Calculation of annual generation of animal by-products

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Determination of waste generation

One of the key conditions for planning the safe handling of animal by-products in agroecosystems is the availability of information on their annual generation.

This parameter is required for:

✓ Determining the capacity of storage facilities to accommodate and store animal by-products for the period of time required for their decontamination;

✓ Determining the arable land area for safe use of animal by-products in the agroecosystem;

✓ Notifying Rosselkhoznadzor of the classification of substances generated during rearing of farm animals as animal by-products.

Determination of waste generation

The amount of generated animal by-products can be determined:

✓ By their direct measurement (weighing or volume determination followed by conversion to mass);

✓ By calculation using normative (reference) values for animal by-products, process water use, etc.

When planning the annual generation of animal by-products, it is advisable to use the calculation method with subsequent adjustment of the parameter according to the actual data (if necessary).

Determination of waste generation

When determining the annual manure generation, the following components are taken into account:

✓ Animal excrement (determined by the number of animals of different sex and age groups);

✓ Process water used for washing of feeders, cleaning of premises, excrement removal, flushing of canals, etc. (determined by animal management technology and manure removal technology);

✓ Bedding, if used (determined by animal management technology).

When determining the annual waste generation, reference values of daily excrement generation in different age and sex groups are normally used; daily water consumption rates, etc. (RD-APK 1.10.15.02-17 "Guidelines on Technological Design of Manure Removal and Preparation Systems")

Task

1. Calculate the annual waste generation at a full-cycle pig farm with the following pig population:

Sex and age group	Number of heads
Boars	40
Empty sows	1,400
Pregnant sows	1,400
Nursing sows	3,200
Post-weaning pigs	27,000
Fattening pigs	43,000

The farm uses an intermittently operating gravity manure transfer system

Average daily amount and moisture content of excrement per one animal of different sex and age groups (RD-APK 1.10.15.02-17)

Age and sex groups of pigs	Parameters	Excrement composition		
		total	including	
			feces	urine
Boars	Weight, kg	11.1	3.86	7.24
	Moisture, %	89.4	75.0	97.0
Sows:				
– empty	Weight, kg	8.8	2.46	6.34
	Moisture, %	90.0	73.1	97.5
– pregnant	Weight, kg	10.0	2.6	7.4
	Moisture, %	91.0	73.1	98.3
– nursing	Weight, kg	15.3	4.3	11.0
	Moisture, %	90.1	73.1	96.8
Piglets (age, days):				
26–42	Weight, kg	0.4	0.1	0.3
	Moisture, %	90.0	70.0	96.7
43–60	Weight, kg	0.7	0.3	0.4
	Moisture, %	86.0	71.0	96.0
61–106	Weight, kg	1.8	0.7	1.1
	Moisture, %	86.1	71.4	96.3
Fattening pigs (weight, kg):				
≤70	Weight, kg	5.0	2.05	2.95
	Moisture, %	87.0	73.0	96.7
>70	Weight, kg	6.5	2.7	3.8
	Moisture, %	87.5	74.7	96.9

Process water consumption for manure removal and canal flushing (RD-APK 1.10.15.02-17)

System of manure removal from livestock houses	Water consumption rate per animal per day, L		
	pigs	cattle	
	group housing	on fattening and heifer farms	on dairy farms
Gravity system:			
– continuously operating	1.5	18	15
– intermittently operating	7.0	15	30
Water wash system:			
– tanks, nozzles	20.0	–	

Water consumption for washing of feeders and cleaning of premises per head, L/day (Industry-Specific Process Engineering Standard 2-96)

Animal group	Water consumption rate per head, L/day			
	total	Including		
		watering	washing of feeders and cleaning of premises	washing of feeders and cleaning of premises when keeping on slatted floor
Breeding boars	25	10	7.5	4.0
Pregnant and empty sows	25	12	7.0	4.0
Nursing sows with piglets	60	20	20	10.5
Post-weaning pigs	5	2	1.5	0.8
Replacement gilts	15	6	4.5	2.0
Fattening pigs	15	6	4.5	2.0

Task

2. Calculate the moisture content of the generated waste

Sex and age group	Initial moisture content of excrement	Amount of water to be added, L	Moisture content of manure including added water
Boars			
Empty sows			
Pregnant sows			
Nursing sows			
Post-weaning pigs			
Fattening pigs			

✓ Determine the content of water and dry matter in excrement with the initial moisture content
✓ Determine the total amount of water in manure (water in initial excrement + moisture content)
✓ Determine the moisture content of the formed manure (proportion of total water in the formed manure, %)

Task

3. Determine the generation of solid and liquid fractions of pig manure, if the efficiency of dry matter separation on the equipment is 75%, and the moisture content of the separated fraction is 70%.

Type of manure	Moisture, %	Dry matter, t	Water, m^3	Total volume, t (m^3)
Before separation into fractions	90.5	21,424	204,095	225,519
Solid fraction	60.0	17,139	25,708	42,847
Liquid fraction	97.7	4,285	178,387	182,672

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Thank you!