Innsbrucker Abfall- und Ressourcentag 2018

Klärschlammstrategien und Co-Vergärung

Sewage Sludge Pyrolysis as decentralized treatment concept

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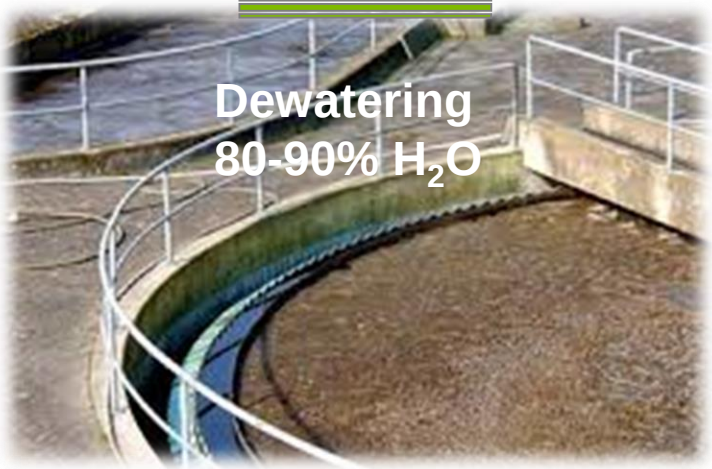
Sewage Sludge Pyrolysis …

MATERIAL MORPHING TECHNOLOGY

Use as drying heat

drying



Pyrolysis Gas

- Middle Caloric Gas
- Mass ratio: ca. **50%** (of input)
- Heat content: **17,4 MJ/kg**

Pyrolysis Coke

- Mass ratio: ca. **50%** (of Input)
- Heat content Koks: **8,4 MJ/kg**
- C-content ca. 20-30%
- ash: ca. 70-80%
- ca. 10-20% P as P_2O_5

System for 30-40.000 inhabitants

<100 kg/h T:CRACKER

Drying heat

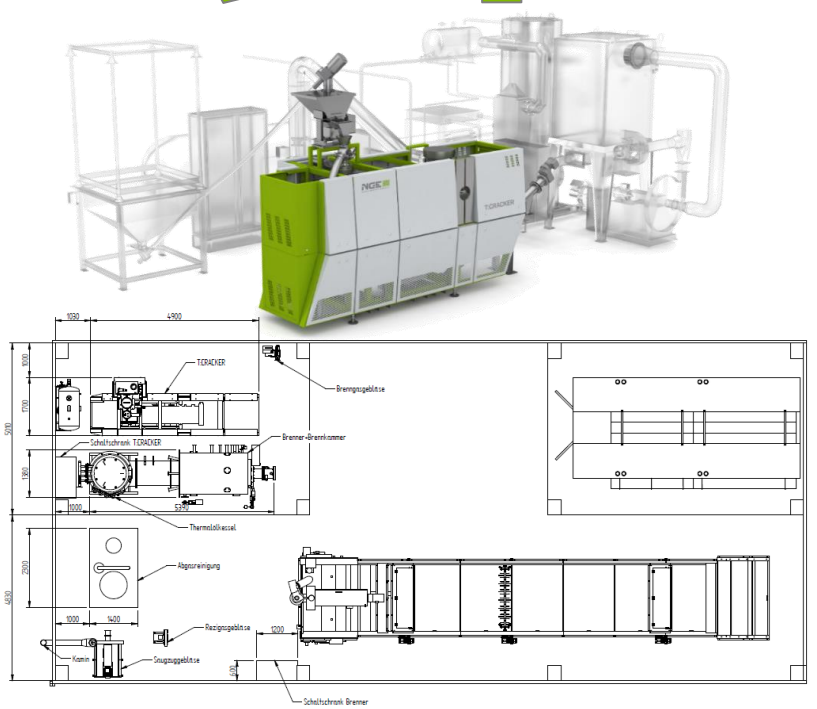
Dried Sludge
460 t/a [90% DM]

Thermal Drying

Dewatered Sludge
1.680 t/a [25% TS]

dewatering

Calculated raw sludge
8.300 t/a [5% TS]



20 x 10 m

Pyrolysis Gas

- **Mass flow: 200 t/a**
- **Heat flow: 960 MWh/a**
- **Therm. Power: 120 kW$_{(theor.)}$**

PyroCoke

Mass flow: 200 t/a
Heat content: 466 MWh/a

(bei 8000 Betriebsstunden/a)

System for 300.000 inhabitants

1000 kg/h T:CRACKER

Drying heat

Dried Sludge
8.000 t/a [90% DM]

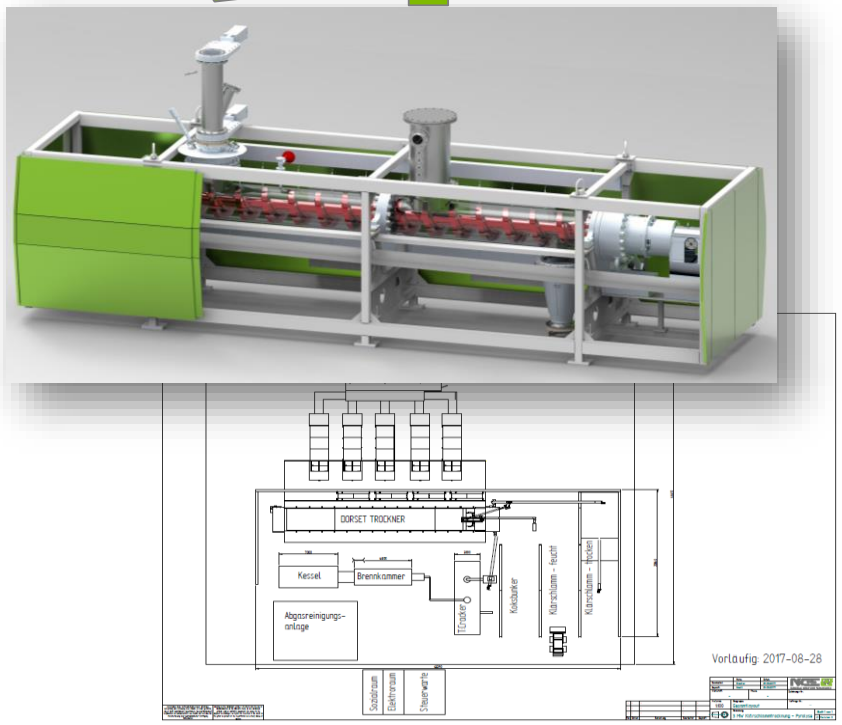
Thermal Drying

Dewatered Sludge
28.000 t/a [25% TS]

dewatering

Calculated raw sludge
140.000 t/a [5% TS]

(bei 8000 Betriebsstunden/a)



50 x 40 m

Pyrolysis Gas

- **Mass flow: 3.600 t/a**
- **Heat flow: 17.400 MWh/a**
- **Therm. Power: 2,2 $MW_{(theor.)}$**

PyroCoke

Mass flow: 3.600 t/a
Heat content: 8.400 MWh/a

Pyrolysis Product - PyroGas

- Gas flow after T:CRACKER (>450°C) directly guided to incineration system where a controlled combustion according the waste incineration directive (850°C / 2s) is realized.
- Indicative composition of the PyroGas:
  - ca. 15-20% Permanent Gas (CO, CO_2, H_2, N_2, H_2S, CH_4…)
  - ca. 85-80% condensable components → H_2O & „org. staff“ (acetic acid ,Toluol, Acetamid, Hexamethylcyclotrisiloxan, Buttersäure,N-Methylacetamid,C8 Aromat, Styrol, 4,7-Dimethylbenzofuran,5-Ethyl-2-methylphenol, 3,3-Dimethyl-2,5-pyrrolidinedion, etc.)
  - Calculated heat value: 17-18 MJ/kg
- Indicative composition of the offgas at λ = 1,4:

CO_2	10 v%
H_2O	15 v%
SO_2	0,075 v%
O_2	5 v%
N_2	70 v%
Staub	<100 mg/m³

Challenges regarding the gas cleaning:
- high SO_2 concentration
- NOx because of organic N-components → staged combustion!

Pyrolysis Product – PyroCoke

Analytics of sewage sludge material before and after treatment

Parameter	unit	Input material	Pyrolysis Coke
Dry Matter	%	92,9	99
Ignition loss	%	50,5	26,6
pH		6,8	7,2
Heat value (OS)	MJ/kg	10,3	7,9
nutritions:			
N / NH_4-N	%	3,4 / 0,31	2,4 / <0,05
P as P_2O_5	%	6,2	9,4
Plant available (citric acid 2%)	%	73	85
K as K_2O	%	0,35	0,55
Mg as MgO	%	0,9	1,3
Ca as CaO	%	2,8	4,2

Generally related to DM / Institute: AgroLab, Plauen (D)

Pyrolysis Product – PyroCoke

Analytics of sewage sludge material before and after treatment

Parameter	Unit	Input material	Pyrolysis coke	Limit (DüMV)
Heavy metals:				
As	mg/kg	8,0	8,9	40
Pb	mg/kg	49,7	73,6	150
Cd	mg/kg	1,59	2,4	1,5
related to P_2O_5	mg/kg	25,8	25,5	50
Cr / Cr ^{VI}	mg/kg	170 / <1,0	250 / <1,0	- / 2
Cu	mg/kg	270	400	900
Ni	mg/kg	40	60	80
Hg	mg/kg	0,55	0,06	1
Zn	mg/kg	1200	1830	4000

Pyrolysis Product – PyroCoke

Analytics of sewage sludge material before and after treatment

Parameter	Unit	Input material	Pyrolysis coke	Limit (DüMV)
Organic polutants:				
AOX	mg/kg	208	38	400
PCB (180)	mg/kg	<0,002	< NWG	0,1
TE-WHO PCDD/F + dl-PCB	ng TE/kg	6,3	<1,0	30
Perfluorierte Tenside (sum PFT)	µg/kg	<10	<10	100
PAK nach EPA	mg/kg	3,24	0,6	
Benzo(a)pyren	mg/kg	0,18	<0,05	1

Utilization of Sewage Sludge Mineral Fertilzer with >5% P_2O_5 principally possible…

Summary…

- **Compact and robust plant concept at low CAPEX and OPEX especially for decentralized systems having smaller plant size**
- **Benefits of decentralized solution**
  - **Logistical benefits (material transport etc.)**
  - **Plant availability distributed – shut-down risk minimized**
  - **Environmental aspects (smell, offgases etc.) “decentralized”**
- **Benefits of PyroGas**
  - **Best controllability due to gas combustion**
  - **Low offgas amounts in comparison to sold combustion (fluidized bed or grate firing)**
  - **Flexible use of therm. Energy**
- **Benefits of PyroCoke**
  - **Direct use as Mineral Fertilizer having P_2O_5 > 5%**
  - **Direct use (e.g. fertilizer supplement) – 1 kg PyroCoke is capturing 1,1 kg CO_2**
  - **Use for Phosphor-Recovery as Carbon Source (z.B. RecoPhos® (ICL), MePhrec®; AshDec®…) - PyroCoke carbon content 30% !**
  - **Bei Bedarf kann der Koks zur vollständige Energieausnutzung nachverbrannt werden**

Warmly Welcome to visit our testing facility…

NGE MATERIAL MORPHING TECHNOLOGY

JOHANNES KEPLER UNIVERSITÄT LINZ | JKU

FFG Austrian Research Promotion Agency