Biological Waste Treatment

Unit 8

Composting of sludges from waste water purification

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Inhalt

8 Composting of sludges from waste water purification

8.1 Introduction

8.1.1 Historical development

Composting of faeces and faecal sludges is a method known for centuries, to use the fertilising value and the organic substances of those wastes in agriculture and thus closing the natural loop. The modern waste treatment in Germany digested waste water sludges (AS) at first together with the mixed wastes collected from households and industry. Not before the Seventies of the 20th century quite a number of pure digestion processes for sludges became relevant. In the beginnings, the technical realisation of composting was carried out with reactors in order to achieve best possible conditions to control the digestion processes. Up to today, enclosed systems (decomposition in reactors, containers or tunnels) are common, windrow composting is, however, more often used, depending on the plant location and throughput capacity.

8.1.2 Frame conditions

Considering the legal requirements for the utilisation of sewage sludges follows

- the direct application,
- the production of sewage sludge products,
- composting,

provided that they are environmentally more compatible than a removal by incineration and landfilling.

The utilisation of sewage sludges is always environmentally compatible when

- emissions to be expected,
- the conservation of natural resources,
- the energy balance and
- the enrichment of harmful matter in the treated products

is more favourable than a removal. The conclusion from this is that sewage sludges, respectively produced composts from sewage sludges, with a lower harmful matter potential, i.e. below the values of the legislation or other bodies of rules and regulations created especially for compost e.g. quality criteria of the BGK e.V. [BGK e.V., 1994], must be utilised.

8.1.3 Quality Assurance Systems for Fertilisers from Secondary Raw Materials

In the range of fertilisers from secondary raw materials several serious quality assurance systems exist which are independent from each other. For Germany these are:

- The German Compost Quality Assurance Organisation (BGK e.V.) is competent for composts from biowastes and green wastes, in other countries you have to look for the responsible organisation.
- The producers of products from peat founded an association of voluntary quality control.

8.2 Basics of Waste Water Sludge Composting

8.2.1 Requirements for the decomposition material

Compost is the product of an aerobic microbial decomposition process of organic substances.

A sufficient oxygen supply of the microorganisms, which are active during decomposition, together with an optimal water supply is most important. The free available air pore volume is of central importance here. It is the precondition for a successful gas exchange (oxygen supply, release of the metabolic product CO_2) and strongly dependent on the structure and water content of the compost material. De-watered waste water sludges (AS) still contain more than 70 % of water at a small air pore volume and a weak pore structure (compare *Chapter 2.3 Physical and chemical material properties – qualification criteria for composting*). Therefore **structure material** is an essential component in nearly all current treatment processes where waste water sludges (AS) are composted.

Well-established structure materials are:

- Shredded bush cuttings,
- shredded straw or wood,
- coarse meal from bark,
- sawdust and
- shredded paper.

All these additives have the main purpose of reducing the water content of the compost raw material and to guarantee an optimal bulk height in the reactor or on the windrow at a sufficient air pore volume. The very close C/N ratio which is found in municipal sludges (approx. 6-10) is distinctly enlarged (up to 20). This is definitely advantageous for the decomposition process, whereby it must be said, that the carbon supplied by the described structure materials is available in noteworthy amounts for the microbial material turnover not before the mesophile decomposition phase starts. The widespread term “carbon carrier” is misleading at least for the first (thermophile) decomposition phase.

8.2.2 Decomposition process

The self-heating process of compost during decomposition can be regarded a positive side effect concerning decontamination of the decomposition material. The generated temperatures of over 70 °C are killing the pathogenic germs in the waste water sludges (AS). Thus, the waste water sludges (AS) are hygienised by the decomposition process. A restriction of application times or a prohibition of application on account of hygiene reasons like with the pure waste water sludges (AS) is not required.

Decomposition from not digested or only partially digested waste water sludges (AS) has very typical characteristics, whereby the temperatures rapidly rise to more than 70 °C (within 48 hours) on account of easily degradable sludge components. Maximum temperatures in the decomposition material of over 80 °C are not seldom when not digested sludges (raw sludges) have been used. On account of a reduced variety of species of the organisms partaking in the composting process due to such high decomposition temperatures, the easily degradable portions of the decomposition mix will be decomposed during the first two to three weeks of decomposition, i.e. the components of the waste water sludge (AS) are decomposed.

Structure materials with a regularly high content of cellulose and lignin (wooden material, straw and paper) are, if used, only appreciably degradable after a decrease in temperature to below 60 °C. Thus, it can be assumed that the degradation of organic matter during the first three weeks exclusively concerns sludge components, and that at this time the used structure material is in larger parts not yet degraded.

On account of their low content of organic matter (oDM) digested sludges are suitable for composting only to a little degree. Shredded material e.g. from green cuttings should be added (compare *Chapter 8.2.1 Requirements for the decomposition material*) which is able to produce a sufficient self-heating (product hygiene) without the addition of waste water sludge (AS). However, it must be said that a mesophile sludge composting (e.g. with shredded straw) can be able to produce a hygienically irreproachable product. Hygienic examinations at triangular windrows of about 1.8 m height, which were re-stacked in a weekly rhythm and achieved 45 °C at maximum in the windrow core showed that salmonellae and Escherichia coli had been killed effectively after a three months' decomposition [NIV, 1994].

8.3 Technology of Waste Water Composting

8.3.1 Process

Following the documentation of the ANS e.V. about 60 to 70 composting plants for waste water sludges (AS) with two different decomposition processes were operated in Germany by the beginning of the year 1999.

Windrow composting processes can be operated with little technology, but need a large area. The location of a composting plant must be chosen carefully with regard to odour annoyances. Structure materials are green cuttings, wood and straw chippings, but also bark meal and straw (compare *Chapter 8.3.2 Windrow composting*).

Decomposition takes place in enclosed systems like e.g. vertical or horizontal reactors, tunnels or containers with little need of room, a controlled oxygen supply of the decomposition material and the possibility of exhaust air purification for odorous material. A subsequent decomposition in windrows or in another reactor/container follows in most of the cases (compare *Chapter 8.3.3 Decomposition in enclosed systems*).

The following explanations just include the principles of the operational processes windrow composting and decomposition in enclosed systems as the decomposition systems being currently on the market can be allocated to both basic patterns except deviations in details. A list of addresses of manufacturers of single processes and manufacturers of complete decomposition systems is available on request from the author.

8.3.2 Windrow composting

Figure 8.1 shows the basic process of a windrow composting for waste water sludges (AS).

The sludges (raw and/or digested sludges) usually dewatered in mechanical centrifuges, screen conveyor presses or chamber filter presses are transported into the sludge bunker with a corresponding discharging equipment, the ready-for-use additives (sawdust, bark meal, shredded material and paper etc.) get into the bunker for structure material for intermediate storage.

A shredder (for paper, green cuttings, wood, straw) must be provided depending on the type of the structure material and the way of delivery. If any residues are used (compost, screen residues), they are stored either in a third bunker or together with the other structure material.

Raw compost normally consists of a mixture of dewatered sludge and structure material at an approximately equal volume, whereby structure material can be partly replaced by (dry) mature compost. Mixing takes place in forced mixers, by means of a dung spreader or a wheel loader.

It has to be seen that the decomposition material has a sufficient air pore volume what is achieved at a water content in the mixture of approx. 65 %. A special case is the use of sludge pellets as structure material. The pellets are fabricated from a mixture of waste water sludge (AS) and dry material from compost or screen residues), thereby other structure materials are not required.

The mixed compost-straw material is directly transported to triangular or table windrows during the process of windrow composting (*Figure 8.1*) or into a horizontal silo, known from agriculture. It is turned in regular intervals either with a special re-stacking machine or with a wheel loader. A possibility for humidification of the composting material during turning should be provided in order to keep up optimal decomposition conditions (compare *Chapter 3.3 Aeration*).

The decomposition takes 3 to 10 months depending on the utilisation of the compost and the decomposition plant.

A paved and sealed decomposition site is necessary for the collection of press water and leachate and contaminated surface water. In areas with heavy rainfalls it is advisable to establish a roof over the windrow site or cover the windrows with permeable canvas.

According to the standard process of composting waste material, a roofed compost storage follows windrow decomposition. The grain size of the produced compost, the used structure material and the sales markets possibly make fine screening necessary. Should screen residues arise, they can be returned into the process.

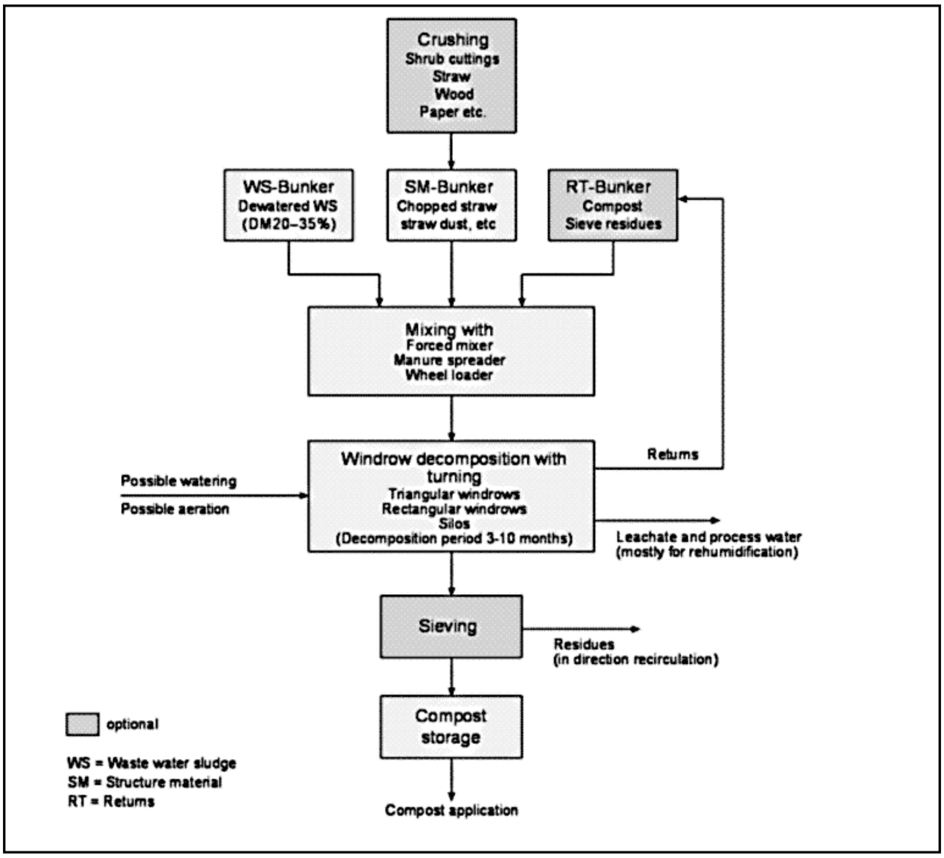

Fig. 8.1: Process pattern of waste water sludge composting (ASK) on windrows

The water content of the ready-mixed raw compost is in the first instance dependent on the dewatering degree of the used sludges. By means of an example, *Figure 8.2* shows the processed quantities of fresh matter per working-day (wd) for a decomposition plant with an annual throughput of 3,000 Mg dry sludge mass. This example is based on a constant structural material and water content and quantity of compost or green cuttings, the water content is set to 65 %. It makes clear that an increase of the dry sludge mass from 20 to 30 % in the FM approximately effects a halving of the amount of degradable fresh mass and the saving of more than 80 % of the necessary structure material (here sawdust).

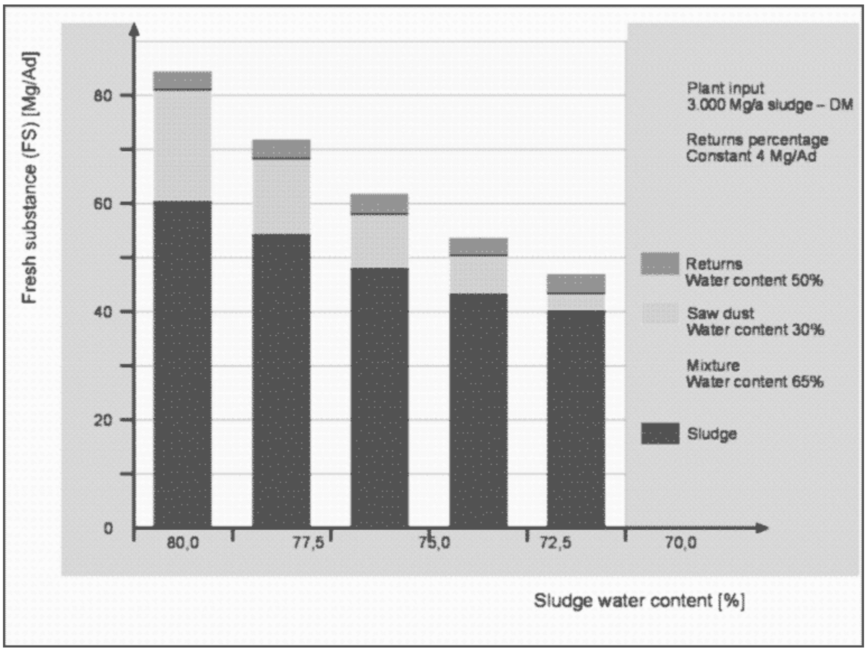

Fig. 8.2: Input quantities per working day dependent on the water content of used sludges

The influence of the water content of the structure material is marginal. An increase of the water content in the additive from 25 to 35 % entails an increase of the consumption of structure material of about 30 % at a constant water content of the used sludge of 75 % and a constant compost or green cuttings portion of 4 Mg/wd (50 % DM) for the same plant example. Hereby the processed fresh matter amount per day increases insignificantly by approximately 5 % (*Figure 8.3*).

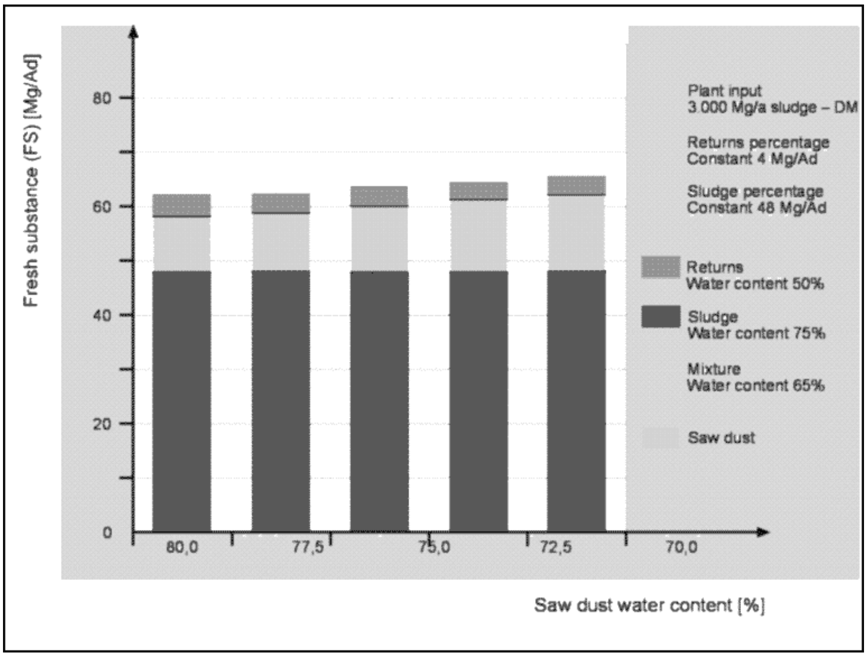

Fig. 8.3: Input quantities per working day dependent on the water content of the used structure material

8.3.3 Decomposition in enclosed systems

The operational process in a decomposition plant for waste water sludges (AS) equipped with reactors/containers as shown in *Figure 8.4* differs from the process used in windrow composting in the following points:

- The used conveyor aggregates make a screening of the structure material (above all with bush cuttings, material from wood choppings and the like) necessary.
- At least the main decomposition (approx. 12-14 days) takes place in an enclosed system with a corresponding forced aeration and subsequent exhaust air purification.
- On account of the exhaust air collection, the generation of heat from the exhaust air stream by means of heat exchangers for the purpose of building heating, warm water preparation and pre-warming of additional air is possible [Kraner, 1989].

Furthermore in some reactor processes an additional decomposition container is used for post-decomposition (retention time 2-4 weeks). But mostly the post-de-composition takes place in windrow composting during several weeks. All other parts of the process are identical to windrow composting (compare *Chapter 8.3.2 Windrow composting*).

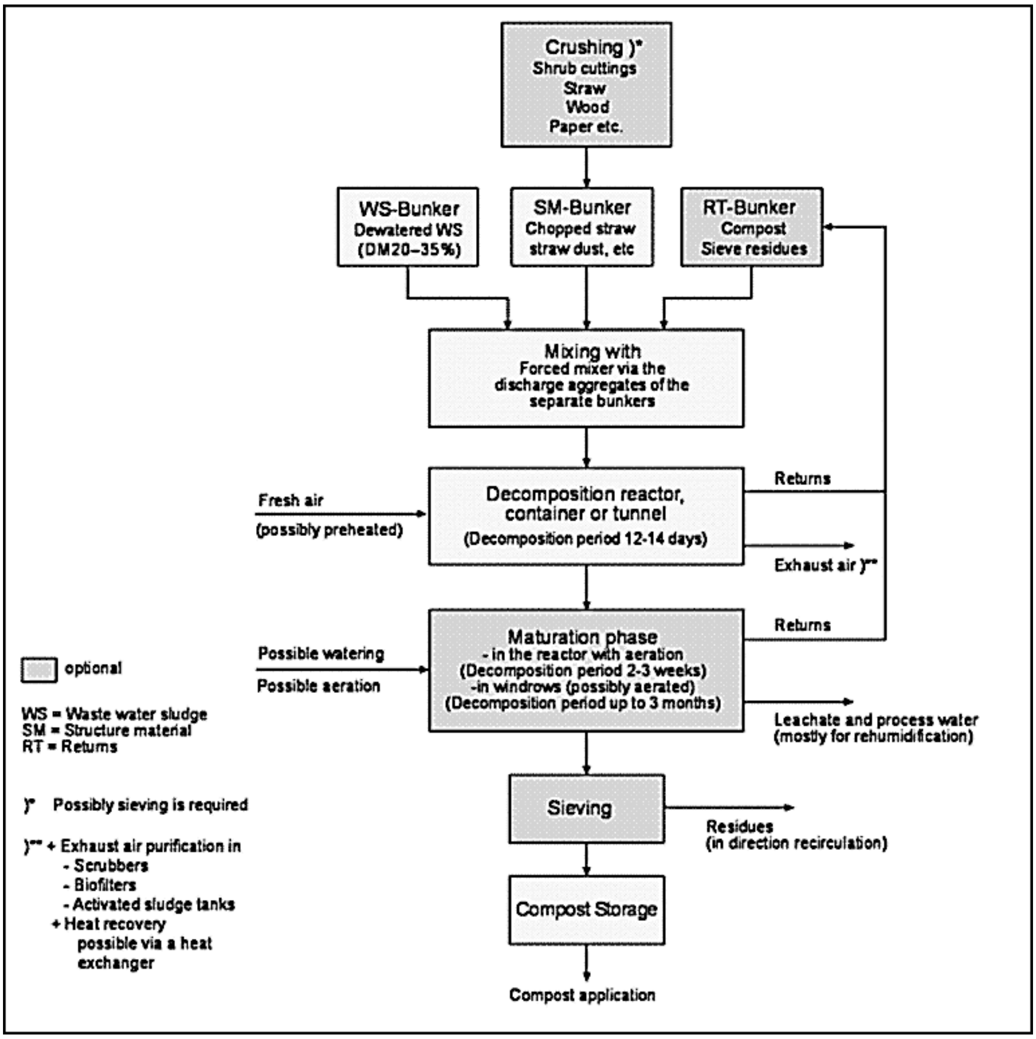

Fig. 8.4: Process diagram of waste water sludge decomposition in enclosed systems

Finally it must be pointed out that working with waste water sludges (AS), above all with raw sludges, requires an increased hygiene awareness of the plant staff. This refers to both personal hygiene and product hygiene. Special risks for the staff working with waste water sludges (AS) in decomposition arise in the first instance from a possible contamination of the sludges with hepatitis pathogens and salmonellae. It must be recommended to adopt the hygiene standards that are common in sewage plants and to take care of the following points:

- Optimised protection for persons by suitable safety clothings (e.g. gloves, mouth/nose protection)
- Bearing of a bacteria-tight protection for mouth/nose that must be changed regularly at working places with increased dust development or intensified release of microorganisms from turning of organic wastes
- Disinfection of hands when leaving the working place, especially before dinner, drinking and smoking
- General prohibition of smoking and eating in the working areas
- Taking a shower in the plant at the end of the working day
- Cleaning of the working clothes in the plant
- Physical examination when personnel is employed (examination of the immune status considering hepatitis A and B, protection provided by vaccination (tetanus and polio etc.), presence of allergies etc.)
- Training of staff regarding safety at work and hygiene

Of decisive importance regarding the product hygiene at the operation of a decomposition plant for waste water sludges (AS) is the fact that no pathogens (salmonellae etc) are displaced from the used sludge into the mature product (compost). This can already happen when e.g. the wheel loader used for the piling up of fresh windrows is also used for the loading of compost. In any case it has to be cared for the strict separation of raw waste water sludge and fresh compost from already hygienised compost that has passed the decomposition process.

8.4 Costs

8.4.1 Original data

Two examples shall explain the costs of composting of waste water sludges from municipal sewage plants (see *Chapter 8.4.2 Assessment*).

- In the first case an upright standing reactor with subsequent open (paved) decomposition area is considered.
- In the second case an open windrow composting on a paved area is considered.

Both plants have a wheel loader. The piling-up of the windrows (open windrow composting) shall be operated by a dung spreader, the screening of the mature compost is done by a mobile screen (work contractor).

The sludge dewatering has not been allocated to the costs of composting, as it is also necessary with other processes of sludge treatment/utilisation (besides direct application). Costs of 5-300 €/(Mg*DM) must be calculated for this process step depending on the processing [K.G. Schmelz, 1996]. The costs of the sludge bunker were added to dewatering.

The following data were assumed for these examples:

- Size of the sewage plant: 25,000 PE (population equivalent)
- Raw sludge amount: 820 Mg DM/a (DM = dry matter)
- Before the centrifuge (4.0 % DM): 20,500 m^3/a
- After the centrifuge (approx. 23 % DM): 3,600 m^3/a
- Structure material (sawdust, approx. 70 % DM): 3,900 m^3/a

- Compost/green cuttings (reactor output, approx. 50 % DM): 1,400 m^3/a
- Reactor input (approx. 35 % DM): 5,000 Mg/a
- Reactor decomposition time: Approx. 14 d
- Subsequent decomposition time (windrows operated with wheel loader): 56 months
- Compost quantity (approx. 60 % DM): Approx. 2,300 Mg/a
- Structure material (shredded green cuttings, approx. 65 % DM): 4,200 m^3/a
- Windrow input (approx. 35 % DM): 5,000 Mg/a
- Decomposition time (windrows operated with wheel loader): 6-8 months
- Compost quantity (approx. 60 % DM): Approx. 2,300 Mg/a

8.4.2 Assessment

Table 8.1 shows the annual costs and the specific costs of both reactor plant (left row) and windrow plant (right row). On account of the lower technical costs at the pure windrow composting (unaerated windrows) with shredded green cuttings this type lies only at about 40 % of the costs than the reactor system where sawdust is used.

Both examples point out very clearly the range of costs that can be expected for waste water sludge composting in smaller municipal plants. However, it must be observed that with larger decomposition plants from about 12,000 Mg/a FM-through-put (corresponding to approx. 2,000 Mg/a sludge DM) specific costs have to be calculated which are about 20 % more favourable.

8.5 Compost Quality and Compost Sale

8.5.1 Compost sales - Requirements of the product

The sale of the composts produced from waste water sludges depends on quality regarding **plant compatibility**, nutrients and harmful matter. Possible customers are:

- Public amenity plantings (parks and cemeteries),
- administrations of road construction (sound insulating walls etc.),
- horticulture and landscaping companies (recultivational measures, new plants, sport grounds etc.),
- tree nurseries and perennial gardening,
- earthen works (e.g. substrates for green roof technology, ornamental and balcony plants, grass paver blocks etc.),
- agricultural enterprises and
- private customers.

The most important and limiting factors for the application of waste water sludge composts (ASK) are:

- The content of heavy metals and
- possible organic harmful matters.

It is beyond any doubt that without an application of waste water sludge composts (ASK) on agriculturally used soils a contamination with heavy metals by impacts through the air, feed additives, plant protectants and mineral and other fertilisers cannot be avoided. These input paths have not yet been put into the centre of social and political interests.

Tab. 8.1: Costs of composting of waste water sludge, examples for a connected value of 25,000 PE (population equivalent)

Reactor plant		**Windrow plant**	
Investments		Investments	
Reactor (400 m³) with medium-sized structure silo, aeration, mixer, conveyor technique etc.	1,400,000 €	Decomposition areas including traffic areas, dewatering etc. (4,000 m²)	240,000 €
Subsequent decomposition area (2,400 m²)	144,000 €	Dung spreader	25,000 €
Wheel loader	100,000 €	Wheel loader	100,000 €
Capital costs		Capital costs	
Depreciation and interests	230,000 €	Depreciation and interests	56,500 €
Operational costs		Operational costs	
Staff	37,500 €	Staff	37,500 €
Maintenance and repair	40,000 €	Maintenance and repair	7,500 €
Energy, supplies	30,000 €	Energy, supplies, work contractor	25,500 €
Structure material (35 €/Mg)	30,000 €	Structure material (35 €/Mg)[2)]	48,500
Others (laboratory, insurance, administration, etc.)	27,000 €	Others (laboratory, insurance, administration, etc.)	27,000 €
Annual costs	394,500 €	Annual costs[3)]	204,500 €
			(156,000 €)
Per Mg dewatered sludge	109.5 €	Per Mg dewatered sludge[3)]	56 €
			(42.5 €)
Per Mg dry sludge matter	481 €	Per Mg dry sludge matter[3)]	249 €
			(190 €)
Per PE	15.78 €	Per PE[3)]	8.10 €
			(6.24 €)
[2)] These operational costs can be completely saved if e.g. green cuttings are used, potentially a credit of 10-20 €/Mg can be calculated for the shredding of green cuttings			
[3)] Values in parentheses without costs for structure material			

Tab. 8.2: Admissible heavy metal contents in waste water sludges, waste water sludge composts and other composts used in agriculture, according to different bodies of regulations [Rasp, 1996]

pH value	Metal [mg/kg DM]	Soil values acc. KVO[1)]	AS acc. KVO[1),4)]	ASK acc. KVO[1),5)]	ASK acc. ANS e.V.[2),5),6)]	Composts acc. BGK e.V.[3),7)]	LAGA M10 category II[8),9)]	Compost decree Ba.Wü.[7),8)]
6	lead	100	900	450	335	150	250	100
	cadmium	1.5	10	5	2.5	1.5	2.5	1.0
	chromium	100	900	450	335	100	200	100
	copper	60	800	400	300	100	200	75
	nickel	50	200	100	75	50	100	50
	mercury	1.0	8	4	2.0	1.0	2.0	1.0
	zinc	200	2,500	1,250	935	400	750	300
> 5 and < 6	cadmium	1.0	5	2.5	1.2	1.5	2.5	1.0
	zinc	150	2,000	1,000	750	400	750	300

AS = Waste water sludge; ASK = Waste water sludge compost

1) Values not standardised, limit values

2) Values not standardised, standard value

3) Values standardised on 30 % oDM, standard value

4) Application quantity 5 Mg DM/(ha*3a)

5) Application quantity 10 Mg DM/(ha*3a)

6) At 5 Mg DM/(ha*3a) twice the value is valid

7) No time limitation

8) Values standardised on 30 % oDM, benchmarks

9) Application quantity 15 Mg DM/(ha*3a), but maximum 25 Mg DM/(ha*5a)

Tab. 8.3: Admissible contents of organic harmful matter in waste water sludges, waste water sludge composts and other composts used in agriculture according to different bodies of regulations [Rasp, 1996]

Material group	Unit	AS acc. KVO	ASK acc. KVO	ASK acc. ANS e.V.	LAGA M10 category II	Compost decree Ba.Wü.[3)]
PCB[1)]	[mg/kg DM]	0.2	0.1	0.1	max. 0.1	0.033[4)]
PCDD/F[2)]	[ng/kg DM]	100	50	50	max. 40	17[4)]
AOX	[mg/kg DM]	500	-	-	-	

AS = Waste water sludge; ASK = Waste water sludge compost

1) Per single component for components 28, 52, 101, 138, 153, 180

2) I-TEQ (toxic equivalent acc. 17th BimSchV

3) Values standardised on 30 % oDM

4) Deviations of 30 % are allowed

Tab. 8.4: Annual harmful matter freights at an application quantity of 10 Mg DM/(ha*3a)

pH value	Metal [g/(ha*a)]	ASK acc. KVO	ASK acc. ANS e.V.	LAGA M10 category II[4),5)]	Composts acc. BGK e.V.1)	Compost decree Ba.-Wü.[1),6)]
6	lead	1,500	1,117	595 (893)	357	238 (714)
	cadmium	16.7	8.3	6.0 (8.9)	3.6	2.4 (7.2)
	chromium	1,500	1,117	476 (714)	238	238 (714)
	copper	1,333	1,000	476 (714)	238	179 (537)
	nickel	333	250	238 (357)	119	119 (357)
	mercury	13.3	6.7	4.8 (7.1)	2.4	2.4 (7.2)
	zinc	4,167	3,117	1,786 (2,679)	952	714 (2,142)
> 5 and < 6	cadmium	8.3	4.0	6.0 (8.9)	3.6	2.4 (7.2)
	zinc	3,333	2,500	1,786 (2,679)	952	714 (2,142)
Organic harmful matter						
PCB [g/(ha*a)][2)]		0.33	0.33	max. 0.33 (0.50)	-[3)]	0.08 (0.24)[7)]
PCDD/F [mg/(ha*a)]		0.17	0.17	max. 0.13 (0.20)	-[3)]	0.04 (0.12)[7)]
AS = Waste water sludge; ASK = Waste water sludge compost						
[1)] Assumption: oDM = 50 %						
[2)] Per single component for components 28, 52, 101, 138, 153, 180						
[3)] No standardised values stipulated						
[4)] Assumption: oDM = 50 % (only heavy metals)						
[5)] Values in parentheses: Max. allowed application quantity 15 Mg DM/(ha*3a)						
[6)] Values in parentheses: Max. allowed application quantity 30 Mg DM/(ha*3a)						
[7)] Deviations of 30 % are allowed						

The second limiting factor for an application of waste water sludge composts (ASK) is its content of plant nutrients. The KVO rules the soil investigations on plant-available nutrients at agricultural or horticultural utilisation. According to H. Schaaf [1994] nutrient overloads at fertilisation are not at all allowed, because they are unnecessary (fertiliser law) and not desirable (leaching) in the sense of "good expert practice".

Sludges from waste water have significant amounts of nitrogen and phosphorus, potassium is rather under-represented. The relative nutrient ration in waste water sludges according to H. Schaaf [1994] is:

$N/P_2O_5/K_2O = 1/1.8/0.15$

Of course this ratio also affects the production of waste water sludge composts (ASK), so that the first limiting nutrient is phosphate, limiting the application quantity even before the heavy metal contents (see also *Table 8.2*).

Tab. 8.5: P_2O_5-fertiliser demand according to soil investigation and waste water sludge quantities suitable for application in Hesse according to Schaaf [H. Schaaf, 1994]

Content class soil investigation	Necessary nutrient quantity P_2O_5 [kg/ha][1)]	Nutrient account at fertilising with 5 Mg DM/3a (AS)[2)]	AS-quantity [Mg/ha][3)]
A	440	-150	5
B	330	-31	5
C	220	79	3.67
D	110	189	1.83
E	0	299	0
AS = Waste water sludge			
1) According to soil investigations in Hesse			
2) Mean value in Hesse: 299 kg/ha			
3) Upper limit 5 Mg DM/(ha*3a)			

8.5.2 Quality criteria for composts from waste water sludges

The idea to assure a qualification for composts and products from composts with generally valid standards has already got a certain tradition. In Germany there was at first a quality label for composts and substrates from bark. The operators of decomposition plants for waste water sludges started to set up quality guidelines in 1988 which were gathered by an experience exchange organised by the ANS e.V. in order to distinguish themselves from the bad image the sewage sludges had.

These endeavours led to the foundation of the Federal Organisation of Quality Assured Composts [BGK e.V., 1992] after other compost producers and utilisers joined the idea. However, on account of the bad image of waste water sludges as an original material for composting in public, ASK was not included into the standards of the BGK e.V. Now the BGK e.V. has developed own standards and regulations especially for composts from waste water sludges, which are based on the standards of the BGK e.V. [1994].

Basically it has to be said that the sale of the processed product must be the basis of each waste treatment (disposal safety). For compost this means that the saleable product has to have a consistent good quality. Only by these means the demands of the Closed Loop Waste Management Act [KrW-/AbfG, 2000] and TASi (Technical Data Sheet of Urban Wastes) [TASI, 1993] for an environmentally friendly treatment of wastes can be realised (compare *Chapter 8.5.1 Compost sales - Requirements of the product*).

Decisive for the compost quality are:

- Sanitary harmlessness,
- a widely absence of impurities,
- a low content of potential harmful materials,
- a balanced content of nutrients (dependent on the use in plant cultivation),
- continuous product quality and
- storability.

In order to meet the demands a quality assurance system that monitors the individual quality criteria is necessary. It should consist of the following elements:

- Continuous and independent external monitoring of the quality,
- self-monitoring of the compost production by the enterprise,
- guidelines for a standardisation of the product quality,
- obligation to declare the properties and ingredients of compost,
- recommendations for a professional application of compost and
- quality sign/quality label for the labelling of the tested compost quality.

In the future, composts that do not meet these demands will have almost no chance on the markets, therefore their adherence is compulsory for reasons of a safe disposal.

Manufacturers of composts from waste water sludges that want to obtain the quality label must fulfil the following determinations for approval:

- First quality inspection: The test procedure lasts for at least six months, whereby a neutral inspector has to take samples in the first week of six following months. These samples from the actual saleable batch are analysed according to the guidelines [BGK, 1994]. Alternatively, corresponding results from the analysis of semiannual tests of the last 3 years can be provided. The used waste water sludges must fulfil the determinations of the KVO [NIV, 1997] for agricultural utilisation.
- Monitoring procedure: The use of the quality label requires sample drawing and analysis by a neutral inspector according to the quality guidelines [3]. Subsequent inspections of the actual saleable batch have to be carried out once in three months (all parameters except organic harmful matters). The content of organic harmful matters must be examined every two years. According to the KVO [NIV, 1997], the used waste water sludge must be examined twice a year, the limit values must not be exceeded.
- Suitability test: The sanitary effectivity of the decomposition process concerning epidemic danger must be verified by temperature measurements at regular intervals. Also examinations that are necessary for an expert recommendation for application are subject to self-control. Though, this self-control must not replace the analyses of the first quality inspection or the monitoring procedure.

The results of the named tests are controlled by a quality commission that is elected every two years. If required this quality commission awards the quality label for composts to members of the GK. The commission is also authorised to deprive plants of the label when quality guidelines and the quality label ordinance have not been respected.

8.6 Conclusions and future prospects

The advantages of sludge composts compared with directly applied sewage sludges are apparent:

- The produced material is optically appealing (earthen odour, earthen consistency).
- Sludge compost is hygienically irreproachable. As mature compost it can be stored without any problems.
- The water content of the compost is at a maximum of 40-50 % due to the biological drying effect.
- Sludge composts are suitable for the production of substrates, they are usually poor in harmful matter and have a distinctly improved image compared to non-treated sewage sludge.
- Sludge composts are more suitable for erosion protection and soil improvement.

Moreover, composts from waste water sludges contain almost no impurities, like e.g. plastics or glass, and have a high portion of fine particles. This distinguishes them positively from other waste composts.

The compliance with quality criteria at compost production gives the user the safety for a product that is clearly defined regarding properties and ingredients. The quality assurance system that has been created especially for composts from waste water sludges offers a good basis for counter-acting the bad image of sewage sludges and the generated products thereof and to make propaganda for the generally known advantages of compost application.

As a biological recycling process, the production of composts from waste water sludges has a very high environmental compatibility, if the harmful matter load of the waste water is not too high. In the case of a satisfactory solution of the sale problematic for the produced soil improving agent, a tested technology is available to produce a highly qualified and hygienically irreproachable compost material. The harmful matter content of composts can be effectively influenced only with controls of the discharging processes up to the installation of preliminary clarification steps.