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1 Introduction on bio-waste management in Belgium (Flanders)

Belgium has three regions: Flanders, Brussels and Wallonia. In Belgium, waste legislation is a competency of the Regions. In the Flemish Region in the last two decades, the Public Waste Agency of Flanders (OVAM) has given very active attention regarding biowaste treatment, composting, digestion and sustainable use of compost and digestate. The Flemish waste management policy is built upon the hierarchy of waste management options: prevention > recuperation > waste treatment for recycling > incineration > landfill. Separate collection has been a focus in Flanders from the early nineties. It is nowadays still important, but the main focus has shifted towards prevention since the late 1990s. Whereas in the beginning compost was produced from mixed residual waste, with poor market opportunities and severe quality shortfall (chemical, physical, microbiological), gradually the quality of compost as a product has improved. Not only due to pre- and post-treatment, but rather because of strict acceptance rules. In the beginning, the product standards for compost as described in the VLAREMA (Flemish Regulation on Sustainable Materials Management and Waste) were not maintained. Separate collection initiatives in the Flemish Region have been very successful since then. In the early nineties, the municipalities and inter-municipal waste associations were obliged to implement the separate collection from households for either green waste or vfg-waste (kitchen and garden waste). In that time, sorting analyses showed that about half of the residual waste consisted of an organic-biological fraction. Together with the setting up of systems for separate collection, the treatment plants were built in the early nineties. Further investments and efforts in separate collection and treatment of biowaste, pushed by legislative rather than sheer economic aspects, resulted in new experiences and satisfactory results. Since 2006 about 40 digestion plants started up. They process a combination of manure, energy crops and industrial biodegradable waste.

Nowadays the composting and digestion plants in Flanders produce high quality compost and digestate and fit in all cases as a soil improver or organic fertilizer in agriculture, horticulture, private households, landscaping, ...

2 National concept/strategy on bio-waste management

2.1 Legal framework

In 2012 the new Material Decree got operational. This Decree anchors the sustainable materials management in Flanders. The Decree implements the European framework directive (EC) 2008/98 on waste management in Flanders. Parallel to the Decree, a new Implementing Act was adopted. VLAREMA, the Flemish regulation for the sustainable management of material cycles and waste, contains more detailed rules on waste, raw materials, selective collection, transport, the registry duty and the extended producer responsibility.

The VLAREMA-regulation (Annex 4.1, Section 1) amends the compulsory quality certificate whenever biowaste is treated in a licensed biological treatment plant producing organic fertilisers or soil improvers by composting and anaerobic digestion. Only when all conditions are met, the end products can be considered as secondary raw materials meaning that they can be applied safely.

Treated biowaste that has been granted with a Vlaco-certificate, assures sustainable application and states that unacceptable diffusion of unwanted or polluting substances is avoided when being applied as a fertiliser or soil improver. When the biological processing excludes biowaste (e.g. only manure, energy crops, primary materials), the certification is not compulsory.

Biological treatment is the aggregate term for treatment processes in which micro-organisms are responsible for the organic breakdown of organic-biological material into products applicable as fertiliser or soil improver.

Processes that are considered into the scope are composting, anaerobic digestion and biothermal heating (partly composting of manure with biowaste).

In some occasions, a non-biological post-treatment can have an influence on the composition, properties and application terms of the end product. As a consequence, also the quality of the post-treated products is co-assessed during the certification process. In anaerobic digestion, this means quite a few digestate-derived products, as such placed on the market.

All facilities producing biowaste compost, green compost and the final material of the biological treatment of biowaste (including digestate products) must be licensed for the biological processing of biowaste, and are obliged to apply for the quality certificate.

2.2 Waste management programs and strategies

A key factor in the Flemish waste legislation is the **non-dilution principle**: biological treatment plants cannot be used as a solution for getting rid of polluted substances: only biowaste that complies with the end product standards can be accepted as an input material. Furthermore the treatment of (bio)waste should not divert the problems to other environmental compartments. Closing the biological cycle for biowaste also implies proper use of the end product and a decent control system.

Flanders' waste policy follows the generally accepted waste hierarchy. It first strongly focuses on waste prevention. Avoiding the collection of biowaste by means of home composting is also seen as waste prevention. Then comes re-use and recycling. Waste that still has to be disposed of, should preferably be incinerated with energy-recuperation, or failing that incinerated without energy-recuperation and only if no other possibility remains, the waste may be landfilled. Laws and rules have been set in order to put these principles in practice. Some examples:

Incineration ban

It is prohibited to incinerate:

- selectively collected wastes that can be recycled, with the exception of some high calorific wastes for renewable energy purposes;
- household waste that is unsorted;
- industrial waste that is unsorted.

A motivated derogation is possible.

Landfill ban

It is prohibited to landfill:

- unsorted household and industrial waste;
- wastes that were selectively collected for the purpose of recovery;
- combustible residues from the sorting of household waste or comparable industrial waste;
- pharmaceutical waste.

A motivated derogation is possible.

Flanders applies the 'polluter pays' principle. Simultaneously, a price-differentiation distinguishes between the fraction for incineration or landfilling (the 'rest-fraction' or residual waste stream) and the fractions collected separately for recycling. The Flemish Government has also imposed additional environmental taxes on the residual waste stream (landfilling being the treatment method with the highest tax). The selectively collected recyclable stream is tax-free. The purpose of these taxes is to stimulate prevention and recycling, and also to finance regional environmental policy.

2.3 National standards and technical guidelines (collection, treatment and use)

The Quality Assurance System is explained in the 'General Regulations for the Certification', a document which is anchored by law in the VLAREMA legislation. The actual version of the document is available in Dutch on the website of the OVAM (as a pdf document) and can be obtained there. The document describes from A to Z all the requirements for the certification of compost and digestate products.

The General Regulations describe the certification requirements (scope, certification process, requirements of conformity, evaluation, decisions) for the granting of a certificate for the treatment of biowaste to become a secondary raw material (to be used as a fertiliser or soil improver). Vlaco is acknowledged by the Flemish Minister of Environment to organise, within the framework of the VLAREMA-legislation, the control and certification of treatment plants of biowaste (= producer). Only when a certificate is achieved, the treated biowaste can be considered as a secondary raw material (and not a waste).

Within the scope of the certification activities, several different biological treatment processes are included: (aerobic) composting, anaerobic digestion, biothermal heating, ... End products as well as intermediary products can be part of the control and certification activities.

The certification system is based upon the principle of auto control: the treatment plant of biowaste implements an internal quality system, taking into account input and acceptance of biowaste, monitoring of the quality of the treatment process, quality assurance of the end product and reasoned application of the end product as a fertiliser or soil improver. The producer is assessed for the implementation of this internal quality system by a recognised certification body (Vlaco). The instruments used by the certification body for the quality assessment are regular auditing, sampling and analysis and administrative controls.

The decision on granting, maintaining, suspending or withdrawing of a certificate is taken based on the judgement of the audits, administrative controls, corrective measures implied in a corrective action plan and several analysis results of the end products and intermediate products.

The certification activities of the quality assurance organisation (Vlaco) are supervised by the OVAM. The General Regulations of Certification are set up and agreed upon by OVAM.

The VLAREMA-legislation for use of treated biowaste as a secondary raw material (fertiliser or soil improver) sets up limit values for the most important environmental parameters, both organic (PAH, PCB, volatile compounds, ...) and inorganic (e.g. heavy metals). The Vlaco QAS is based on limit values that are even stricter than these values, and carries along parameters indicating the agronomic importance of the end products (nutrients, soil organic matter) as well as the physical and biological quality aspects (impurities, viable seeds, stability). In table 1, the quality standards for green compost are shown, in table 2 the standards for vfg compost. In table 3 the standards for digestate products. Nutrient composition is tested and to be declared to the user, not regulated.

TABLE 1: Standards for green compost

	QO ¹	Percentile	Standard	Unit
GENERAL PARAMETERS				
Dry matter	>50	20	>45	weight %
Organic matter	>16	20	>14	weight %
pH (water)	-	-	6,5 - 9,5	-
HEAVY METAL CONCENTRATION				
Arsenic	<15	75	<20	mg/kg DM
Cadmium	<1,5	75	<2	mg/kg DM
Chromium	<70	75	<70	mg/kg DM
Copper	<90	75	<150	mg/kg DM
Mercury	<1	75	<1	mg/kg DM
Lead	<120	75	<150	mg/kg DM
Nickel	<20	75	<30	mg/kg DM
Zinc	<300	75	<400	mg/kg DM

¹ QO = Quality Objective

IMPURITIES, STONES AND VIABLE SEEDS				
Impurities > 2 mm	<0,5	75	<0,5	weight % DM
Stones >5 mm	<2,0	75	<4	weight %
Viable seeds	<1	90	Max. 1	#/0,5l
STABILITY/MATURITY				
Decomposition degree (temperature)	<30	80	<40	°C
Respiration (Oxitop)	<10	80	<15	mmol/kg VS/h
MICROBIOLOGICAL PARAMETERS				
Salmonella			absent	/25g

Product standards to be judged upon sampling: product appearance. The product must be loose and not compacted.

TABLE 2: Standards for vfg-compost

	QO ²	Percentile	Standard	Unit
GENERAL PARAMETERS				
Dry matter	>50	20	>45	weight %
Organic matter	>16	20	>14	weight %
pH (water)	-	-	6,5 - 9,5	-
HEAVY METAL CONCENTRATION				
Arsenic	<15	75	<20	mg/kg DM
Cadmium	<1,5	75	<2	mg/kg DM
Chromium	<70	75	<70	mg/kg DM
Copper	<90	75	<150	mg/kg DM
Mercury	<1	75	<1	mg/kg DM
Lead	<120	75	<150	mg/kg DM
Nickel	<20	75	<30	mg/kg DM
Zinc	<300	75	<400	mg/kg DM
IMPURITIES, STONES AND VIABLE SEEDS				
Impurities > 2 mm	<0,5	75	<0,5	weight % DM
Stones >5 mm	<2,0	75	<4	weight %
Viable seeds	<1	90	Max. 1	#/0,5l
STABILITY/MATURITY				
Decomposition degree (temperature)	<40	80	<45	°C
Respiration (Oxitop)	<10	80	<15	mmol/kg VS/h
MICROBIOLOGICAL PARAMETERS				
Salmonella			absent	/25g

Product standards to be judged upon sampling: product appearance. The product must be loose and not compacted.

² QO = Quality Objective

TABLE 3: Standards for digestate products

	QO ³	Percentile	Standard	Unit
GENERAL PARAMETERS				
Dry matter	-		-	weight %
Organic matter	-		-	weight %
pH (water)	-	-	≥6	-
HEAVY METAL CONCENTRATION				
Arsenic	-	-	<20	mg/kg DM
Cadmium	-	-	<2	mg/kg DM
Chromium	-	-	<100	mg/kg DM
Copper	-	-	<800	mg/kg DM
Mercury	-	-	<1	mg/kg DM
Lead	-	-	<150	mg/kg DM
Nickel	-	-	<50	mg/kg DM
Zinc	-	-	<1500	mg/kg DM
IMPURITIES, STONES AND VIABLE SEEDS				
Impurities > 2 mm ⁴	<0,5	75	<0,5	weight % DM
Stones >5 mm	<2,0	75	<4	weight %
Viable seeds	<1	90	Max. 1	#/0,5l
STABILITY/MATURITY				
Respiration (Oxitop)			<50	mmol/kg VS/h
MICROBIOLOGICAL PARAMETERS				
Salmonella			absent	/25g

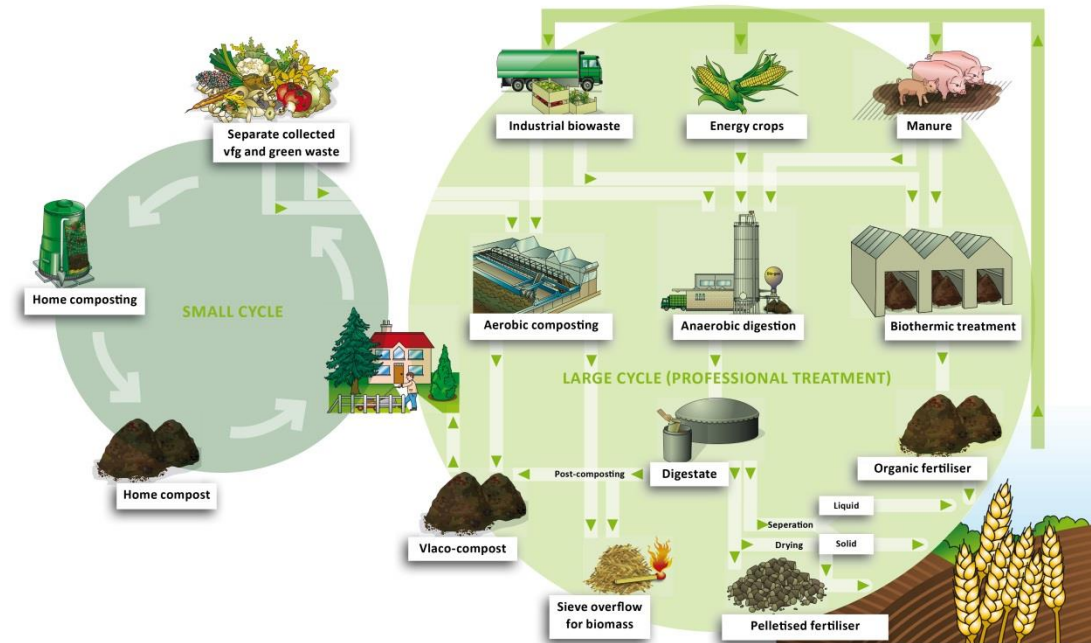
³ QO = Quality Objective

⁴ For liquid digestate products (whole digestate, liquid fraction, effluent, concentrate) the limit value for impurities (<0,5%) is expressed on fresh matter basis

2.4 Quality Assurance Scheme (QAS) and National Quality Assurance Organization (NQAO)

Vlaco npo is the reference centre in Flanders in relation to composting and digestion, both centralised and at home.

Since 2004 Vlaco npo is responsible for the quality control of all treatments of biowaste (from households and industry). The different treatments are composting, digestion and biothermal heating. This is illustrated in the figure below.



Since its start-up in 1992, Vlaco considers quality as a key issue. A quality assurance system (QAS) has been put in place, which is obligatory for all professional composting and digestion plants in Flanders. This QAS is based on the principles of integral chain management. The QAS takes into account all aspects of the treatment and production chain, from the acceptance of biowaste, the quality of the treatment process, end product quality up to customer support for a reasoned use. The outcome of the QAS on treatment plant level is a product certificate, showing that the compost or digestate is produced according to the criteria set up in the certification scheme and the waste legislation. Without the control certificate, treated biowaste cannot be used as a secondary raw material. Control of compliance with this certification scheme is done by means of regular audits and product sampling.

The most important aspects of the quality assurance system are:

- (a) a strict acceptance protocol (input)
- (b) process management according to ISO-principles (throughput)
- (c) quality monitoring of the end product (output)
- (d) reasoned use of the end products

3 Source separated collection of bio-waste

Treatment plants must have procedures describing the acceptance of inputs for green waste composting, VFG waste composting or anaerobic digestion of biowaste. Only separately collected biowaste is allowed to be used as an input for professional composting and digestion. Treatment contracts exist between all professional biowaste treatment plants and the municipalities or inter-municipalities, which guarantees the intrinsic quality of the input material. These contracts also exist for the biowaste that is treated through anaerobic digestion for the production of digestate. Through visual control at the gate, analysis of quality parameters and regular sorting tests of the biowaste being presented, treatment plants ensure an input stream of continuous high quality. In case of non-conformity with the acceptance criteria, the biowaste is refused, and the cause of incompliance must be addressed. The quality of separately collected biowaste from households, if insufficient, can be adequately improved by raising awareness and information campaigns. The acceptance of industrial biowaste from the agro-food industry is only possible when regular analyses on agricultural and environmental parameters are carried out, as well as a risk assessment of the input material (origin, traceability, EWC code, registration, ...). For acceptance, the input material is subdivided into 3 different risk categories. According to the risk, there is an adopted analysis protocol of the input material. The biowaste has to meet the standards for the end-products, no dilution is allowed.

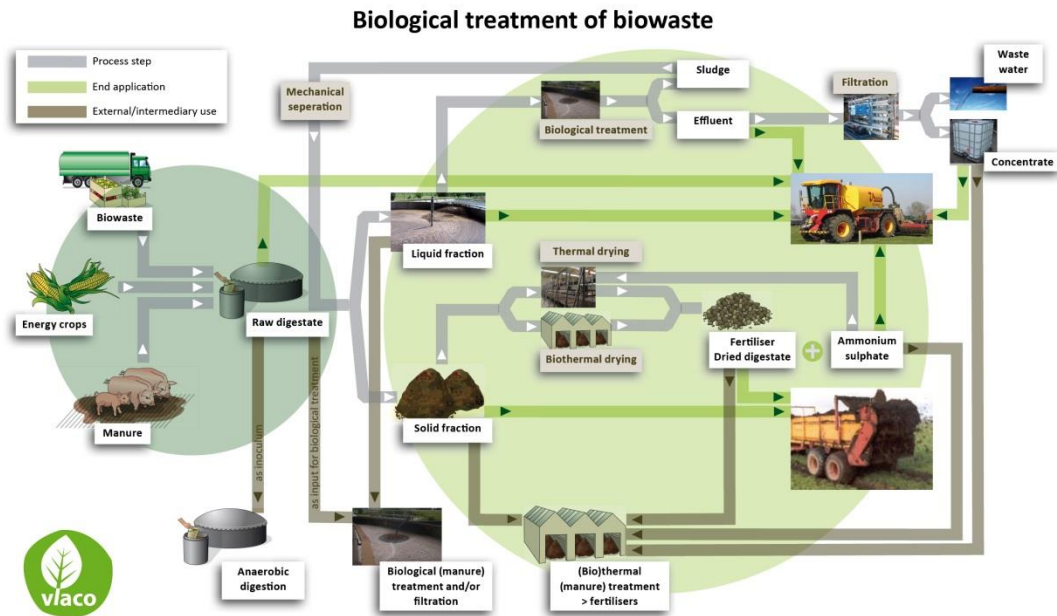
4 Bio-waste treatment (recycling, material/energy recovery)

In 2019 90 plants treated more than 2,5 million tonnes of waste materials. 436.000 tonnes of compost is produced.

TABLE 4: Biowaste treatment and quality assurance in Flanders in 2019

	number of plants	number of audits	processed waste
green composting plants	42	39	645.000 tonnes
vfg-composting plants	9	9	345.000 tonnes
anaerobic digestion plants	39	37	1,45 mio tonnes

The digestate is treated in different post-treatment steps, to obtain different end-products: whole digestate, liquid fraction, solid fraction, effluent, concentrate and dried digestate. In anaerobic digestion, in addition to biowaste, also energy crops and manure is treated. In total 1.450.000 tonnes of digestate products were produced in 2019.



5 Application and market

Vlaco tries to reach a smart market for green organic soil improvers and fertilisers. The figures below show the markets for Vlaco-compost and digestate. In 2019 about 440.000 tonnes of Vlaco-compost were marketed (Figure 1), subdivided into about 327.000 tonnes of green compost and 109.000 tonnes of biowaste compost (vfg compost). The trend for green compost is still increasing while the trend of biowaste compost remains more or less stable.

Vlaco investigates in further research how and under which conditions, different types of compost can be used for certain applications. There is a strong focus on the long-term effects of compost.

It is of no use to have separate collection and composting and digestion, if compost and digestate as an end-product, are not applied in a sustainable way. The marketing activities of Vlaco are therefore considered of major relevance. Much emphasis is put on the specific characteristics of compost as a soil improver. Compost is neither a chemical fertiliser, nor a substrate as such. Besides simple advertisements, participation in commercial fairs, and many more marketing activities, it is of equal importance to give correct information on the possible use and application conditions for the different compost types. The figure below gives the market shares for Vlaco-compost.

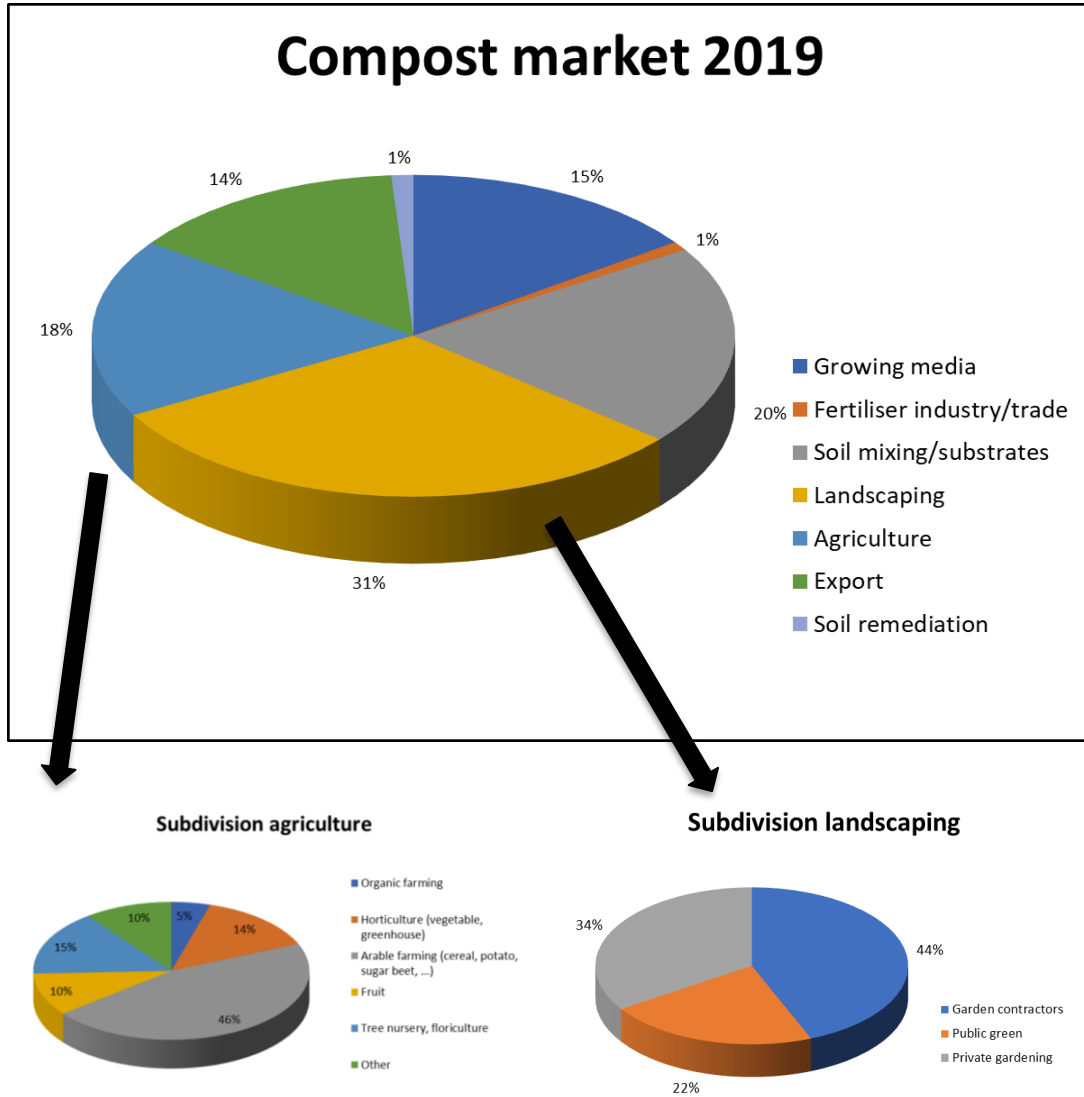


FIGURE 1: Market of compost in Flanders in 2019.

Compared to compost, digestate (products) are more relevant as organic fertiliser than as soil improver. They contain more available nutrients in comparison to compost, and the market for digestate products is mainly focused on agriculture. The types of digestate produced and market shares are shown in Figure 2.

In 2019, about 1,45 million tonnes of digestate products were produced. Not all digestate is marketed as liquid digestate. The post-treatment of raw digestate (whole digestate) creates a number of different digestate products. Only dried digestate is applied in other markets than agriculture: 5 anaerobic digestion plants are allowed to market dried digestate for landscaping, public green, private gardening. This is still a very small market. Vlaco is further investing in research and development of differentiated markets for digestate products.

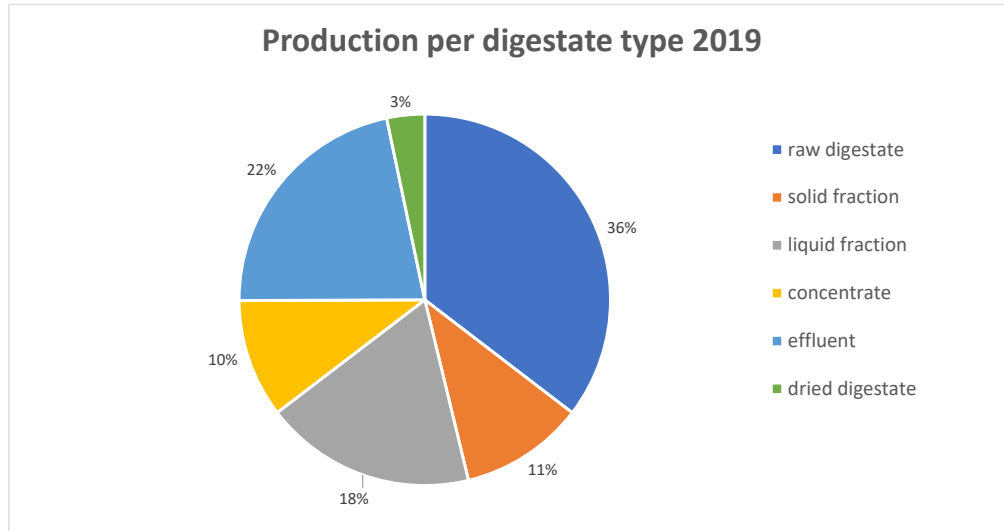


FIGURE 2: Digestate production in Flanders in 2019

6 Expected trends and developments

In the future Vlaco will invest a lot in product differentiation. We support the Flemish producers to make customized compost and digestate products. Research and product development will be necessary to reach this goal.

The Circular Economy Action Plan from the European Commission and the revision of the Waste Framework Directive towards a better recycling of biowaste will boost the production and use of compost and digestate products in Europe.

The revision of the Flemish Regulation on Sustainable Materials Management and Waste imposes the mandatory separate collection of biowaste for large companies from 1.01.2021. More waste material for biological treatment is expected. On the other hand, the legislation is evolving towards prevention and less food losses.

The produced compost and digestate market will in the future be influenced by the European Fertilising Products Regulation (Regulation (EU) 2019/1009). The development of this Regulation is closely followed.

The sustainability of the production and use of compost and digestate (as recycled nutrients and organic matter) is supported by Vlaco's carbon footprint tool. This is a tool that calculates the CO₂-equivalents per tonne of compost or digestate that is used in different applications.

Another focus point in the future is the fate of compostable plastics in the in the biological cycle. An OK compost label can't be considered as a claim to acceptance in a composting or AD plant. For the future, a positive list of well-defined materials that can be allowed in the biobin can be taken into consideration.

We highlight the fullest potential of organic recycling by a combination of the production of green soil improvers, fertilisers and green energy.

7 Contacts and sources of information

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Annexes (Please attach any regulation, directive on bio-waste, fertiliser etc. of your country)

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