ABSTRACT

The BAT study (manure) co-digestion focuses on installations where manure and/or energy crops and/or organic waste streams are converted into biogas and digestate. The study selects and describes the BAT for this sector or group of similar activities.

➔ **See chapter 1 for a description of the concept of Best Available Techniques (BAT) and its interpretation in Flanders, as well as the general framework of this BAT study.**

(MANURE) CO-DIGESTION INSTALLATIONS

(Manure) co-digestion installations can be classified in several ways, for example depending on input streams, location, scale or processing capacity, operating temperature, dry matter content, the nutritional regime of the digester, the method of mixing the reactor contents and the number of digestion stages. In this BAT study, the analysis and BAT-selection is differentiated -if relevant- depending on the

- used input streams:
  - with or without co-digestion of manure;
  - with or without addition of animal by-products.
- location:
  - farm digesters (agricultural area);
  - industrial digesters (industrial area).
- scale of processing:
  - installation on a (very) limited scale and tied to a single company (small-scale digestion);
  - installation on a limited scale, not tied to one company;
  - large-scale installations, on such a scale that it actually concerns industrial companies.

PROCESS STEPS

The BAT study focuses on the process steps 'pre treatment', 'digestion', 'biogas treatment' and 'digestate treatment' in (manure) co-digestion installations.

OBJECTIVES OF THE BAT STUDY

One of the objectives of the BAT study is to describe the applied techniques and environmental aspects of (manure) co-digestion and to describe the state of art of (manure) co-digestion in Flanders (e.g. input streams, location and digestate treatment techniques). Furthermore, the study aims to select the BAT to reduce water and energy consumption, to prevent waste and to prevent nuisance from noise and vibration. It is also the aim to select the BAT to reduce or prevent emissions to water and air (e.g. NH_3, CH_4, odour and dust), and to select the BAT to reduce explosion risks and to improve safety (e.g. storage H_2SO_4). The aim of the study is also to identify the applicable environmental regulations and where appropriate to formulate proposals to adapt or supplement the Flemish environmental legislation.

➔ **See chapter 2 for a description of the (manure) co-digestion installations and the main socio-economic and environmental legal aspects of this activity.**

(MANURE) CO-DIGESTION INSTALLATIONS IN FLANDERS

The BAT study contains an inventory of (manure) co-digestion installations in Flanders (as of October 2010). In 27 of the 36 installations, manure is digested, in addition to energy crops and/or organic waste streams. These installations are often located in agricultural areas. In the remaining nine installations, only energy crops and/or organic waste streams (no manure) are used as input. These installations are often located in industrial areas.

➔ **See chapter 3 for a description of the typical processes in the sector and the associated environmental impact.**

APPLIED PROCESS

Each (manure) co-digestion installation in Flanders is unique. It is therefore difficult to describe a typical combination of techniques for the treatment of digestate. A first applicable step in the treatment of digestate is the separation of the digestate into a thick and a thin fraction. The thick fraction of the digestate can be further treated for example by post-digestion, drying, composting/biothermal drying, liming and/or graining. Pasteurisation/sterilisation can be applied as well. Techniques that can be applied for further treatment of the liquid fraction of digestate are: biological treatment, liming, drying, evaporation, condensation, membrane filtration, nutrient recovery, ammonia stripping and/or constructed wetlands/lagoons.

ENVIRONMENTAL IMPACT OF (MANURE) CO-DIGESTION INSTALLATIONS

(Manure) co-digestion may be associated with odour. Storage, supply and treatment of input streams are the main sources of odour emissions. In addition, the treatment of the digestate (e.g. drying or separation) can cause odour emissions as well.

A number of process steps require energy, e.g. for the temperature control of the content of the digester, for mixing the reactor contents and for pumping materials. Depending on the applied digestate treatment technique(s), the energy requirement can significantly increase (e.g. drying of the digestate).

During the digestion process there is a potential risk of fire and explosion by the presence of methane gas (biogas).

Other environmental aspects which can occur in (manure) co-digestion installations are pollution of soil or water (e.g. in case of spill, overfill or leaching from storage), noise (e.g. transport movements), air emissions (e.g. biogas treatment) and waste (e.g. ferrous sludge or filter material, depending on the applied digestate treatment techniques).

➔ **See chapter 4 and 5 for a description of the environmentally friendly technologies.**

ENVIRONMENTALLY FRIENDLY TECHNIQUES AND BAT

Chapter 4 provides an overview of the available environmentally friendly techniques for (manure) co-digestion installations based on literature, supplemented with practical information on the sector.

Chapter 5 evaluates the environmentally friendly techniques from Section 4 on their technical feasibility, environmental benefits and economic feasibility. This evaluation indicates whether the specified environmentally friendly techniques are BAT or not for (manure) co-digestion installations.

In the BAT study, more than 20 techniques are selected as BAT. The study contains many examples of measures to concretise these BAT. The BAT selection was carried out in close consultation with industry representatives and experts from the administrations, and is based on literature research and company information.

SOME EXAMPLES OF BAT

Most of the BAT for (manure) co-digestion installations are preventive and process-integrated measures. Some examples are: (1) prevent the use of water, e.g. by reintroducing spilled input- and output streams to the storage installation instead of cleaning them with water (2) limit the quantity and load of waste water/liquid wastes by using overfill protection on storage tanks for liquid materials, (3) avoid excessive use of energy by monitoring energy use of the most energy intensive processes, (4) use fresh and pure input material, (5) prevent noise nuisance at the source by choosing low noise installations during the design phase, (6) guarantee safety on the site and at the level of the (manure) co-digestion installation by implementation of a safety program, (7) run odour causing processes in a closed space under subnormal pressure.

If preventive and process-integrated measures are insufficient to achieve acceptable levels of emissions, it is BAT to capture air emissions at source by (point) extraction and to implement appropriate (combinations of) end-of-pipe air treatment technique(s).

➔ **See Chapter 6 for recommendations on (manure) co-digestion installations based on BAT.**

Based on the BAT analysis, we formulate concrete recommendations and suggestions concerning environmental legislation, eco-investments and further research in chapter 5.

RECOMMENDATIONS FOR ENVIRONMENTAL LEGISLATION

We investigate how the BAT can be translated into environmental legislation, and we formulate suggestions to concretise and/or supplement the existing environmental regulations for (manure) co-digestion installations in Flanders.

On the one hand we formulate recommendations for adapting the list of establishments considered to be a nuisance of VLAREM I, e.g. for small-scale digestion, digestion of energy crops and mono-digestion of animal by-products. On the other hand we formulate recommendations for sectoral environmental conditions in Chapter 5 of VLAREM II. The review of existing sectoral environmental conditions based on the BAT was performed for (manure) co-digestion installations licensed under section 9, section 28.3 and/or section 2 of VLAREM I.

RECOMMENDATIONS FOR ECO-INVESTMENT SUPPORT

We examine the way environmentally friendly techniques for (manure) co-digestion installations can be taken into account for eco-investment support in Flanders.

(Manure) co-digestion installations or their components for which certificates for green power or combined heat and power are obtained, are not eligible for eco-investments. The majority of the (manure) co-digestion installations in Flanders are therefore de facto excluded from eco-investments. (Manure) co-digestion installations that use the biogas for production of heat (that do not generate electricity), may be eligible for eco-investments.

Possible future developments for (manure) co-digestion installations include biogas valorisation as heat, biogas valorisation by injection on the net and nutrient recovery. If these trends persist and depending on the legal framework, it should be examined whether the related techniques (e.g. heat networks, biogas cleanup, recycling nutrients) can become eligible for eco-investment support.

RECOMMENDATIONS FOR FURTHER RESEARCH

We identify a number of relevant items for (manure) co-digestion installations for which further research and technological development is desirable. We also describe a number of innovative technologies which can become BAT in the future.