF) for energy recovering
- Production of fine organic fraction to be used in the AD process

Bulky Waste

- Reduction of waste size by shredding
- Separation of ferrous metals for further recycling
- Production of a high calorific value fraction (RDF) for energy recovering
- Disposal of remaining waste on landfill

Wet Pre-Treatment

- Mixing of pre-treated household waste (fine fraction) with process water in order to suspend the organic part of the waste and to generate a pumpable slurry with a solid content of approx. 10-14%
- Separation of rejects (removal of heavy and light rejects)
- Pumping of waste suspension to AD Facility

Digestion (at BGP site)

- Microbial degradation of organic waste substances with simultaneous biogas production

Gas Utilization (at BGP site)

- The biogas is burned in co-generation units to generate electricity and thermal energy

Dewatering of Digestate (at BGP site)

- Reduction of water content at the output of the AD facility by mechanical dewatering using decanter centrifuges.

Treatment of Surplus Water (at BGP site)

- Treatment of surplus water to meet the current discharge requirements respectively to allow for reuse

Exhaust Air Treatment (at both sites)

- Reduction of pollutants
- Odour control

Process Description

MBT Plant Concept

The following sections describe in detail the process for the treatment of municipal and bulky waste.

Waste Reception

The waste – municipal as well as bulky waste - will be delivered by lorries into the waste reception hall and stored on concrete flooring. The hall shall provide storage capacity for approx. 1-2 days collection. The storage of waste should be restricted to a minimum time frame to prevent odour problems caused by decomposition.

A visual control of waste quality will take place before loading the waste into the bag opener or bulky shredder. Examples of unsuitable materials that may be rejected to prevent damage or performance degradation of the Process Plant are:

- Concrete blocks, bricks etc.
- Engine blocks, gear boxes
- Large metal units, steel plates, steel girders, metal blocks etc.
- Chemicals, paint and varnish
- Explosive or dangerous material / containers including explosive or dangerous material
- Vehicle tyres
- Automotive batteries

- Electric cables
- Hoses
- Mattresses, springs etc.
- Carpets

Materials which could wrap upon the axles of the shredder's cutting table should not be fed into the pre-shredder, any such materials entering the shredder must be removed at regular intervals.

Oversize and other reject materials are taken off by means of a grab crane or wheel loader. It is assumed that these materials will be a quantity of approx. 3-5% of total input waste. Rejected materials shall be loaded in separate containers and disposed.

The pre-sorted bulky waste will also be fed by a mobile tulip grab or wheel loader into the shredder.

Disturbing material or waste mostly including construction material shall be taken off before the shredder. These materials shall be loaded in separate containers and disposed on landfill.

Air Curtains

Each of the 5m wide x 8m high doors to the reception hall has an air curtain mounted either side of the opening. Each air curtain has 4 sections and each section has 3 fans therefore for each door there are 12 fans each side of the door. Individual motor failures will not significantly impact the curtain performance significantly.

Dry Mechanical Pre-Treatment

The mechanical pre-treatment of waste is the first step of the process plant. This treatment step should separate the main fractions of the municipal waste into recyclable, usable or non-recyclable waste streams. The recyclable waste streams are the RDF fraction and both ferrous and non-ferrous metals. The usable waste stream is the biological or fine fraction which is optimised for use in the AD process.

The following objectives are achieved using mechanical treatment:

- Production of a free fine fraction optimised for the digestion process
- The separation of different waste fractions for recycling/further treatment (e.g. metals, RDF)

Material Input

Two waste charging lines will be installed, one line for municipal waste, one separate line for bulky waste. The pre-sorted municipal waste will be fed by mobile tulip grab crane or wheel loader into the bag opener. A mobile tulip grab or also a wheel loader feeds the pre-sorted bulky waste to the pre-shredder of the bulky line.

Mechanical Treatment of Municipal Waste

The line for mechanical treatment of municipal waste is described in the following.

Bag opener

Here, bags will be opened, reject material can be detected and removed, and the flow of material will be batched. The total amount of the material shall be processed within a two-stage screening.

Magnetic Separator

The waste fraction shall be processed by a magnetic separator before entering the drum screen. The over-belt magnetic separator will be installed in transport direction. The recovered iron-containing material will be conveyed to a storage container.

Drum Screen

The drum screen allows the production of two fractions: The separation of input material with a size of < 150mm and >150 mm. The screen overflow will contain mainly material of high calorific value and shall be baled.

Star Screen

Fractions with a size of < 150mm shall be separated by a second screen. This star screen enables the separation into two fractions providing sizes of < 40mm and 40 - 150mm. One advantage of star screens compared to drum screens is the effective separation of long parts which could disturb in the down-stream process (e. g. twigs or similar).The fines shall be separated from ferrous and non-ferrous material, e. g. aluminium. The remaining flow of material <40mm shall be processed within the biological treatment (AD). The flow of material may also be delivered to containers (when the wet pre-treatment should be out of operation). The star screen overflow (40/150mm) shall be delivered to heavy / light separation.

Ballistic Separation (Optional)

The ballistic separation of fractions with size of 40/150mm shall be done by a belt air classifier. The air separation results in the production of two materials streams. At this stage, the material shall be divided into light fraction material and into a solid material fraction.

The light fraction includes tenacious and flexible materials, e. g. textiles, foils and paper. The solid fraction includes solid and dense parts, such as stones, cans, bottles, timber, metals and solid plastics.

Near Infrared Separation
The solid fraction resulting shall be delivered to a separator that provides near infrared technology. During this separation process, most of the plastic material, paper, cardboard, wood and textiles will be detected by optical sorting and shall then be removed by means of compressed air. A bale press shall be provided to reduce the RDF volume which has to be stored.

Magnetic Separators
The fine fraction < 40mm and the residues resulting from NIR separation shall be processed by magnetic separators. Over-belt magnetic separators are installed in transport direction and above the driving pulleys of the conveying belts. The recovered iron-containing material will be conveyed to a storage container. Inside the container, the material is distributed by means of a shuttle conveyor (moveable conveyor).

Separator for Non-Ferrous Material
Following the magnetic separators for non-ferrous material are installed. Non-ferrous materials e.g. aluminium shall be separated from the materials stream and will then be discharged into a container.

Second Near Infrared Separation
An additional optical sorter shall be placed on the heavy path to landfill, this shall divert approx. 50% of the organic material still included in this line to the AD Process. A shredder shall be installed to reduce the size to < 40 mm before the material is brought to the conveyor infront of the mixers.

Mechanical Treatment of Bulky Waste

After big disturbing parts have been removed the bulky material will be fed to the pre-shredder of the bulky line. The mechanical treatment of bulky waste is only targeted on coarse size reduction and separation of ferrous metals. The mechanical treatment line for bulky waste includes the following components:

Pre-Shredder
The first step of bulky waste treatment is the coarse size reduction by means of a pre-shredder.

Vibrating Screen
Since the throughput of the bulky waste line is less than the one of the municipal waste treatment line the screening shall be done by a vibrating screen. This allows also the production of three fractions: The separation of input material with a size of < 30mm, 30 – 150mm and the screen overflow > 150mm. The overflow will be discharged to a ballistic separator. The vibrating screen separates effectively the fine material < 30 mm of the input, mainly containing inert material. The separation of fines will improve the RDF quality.

Ballistic Separation
The ballistic separation of fractions with size of >150mm shall be done by a belt air classifier.

The air separation results in the production of two materials streams. At this stage, the material shall be divided into light fraction material and into a solid material fraction. The light fraction is conveyed to a press container station for RDF material.

Near Infrared Separation

The solid fraction resulting from the ballistic separation and the fraction 30 – 150 mm shall be delivered to a separator that provides near infrared technology. During this separation process, most of the plastic material, paper, cardboard, wood and textiles will be detected by optical sorting and shall then be removed by means of compressed air. The separated RDF material shall also be pressed in containers.

Magnetic Separator

The remaining fraction will pass a magnetic separator. Iron-containing material shall be removed by an over-belt magnetic separator. The residues shall be loaded / pressed into containers and will be landfilled.

Wet Mechanical Treatment

The fine grain fraction from the municipal waste line, with a grain size that is less than 40 mm shall be transported out of the mechanical pre-treatment area to the wet mechanical treatment area. Here the waste fraction will be mixed to a pumpable suspension with process water. Reject heavy and light-density materials are removed. All treatment steps referring to the fine organic fraction (< 40 mm), including wet pre-treatment, anaerobic digestion, dewatering, wastewater treatment and the biogas system, are illustrated in Figure 2.

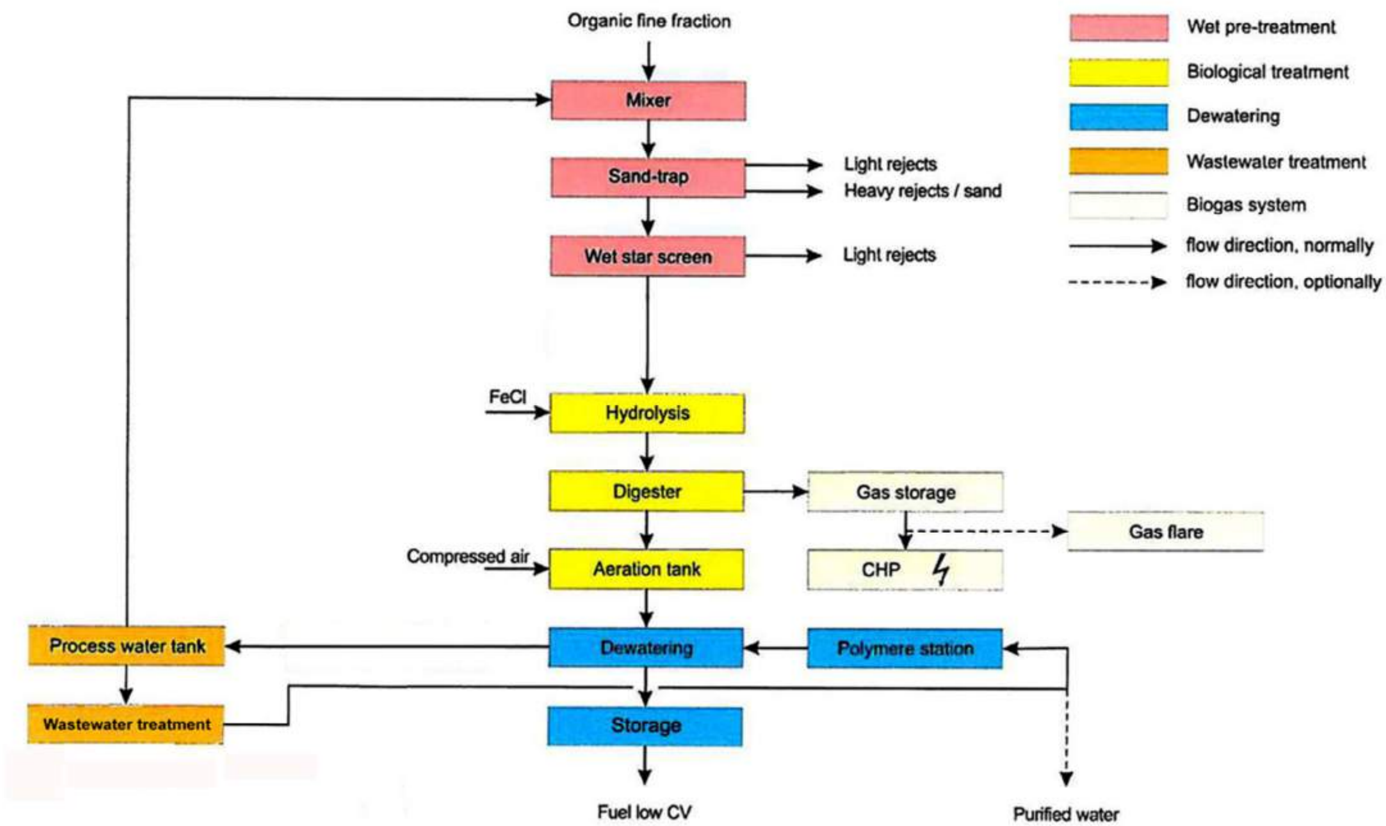

Organic fine fraction
Mixer
Sand-trap
Light rejects
Heavy rejects / sand
Wet star screen
Light rejects
FeCl
Hydrolysis
Digester
Gas storage
Gas flare
Compressed air
Aeration tank
CHP
Process water tank
Dewatering
Polymere station
Wastewater treatment
Storage
Fuel low CV
Purified water
Wet pre-treatment
Biological treatment
Dewatering
Wastewater treatment
Biogas system
flow direction, normally
flow direction, optionally

Figure 2: Block diagram regarding the treatment of the organic fine fraction

Mixers

The organic fine fraction with a grain size of <40 mm, produced from input waste in the mechanical pre-treatment stage, is largely free from interfering materials and shall be transported to the mixers via a series of conveyors/screws.

Each mixer operates on a batch process. The material that arrives continuously from the mechanical pre-treatment shall be distributed alternately to the different mixers. The organic fine fraction becomes a biological waste suspension with solid matter content (SM) of approx. 10-14 % SM by adding internal process water. In the mixers the proportion of the biological waste that can be digested shall be crushed, suspended and partially made into a solution, whilst the components that are not biologically degradable (plastics, textiles, metals, glass etc.) will in the main remain undamaged. When the mixing process is completed the slurry flows into the sand trap.

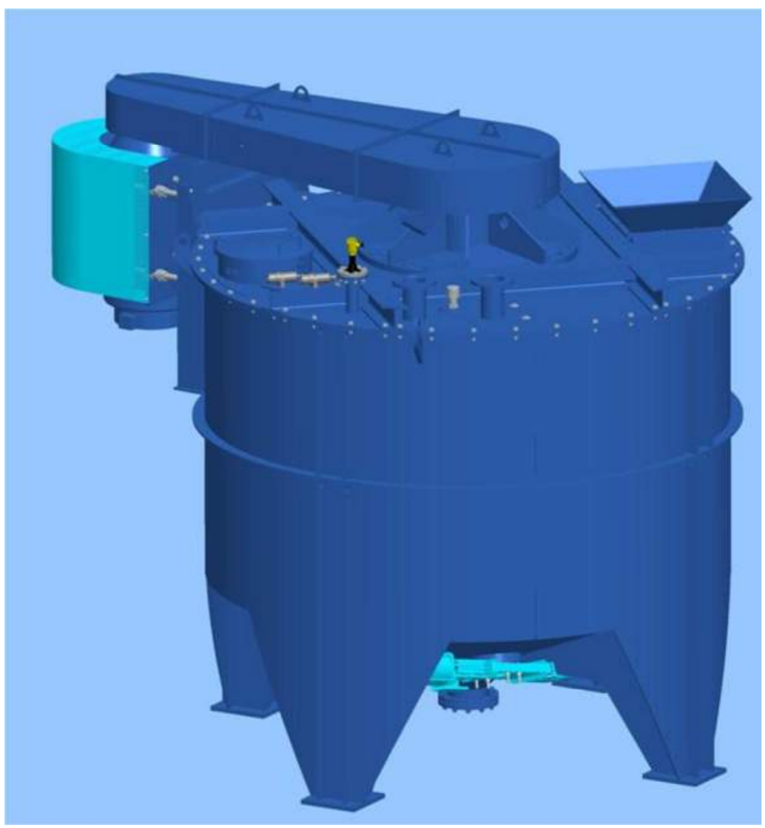


Figure 3: Waste Mixer

Sand Trap

After the mixing process is finished the slurry passes the star screen and then flows through the sand trap. Here the heavy fraction e.g. sand, glass and small metal parts will be removed from the liquid by means of sedimentation. Separating these inert components particularly protects downstream containers, pumps, the drainage system and other components from abrasion. This also minimises the settling of medium solids in the contents in the downstream tanks due to sedimentation. Screws convey these inert components into a container. The sand is washed with process water within the rising screw to remove organic contaminations to prevent malodour resulting from sand container. A certain turbulence is still necessary in order to avoid sedimentation of organic compounds. This is achieved by blowing in air from one side of the sand trap in order to generate a water barrel. The air stream can be adjusted manually by means of valves provided at the sand trap. The water barrel must be below the water surface. The air stream adjustment is a compromise between sedimentation of the heavy material, flotation of the light fraction and suspension of the organic compounds.

Floating materials are taken off from the surface. They are also transported into a container. The suspension is pumped out of the sand trap's buffer tank into the mixing tank which belongs to the anaerobic digestion process located at the Biogas Plant site in a distance of approx. 500m.

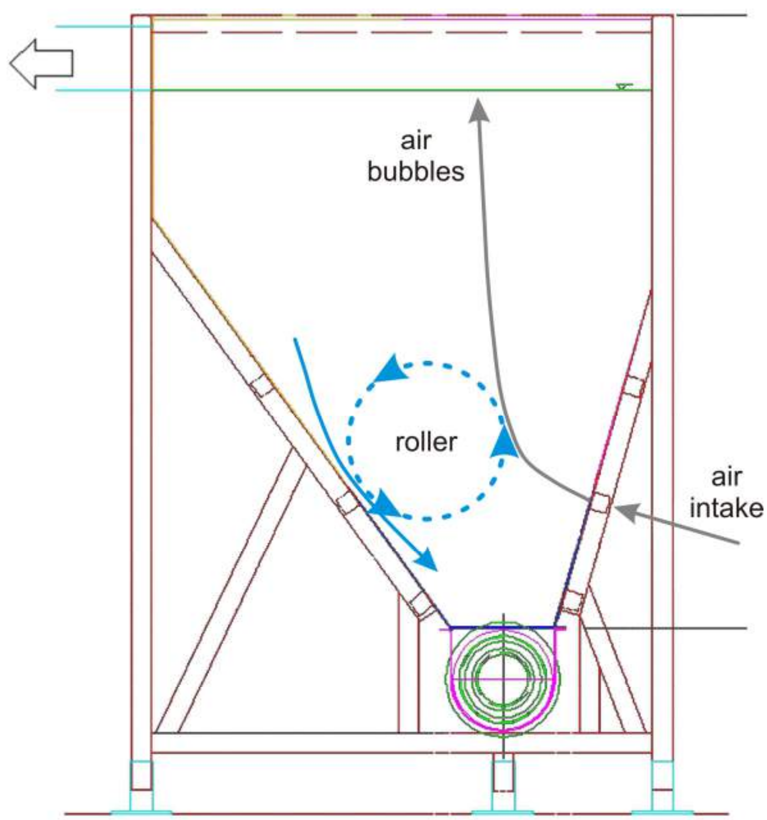


Figure 4: Cross section of a sand trap

Anaerobic Digestion

The advantages of anaerobic treatment can best be indicated by comparing this process with aerobic treatment. During aerobic treatment, the waste is mixed with large quantities of microorganisms and air. Microorganisms use the organic waste for food, and use the oxygen in the air to burn a portion of this food to carbon dioxide and water for energy. Since these organisms obtain much energy from this oxidation, their growth is rapid and a large portion of the organic waste is converted into new cells.

In anaerobic treatment, the waste is also mixed with large quantities of microorganisms, but here, air is excluded. Under these conditions bacteria grow which are capable of converting the organic waste to carbon dioxide and methane gas. Unlike aerobic oxidation, the anaerobic conversion to methane gas yields relatively little energy to the microorganisms. Thus, their rate of growth is slow and only a small portion of the waste is converted to new cells, the major portion of the degradable waste being converted to methane gas.

The anaerobic digestion process is a 4-step process (please refer to Figure 5 below).

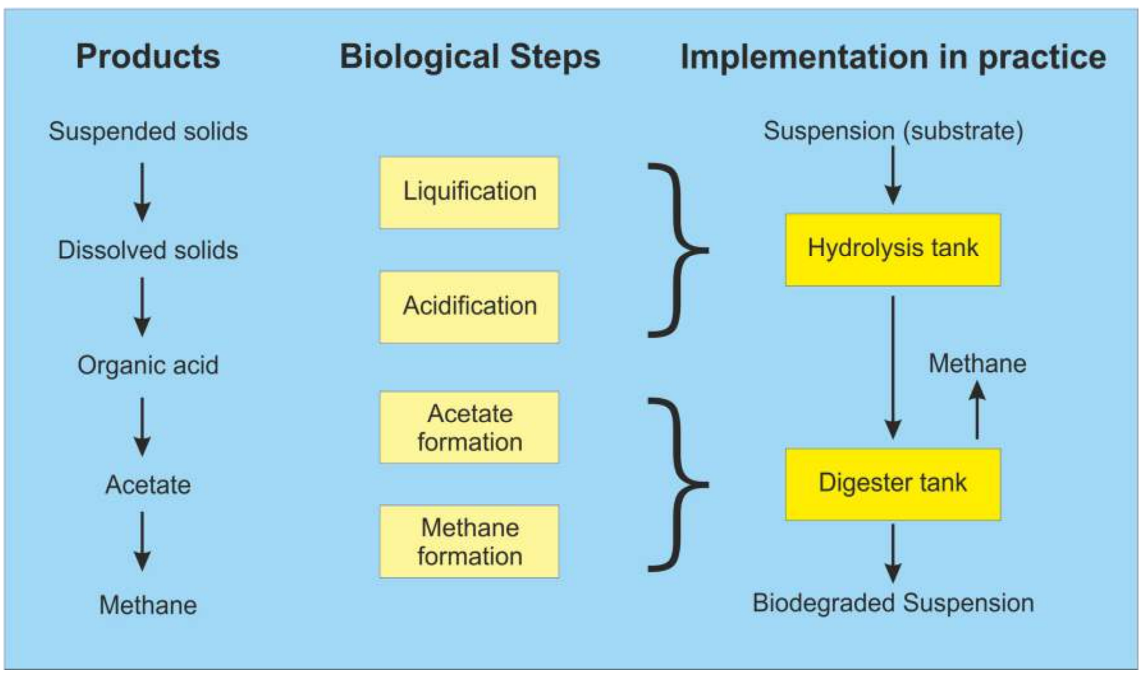


Figure 5: Steps of the anaerobic digester process

Besides the described formation of methane two further important biological processes take place during the fermentation:

Sulphate reduction

Sulphate reducing bacteria convert sulfate (SO_4^{2-}) to sulfide (S^{2-}) under anaerobic conditions as shown in Figure 6.

Formation of sulfide:

$$\underset{\text{sulfate}}{SO_4} + \text{org. substrate} \longrightarrow \underset{\text{sulfide}}{S^{2-}} + 2\,CO_2$$

Figure 6: Chemical process of sulphate reduction

S^{2-} is soluble but depending on the pH value it is in an equilibirium with HS^- and H_2S. H_2S is an acid gas with toxic properties. H_2S can release the liquid phase and penetrate the biogas system, where in high concentration it can effect corrosion in the CHP. To reduce the potential of corrosion, a biological desulphurisation process shall be installed in the biogas system and also iron chloride can be added to the mixing tank to precipitate S^{2-} as FeS (iron sulfide), which is insoluble.

Hydrogen sulfide is a highly toxic and flammable gas. Being heavier than air, it tends to accumulate at the bottom of poorly ventilated spaces. Although very pungent at first, it quickly deadens the sense of smell, so potential victims may be unaware of its presence until it is too late.

NH_4^+ / NH_3 formation

There are many substances in the waste containing nitrogen groups. During the fermentation process these groups are reduced to ammonium (NH_4^-), which is soluble in water. With increasing pH value it converts to ammonia (NH_3), which is also a toxic gas with an acrid odour. Certain quantities of ammonia are released in the aeration tank and in the dewatering area, so that an exhaust air treatment is necessary.

Mixing Tank

The mixing tank is used as a storage and homogenising tank. It is compensating the time when no waste is fed into the AD process (e.g. nights, weekend). Peak feed times as well as reduced feed times as well as variations in the concentration are balanced out here. This leads to the tank being operated with a varying level. The tank is designed for a retention time of up to 3 – 4 days, so that there is also sufficient storage capacity at weekends or over public holidays.

In the mixing tank also the pre-acidification takes place. In the hydrolysis phase the high molecular weight, undissolved materials (polymers) must be transferred across by means of enzymes in dissolved fragments. Short warp organic acids, alcohol, hydrogen and carbon dioxide are formed in the acidification phase by the action of different facultative and anaerobic types of bacteria. The anaerobic decomposition process ”starts“ in this first reactor.

The tank is fitted with a top-entry agitator to homogenise the content. The tank shall be connected to the biogas system.

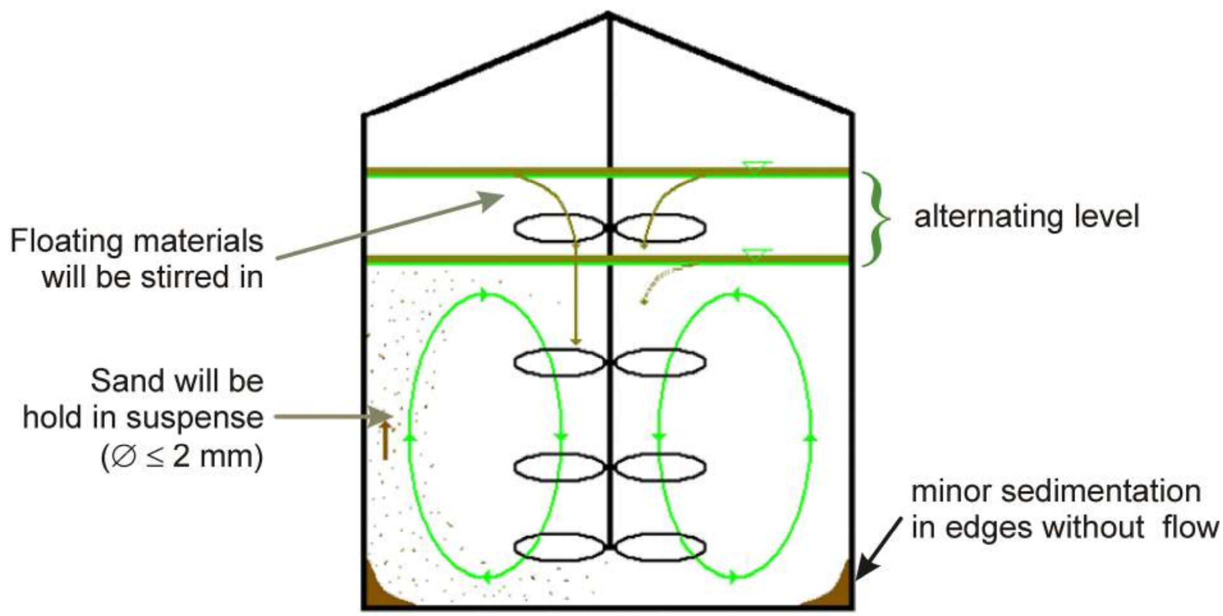
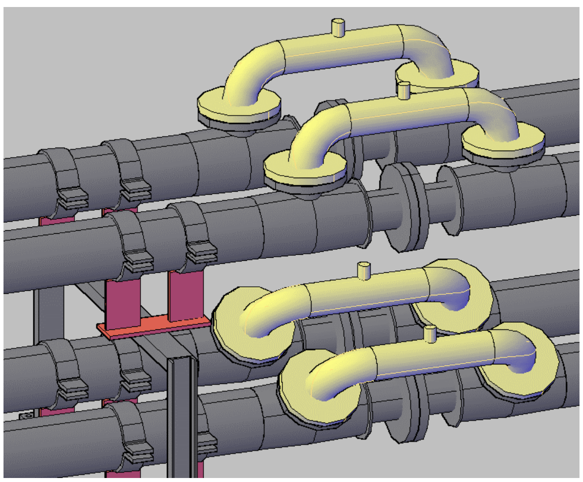


Figure 7: Profile of mixing tank

Digester

The suspension is then conveyed to the digester tanks. The plant is designed to have one mixing tank and three digester tanks. The digesting reactors are operated with a temperature of approx. 55°C. This temperature is suited to pasteurise the substrate. The feed to the digesters is recorded using a flow meter. In order to achieve a feed that is as steady as possible, each reactor is to be fed several times a day.

Each digester has a separate heating cycle for adjustment of temperature. The motor cooling water from the CHP units is used as a heating medium in the heat exchangers. In the double pipe heat exchangers for heating the substrate flows through the inner pipe, whilst the water is pumped through the outer pipe. So the potential risk of a blockage of the substrate pipe can be minimized.



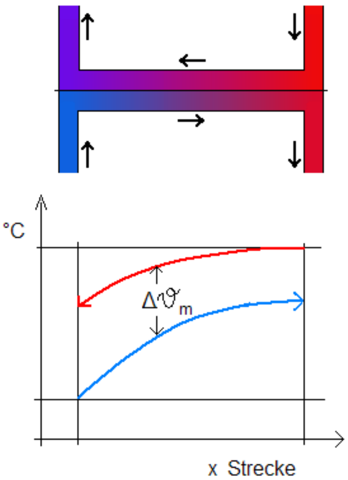


Figure 8: Double pipe heat exchanger

The anaerobic biochemical process takes place in several stages. The methane forming bacteria that are strictly anaerobic react sensitively to changes of pH-value.

In the step model for methane formation, hydrolysis, acid formation and methane formation take place one after the other.

Decomposition of butyric acid: $C_3H_7COOH + 2H_2O \rightarrow 2CH_3COOH + 2H_2$

Decomposition of propionic acid: $C_2H_5COOH + 3H_2O \rightarrow CH_3COOH + 3H_2 + H_2CO_3$

Methane formation: $CH_3COOH \rightarrow CH_4 + CO_2$

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$$

The digesters shall be fully mixed. The hydraulic retention time for the suspension in the reactors is approx. 15 – 18 days. During this time 50% - 60% of the organic dry mass added can be decomposed. The biogas produced is fed into the dry gas accumulator. The digestion residue passes to the storage tank.

Each digester will have the following measuring sensors:

- Temperature measurement for controlling the reactor temperature
- A measuring system for monitoring the level. The specified and limit values are sent to the electric control and will be used for alarms, safety cut offs and locking.
- The mechanical, gas side external protection consists of an over and under pressure safety valve.
- Pressure measurement

Figure 9: Safety Valve

Gas quality measurement will be installed to control the gas composition. The following parameters will be measured: CH_4, CO_2, O_2, H_2S. The tanks mounted up on a concrete foundation within a bund wall. The tanks have to be coated with a suited lining to prevent corrosion. Walls are insulated and clad using trapezoidal wall profiles. The digesters have a footbridge for inspection and maintenance work. It can be reached via a staircase. The tanks are to be positioned inside a bundwall which can hold at least 1.1 times the content of the biggest tank.

The suspension inside the digesters will be mixed by means of gas lances which will provide a proper circulation inside the tanks. The lances will be fixed to the bottom of the tanks.

Protego pressure relief security valves, for proper ATEX environment, will be used in Digesters and Suspension Buffer tanks. Specific model not yet defined; if necessary it can be indicated in a later stage.

Pressure limits foreseen:

- Underpressure: - 5 mbar
- Overpressure: 40 mbar

Aeration Tank

The dewatering of digestate will be operated on 6 days per week. The aeration tank has to provide sufficient storage volume for the operation cycle of the dewatering process. The digestate is pumped directly to this tank. The tank will be equipped with an aeration and mixing system. The aeration kills any remaining anaerobic bacteria and removes a certain percentage of ammonia. A system for dosing of an anti-foaming agent shall be installed to reduce the formation of foam.

The tank will be connected to the exhaust air treatment system. Although the mechanical treatment and the dewatering process are in discontinuous operation during the week, microorganisms in the digesters, however, have to be provided with substrate continuously. Besides their biological functions, the hydrolysis and the aeration tank therefore operate as buffer tanks in order to assure a continuous AD process.

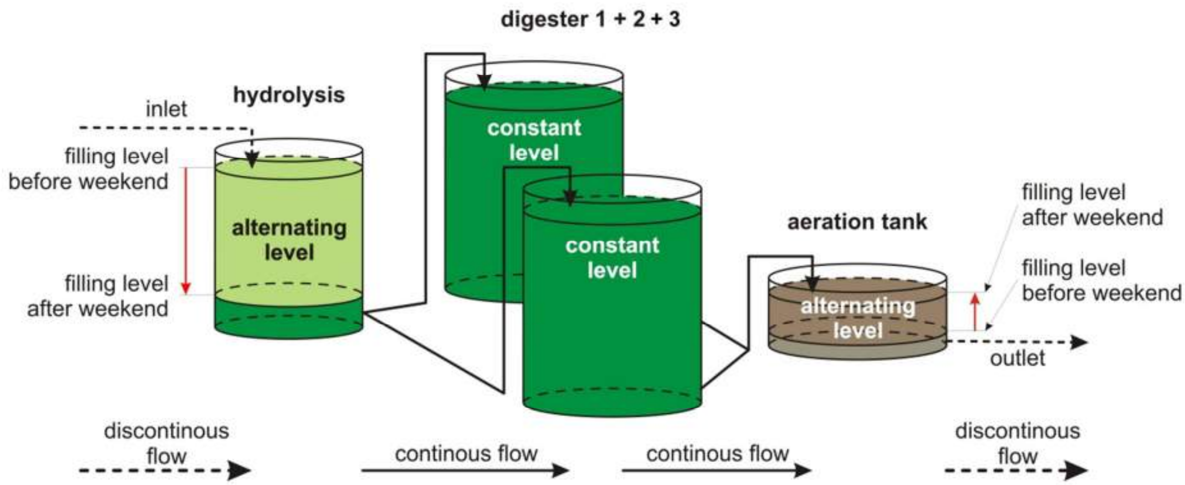


Figure 10: Transformation discontinuous flow / continuous flow between the biological treatment steps

Dewatering the Digested Residues

The anaerobic and aerobic treated substrate is fed via pumps from the aeration tank to the dewatering system. Separation of the substrate into a liquid and solid material flow takes place in this stage.

Decanter

Decanters will be provided for dewatering of the substrate. The dewatered residue will reach a dry solids content of approx. 30%. The principle of the processes performed by the decanters is described in the following section.

The substrate is fed via a central feed pipe into the centrifuge drum, which rotates at high speed. Due to the centrifugal force the solids concentrate on the drum wall. With the help of a screw, which rotates with low speed gradient, the solids are continuously transported outside. In the direction of the solid outflow the centrifuge drum has a conical shape, which brings about the phase of the solids being lifted out of the water and flowing back to the water outflow.

The speed of the solid outflow will be set with the help of the rotation speed gradient. Increasing rotation speed brings about an increasing solid outflow. A lower outflow provides better dewatering. If outflow is too low, the solids will accumulate in the drum and the decanter will be switched off.

A flocculating agent (polymer) is added to the substrate at the point of entry to the decanters and the dewatered residue can reach a content of approx. 30-35% of dry substances.

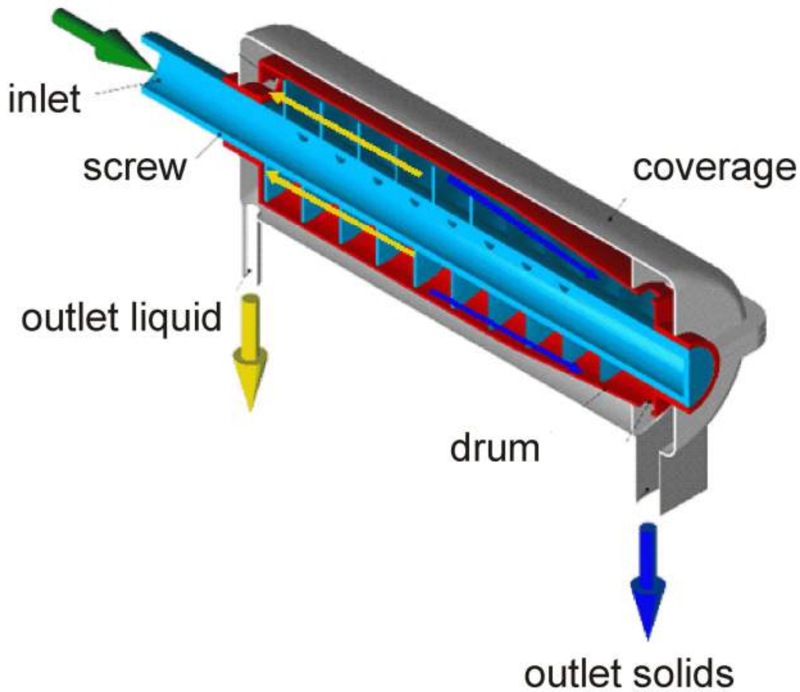


Figure 11: Principle of a decanter

The solid materials are positively charged on the surface. Polyelectrolytes use this property in order to build up the positively charged solids at the numerous negatively charged groups of the polymer to form larger flakes.

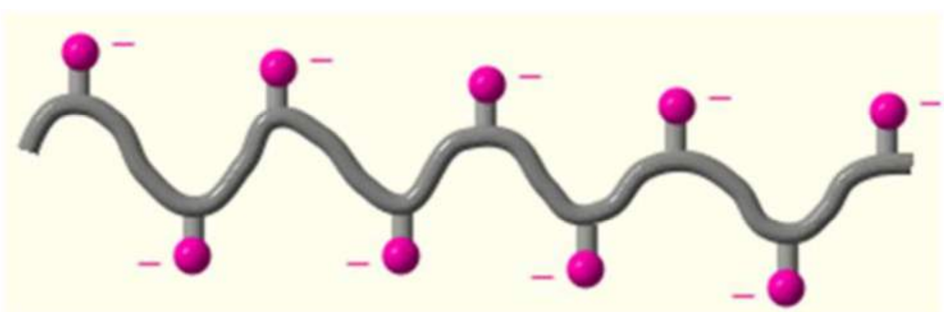


Figure 12: Structure of a polyelectrolyte

The decanters will be installed on the first floor of the maturation hall. The solid material falls down to the ground floor. It will be stored in heaps by means of a wheel loader for maturation and further loss of water.

Figure 13: Decanter

The centrate water will be pumped to the process water tank which has to provide the necessary storage volume for compensation of differences in operation time between dewatering process and mechanical pre-treatment.

Most of process water is to be used for the slurrying process of waste in the mixers. Furthermore process water will be used for washing of sediments (glass, sand, etc.) removed from sand trap as well as for the supply of several flushing devices. But also a certain quantity of excess water that needs to be treated will occur.

Waste Water Treatment

A process water tank is provided, to be used as a storage and feeding tank for the process water. The process water is mainly taken from the decanter centrate which is removed during the dewatering process but can also be diluted with service water if required.

Process water is used to supply a number of areas around the site. Two pumps distribute to a number of process areas including the pre-treatment mixers, sand trap discharge conveyors, hydrolysis and digester tank areas and the dewatering plant.

During normal operation, the process water tank is operated with fluctuating levels in order to achieve a buffer capacity. The process water tank is fitted with a submersible mixer to prevent sedimentation of small solids. Excess process water is fed to the waste water treatment plant.

During the MBT process, different water qualities are required. Process water can be used directly for the mixing process and sand washing whilst water of higher quality is required for flocculation, as a sub-process of the dewatering step. In order to achieve this improved water quality, a waste water treatment plant designed as a membrane plant can be used or a certain quantity of fresh water, if available.

A certain quantity of surplus water will be produced depending on the moisture content of waste and its salinity. At present design the MBT surplus water shall be treated together with the pre-treated manure in the waste water treatment plant of the manure plant. Here a biological system shall be used, mainly designed for nitrogen removal - an external carbon supplement (C-source) that will be regulated by analysing the carbon compounds of the WWTP.

The MBT surplus water will be pumped from the process water tank to the centrate storage tank of the manure plant for mutual treatment.

Process Water Tank

The process water tank is used as a storage and feeding tank for the process water. The process water is mainly taken from the centrate from dewatering, however, if required it can be augmented with service water. From here the mixers are fed with water for production of a pumpable waste suspension. Further excess process water is fed to the waste water treatment plant of the manure plant. In normal operation the tank is operated with fluctuating levels in order to achieve a buffer effect. The process water tank is fitted with a submersible agitator to prevent deposits.

Gas Engineering

The gas engineering system consists of gas pipe work and safety analysis, biological desulphurisation, gas drying and gas storage in a double membrane low pressure tank, and finally utilisation with a CHP or burning in a gas flare. The whole of the gas route is fitted with the necessary safety fittings and deflagration devices for safety reasons.

The biogas flare is used to burn biogas with too low methane content or in the case of a fault in the CHP in a manner that is free from harmful substances. The biogas has a methane proportion of 50 – 65 vol. % and resulting from this a calorific value of 5.0 – 6.5 kWh/Nm3. The hydrogen sulphide content is very much dependent on the input material. Experience with waste from domestic households and organic commercial waste shows that hydrogen sulphide concentrations of 1000 to 4000 ppm are to be expected in the biogas.

Desulphurisation

In the bio-chemical reaction in the anaerobic digestion reactors sulphate reduction forms hydrogen sulphide (H2S).

$$SO_4^{2-} + 4H_2 \rightarrow H_2S + 2H_2O + 2OH^{-}O_4^{2-} + CH_3COOH \rightarrow H_2S + 2HCO_3^{-}$$

S^{2-} is soluble but depending on the pH value it is in equilibrium with HS^{-} and H_2S. H_2S is an acid gas with toxic properties. H_2S can release the liquid phase and penetrate the biogas system, where in high concentration it can effect corrosion in the CHP.

There are chemical and biological options to reduce the H_2S content in the biogas.

Chemical Desulphurisation
One option is to add iron chloride to the hydrolysis tank to precipitate S^{2-} as FeS (iron sulphide), which is insoluble. The sulphide leaves with the digestion residue in a stable phase.

$$2\ FeCl_3 + 3\ H_2S \rightarrow Fe_2S_3 + 6\ H^{+} + 6\ Cl$$

Biological Desulphurisation
A biological desulphurisation process for the biogas shall be included to reduce the consumption of iron chloride and to prevent an unnecessary increase of salinity in the waste suspension.

The biological oxidation process occurs in a reactor filled with material which is settled with specialised bacteria. These bacteria transform H2S to sulphur and sulphite using atmospheric oxygen.

$$2\ H_2S + O_2 \rightarrow 2\ S + 2\ H_2O$$
$$2\ S + 2\ H_2O + 2\ O_2 \rightarrow 2\ H_2SO_3$$

A nutrient solution is sprayed continuously over the filling material, whereas the biogas coming from the digesters will be mixed with a certain amount of air and flows upstream through the reactor. The air dosing will be controlled. The oxidation products sulphur and sulphite will be discharged with the nutrient solution. Therefore the solution which is recycled over the reactor has to be partly displaced. The quantity of waste solution depends on the H_2S concentration in the biogas and on several reaction conditions like pH.

Gas Storage

The gas produced in the digester arrives in a gas store that is designed as a separate double membrane accumulator. The gas quantity to be stored varies dependent on the gas quantity removed or added. A membrane in the inside of the gas accumulator adjusts itself to these volume variations – dependent on filling quantity it either rises or drops. The gas storage is made up of two membranes. The inner membrane that takes up the biogas is surrounded by a protective external membrane. An explosion proof support fan continuously blows air into the space between the inner and outer membrane. The external membrane thus remains blown up tightly, stabilises and protects the construction against wind, rain and snow. The membranes are made of high-strength, polyester cloth coated on both sides with plastic. The membranes have minimal gas permeability. They are also resistant to atmospheric exposure, UV radiation, and fungus and microbe attack, flexible, and at the same time extremely robust. The gas is drawn off continuously via the gas compressor station and fed to the CHP or the gas flare. Consequently there is no storage requirement for the biogas, but rather merely an equalizing buffer for variations in the gas production as a pressure balance and control volume for operating the CHP.

Figure 14: Gas storage with safety device

Gas Booster Station

The biogas is retained at the gas outlet nozzles of the reactors with a flow pressure of approx. 10 - 15 mbar. The biogas is extracted from the reactors via a gas pipe system and fed to certain consumers by means of suitable gas blowers. The biogas consists mainly of methane and carbon dioxide as well as small quantities of nitrogen, oxygen, hydrogen and other trace gases. The gas is fed with a relative humidity of approx. 100% and a temperature of approx. 50 °C. The condensate that arises due to the gas cooling down during transport and separate gas cooling process before the blowers is precipitated via a condensate trap and led to a condensate drain or tank. All units required for the transport of the gas are found in the gas booster stations (GBS).

The gas booster station is fitted in a pre-assembled container that is sub-divided into two gas tight units, separated by a door from one another, and each separately accessible.

The GBS contains all plant parts required for the transport, measurement, regulation and monitoring of the biogas.

The GBS plant parameters are registered by various measuring devices in the machine room and automatically converted in the electrical switch room via control devices.

The flare control is also located in this switch room. Control of the plant takes place with the aid of conventional relay and control technology.

Electrical consumers, drives and transmitters for the control and regulating of the biogas disposal have been tested for many years of use and suitability for the technology used here.

Manufacture and laying of the pipe work will take place in conformity with Gas and Water Authority guidelines. Flange connections for the rated pressure PN 10/16 are designed in the same material quality. The sealing material consists of biogas resistant materials.

The GBS is fitted with the necessary measuring instruments for registration, control, regulation and monitoring.

Gas Flare

When the gas motors are not working and the level of the biogas storage has reached the relevant limit value, the biogas flare is switched on via a pressure switch and the flare is lit via self-ignition.

In order to destroy the organic harmful substances in the biogas, the flare is supplied as a non-insulated combustion chamber with injector burners. It is designed so that over the whole of the dwell time within the (combustion chamber) there is an almost even temperature distribution (> 800 °C). This ensures complete oxidation of methane and thus a complete burn up rate. Combustion takes place with a sufficient excess of air.

Figure 15: Gas Flare

Condensate Drains

Condensate shafts are connected to low points of the gas lines to drain off the condensate that arises in a controlled manner. The condensate collected in this way is pumped into the mixing and hydrolysis unit via an explosion proof pump. The pump is controlled via a level measuring device.

Gas Utilisation

Combined Heat and Power Plant (CHP)

The CHP is used for the production of power and heat. Two packaged engines shall be installed. The motor produces electrical power along with thermal energy. The thermal energy is taken from the motor cooling water for heating purposes. The thermal energy can for example be used for the following:

- For heating the waste suspension up to process temperature
- Should the heat consumers not be using heat some of the time, then the heat is led away via an emergency cooler.
- The electrical energy produced by the generator is network synchronised to be fed into the public network.
- The appropriate transformer and control equipment required to feed the CHP electricity output into the grid shall be provided.

The CHP is made up in the main of the following plant components:

The gas pipe work system
Laying of the pipe work from the gas storage takes place in compliance with the Gas and Water Authority guidelines and is led directly to the gas regulating line for the gas motors.

Gas regulating line
The gas regulating line is a component part of the gas engine and is used to regulate the required pressure or quantity of biogas to gas engines. The radial fan can presurise the gas system to 80 mbar, this allows the regulating line to fulfill its function.

Fittings
All fittings will be in accordance with local utility regulations.

Emergency cooler
Emergency cooler as table cooling system for carrying away the cooling water heat into the ambient air when the heat is not used.

Supply of lubricating oil
The fresh or used oil will be stored in two double walled tanks. The regular oil consumption of the gas engine is equalised via a day tank. After the oil lifetime has passed it can be fed back into the used oil tank via a second pipe system.

Exhaust system
The exhaust gas is fed into the open air via a sound absorber and chimney. The exhaust gas outlet is 10 m above the foundation as a standard.

Container
The gas engine and switchboard plant is accommodated in a separate 40 foot container with the relevant sound and heat insulation.

Figure 16: The combined heat and power (CHP) plant

Process Air Treatment

Process Air Coverage

MTP site
All areas of the MBT plant, in which there is a malodorous process air, are designed to have an air collection system to remove that air by means of suction. Together with the normal hall ventilation some plant parts are to be provided with source segregation of air, in order to reduce the process air flow.

The following areas of the MPT plant are vented in a targeted manner:

- Waste reception hall
- Mechanical pre-treatment hall

Source collected air from defined equipment of mechanical pre-treatment

Wet pre-treatment area with sand trap, mixers
The several process air streams are transported by fans. The process air coming from the mechanical and wet pre-treatment hall is used for ventilation of the reception area. The process air volume flow of the whole plant can be clearly reduced with these measures. The air from the waste reception hall and the source segregated air pass a dust filter before being fed into the exhaust air treatment system consisting of an acid scrubber and a biological waste air treatment system (biofilter). The exhaust air from the mixer / sand trap passes an acid scrubber and will be treated afterwards in the biofilter.

The largest volume of exhaust air results from the waste reception area.

BGP/ AD site
The following areas of the AD plant are vented in a targeted manner:

- Aeration tank
- Dewatering Area

Ammonia is the main reason for odour in these areas thereby requiring an exhaust air treatment system.

Fittings

Manual isolator valves are fitted in front of and behind the units for easy maintenance and assembly of the built-in pumps, blowers and other equipment. All safety relevant substrate carrying fittings are equipped with end of travel limit switches. These enable exact checking of the current opening or closing state of the shut-off devices. The actuators are controlled via the Programmable Logic Controller (PLC). The actuators are operated pneumatically. The compressed air required for this is produced via a piston compressor with a compressed-air storage vessel. Before the compressed air is distributed to the actuators, the condensate is separated and prepared via a refrigeration dryer.

Measuring Technology

The process control and checking of the whole of the plant technology takes place via an extensive measuring system that is connected to the PLC.

The measuring system is made up in the main of the following measuring equipment:

- Level measuring of tanks
- Limit level measuring of tanks
- Pressure measurements for gas and substrate media
- Temperature measurements for gas and substrate media
- Flow measurement for gas and substrate media
- Oxygen measurement
- Measurement of gas quality (H_2S, CH_4, CO_2, O_2)

The required measurements are registered in the PLC and summarised in trends and histories.

Drawings provided in Annex 4 illustrate the plant layout and design.

Anaerobic digestion of animal husbandry waste in the biogas plant

The Biogas Plant (BGP) will process 39,000 tonnes per annum of feedstock derived from solid manure based on the following:

- 35,000 tonnes per annum of cattle manure, and
- 4,000 tonnes per annum of solid poultry manure

These materials will be process in an anaerobic digestion system followed by a biological treatment of the liquid digestate. Integration of the closed anaerobic system ensures that emissions will be minimised and biogas will be produced. This biogas will be transformed into electrical energy and heat with a CHP.

The digestate will be dewatered to separate the solid fraction from the liquid. The solid digestate will be stored in heaps within a roofed area for maturation and further loss of water. The area is designed to provide approximately 2 weeks storage capacity. The matured digestate can be characterised as a compost and can be used as an agricultural fertiliser.

There is no specific area for the maturation of manure since the organic sludge from manure and from MSW are mixed as they are mixed in the digesters. So, the maturation (of compost) is also done all together.

The liquid digestate or centrate will represent 85-90% of the total digestate quantity and will contain approximately 65% of the nitrogen load.

Therefore, the nitrogen load of the centrate has to be reduced as far as possible before discharge to land or sewer or elsewhere. To remove the nitrogen an external carbon supplement (C-Source) will be used. This will be regulated by analysing the carbon compounds of the WWTP.

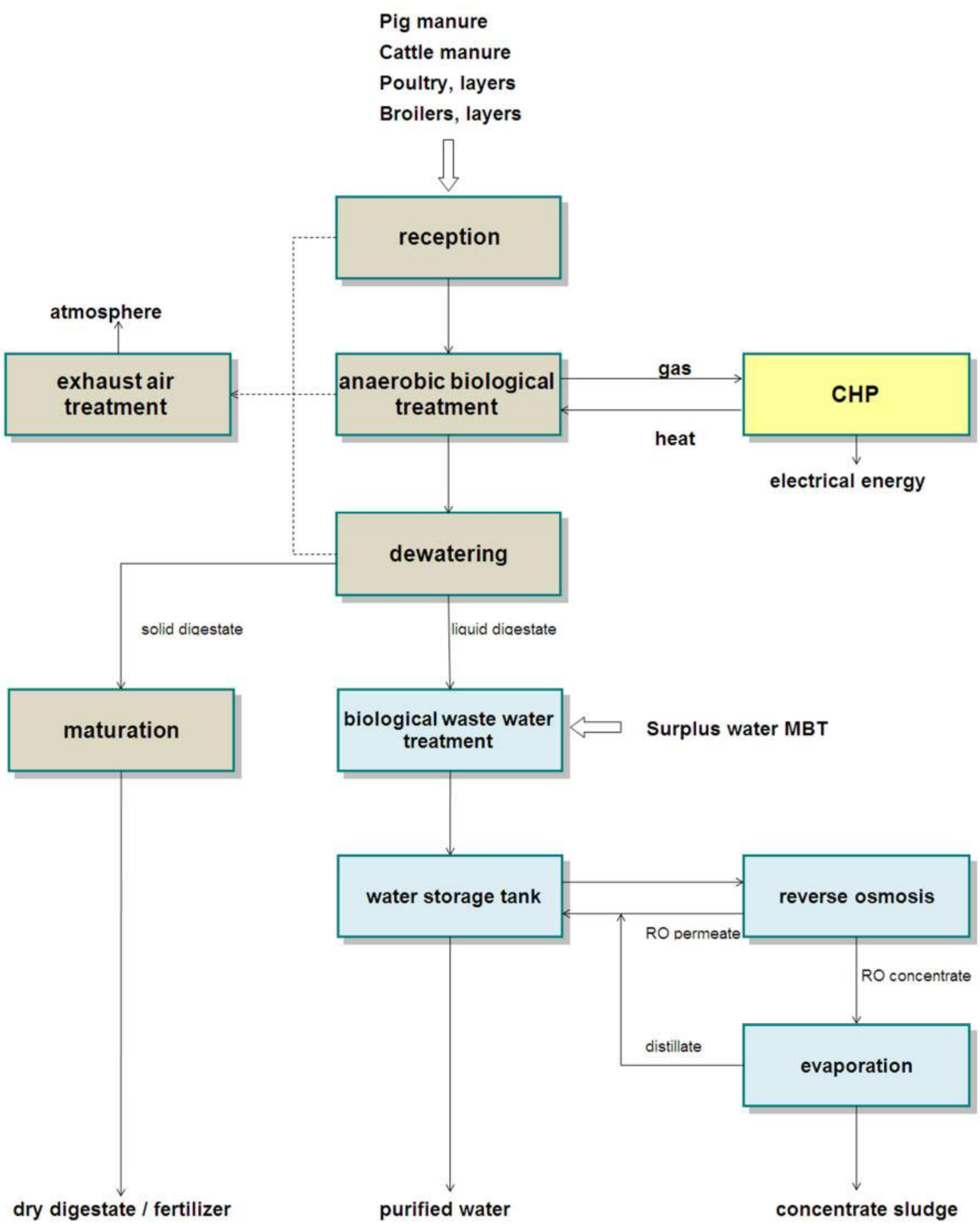
The biological waste water treatment plant is designed as a Sequencing Batch Reactor (SBR). Here the deammonification process will be used, which is a combination of aerobic and anaerobic autotrophic processes. The deammonification process saves approximately 60% of aeration energy compared to the conventional nitrification/denitrification process. In addition, a dosing of a carbon source is not necessary.

However, the deammonification process will reduce ammonium and nitrates only with an efficiency of 85-90%.

The elimination of ammonium in a biological treatment plant will proceed with high efficiency. However, the degradation of organic nitrogen compounds takes place only within the anaerobic stage. An efficiency of degradation to ammonium between 30 to 60% can be expected. Thus, the effluent will contain a certain concentration of organic nitrogen which is not degradable within the biological treatment process.

The discharge limits to sewer regarding Total Kjeldahl Nitrogen (TKN) cannot be met with a biological treatment only. For this reason a second stage. Process needs to be applied. This technique is based on a physical separation process and is able to produce a high quality permeate, in addition to a high concentrated stream.

Figure 17: Block diagram for the BGP (<u>Note</u>: Pig manure is not included within the scope of this application)



Process description

The following sections describe in detail the process for the treatment of animal waste.

Manure reception

Both solid and liquid manure will be received at the biogas plant. Solid manure will be delivered to the reception hall, whereas the liquid manure will be directly pumped into the manure storage tank. Most of the delivered manure will be liquid.

Solid manure input

The reception hall has been designed to house approximately 5 days of input quantity of solid manure. The transport vehicles will unload the manure on the floor. The solids will be fed into a dosing unit by means of a wheel loader. The dosing unit will need to be filled once a day. Screws shall transport the manure into the mixing tank. Here the solid manure will be mixed with the liquid stream to enable transportation into the pasteurization tanks by pumps.

Handling and feeding of solid manure shall be done with closed doors to prevent any odour emissions. The entrance to the reception hall will be by automatic doors.

Liquid Manure Input

The liquid manure shall be pumped directly into the manure storage tank. The tank provides approx. 6 days storage time. That means the transport to the plant shall be done in time and has to be coordinated to guarantee a constant feed of manure into the biogas plant. The storage tank will be covered to prevent odour emissions.

The liquid manure will be pumped via the mixing tank, which is located within the reception hall, into the digester tanks.

Anaerobic digestion

The anaerobic treatment is the same process as chosen for the treatment of the organic domestic waste fraction described above.

The manure will be pumped to the digester tanks. The plant is designed to have two digester tanks. The digesting reactors are operated with a temperature of approximately 37°C. In order to achieve a feed that is as steady as possible, each reactor is to be fed several times a day. The feeding sequences result from the pasteurization cycles. The anaerobic biochemical process takes place in several stages, as described above.

Storage Tank before Dewatering / Secondary Digester

The storage tank is used as a storage and homogenising tank before the dewatering process as well as a so-called secondary digester. That means it provides additional time for biogas production. Its storage function leads to the tank being operated with a varying level. The tank is fitted with a top-entry agitator to homogenise the content. The tank shall be connected to the biogas system.

Dewatering the Digested Residues

The anaerobic treated manure is fed via pumps from the storage tank to the dewatering system. Here the separation of the substrate into a liquid and solid material flow takes place by means of a 2-stage system.

Screw Press and Centrifuge Classifier

A 2-stage system shall be applied for digestate dewatering.

Screw presses shall be used in the first stage to produce a solid fraction with a high dry matter content as well as a liquid fraction. The liquid, i. e. the press water, still contains a certain amount of solids which shall be removed in a second treatment step.

In the second step a centrifuge classifier separator shall be used for further treatment of the press water. More solids will be separated here to produce a centrate with less suspended solids.

The dewatering equipment shall be installed on the first floor of the maturation hall. The solid material falls down to the ground floor. It will be stored in heaps by means of a wheel loader for maturation and further loss of water.

Waste Water Treatment

A centrate storage tank is provided, to be used as a storage and feeding tank for the centrate water before treatment. The centrate will be pumped into the 1st step, the biological waste water treatment plant, designed as a Sequencing Batch Reactor system (SBR).

In contrast to the MBT plant the complete liquid fraction quantity resulting from the dewatering of the digested slurry has to be treated. The centrate water from the biogas plant contains a huge amount of nitrogen.

The main target of the waste water treatment is to reduce the nitrogen concentration to enable a disposal of the liquid residues from slurry digestion. As most agricultural land in Malta is already over-fertilised, an agricultural use of the untreated effluent is not possible.
It is intended to treat the surplus water from the MBT plant together with the liquid slurry in the biological waste water treatment system.

The MBT surplus water will represent a proportion of approx. 20% of the total quantity, but the nitrogen load will be only 5% of the total load.

Characteristics of Liquid Digestion Residues

As told before it is intended to treat the surplus water from the MBT plant and the liquid stream from slurry digestion together in one biological waste water treatment plant. Both waste water streams are pumped into the centrate tank.

The following table shows the estimated concentrations of significant parameters of both liquid streams.

Parameter	Surplus Water MBT-AD Plant **Centrate after dewatering**
Quantity:	acc. to Tenderer's dimensioning
COD:	< 8,000 mg/l
BOD5:	< 1,400 mg/l
TKN:	< 4,500 mg/l
SS:	< 800 mg/l
Conductivity:	15 - 20 mS/cm

Table 1*:* Characteristics of liquid digestion residues

Centrate Storage Tank

The centrate storage tank is used as a storage and feeding tank for the biological waste water treatment which is designed as a sequencing batch system.

The tank is operated with fluctuating levels in order to achieve the required buffer capacity for the batchwise feed and is fitted with a submersible mixer to prevent sedimentation of small solids.

First Stage of Waste Water Treatment (SBR)

Sequencing batch reactors (SBR) are industrial processing tanks for the treatment of waste water. A batch system differs from a continuously operated activated sludge system that the biological degradation process and the settlement of activated sludge occur in the same tank. The different phases of treatment will not happen in separate tanks but at different time intervals.

The first stage of treatment shall use the deammonification process. Deammonification is the metabolic short-cut of N conversion and is catalysed by the very slow-growing Anammox bacteria. This process is an attractive option for the treatment of ammonium rich streams. It provides a high resource of saving potential compared to the common nitrification / denitrification process.

The deammonification process is preferred for waste water with high ammonium concentrations > 200 mg/l and low content of biodegradable organic matter. The examples for such streams are: Leachate from solid waste landfills, supernatants from dewatering of digested sludge, etc. The process has also been applied for the treatment of liquid residues of digested manure.

Most important advantage of deammonification process compared to the conventional nitrification / denitrification is that it needs 60% less aeration energy. Only a little bit more than half of ammonium is oxidised to nitrite. Afterwards the remaining ammonium will be oxidised to nitrogen using the oxygen fixed in the nitrite.

The deammonification comprises both autotroph processes:

1. Partial nitritation (aerob) and
2. Ammoniumoxidation (anoxic)

Because no heterothroph organism participate in the deammonification process, no organic carbon source is needed like in the denitrification process. Furthermore the surplus sludge production is very low.

The deammonification process will achieve efficiency in ammonium nitrogen degradation of 85 to 90%.

Water storage tank

The pre-treated centrate is pumped from the SBR tanks to the water storage tank. This tank is used as a storage and feeding tank.

The RO will be fed continuously. The centrate quantity which has to be treated in the RO stage, depends on the quality of the biological pre-treated centrate. Probably not the total quantity needs to be treated.

The feed to RO will be taken from the water storage tank and the produced permeate will be pumped back to this tank. Result is a discharge with lower salt concentration.

The water storage tank offers approx. 6–7 days storage capacity for the effluent from the waste water treatment plant before use or discharge.

Second Stage of Waste water Treatment (RO)

During the MBT-AD process, different water qualities are required. MBT process water can be used directly for the mixing process and sand washing whilst water of higher quality is required for flocculation, as a sub-process of the dewatering step. Purified water from the water storage tank can be used for this process.

The feed from the water storage tank is pumped under high pressure. While water molecules can pass the membrane, salt and organic compounds are held back. The permeate is almost clean water, the concentrate is highly contaminated.

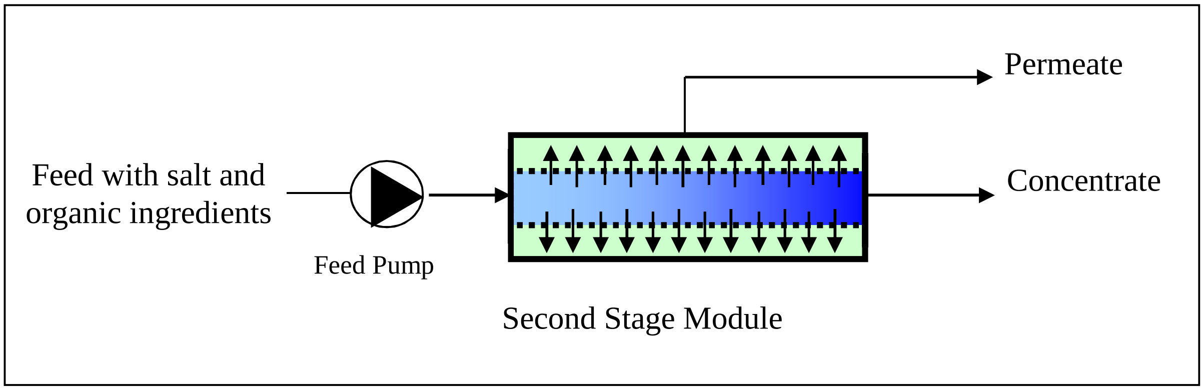


Figure 18*:* Second Stage Module

A 2-stage second phase in combination with two-stage gravel filtration upstream shall be installed as second stage of waste water treatment.

The gravel filtration unit enables further separation of solids from the biological pre-treated water in order to prevent RO-stage blockages. The filtrate contains only dissolved substances. The backflushing water from the filter stage returns to the process water tank.

Gravel filtration is followed by 2-stage second stage for further cleaning of filtrate to the quality recommended for discharge to sewer.

In order to enlarge the membrane surface it is equipped with spiral modules.

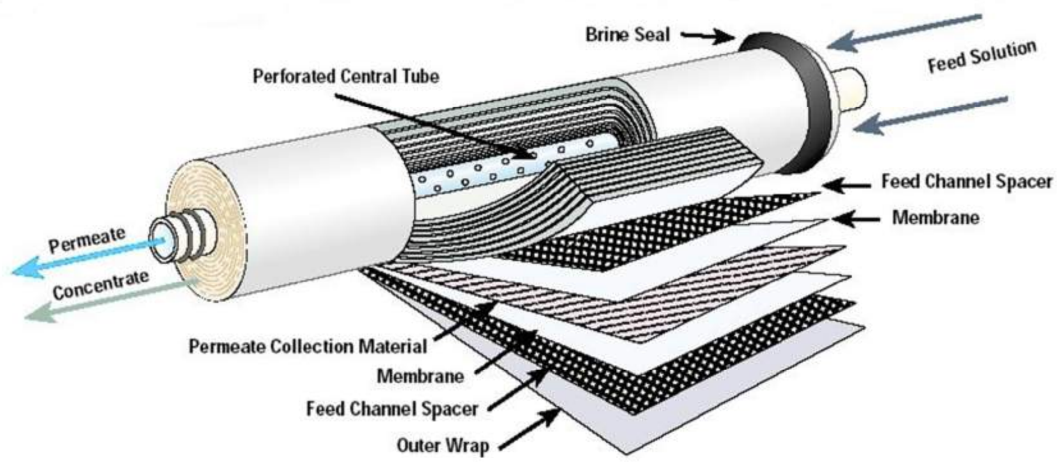


Figure 19: Spiral Module

The RO produces a water (permeate) which is almost free of salts and other dissolved substances, as well as waste water (concentrate) stream which contains all dissolved compounds. The cleaned permeate is controlled online with conductivity measurements and a permeate yield of approximately 75 - 80% is expected, depending on the conductivity level or the salt content of the feed water.

The highly concentrated waste water is discharged into the RO concentrate tank. It shall then be treated in an evaporation plant to reduce the quantity which has to be disposed.

The assumed discharge concentrations of several parameters after different steps of treatment can be found in the following table.

	Limit Values		Max. Load	
COD	mg/l	1,650	kg/day	577.5
BOD_5	mg/l	780	kg/day	273
Suspended solids	mg/l	1,000	kg/day	350
Total nitrogen (target value)	mg/l	182	kg/day	63.7
Total nitrogen (max. acceptable value)	mg/l		kg/day	100
Total phosphorus as PO4	mg/l	8	kg/day	2.8
Conductivity	µS/cm	4,000		
pH		6.5 to 7		
Temperature	°C	< 40		
Daily flow	m^3/day	350		

Table 2*:* Estimated effluent qualities after different waste water treatment steps

The treated effluent may either be used for internal flocculation process, for agricultural or irrigation purposes, or may be discharged to sewer.

Sludge Storage Tank

The sludge storage tank offers approx. 20 days storage capacity for the residue from the evaporator before disposal.

Gas engineering

The gas engineering equipment will be shared with the MBT-AD plant described above.

Process Air Treatment

Process Air Coverage

The following areas of the biogas plant are vented in a targeted manner:

- Manure reception hall / mixing tank
- Manure reception tank
- Dewatering Area

In these areas mainly ammonia is the reason for odour, so that an exhaust air treatment is necessary. The ammonia can be washed out effectively in an acid scrubber.

A biofilter will be located near the reception hall to treat the exhaust air from this area to prevent odour emissions from the storage of solid manure.

B2.2.2 Describe the proposed techniques and measures to prevent and reduce waste and emissions of substances and heat (including during periods of start-up or shut-down, momentary stoppage, leak or malfunction).

Through experience gained in the operation of a similar plant, the operator has identified a number of measures to prevent and reduce waste and emissions. Some of these have already been implemented while others are in the planning phase.

Measures to prevent and reduce the reject rate in the MTP:

- Manual picking stations were established along the dry MTP conveyors to enable the removal of spoiled cardboard and mixed plastics which are then directed to the MRF.
- This facility will include near infrared (NIR) to reduce further the quantity of material directed to landfill.

Measures to utilise excess heat from the AD plant:

- Some excess heat from the CHPs will be used in the process.

Measures to prevent and reduce emission of substances (mainly odours):

<u>MTP/AD site</u>

All areas of the MBT plant, in which there is a malodorous process air, are designed to have an air collection system to remove that air by means of suction. Together with the normal hall ventilation some plant parts are to be provided with source segregation of air, in order to reduce the process air flow.

The following areas of the MTP are vented in a targeted manner:

- Waste reception hall
- Mechanical pre-treatment hall
- Source collected air from defined equipment of mechanical pre-treatment
- Wet pre-treatment area with sand trap, mixers

The several process air streams are transported by fans. The process air coming from the mechanical and wet pre-treatment hall is used for ventilation of the reception area. The process air volume flow of the whole plant can be clearly reduced with these measures.

The air from the waste reception hall and the source segregated air pass a dust filter before being fed into the exhaust air treatment system consisting of an acid scrubber and a biological waste air treatment system (biofilter).

The exhaust air from the mixer/sand trap passes an acid scrubber and will be treated afterwards in the biofilter.

The largest volume of exhaust air results from the waste reception area. The exhaust air volume of this area mainly defines the dimension of the exhaust air treatment facilities.

<u>BGP/ AD site</u>

The following areas of the AD plant are vented in a targeted manner:

- Aeration tank
- Dewatering Area

In these areas ammonia is the primary reason for odours, so that an exhaust air treatment is necessary. Ammonia can be washed out effectively in an acid scrubber.

B2.2.3 Submit a flow diagram summarising the proposed installation activities

Kindly refer to Figures 1, 2, 5 and 17.

B2.2.4 Include a comparison of the proposed activities with relevant BAT conclusions published by the European Commission, where these have been published.[1]

This information is provided at the end of this Annex in Section 'Summary of BREF'.

[1] Available from http://eippcb.jrc.es/reference/ and/or http://ec.europa.eu/environment/air/pollutants/stationary/ied/implementation.htm

B2.2.5 Include an outline of the main alternatives considered to the proposed technology, techniques and measures

Section 4 (page 127) of the Environmental Impact Assessment (EIA) for the Plant elaborated on a number of technical alternatives. The EIA report is being included with this submission.

B2.3 RAW MATERIALS

Identify the raw and auxiliary materials, and any other substances that you propose to use, including fuels.

Give details of quantities proposed to be used annually and submit respective MSDS sheets.

Identify the storage location of these materials on a site layout plan and give details on:

- *Maximum storage capacity;*
- *Containment measures (including bunding capacity, where applicable);*
- *Protective measures (including security).*

MBT Plant - Consumables

Table 3: Chemicals / Consumables MBT

Resource	Consumption
Iron- chloride (approx. 40%)	mainly used for biogas desulphurisation during commissioning quantity depends on sulphur content in waste
Sulphuric acid (96%)	use for acid scrubber (exhaust air treatment MBT-AD Plant) quantity depends on ammonia content in exhaust air (estimation < 100 t/a)
Antifoam agent	approx. 20 t/a, depends on several factors
Polymer powder	approx. 3.5 kg dry polymer / t dry substance, approx. 40 - 50 t/a
Nutrients (biological desulphurisation)	0 – 2,500 kg/a, optionally process water
Oil CHP	approx. 6,000 l/a, depends on H2S concentration in biogas
Grease	to be defined in O&M
Oil	to be defined in O&M
Hydraulic oil	to be defined in O&M
Fuel / diesel	for mobile equipment
Ammonium Sulphate (solution)	output acid scrubber (exhaust air treatment MBT-AD Plant) quantity depends on ammonia content in exhaust air (estimation < 600 t/a)

Manure Plant - Consumables

Table 4: Chemicals / Consumables BGP

Resource	Consumption
Iron- chloride (approx. 40%)	mainly used for biogas desulphurisation during commissioning quantity depends on sulphur content in manure
Sulphuric acid (96%)	use for acid scrubber (exhaust air treatment BGP Plant) quantity depends on ammonia content in exhaust air (estimation < 50 t/a)
Antifoam agent	approx. 5 t/a, depends on several factors
Polymer powder	approx. 3.5 kg dry polymer / t dry substance, approx. 10 t/a
Nutrients (biological desulphurisation)	0 – 1,500 kg/a, optionally process water
Oil CHP	approx. 3,000 l/a, depends on H2S concentration in biogas
Grease	to be defined in O&M
Oil	to be defined in O&M
Hydraulic oil	to be defined in O&M
Fuel / diesel	for mobile equipment
Ammonium Sulphate (solution)	output acid scrubber (exhaust air treatment BGP Plant) quantity depends on ammonia content in exhaust air (estimation < 300 t/a)

Material Safety Data Sheets (MSDS) for all products are included in Annex 5.

All chemical containers shall be appropriately labelled and stored in appropriately bunded areas which are also equipped with spill containment kits.

B2.4 Ozone depleting substances and fluorinated greenhouse gases

Provide a list of equipment using ozone depleting substances and fluorinated greenhouse gases, with a fluid charge of 3 kg or more.

For each equipment, identify the type of equipment (hermetically-sealed systems, fixed systems or mobile systems), its use (fire fighting, refrigeration/air-conditioning or high-voltage switchgear), charge (in kg) and the type of substance (e.g. R22, R407c, R134a).

A list of equipment using ozone depleting substances and the relevant ODSs can be found in document "List of relevant details" at the end of Annex 3.

B2.5 MAINTENANCE

Provide a proposed maintenance programme for the installation, and a template for keeping records of maintenance.

The proposed maintenance programme for the plant is provided in Annex 6.

B2.6 ENERGY

B2.6.1: Provide a breakdown of the proposed annual energy consumption, highlighting the main energy-consuming equipment, and generation by source and end-use (including information on energy generated on site, if applicable)

Kindly refer to Figures 20 and 21 below.

B2.6.2: Describe the proposed basic measures for improvement of energy efficiency

Energy efficiency and renewable energy are said to be the twin pillars of sustainable energy policy. In many countries energy efficiency is also seen to have a national security benefit because it can be used to reduce the level of energy imports from foreign countries and may slow down the rate at which domestic energy resources are depleted.

The Waste Treatment Facility (MBT) as well as the Manure Plant (BGP) will comprise the anaerobic digestion process in which microorganisms break down biodegradable material in the absence of oxygen to release energy.

The process produces a methane and carbon dioxide rich biogas suitable for energy production. This renewable energy is helping to replace fossil fuels.

Furthermore the nutrient-rich digestate from the BGP can be used as fertilizer respectively as low quality compost in the case of digestate from MBT.

As part of an integrated waste management system, anaerobic digestion reduces the greenhouse gas emission into the atmosphere.

The Facilities have been designed to maximise energy efficiency related to both energy generation from the Mechanical - Biological Treatment Plant (MBT) and the Biogas Plant (BGP) as well as energy consumption of buildings and equipment.

The facility design incorporates all reasonable energy efficiency measures including:

- Building insulation to minimum Building Regulation standards
- Pipework insulation
- Variable speed drives where appropriate
- Energy efficient lighting and controls as required by building regulations

Both Facilities shall be energy self-sufficient in yearly average provided that the forecasts regarding waste and manure quantities and compositions will come true. Composition data from 2002 are the basis for the percentage of biodegradable material in the domestic waste. It is assumed that this percentage will further decrease in the future.

The following block diagrams show the energy which is assumed to be produced and consumed in the Manure Plant and in the MBT Plant.

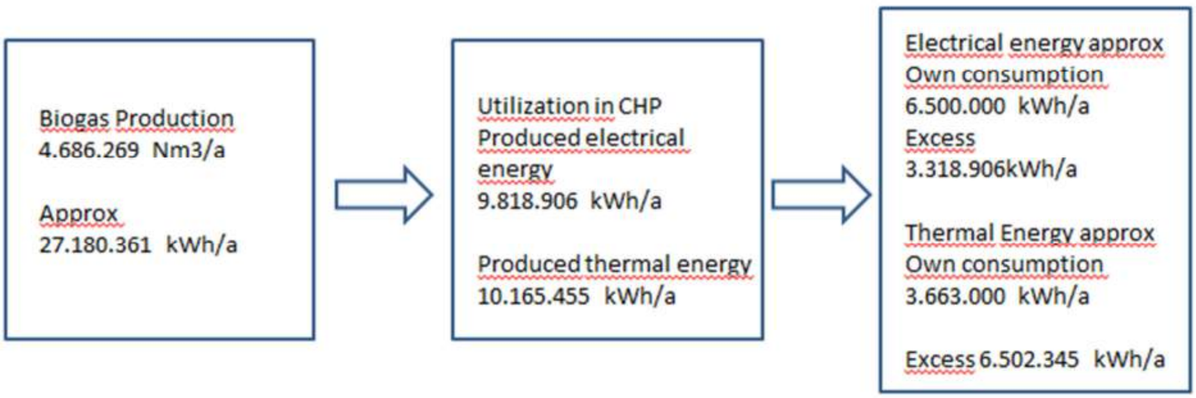


Figure 20: Energy balance of the Plant without Manure Plant

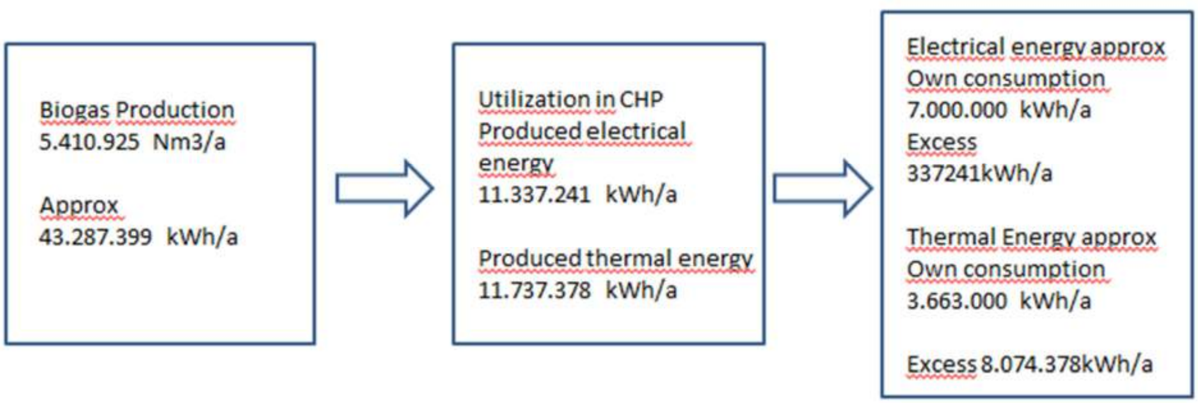


Figure 21: Energy balance of the Plant (estimation)

B2.7 WATER

Provide a breakdown of the proposed annual water consumption by source and end-use.

Details of proposed annual water consumption are provided in Annex 7.

B2.8 RISK ASSESSMENT

Describe the documented system proposed to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

Include:
(a) emergency plans in case of fire and other emergencies (e.g. explosions);
(b) plans for actions to be taken in case of failure of abatement equipment;
(c) plans for actions to be taken in case of other environmentally relevant incidents (e.g. spillages, gas leakage).

Provide certification from a competent company or engineer that the relevant fire safety procedures and equipment are in place.

Certification and fire plans shall include the presence of emergency fire fighting water supplies for use by the Civil Protection Department.

Annex 8 provides information on the proposed risk management system.

Failure of Abatement Equipment

Biogas is in general utilised through the CHPs. If the engines fail to start, the emergency system kicks in automatically and flares all the biogas being generated. Should the flare not function automatically, biogas is vented to the atmosphere as a measure to keep the tanks and auxiliary installations in working order. Should there be such an occurrence, plant personnel check for faults to resolve the situation in the shortest possible timeframe.

Leakages

In enclosed areas, leakages of biogas shall be detected through fixed monitors. Open air leakages, if substantial, shall be detected through the use of personal monitors which detect the presence of methane and hydrogen sulphide in the area.

Spillages

If spillages occur, spill kits will be available on site to be used to control the contamination and reinstate the area.

In case of relevant environmental incidents in respect of spillages or gas leakages, the respective cut-off valves shall be closed. Plant stop, partial or total will depend of the place of the incident. Details are to be indicated in O&M Manuals which shall be provided at a later stage.

B2.9 Training

Please submit a proposal for a training programme and a proposed template for keeping training records. Please submit the name of the technically competent person on site who will be responsible for such training.

At the start of each year a Training Plan is developed for every department within the Company. The Plan, compiled by each respective head of department, indicates the training requirements for subordinates.

A training log (form WSM030 Training Log in Annex 9) is retained for every course attended by an employee and kept on record by the Human Resources (HR) section. Copies of training certificates are kept in the employees' personal files.

Details of all courses attended by employees are inserted in the Training Plan Company Wide document (also included in Annex 9); this serves as a record of all training attended by employees.

Within 6 months of the training, a Training Evaluation document is forwarded by the respective head of department (form WSM010 Training Evaluation in Annex 9).

Organisation of training and relevant record keeping is the responsibility of the HR section of the Company.

Below is a description of the principles of the initial and on-going training programme to be provided by the Contractor to ensure that the operating and maintenance requirements of the MBT facility are carried in strict accordance with the detailed operating manuals.

The Contractor has to provide suitable initial and on-going training for the Client's staff to be completed by the end of the acceptance testing period.

The training programme will be undertaken in conjunction with the general staff training procedures which will include the following:

- General staff inductions.
- Health and Safety awareness training.
- Specific training for mobile plant and equipment.
- Standard operating procedures.
- Environmental permit conditions including any relevant changes.

- Environmental issues awareness with special reference to the waste management industry.
- On-going toolbox talks

Role specific Operational hand books have to be developed by the Client with assistance from the Contractor with the aim to provide to the role holders an easy to reference guide on the approach to be taken to undertaking their duties on the plant.

Initial Training Programme

The initial training programme shall be provided such that all relevant staff are properly trained prior to the commencement of the hot commissioning of the plant.

The Client has to ensure that all the operating staff shall attend the initial training programme. Staff will not be allowed to operate the facility until suitable training has been undertaken.

Staff Training

This training shall be carried out on site with the aid of the draft operating and maintenance manuals. The on-site training has to be provided by competent personnel experienced in the operation and maintenance of such plants.

The training will take the form of both practical and more formal 'classroom' sessions which expand on the theory and detail of the plant design and operation. The responsible staff have to be competent and qualified for the required training and operation of the MBT plant.

Practical Training

The relevant operating staff has to be available prior to the construction completion of the plant. The Client's key personnel and management shall be present on site at least six months in advance of construction completion. The Client's staff shall work alongside the Contractor throughout the commissioning process. The Contractor will afford the maximum opportunity for the staff to be involved in the final erection, commissioning, operation and maintenance of the plant.

Classroom Training

The Contractor has to submit a Training Manual, Training Schedule and Training Program to the Client.

The Training shall take place over a period of 10 to 15 working days (Monday – Friday) and will take the form of short lectures in a classroom environment followed by practical demonstrations of the theory covered by the lectures on the plant. The lectures shall cover the design and operating theory behind each section of process plant in turn, including, but not limited to:

- Health, safety and environmental issues
- Plant start-up and shut down
- Normal operation and fault conditions
- Control systems operation
- Fault finding
- Corrective actions
- Emergency actions and procedures
- Routine and breakdown maintenance
- Interfaces with other areas of the plant

These conditions and areas shall then be demonstrated on the plant, including the simulation of fault conditions as far as practical with a non-operational plant.

The Contractor shall verify that the training provided is being understood by the trainees, by posing problems for the attendees to solve and summary tests of their understanding.

Classroom training at this stage will be the same for all disciplines of staff.

The following table identifies the discipline of staff for which training shall be provided.

Discipline
Group 1
Technical Manager (Off Site based)
Plant Managers (Site based)
Maintenance Managers (Site based)
Shift Managers
Group 2
Electrical Maintenance Technicians
Instrumentation and Controls Technicians
Mechanical Maintenance Technicians
Plant Operators

Table 5: Training groups (example)

The Contractor has to develop a Training Schedule which demonstrates that the training requirements described can be met. Client and Contractor shall discuss and agree this Schedule prior to commencement of any classroom training.

All of the Client’s staff who have attended training, will be required to pass a written test, confirming that they understand the training objectives and that they have received adequate training.

As well as providing training and instruction on how to operate and maintain the waste processing plant the Contractor has also to extend the training programme to relevant staff who will be responsible for the operation and care of the overall site and buildings associated with the MBT plant.

This specific training will include the following site systems:

- Safety alarms (fire, smoke,gas etc)
- Roller shutter doors
- Site CCTV and intruder detection.
- Site drainage systems and interceptors
- Lighting systems
- Electrical distribution including the Contractors HV power responsibilities
- General building upkeep
- Site housekeeping facilities including wash down and vacuum systems.

On-going Training Programme

Following the initial training activities the Contractor shall provide assistance and advice to the Client to ensure an adequate on-going operational training programme is set up and implemented.

Up to the point of completion of acceptance testing the Contractor shall provide the following training input:

- Training to new operational staff to replace those who do not remain employed at the facility due to normal staff turnover or issues of competence.

- Assistance to the Client with additional training which may be required to remedy knowledge gaps or competence issues related to specific operational staff.
- Updating the operational team on issues related to the facility found during the commissioning and testing activities.

Documentation

The following training documentation shall be produced.

Document
Introduction Check List
Operational Handbooks
Standard Operatiomal Procedures
Health and Safety Induction materials (Interactive CD)
Training Manual
Training Schedule
Initial Training Programme
Training requirements matrix
Operational Training Programme

Table 6: Training documentation

B2.10 CESSATION

Submit an outline decommissioning plan describing the draft proposed measures upon definitive cessation of activities, to avoid any pollution risk and return the site of the installation to a satisfactory state (including relevant measures for the design and construction of the installation).

This plan shall include:

- *A qualitative assessment of the potential for contamination of land and groundwater pollution which might arise from the historical and current processes carried out at the installation.*

- *A draft waste management strategy including:*
  - *The identification and characterisation of sources, types of wastes (including equipment, tanks, fuels and by-products);*
  - *Criteria for segregation of wastes;*
  - *Proposed treatment, conditioning, transport, storage and disposal/recovery methods;*
  - *Potential reuse/recycling of such wastes.*

This section describes the cessation of activities and deconstruction, to avoid any pollution risk and return the site of the installation to a satisfactory state.

Before starting the decommissioning and demolition, a risk analysis has to be done. In this risk analysis the dangers are to be examined that can be generated by waste from the operation of the plant (e. g. remaining gases, water pollutants, remaining electric voltage in parts of the plant). Appropriate safety measures are to be taken. This includes the establishment of scaffolds (e. g. for the dismantling of the tanks). It also includes measures to comply with the safety on the construction site and the protection of residents from dust and noise. In order to make sure, that one always can fight fire, the water supply of the construction site must not be interrupted before the deconstruction job has finished.

Preparatory Activities

The first step is to clear up whether machines or other devices can be used in other treatment plants or industry branches. After this it is necessary to calculate the volumes or masses of the different fractions for recovery of materials:

reusable fractions		fraction for disposal	
metal fractions (iron or other metals)	….. to ……m3	residual chemicals	….. to ……m3
cables	……to ……m3	……………………	….. to ……m3

Table 7: Planning scheme of materials for recycling or disposal

The second step is to calculate the intermediate storage areas for the different fractions with respect to environmental requirements. The third step is to elaborate a logistic plan to transport the different fractions.

The following describes what has to be done in the several areas of the plant.

Tipping hall

Step 1 Removal of the cabling and WEEE
Step 2 Removal of trays and support
Step 3 Removal of MPT equipment

MPT hall

Step 4 Removal of the cabling, control panel and WEEE
Step 5 Removal of trays and supports
Step 6 Removal of the connecting pipe works of Compressed air supply
Step 7 Removal of the access steel work (e.g. platforms)
Step 8 Removal of the MPT equipment
Step 9 Removal of the container filling stations
Step 10 Removal of the associated equipment in the hall

WPT hall

Step 11 Removal of the cabling and WEEE
Step 12 Removal of trays and supports
Step 13 Removal of the connecting pipe works of Mixer, Sand Trap, Wet Star screen
Step 14 and Buffer tank
Step 15 Removal of Mixer, Sand Trap, Wet Star screen and Buffer tank
Step 16 Removal of the container filling stations
Step 17 Removal of the Dust Filters
Step 18 Removal of the associated equipment in the hall

Dewatering area

Step 19 Removal of the cabling and WEEE
Step 20 Removal of trays and supports
Step 21 Removal of the connecting pipe works and discharge chutes
Step 22 Removal of Decanter, Polymer Unit, Anti foaming agent supply and
Step 23 Conveyors / screws
Step 24 Removal of the associated equipment in the hall

Tank area

Step 25 Removal of the cabling and WEEE
Step 26 Removal of pipe work
Step 27 Removal of trays and supports
Step 28 Dismantling of the agitators
Step 29 Discharge of the residual contents of the tanks
Step 30 Deconstruction of the tanks
Step 31 Removal of the associated equipment

CHP area

Step 32 Removal of the cabling and WEEE
Step 33 Removal of pipe work
Step 34 Removal of trays and supports
Step 35 Dismantling of the container

Step 36 Removal of the associated equipment

Deconstruction finishing

Step 37 Deconstruction of halls

Step 38 Removal of concrete building constructions

Step 39 Dismantling of the cladding

Step 40 Removal of the roof

Step 41 Deconstruction of the steel work

Step 42 Evacuation of the site

Step 43 Removal of the associated equipment

B3.1 WASTE[2]

B3.1.1: Characterise (using the European Waste Catalogue code, in accordance with LN 184 of 2011 as amended[3]) and quantify each waste stream from the installation.

Table 8: Mechanical Treatment Plant (MTP) for municipal waste

Input		Output			Output's Final Destination
EWC Code	**Weight (Tonnes/yr)**	**EWC Code**	**Weight (Tonnes/yr)**	**%**	
20 03 01	**66,000**	**19 12 02**	3,089	4,7%	Baled and sold to authorised waste brokers to be exported for recycling.
		19 12 03	1,872	2,8%	Baled and sold to authorised waste brokers to be exported for recycling.
		19 12 12	8,414	12,7%	To landfill – this fraction consists of a mixture of materials.
		19 12 01	1,599	2,4%	Baled and sold to authorised waste brokers to be exported for recycling.
		19 12 10	8,881	13,5%	Baled and sold to authorised waste brokers to be exported for recycling OR To be directed to landfill unitl alternative treatment is available.
		19 12 04	1,023	1,6%	Baled and sold to authorised waste brokers to be exported for recycling.
		Organic Fraction	41,122	62,3%	To wet pre-treatment
Total	66,000		66,000	100%	

Table 9A: Sorting line for bulky waste

Input	Output	Output's Final Destination

[2] For installations carrying out waste management activities (activities listed in "Section 5: Waste management" of Annex I of the Industrial Emissions Directive), please use this section to document both incoming and outgoing waste.
[3] http://www.mepa.org.mt/file.aspx?f=6289.

EWC Code	Weight (Tonnes /yr)	EWC Code	Weight (Tonnes/yr)	%	
20 03 07	**47,000**	**19 12 02**	9,318	19,8%	Baled and sold to authorised waste brokers to be exported for recycling.
		19 12 01	2,623	5,6%	Baled and sold to authorised waste brokers to be exported for recycling.
		19 12 10	22,604	48,1%	Baled and sold to authorised waste brokers to be exported for recycling OR To be directed to landfill unitl alternative treatment is available.
		19 12 04	1,665	3,5%	Baled and sold to authorised waste brokers to be exported for recycling.
		19 12 12 (including big disturbing parts, heavy fraction and fines)	10,789	23,0%	To landfill – this fraction consists of a mixture of materials.
Total	47,000		47,000	100%	

Table 9B: Wet pre-treatment organic fraction recovered from municipal waste

Input		Output			Output's Final Destination
EWC Code	Quantity (Tonnes/ yr)	EWC Code	Quantity (Tonnes/ yr)	%	
Organic Fraction	41,222				
		19 12 12	10,435	25,31%	To Landfill
		Organic fraction mixed with water	30,787	74,69%	To AD plant
Total	41,222			100%	

Table 10: AD plant for organic fraction recovered from municipal waste

Input		Output			Output's Final Destination
EWC Code	Quantity (Tonnes)	EWC Code	Quantity (Tonnes)	%	
Organic fraction mixed with water	173,440	**19 06 04**	21,601	12,45%	To compost
Total	173,440		21,601	12,45%	

B3.1.2: Describe the proposed measures for waste management, storage and handling.

Indicate the storage location of wastes on a site layout plan and give details on:

- *Maximum storage capacity;*
- *Containment measures (including bunding capacity, where applicable);*
- *Protective measures (including security).*

Maximum storage capacity

MTP Reception Hall: 1-2 days collection.

BGP Reception Area: 2 weeks storage.

A substantial amount of the plant equipment will be housed in fully enclosed sheds which have concrete flooring. External areas will be either concreted or tarmaced. The entire area will be fully bunded such that any contaminated run-off is directed automatically to dedicated reservoirs.

Protective measures include manning of the facility on a 24 hour basis, 7 days a week.

Calculation of bunding capacity of hazardous liquid waste collection, in digesters pit, is included at the end of this annex, and fulfils the minimum capacity requirements.

Additional protective and security measures:

- Digesters pit has a sloping floor to direct the flow of rain water towards open channel gutters located at the North and South walls;
- These gutters will channel the liquids to a pump sump which shall deliver the liquid into the 3rd chamber of the AD 2nd class reservoir;
- The sump pump will be manually operated to ensure that no contaminants are delivered to 2nd class water system;
- In case of contamination (e.g. spillage), the pump shall not be started and the liquid shall be removed by mobile equipment for further treatment.

B3.1.3: Describe how each waste stream is, in order of priority and in accordance with Directive 2008/98/EC, prepared for re use, recycled, recovered or disposed of.

If you propose any disposal, explain why recovery is technically and economically impossible and describe the measures planned to avoid or reduce any impact on the environment.

Give details on authorised disposal/recovery facilities proposed to be used for each waste. If any on-site recovery of waste is proposed, provide details.

For each waste, give details on off-site transportation, including registered waste carriers/brokers to be used.

All wastes generated at the facility shall be managed through authorised waste brokers and waste management facilities. All wastes sent for recovery shall be exported through the services of authorised waste brokers. Wastes sent for disposal shall be directed to the Ghallis non-hazardous waste landfill (IP001/06/B). Records of all movements shall be available for verification.

The transportation of wastes shall be conducted by means of registered waste carriers.

B3.3 EMISSIONS TO SEWER

B3.3.2 Does the installation have a cesspit?

Details related to the collection of foul water are identified in drawings included in Annex 4:

- VBL-MT-CIV-TDT-DWG-0004 – MTP foul water drainage
- VBL-AD-CIV-TDT-DWG-0004 – AD foul water drainage

Surface rain water from asphalt areas will be collected through a series of culverts channeling the water to an oil/sand separator prior to its collection in the reservoirs.

Conditions and reasons upon which the water from reservoirs may be emptied by bowser:

- Tank repair ➔ water transferred to other sections (separated section of tanks);
- Surface contamination ➔ water transported for further treatment accordingly with the contamination needs.

These details are identified in drawings, included in Annex 4:

- VBL-AD-CIV-TDT-DWG-0001- AD Underground services
- VBL-MT-CIV-TDT-DWG-0001 - MTP Underground Services

The only process effluent is produced by WWTP. This effluent will not be discharged to cesspit/sewer but a connection point will be provided for the operator to transport and dispose accordingly.

The source of water reservoir for fire fighting can be found in the drawing “VBL-MT-CIV-ARC-DWG-0006 - MTP Layout for IPPC”, labelled OD4, in Annex 4.

B3.5 RAINWATER

Describe how rainwater is handled on site. Attach a site drainage map indicating rainwater capture and harvesting/discharge.

The design of the plant incorporates a comprehensive surface water drainage system.

Rainwater collected access roads shall be directed along the sloped surfaces to drain collection points located at kerb perimeter and diverted to a settling tank and subsequently to the a series of reservoirs via a system of underground unplasticised Polyvinyl Chloride (PVC-U) pipes. The reservoirs shall have the following capacities:

- MTP site : Reservoir A 8,000m^3
- MTP site : Reservoir B 3,000m^3
- MTP site : Reservoir C 2,000m^3
- AD site : Reservoir D 9,000m^3

Reservoirs shall be located as indicated in the drawings in Annex 4.

Water collected from roofed areas shall be disposed directly to the reservoirs through the underground pipe disposal network. The entire installation shall be gravitational and pipes shall be laid underground.

Water collected shall be utilised:

- as a primary source of water supply to the AD process: outlets connections and necessary pumps to supply water to the AD plant shall be provided.
- for firefighting purposes (outlet connections to Wet Risers to BS 336 shall be provided at locations indicated in the Drawings);
- Cleaning purposes
- Disinfectant Wheel Wash facility
- Irrigation of Landscape Area

B3.6 Emissions to Air

Identify if there may be emissions of substances to air.

If any are identified, submit details of each emission point, the nature and the proposed quantities of substances emitted from each point and treatment/abatement measures. A block plan of the site showing each emission point should be submitted.

For each boiler/generator, submit the following details: rated thermal input, energy output, date of manufacture, stack height, fuel type and annual fuel consumption.

Section 11 of the Environmental Impact Assessment (EIA) for the Plant elaborated on the main sources of emissions to air and respective mitigation measures. The EIA report is being included with this submission.

A block plan which indicates all the emission point on site can be found in Annex 4:

- Drawing VBL-AD-CIV-ARC-DWG-0008-AD Layout for IPPC.
- Drawing VBL-MT-CIV-ARC-DWG-0006-MTP Layout for IPPC.

Technical specifications of equipment resulting in emissions to atmosphere can be found at the end of this annex. Further to this more detail on emissions can be found in the “List of Relevant Details” at the end of this annex.

B3.7 ODOUR EMISSIONS

If any are identified, submit details of the main sources of odour, and the proposed techniques and measures for control of odour.

Section 11 of the Environmental Impact Assessment (EIA) for the Plant elaborated on the main sources of odours and respective mitigation measures. The EIA report is being included with this submission.

In the areas where the odour production is higher, the air will be treated in a system of biofilters due to the high odour concentrations inside these areas – MSW, biowaste and manure reception halls which will be contained by fast roller doors and air curtains.

With regards to the air filtering system, we will use nutrients on both biofilters. The nutrients are used to feed the bacteria's inside the biomass, once the air comes from the scrubber with a percentage of sulfuric acid.

Additionally, extractors are located in areas housing the most critical equipment namely the pulpers, GRS, sieve drum, bunker, etc. This will reduce the dispersion of odours from these areas.

In order to reduce the impact of any failure in the deodorizing system two separate systems are used composed of several independent circuits for extraction (piping, ventilation) allowing separate maintenance without resorting to system shutdown.

For design proposes the following odour guarantees were considered, namely:

- Odour at biofilter outlet < 500 OUe/m3 (hourly average)
- Dust at biofilter outlet < 10 mg/m3 (hourly average)

Further to this more detail on odorous emissions can be found in the "List of Relevant Details" at the end of this annex.

B3.9 Noise

Describe:

B3.9.1: *The main sources of noise and vibration (including infrequent sources) of the proposed installation;*

Section 10 of the Environmental Impact Assessment (EIA) for the Plant elaborated on the sources of noise and relevant impacts. The EIA report is being included with this submission.

B3.9.2: *The proposed techniques and measures for control of noise;*

Section 10 of the Environmental Impact Assessment (EIA) for the Plant elaborated on the proposed techniques and measures for the control of noise. The EIA report is being included with this submission.

B3.9.3: *The nearest noise sensitive locations and distance away from the site (a site map shall also be submitted for this purpose); and*

Section 10 of the Environmental Impact Assessment (EIA) for the Plant elaborated on the sources of noise and noise sensitive locations. The EIA report is being included with this submission.

B3.9.4: *Relevant environmental noise measurement surveys which have been undertaken (monitoring shall be according to the latest revisions of ISO1996 and the rating of industrial noise affecting residential areas shall be according to BS 4142; monitoring shall be carried out exclusively using type 1 sound level meter).*

Section 10 of the Environmental Impact Assessment (EIA) for the Plant elaborated on the survey and predictions conducted as part of the EIA process. The EIA report is being included with this submission.

A proposal for monitoring of noise from the operation of the facility will be provided at a later date as explained in section B3.10 below.

B3.10 MONITORING

Describe the proposed measures for monitoring emissions including any environmental monitoring. The following must be specified:

An environmental monitoring programme covering air, land, water and noise is currently being implemented in connection with the operation of the neighbouring landfill facilities; this shall be pursued and adapted to include monitoring of parameters relevant to the operation of the new facility.

It is WasteServ's plan to engage consultants to:

- Consider the already existing data gathered for the close proximity sites (Zwejra and Ghallis). This data will provide a baseline assessment prior to the operation of the Malta North Waste Treatment Plant.

- Consider the sensitive receptors at the vicinity of the new plant – including AD and MTP.

- Consider the effluents, emissions and other potential pollution generated from the operation of the plant – including the AD and the MTP.

- Consider the experience gained through the operation of the Sant'Antnin Waste Treatment Plant.

- Determine the monitoring requirements for:
    - Air quality monitoring (both offsite and onsite)
    - Stacks monitoring
    - Waste water, ground water, surface water
    - Soil and agricultural products
    - Coastal water and coastal sediments
    - Noise
    - Odour

At this point WasteServ cannot submit a full programme for monitoring since the plant is not yet operational. Ideally the programme is compiled after some months the plant is operational so as to base the programme on facts.

B3.11 EMISSIONS & WASTE SUMMARY

By means of a mass flow diagram, summarise the emissions and waste described in sections B3.1, B3.2, B3.3, B3.4, B3.6, and B3.8 of this application.

Kindly refer to Figures 4.54-4.58 in section 4 of the Environmental Impact Assessment (EIA) for the Plant for mass flow diagrams related to waste. Figures 11.5-11.7 in section 11 provide details of emissions to air.

B4.1 ENVIRONMENTAL EFFECTS

Provide an assessment of the potential significant environmental effects (including transboundary effects) of the foreseeable emissions.

Kindly refer to Sections 6-11 of the Environmental Impact Assessment for the Plant. The EIA report is being included with this submission.

B4.2 Effects on other sites

Provide an assessment of whether the installation is likely to have a significant effect on another site in Malta and, if it is, provide an assessment of the implications of the installation for that site.

Kindly refer to Sections 6-11 of the Environmental Impact Assessment for the Plant. The EIA report is being included with this submission.

B6.2 OTHER SITES

The MBT-AD plant shall form part of the operations of the larger Ghallis complex. The adjacent sites include:

EP 006/09/D	Maghtab Civic Amenity Site
IP 001/06/B	Ghallis Non-Hazardous Waste Landfill
IP 001/05/B	Ta' Zwejra Non-Hazardous Waste Landfill

B9.1 EXPENDITURE PLAN

Please provide a plan of the estimated expenditure for each phase of the following specified activities.

The plan should include the likely costs of:

- *monitoring (emission/discharge and ambient monitoring);*
- *clearing the installation (including drainage systems) of all wastes;*
- *remedial action in the event of the failure of pollution control systems.*

Table 12: Expenditure plan

Item	**Cost (excl. VAT)**
Monitoring	116,700
Clearing of installation	132,700
Remedial action should pollution control systems fail	2,550,000