Anaerobic systems for biological treatment in ecological sanitation systems (Ecosan) for biogas and fertilizer production

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- Technical description of the different biogas systems for waste and waste water treatment
- Practical operation and energy output
- Compost and substrat quality
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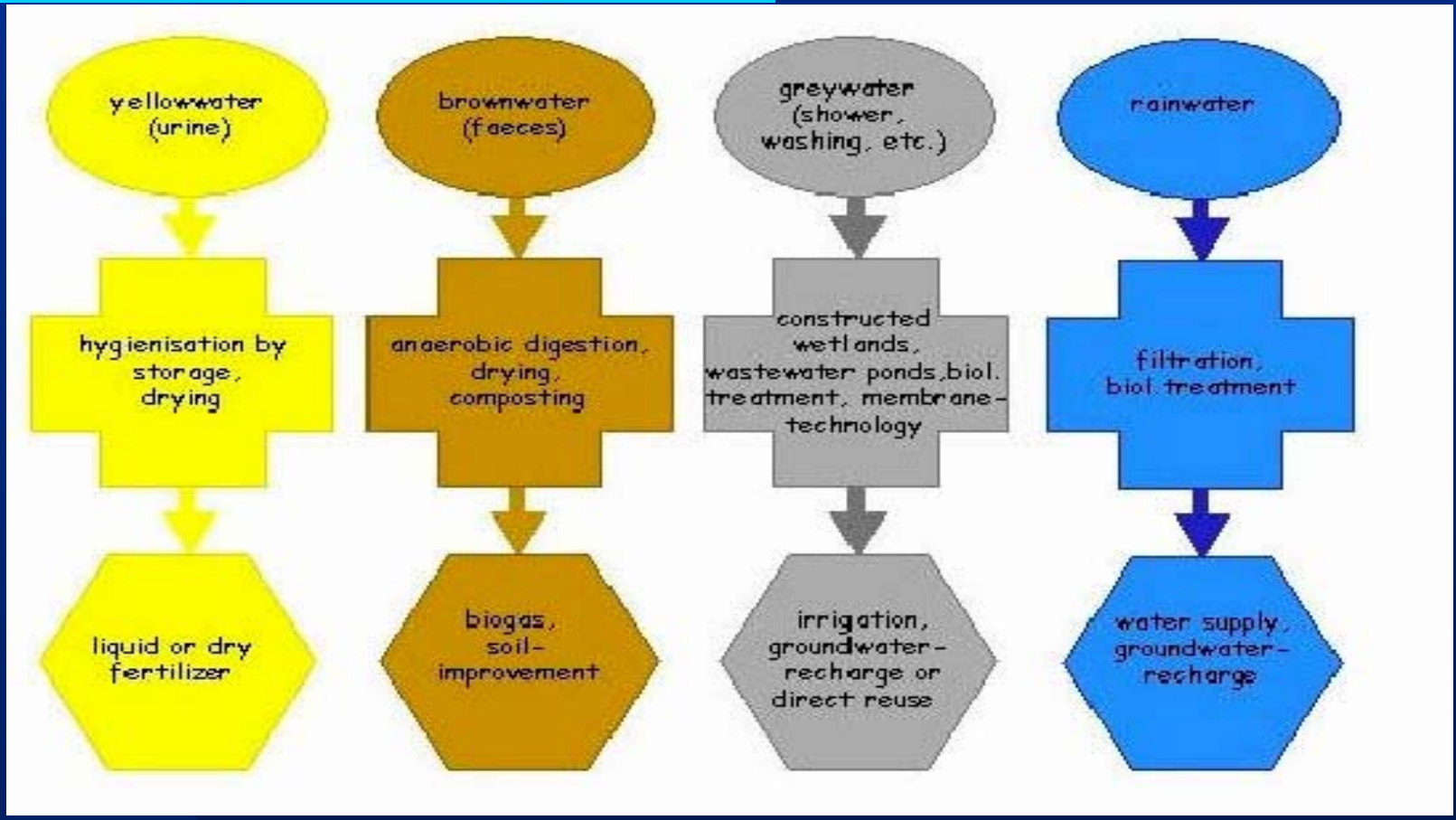
- With biogas technology optimised ecological sanitation systems in bigger settlements of the semiarid climate zone

General description of an ecological sanitation system

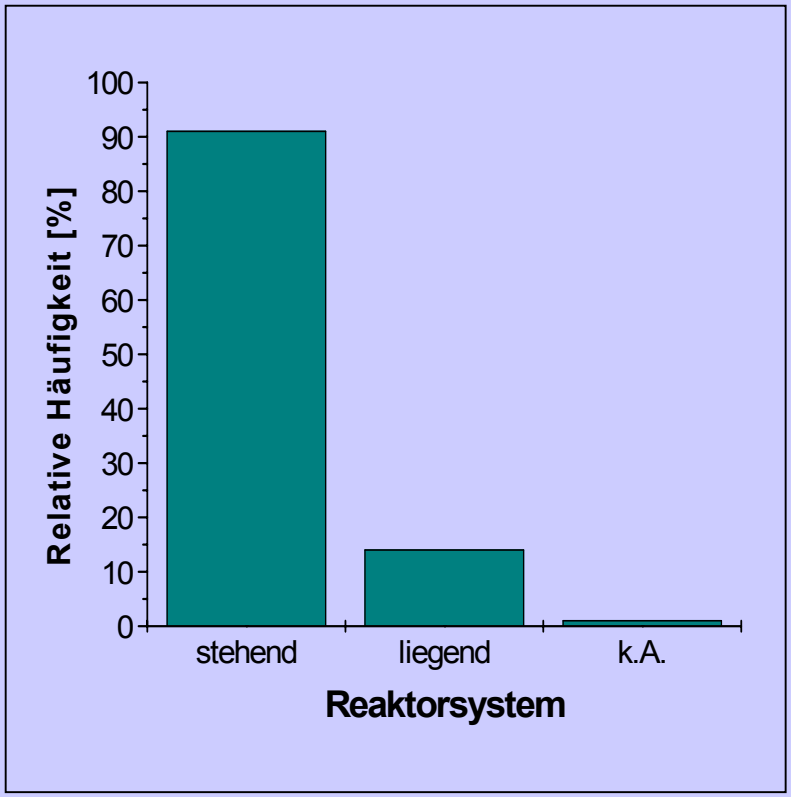


(Ecosan, GTZ 2002)

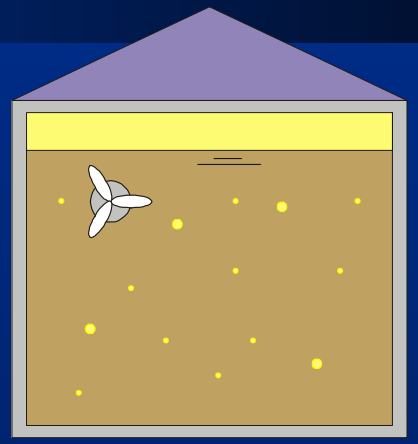
Biogas production

	DS (in %)	ODS (% of DS)	C / N ratio	m³ Biogas per kg ods	Gas yields (rel. to fresh substance and cult. area)	
					m³ / t FS	m³ / ha
Bio waste	40 - 75	45 - 70	25 – 80	0,45	120	--
Fodder beets	15	90			93,5	9350
Gras silage	40	83	12 - 27	0,455	220	5720
Grain straw (diverse)	85 - 90	85 - 89	70 - 165	0,3 – 0,6	217- 481	1084 - 2403
Poultry manure	50 - 70	60 - 70		0,55 – 0,65	300 - 490	--
Vegetable waste	5 - 20	60 - 90	15	0,45	80	--
Canteen waste	9 - 18	90 - 95	15 -20	0,55 – 0,78	80 - 170	--
Chicken manure	21	75	10	0,5	160	--
Potato waste	20	0,94	25	0,55	120	--
Horse manure	28	75	18 - 25	0,45	82	--
Cattle manure	12 - 25	65 - 85	14 - 25	0,2 – 0,3		

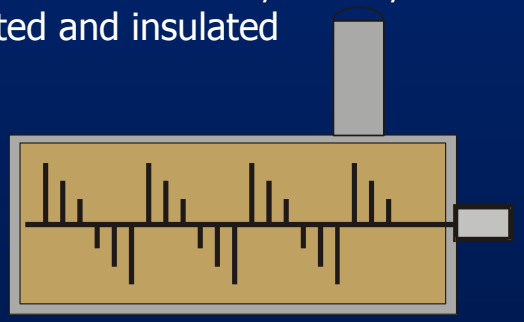
Biogas Technology: Digester Types for wet Systems



Quelle: FAL (2004)

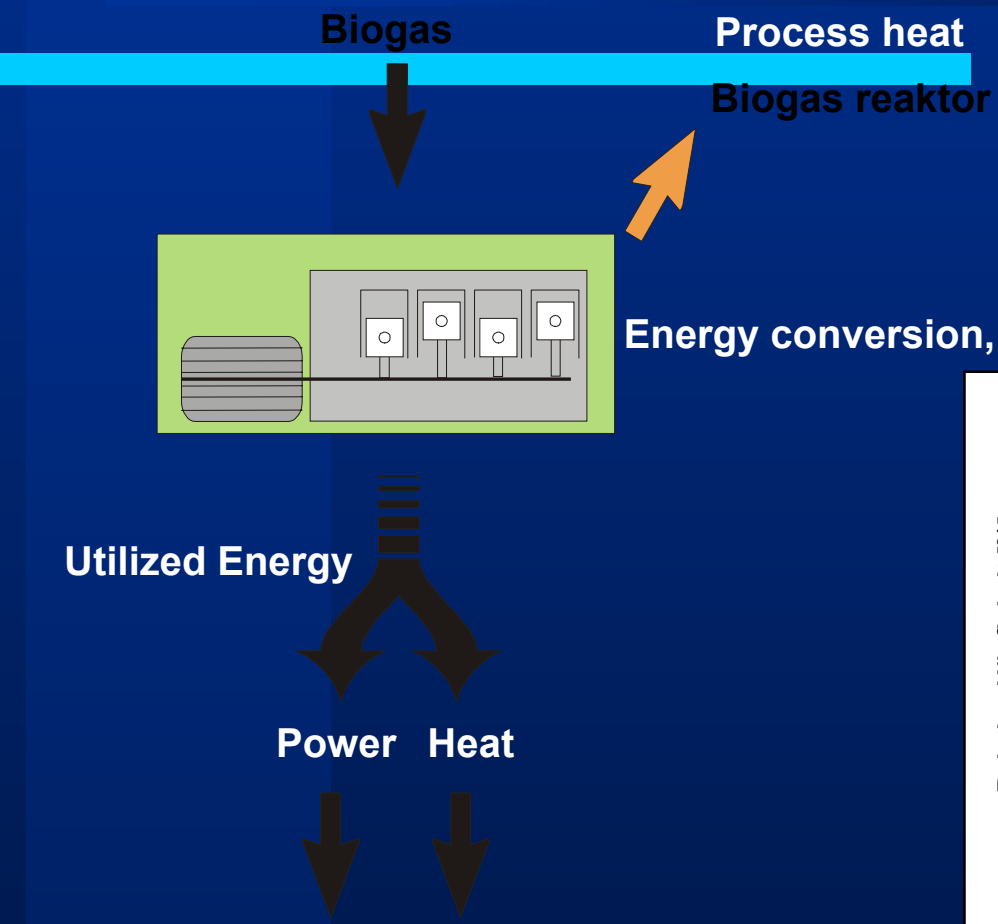


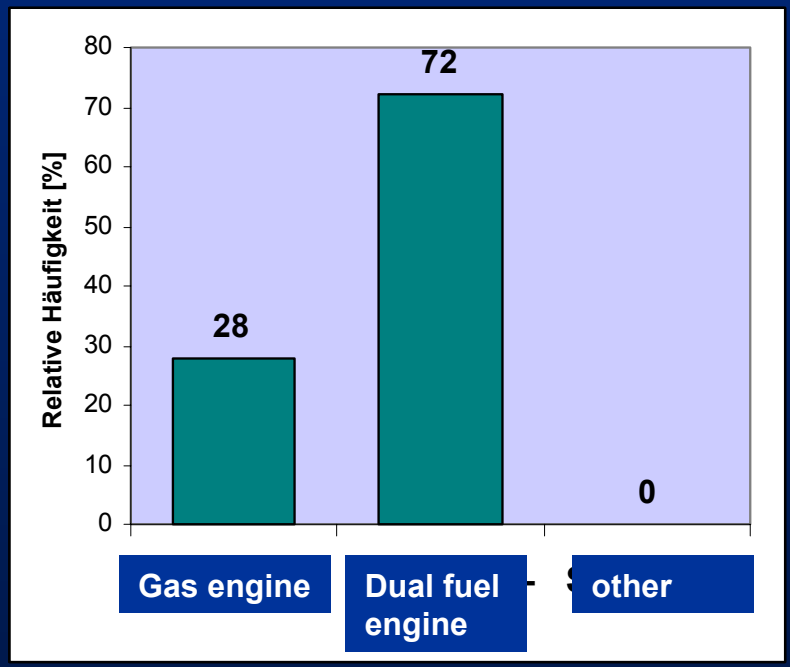
Complety Mixed Digester (standing): Slurry Tank made of Concrete or Steel, stirred, heated and insulated



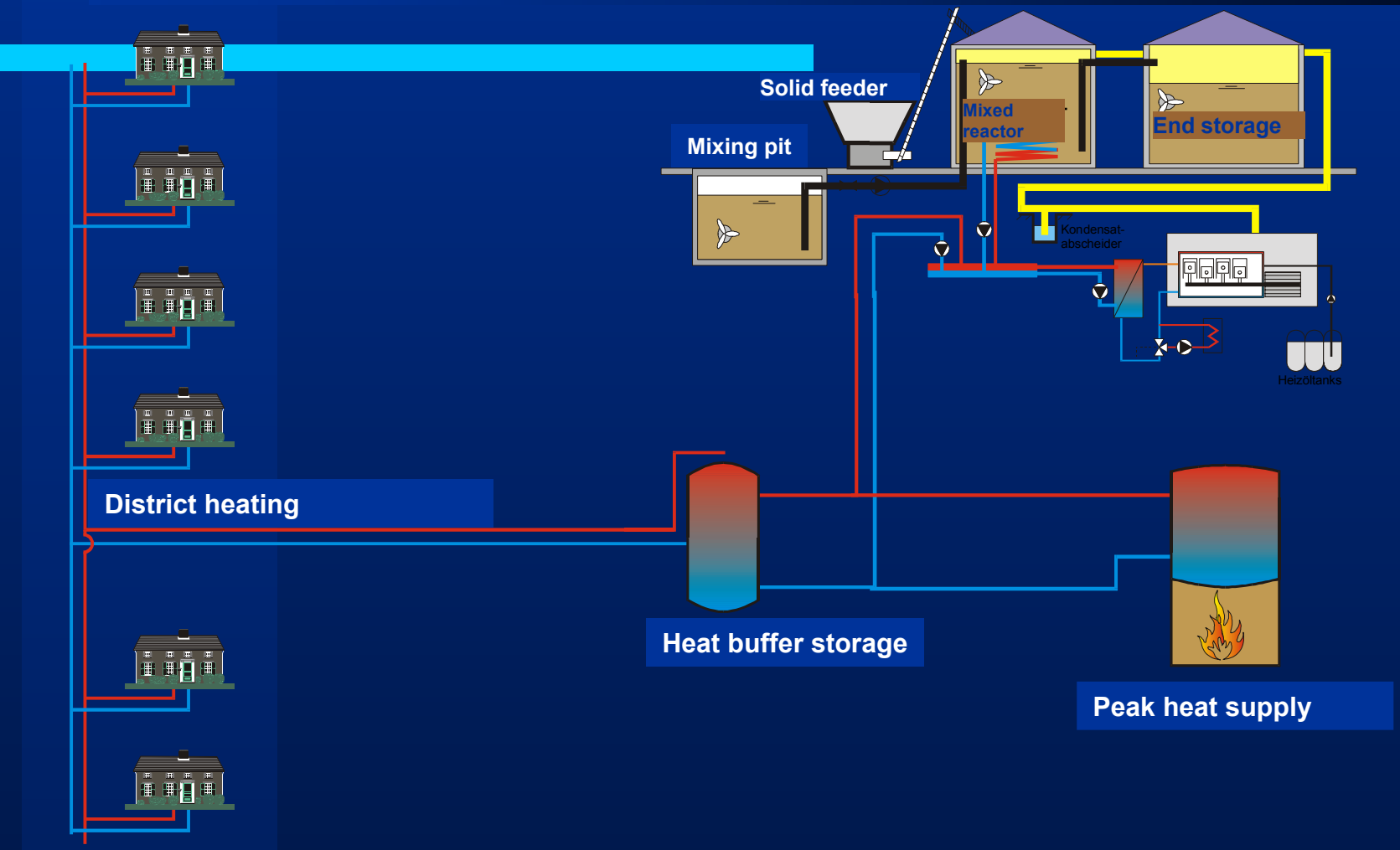
Plug Flow Digester (horizontal): Steel Tank with Paddle Stirrer, heated and insulated

Biogas Conversion





Components of a Biogas Heat and Power Station



Use of biogas digestate

1. Digestate can be spread on the fields
   - no hygiene restrictions with animal slurry and plant material
2. Improved Fertilizer
   - avoids nutrient losses
   - reduces the burning effect on plants
   - improves the flowing properties
   - improves the plant compatibility
   - improves the plant health
   - reduces the germination ability of weed seeds
3. Environmentally sound
   - reduces the intensity of odour
   - reduces the air pollution through methane and ammonia
   - reduces the wash out of nitrate
   - hygienizes liquid manure
   - recycles organic residues (co-fermentation)
   - can avoid costs for the connection to a central sewer

Digester Systems

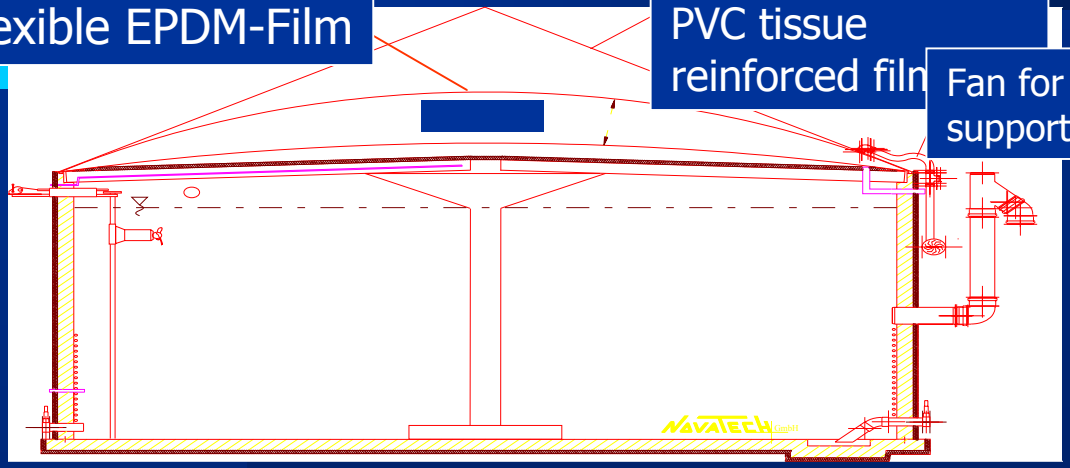
Wet Fermentation

- Completely mixed digester
- Plug flow digester

Dry Fermentation

- Plug flow digester
- Garage type batch digester

Concrete digester with air supported double gas cover



Advantages:

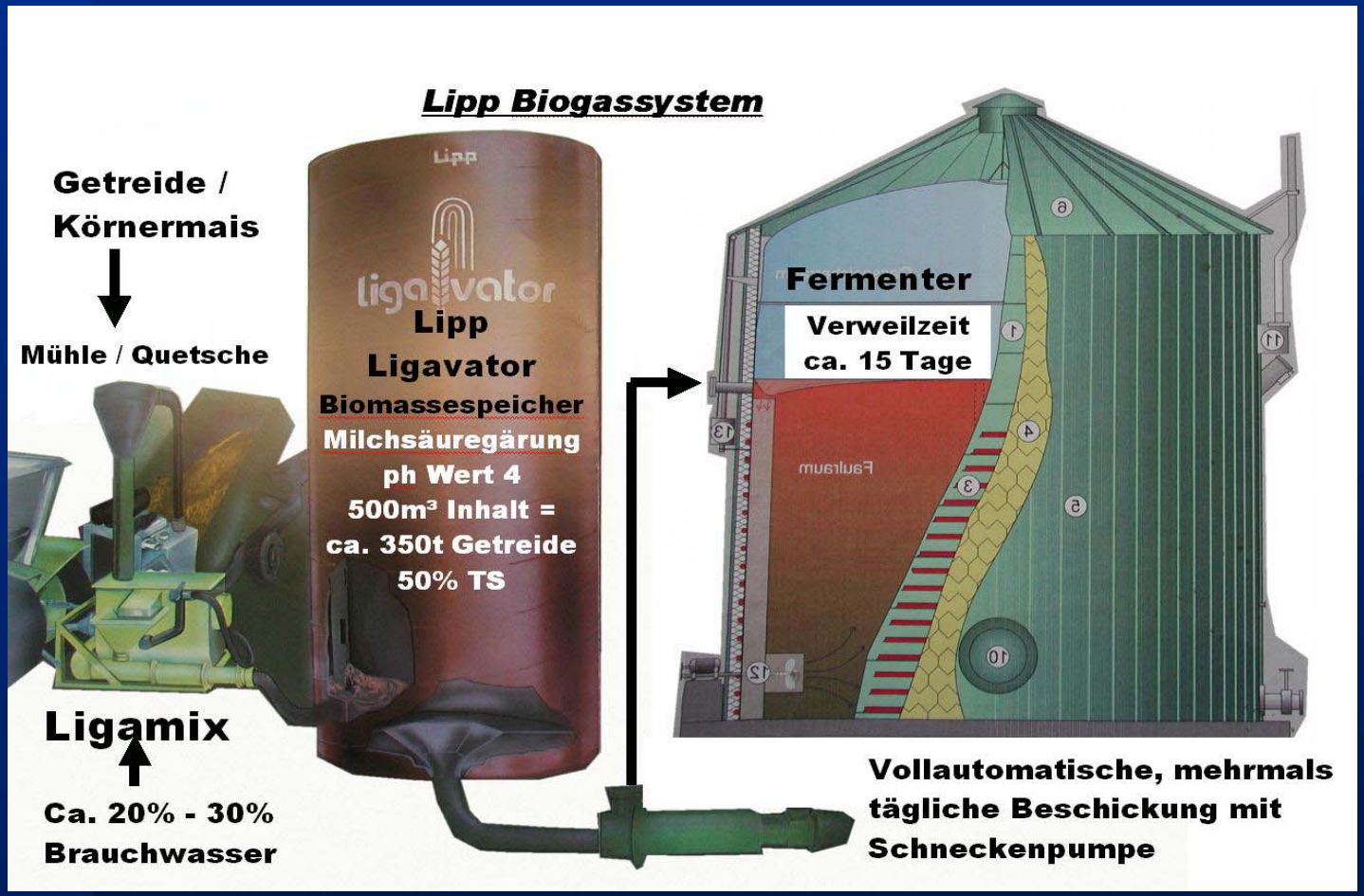
- simple digester repair
- integrated gas holder
- well weather prooved
- easy indication of gas yield

Disadvantages:

- more expensive than one cover
- not 100% gastight
- permanent energy consumption through air fan

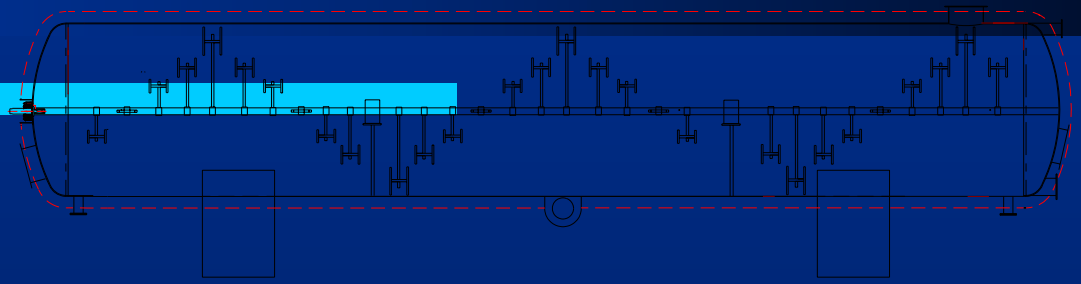
Concrete digester with double membrane cover

Liquid Biomass Feeding



Stainless steel digester

Horizontal digester with paddle stirrer

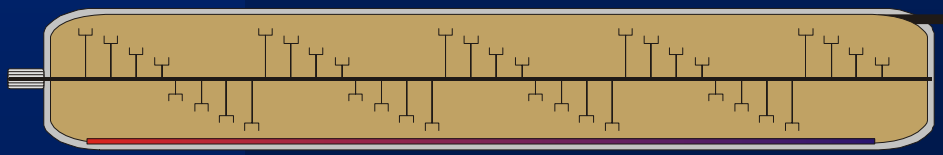


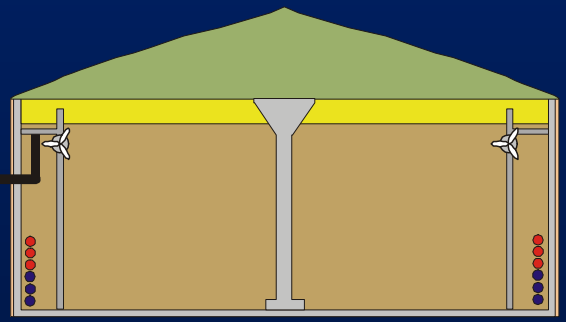
Advantages:

- digesting high solids content
- high loading rate possible
- little short cut flow
- automatic sand drain
- complete mixing
- high digester productivity
- Suitable for dry digestion

Disadvantages:

- high price
- only possible with after digester
- limited in size

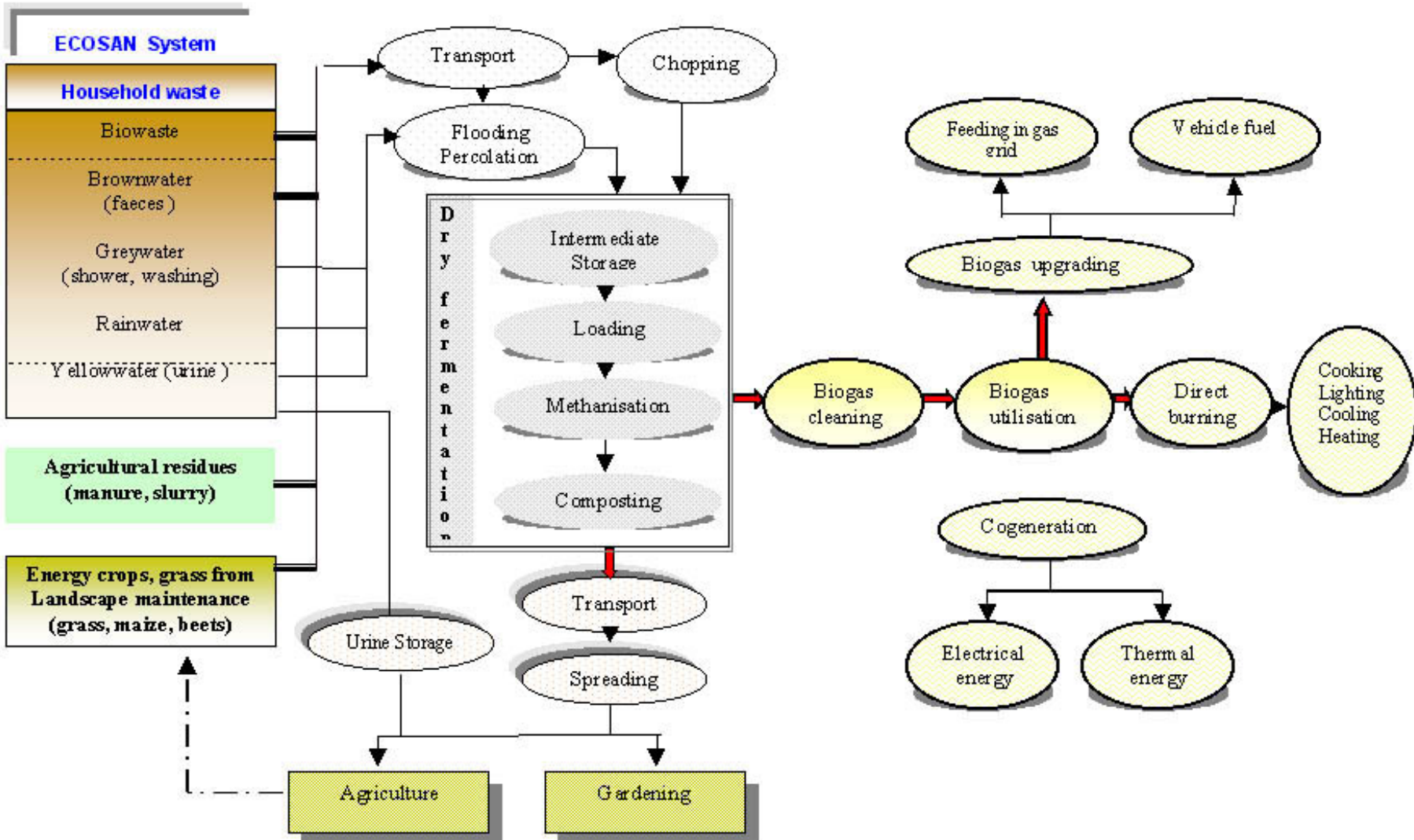




Horizontal digester with paddle stirrer

Steel or
Concrete

Biogas technology as an integral part of an ecological Sanitation System



Technical description of the different dry fermentation systems

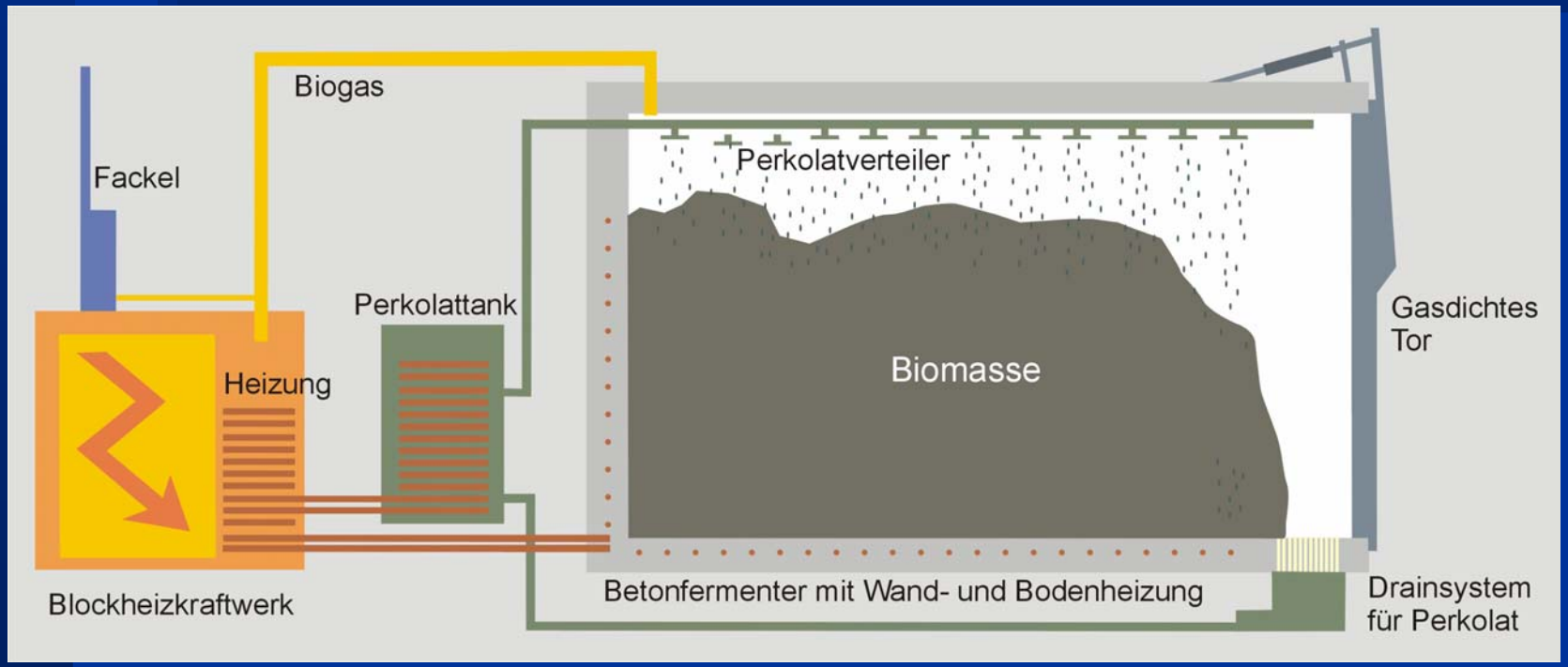
- „garage type“ digester
- „bag type“ digester
- „wet-dry combination“ digester
- „immersion liquid storage vat“ digester

„garage type“ digester

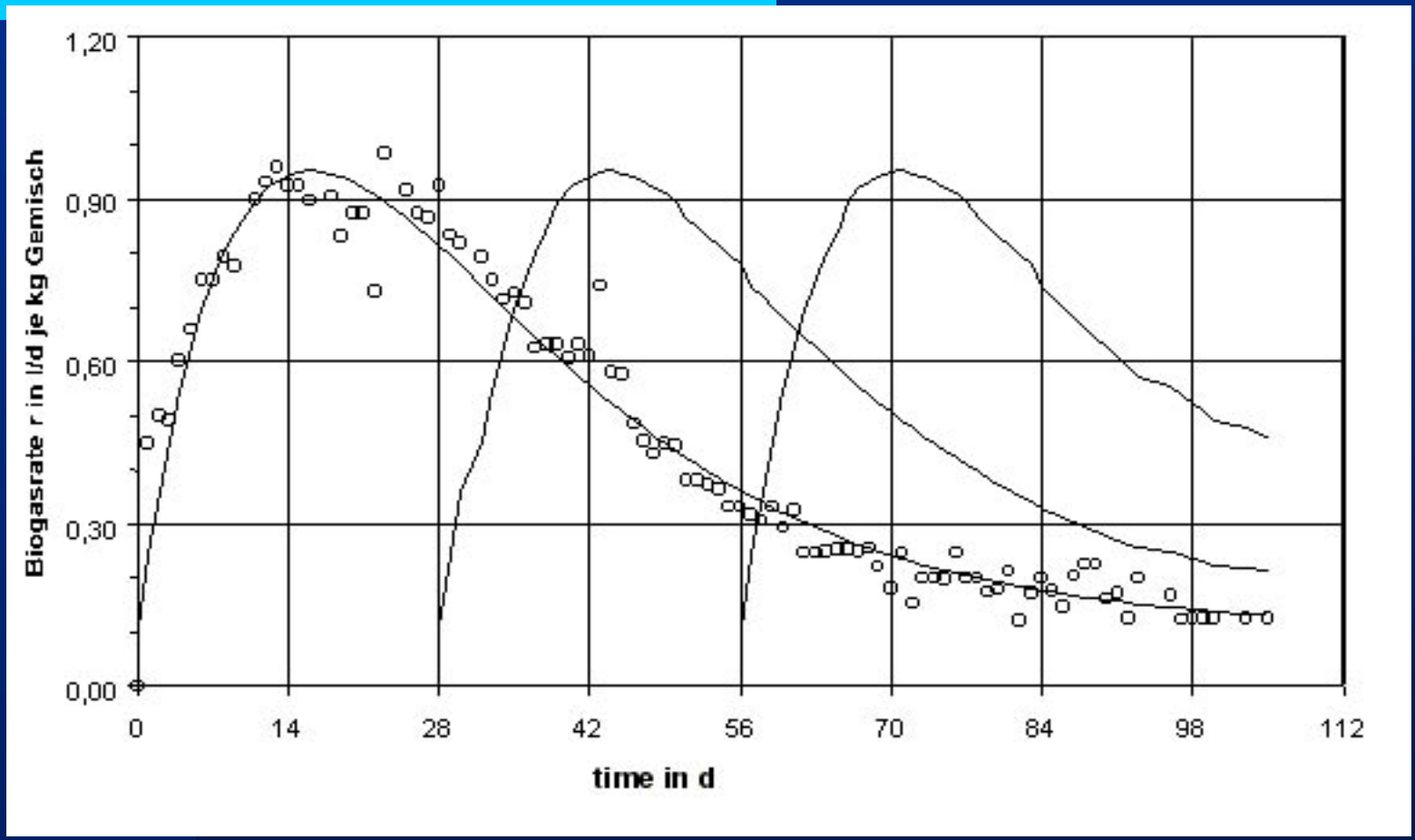
(BEKON, 2005)

The BEKON Dry Fermentation System for Biomass over 20% DS

Prinzipal Function

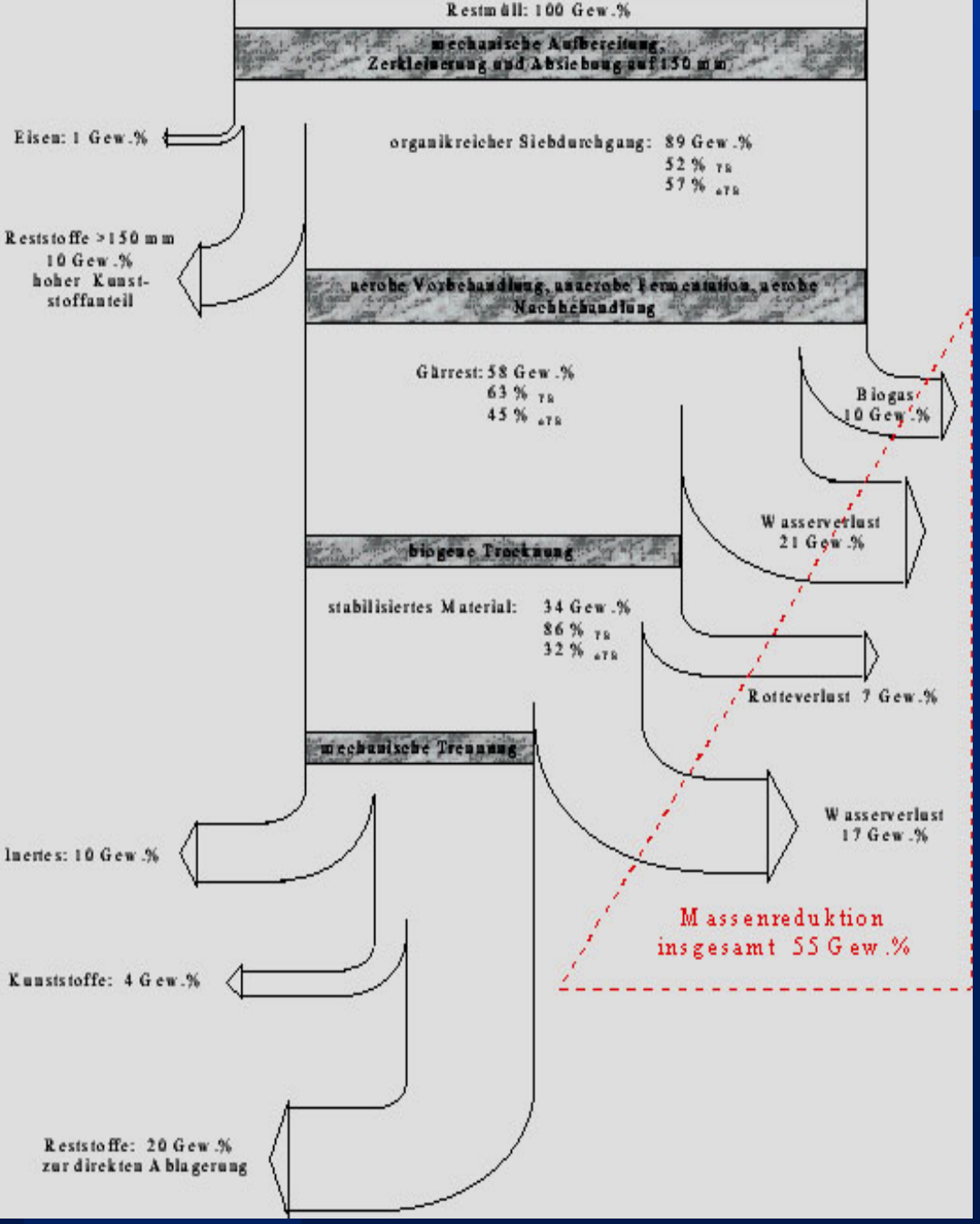


Biogas production rate in dry fermentation



(Linke, 2000)

water consumption and mass balance



Mass flow of a dry fermentation plant (Loock, 1999)

Inactivation of pathogenic microorganisms

Pathogen	Type	Inoculum (cfu / g)	In compost after 21 days (cfu days /g)	% reduction
Enterobacteriaceae	Human and animal pathogenic bacteria (faecal contamination)	1.6×10^7	1.2×10^3	>99.99
Salmonella typhimurium	Human and animal pathogenic bacterium (intestine infections)	1.4×10^7	<3	>99.99
Pseudomonas solanacearum	Plant pathogenic bacterium (potato brown rot)	Infected potatoes tissue (+/- 50 units total)	<1	>99.99
Fusarium oxysporum	Plant pathogenic fungus (root disease)	8.4×10^4 biowaste	<1	>99.99

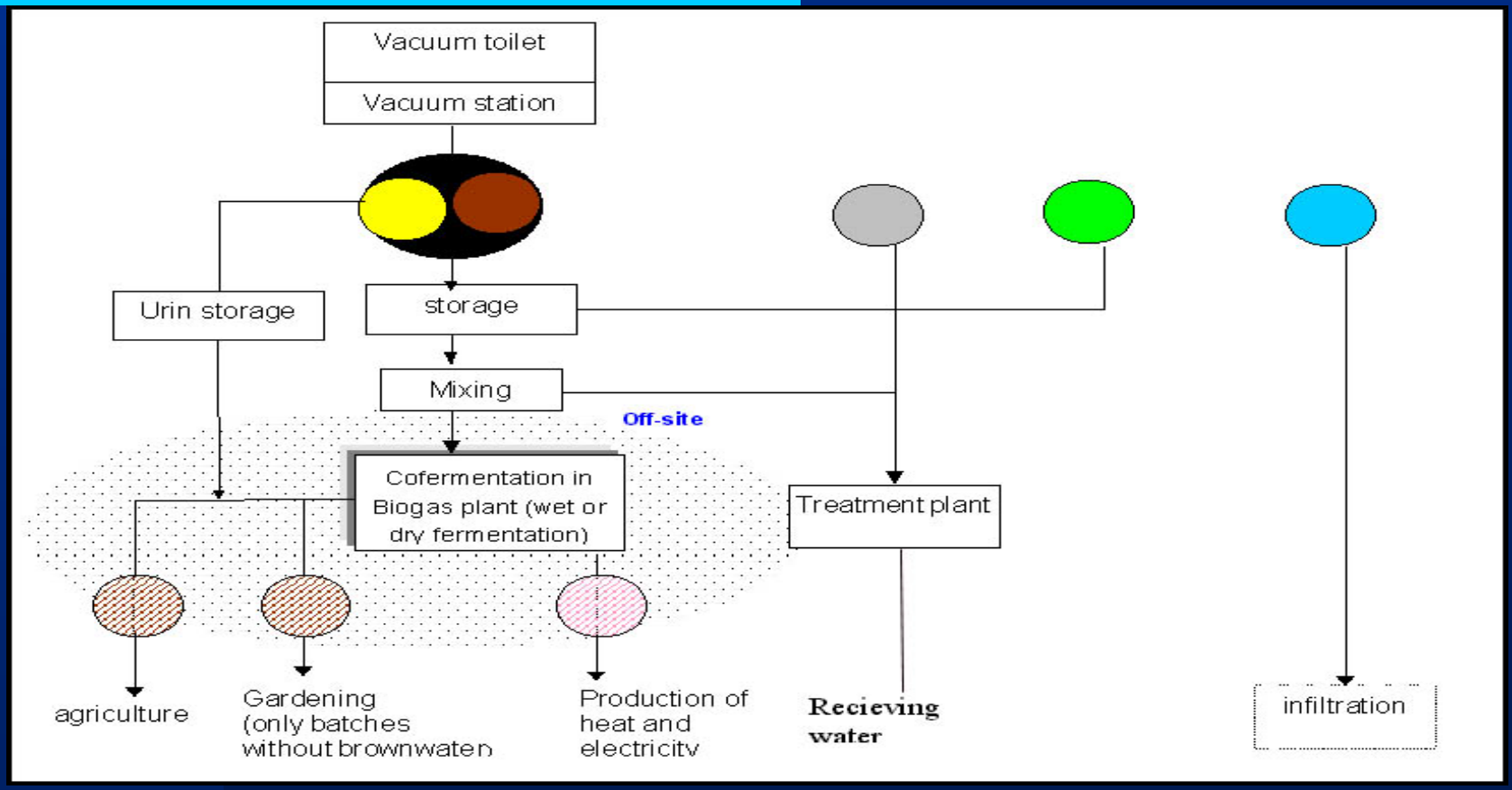
(Ten Brummeler, 2000)

Optimised ecological sanitation systems in bigger settlements of the semiarid climate zone

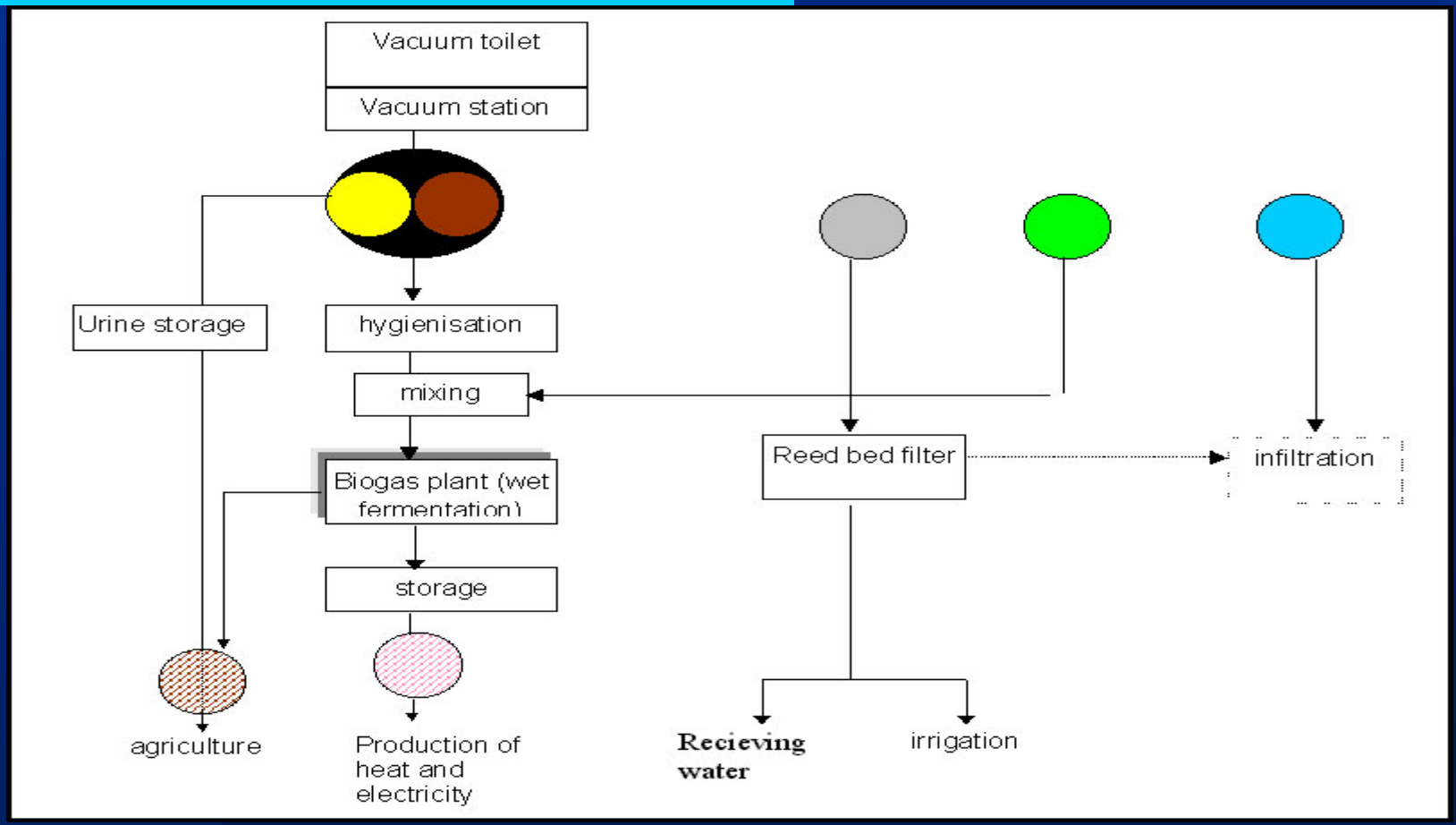
Water saving and hygienisation for settlements of ~100-500/2000 inhabitants

- with wet or dry fermentation biogas plant
- with wet fermentation biogas plant
- with dry fermentation biogas plant

Water saving and hygienisation for settlements of ~100-500/2000 inhabitants with wet or dry fermentation biogas plant

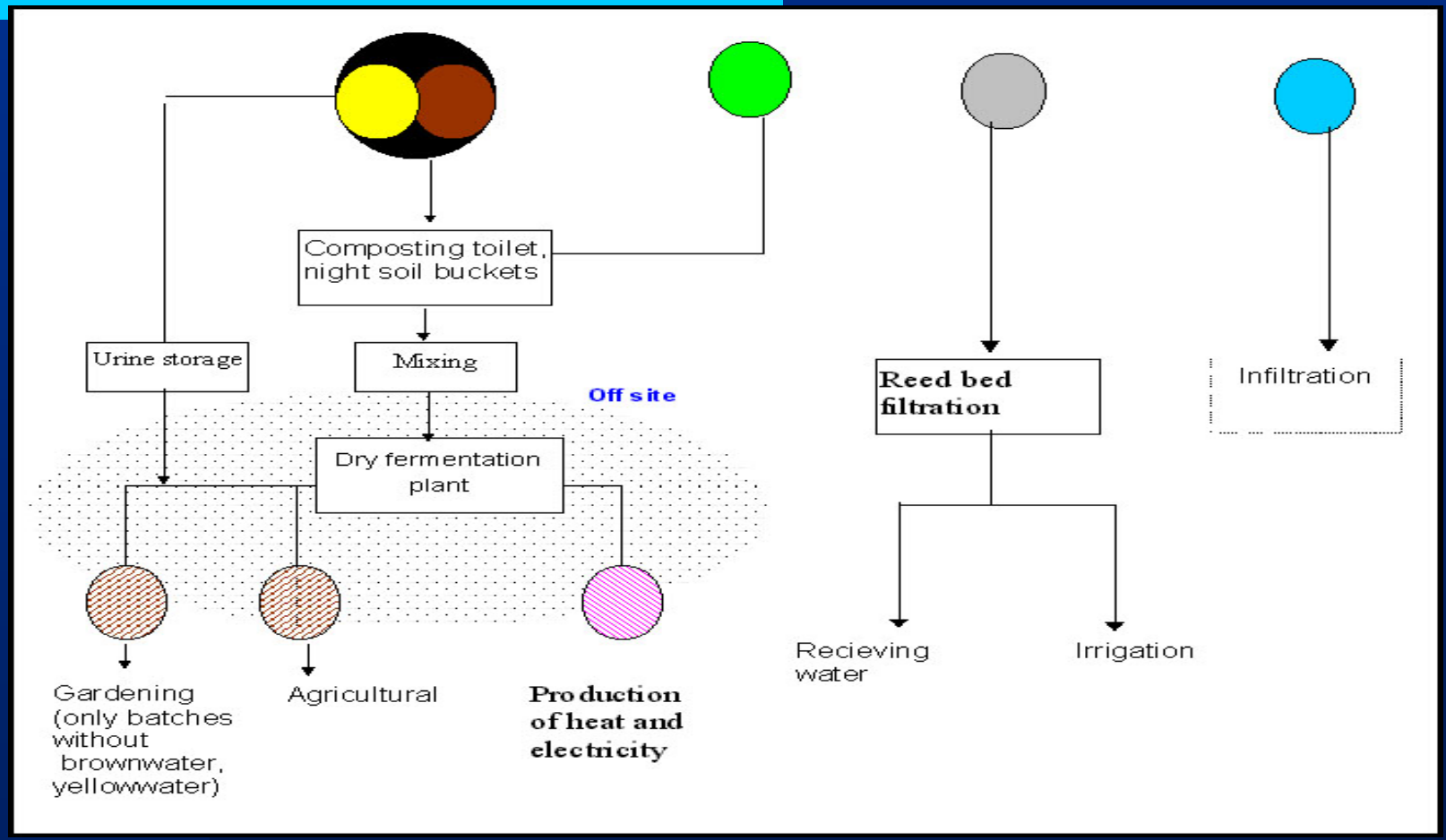


Water saving and hygienisation for settlements of ~100-500/2000 inhabitants with wet fermentation biogas plant



Ecosan GTZ, 2002 altered

Decentralised off site option for settlements ~100-500/2000 inhabitants with dry fermentation biogas plant



Ecosan GTZ, 2002 altered

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Thank you for your attention !