

Sludge to Resource – StR[©]

Advanced Processing of Sludge by German Technology

BHU

Umwelttechnik

Environmental Technology – Water & Sludge



Renewed energy provides future.

Increasing water scarcity in the world calls for sustainable solutions in the face of drought, population growth and outdated infrastructure. BHU Umwelttechnik GmbH offers state-of-the-art technologies, processes and systems for water treatment, wastewater and sludge treatment.

BHU Umwelttechnik GmbH covers the entire spectrum of processes and technologies for water and sludge treatment for municipal and industrial applications - for new plants as well as for upgrading existing establishments. Our know-how makes us a reliable partner who supports you in all phases of the project, from the planning through to the ready-to-operate plant.

Our engineers specialize in the physical, chemical, biological and thermal aspects of water and sludge technology processes, providing you with the best possible solution for your job. We

determine the optimal treatment stages and integrate them into a holistic, technically and economically optimal plant. The know-how and many years of experience of our employees enables us to process all types of water resources and to produce the desired water quality. Our in-house technology spectrum offers the necessary prerequisites for this.

Some key facts about us

- » Based in Leonberg (Stuttgart), Germany
- » Office in Qingdao
- » More than 60 projects worldwide
- » 10 municipal & industrial water projects in China
- » Traditional company with long history, originally grounded in 1896, actual company & label BHU established in 2000.

WATER
TREATMENT

WASTEWATER
TREATMENT

SLUDGE
TREATMENT

INDUSTRY

MUNICIPALITY



by partner company Suezle-Klein

Sludge to Resource[®] - Process

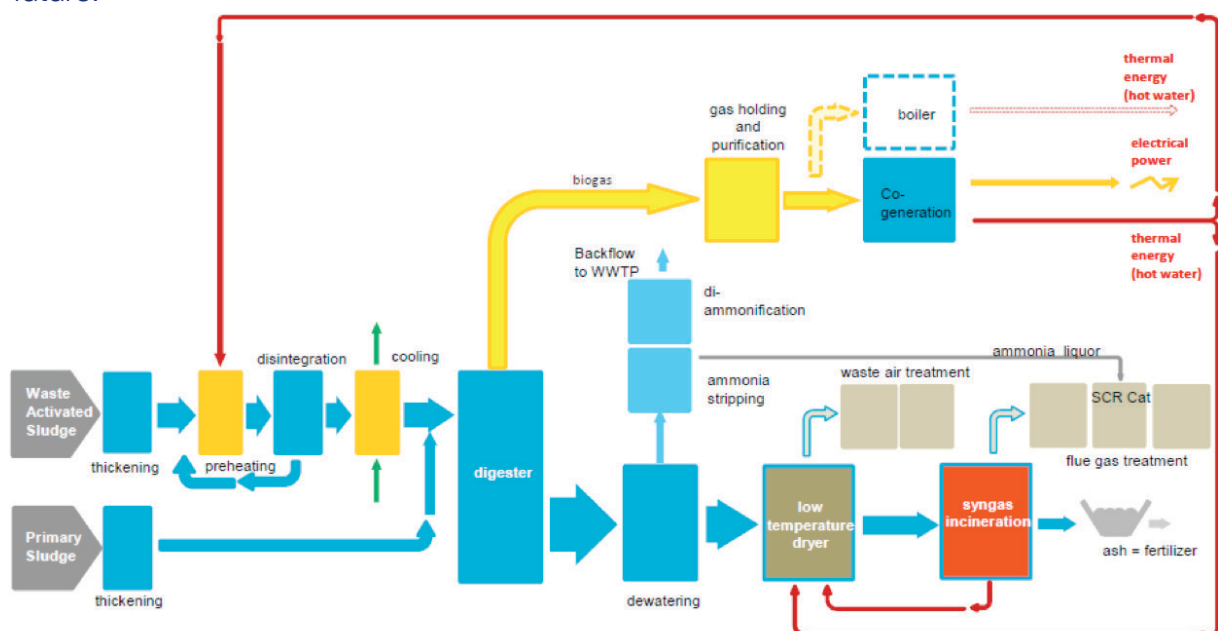
The complete solution for sewage sludge disposal

We can not only provide high standards for users in accordance with German standards, that is, the so-called high-quality, all-chain of the overall solution, but also to provide users with step-wise solutions. Our phased program is forward-looking to enable users to upgrade existing sludge treatment processes to a cycle, green, low-carbon, healthy closed-loop design with sufficient funding and policy allowable future.

We have been collecting experience with Chinese projects for 12 years. Therefore, it is time to apply our strong expertise in sludge treatment in China as well. For this we deliver:

Advanced solution - Full StR[®]

Step-by-step solution - Partial StR[®]

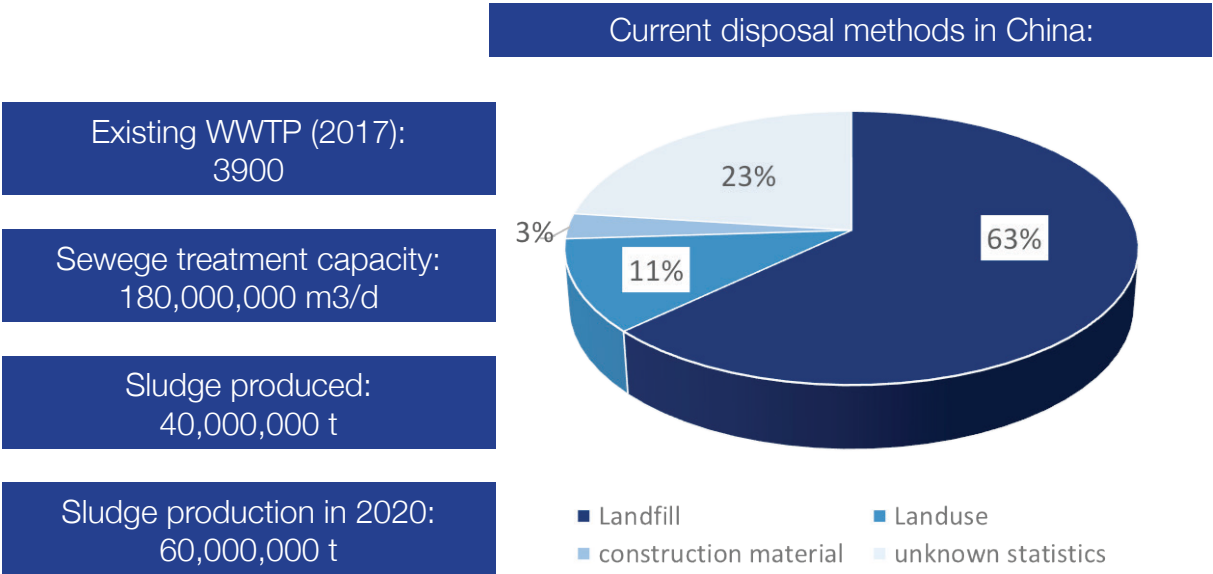
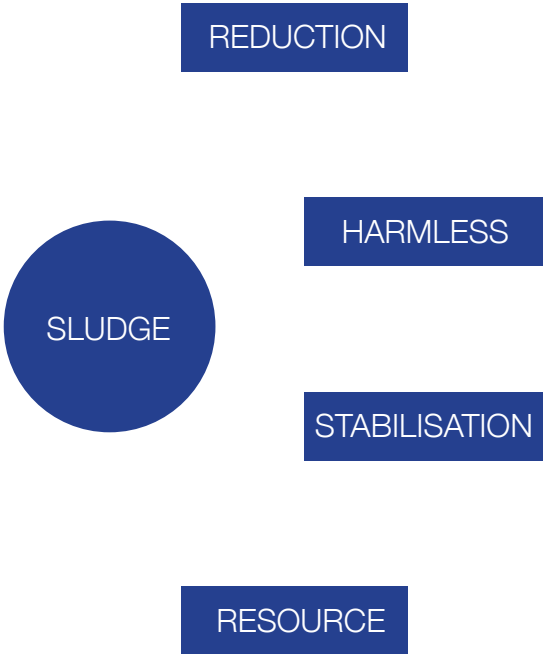


Sludge Treatment Policy in China

National 13th Five-Year Plan

“Thirteen five” national urban sewage treatment and recycling facilities construction planning“ in the sludge treatment and disposal of technical requirements:

Adhere to the principle of harmless treatment and disposal, combined with the level of economic and social development in various places, and adopt mature and reliable sludge treatment and disposal technology according to local conditions. Encourage the use of energy and resource technology to recycle energy and resources in the sludge as much as possible, and encourage the sludge that has been stabilized and harmless to be made into organic carbon soil that meets relevant standards for afforestation in wasteland. Seedling raising, landscaping, etc.

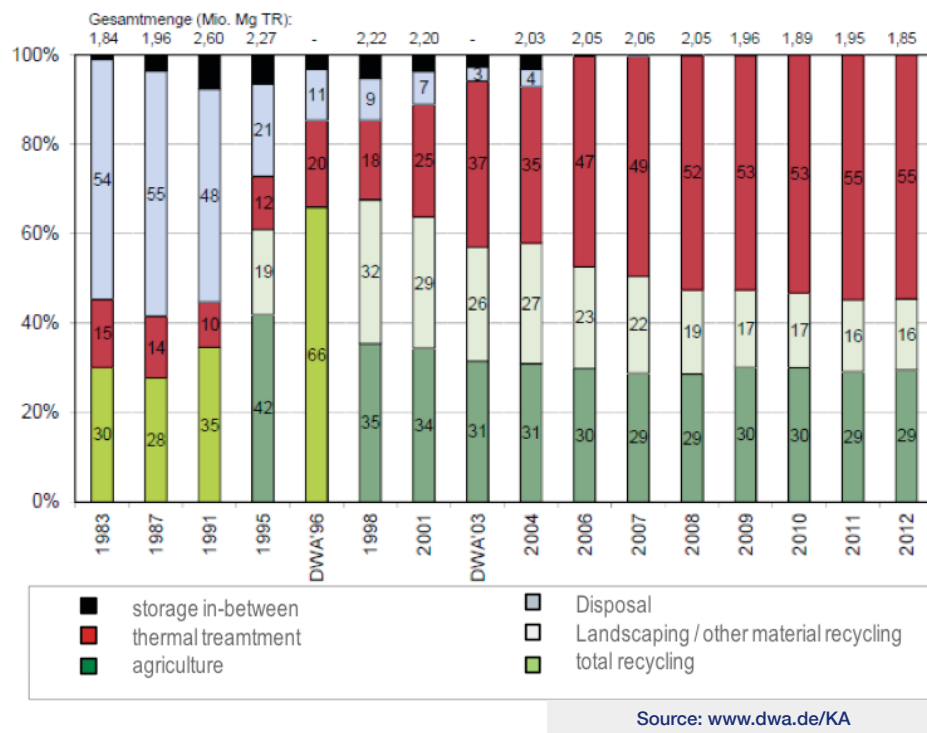


Sludge Treatment Policy in Germany

Germany also deals with sludge treatment - over 30 years of discussion and controversy. In 2005, the sludge disposal approach was discontinued in the form of a law and a new sewage sludge law was introduced in August 2017. The new law stipulates that after a defined transition period (12 or 15 years) all sewage treatment plants with more than 50,000 population equivalents (approx. 10,000 m³/d) must carry out phos-

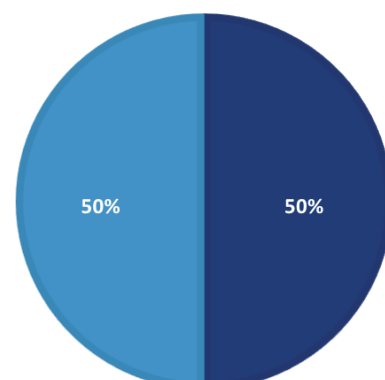
phorus return from sludge or sludge ash, whereby the use of sludge is prohibited. Dry sludge incineration in combination with previous anaerobic digestion will become the main path of sludge disposal in Germany.

There are also other supporting policies and laws, such as EEG since April 2000 to promote the use of renewable energy.



CURRENT DISPOSAL METHODS IN GERMANY

■ Incineration ■ Landscaping and fertilizer

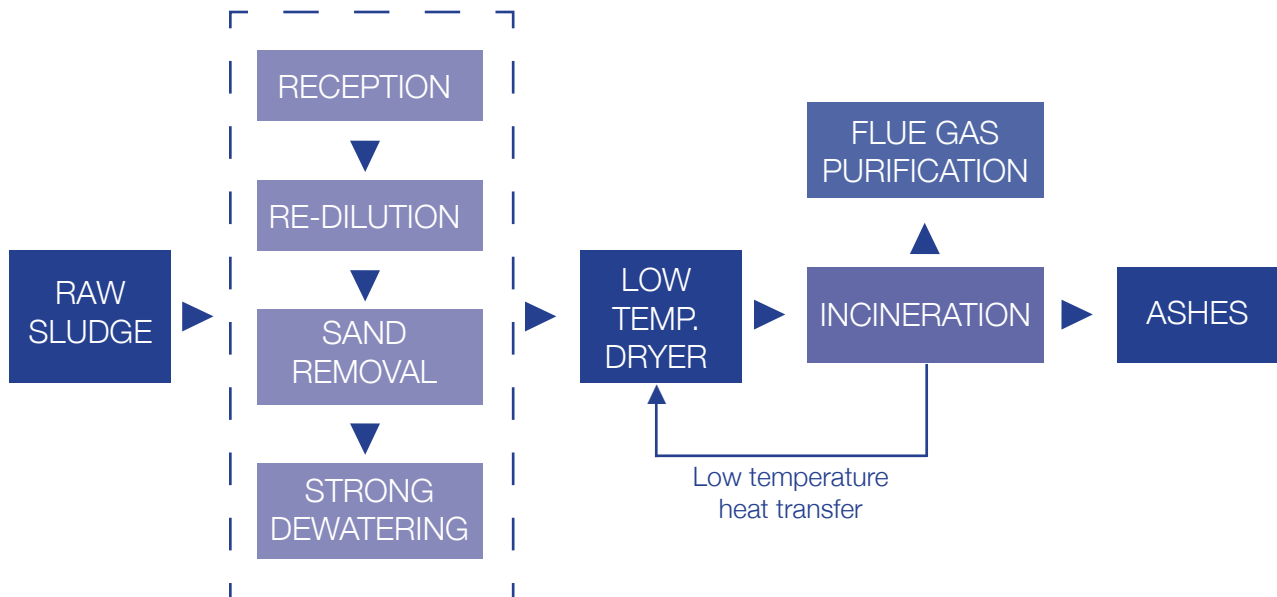


Total sewage sludge:
approx. 2 millions tDS / a

StR® - Mode of Treatment

Centralized treatment

Sludge from different waste water treatment plants is delivered to the sludge treatment center and get treated there.



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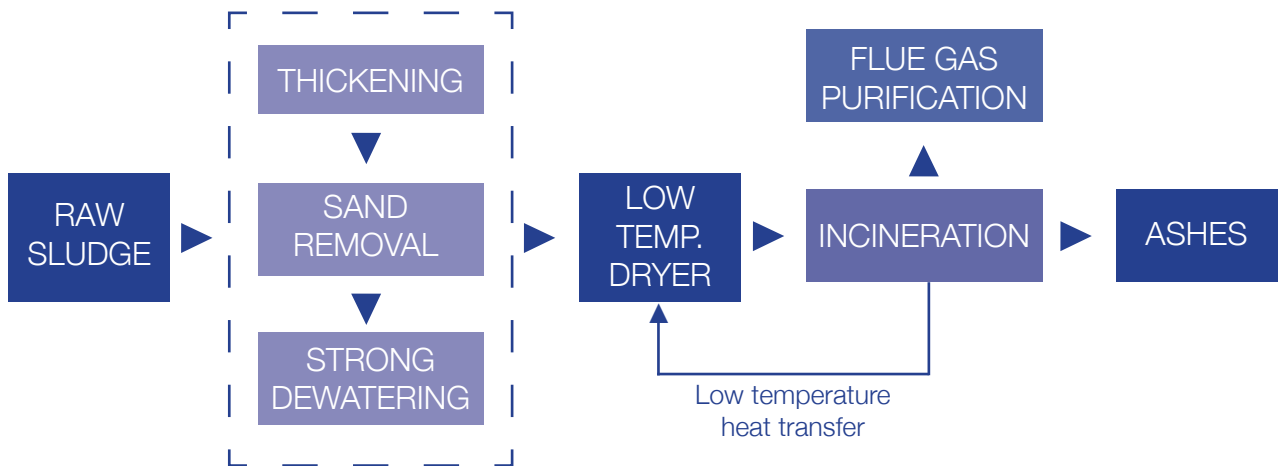
Individual treatment

Sludge from the waste water treatment plant is directly treated in its own sludge treatment plant.

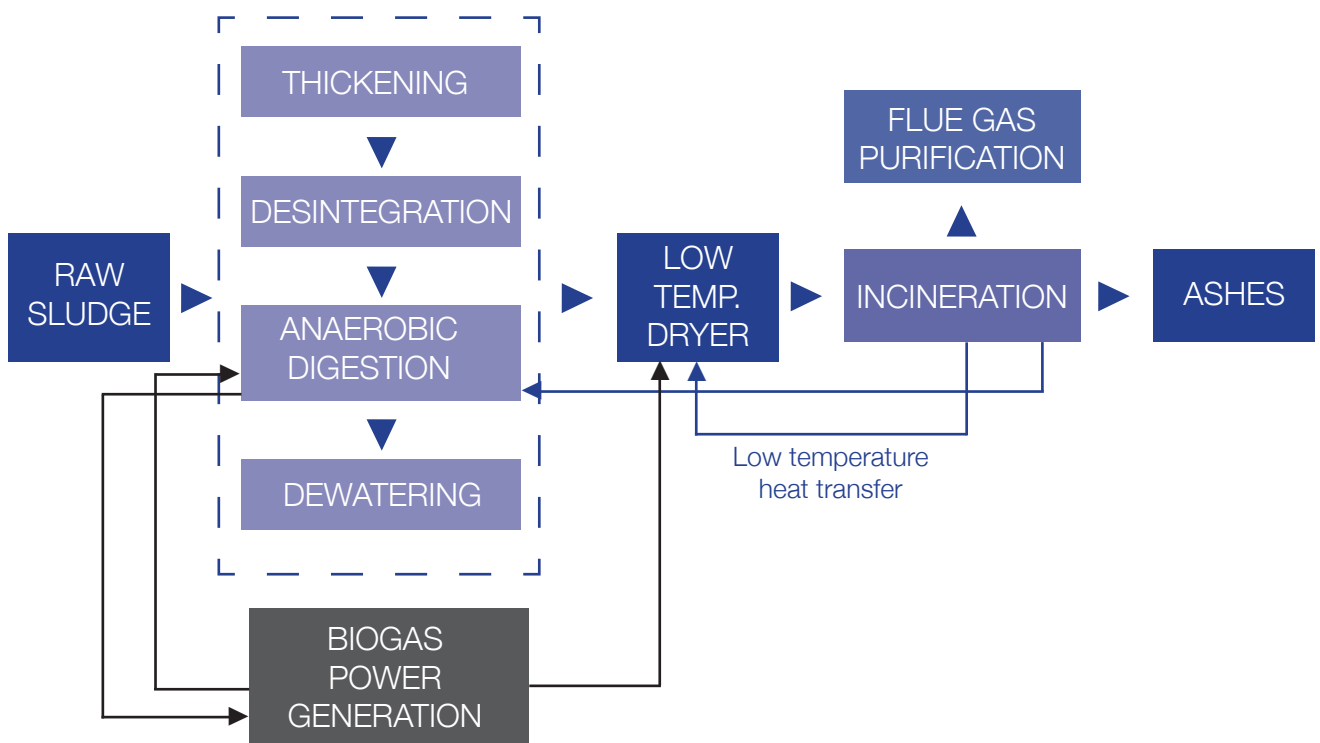
Individual treatment

Sludge from the waste water treatment plant is directly treated in its own sludge treatment plant.

Individual treatment – Low Organic Dry Matter



Individual treatment – High Organic Dry Matter



StR® - Characteristics

- Proven technology from Germany with 38 references in Europe
- Auto-thermal operation (no demand of natural gas co-firing in continuous operation)
- Small footprint
- Low operation cost
- Special design for Chinese market
- High rate of return
- High resource recovery
- 8000 operation hours guaranteed
- upgradable in steps compliant to more strict government rules in the coming years
- Qualified emission of the whole process and single unit according to Chinese regulations

BHU has 40 years of experience in municipal sludge treatment, and the relevant incineration plant in Germany has been in good operation for more than 15 years. Until now, there is not any environmental problem occurred. The emission of the process fully fulfill the chinese standards,

including „GB16297-1996“, „GB18485-2014“ and „GB 14554-1993“.

The final production of the process contains rich Nitrate and Phosphorus, which is resource utilization of the municipal sludge.



StR® - Main features

SLUDGE HYDROLYSIS

- Simple design
- Heating up to 65°C only
- Normal pressure reaction vessel, RT 2 hours
- Moderate design of sodium hydroxide solution (NaOH)
- Biogas production in the digester increased by 30%
- ODS after digestion reduced by 30%
- Necessary retention time in digester reduced by 25 %
- Digester volume reduced by 20 %
- Improved dewaterability of sludge



DIGESTION

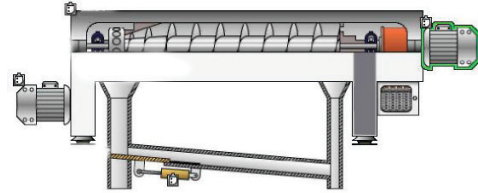
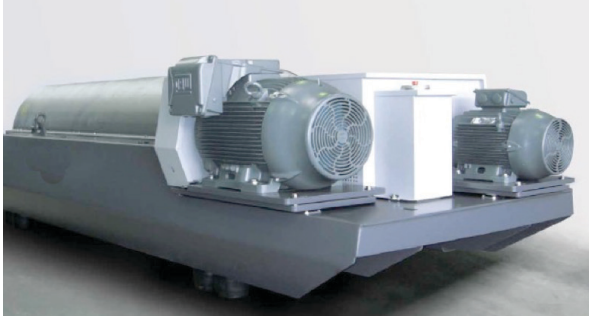
- Complete mixing without sludge settling zones
- Proper gas flow guide inside the reactor
- Optimized reaction temperature of 37 °C
- Well designed reaction tank



StR® - Main features

DEWATERING

- High dewatering efficiency by high speed
- Small foot print
- Efficient abrasion protection



Typical dewatering efficiency:

- | | |
|----------------------------------|-----|
| ■ Raw municipal sludge: | 28% |
| ■ Digested sludge: | 30% |
| ■ Digested after disintegration: | 32% |

LOW TEMPERATURE DRYER

- Heated with waste heat
- Small foot print
- Explosion proof
- Compliant waste air treatment
- High thermal efficiency
- Remaining water content less than 10 %

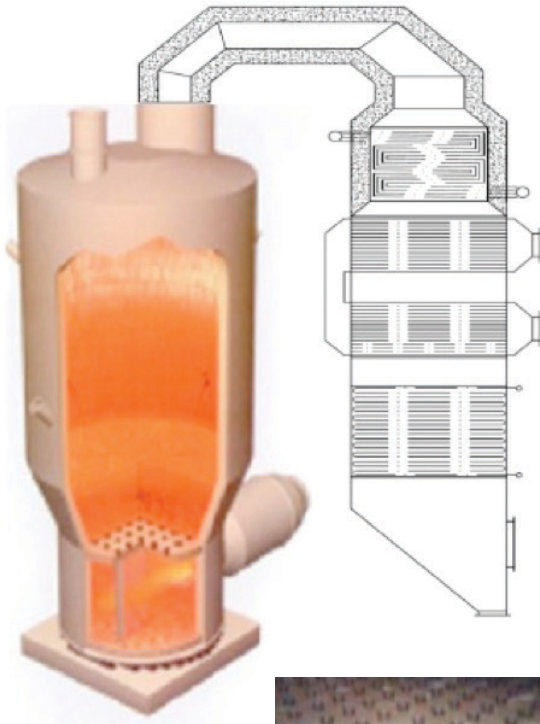


After Drying:

- Consistent granulation of residue
- Dust content < 2%
- Pneumatically conveyable
- Easy to be stored
- Hygienized according to USEPA Class A

StR® - Main features

FLUIDIZED BED INCINERATION



- Developed as decentralized incineration with a small firing capacity
- High thermal efficiency
- No deposit tendency of residues in the boiler
- Good quality of ashes
- Small foot print by small reactors
- Extremely low pollutant values in the exhaust gas
- Compliant flue gas treatment according to Chinese Standards (GB18485-2001, GB16297-1996, GB14554-93)



by partner company MPE

StR® - References

No.	Country	Municipality	Process type	Biogas production [m³/h]	Biogas storage [m³]	Biogas drying [m³/h]	Biogas cleaning [m³/h]	Size of digester [m³]	Digester capacity [m³]	Year of commissioning
1	Germany	Walden	Biogas Digester					2.000	6.000	1995
2	Germany	Municipality of Helmstedt	Biogas Digester						11.000	1995
3	Germany	Helmstedt, City of	Biogas Digester					1.000	6.000	1995
4	Germany	County of Helmstedt	Biogas Digester					3.000	20.000	1997
5	Germany	Walden, City of	Biogas Digester					2.000	10.000	1998
6	Germany	Walden, City of	Biogas Digester					3.000	20.000	1999
7	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
8	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
9	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
10	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
11	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
12	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
13	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
14	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
15	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
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17	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
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19	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
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22	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
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32	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
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37	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000
38	Germany	Municipality of Helmstedt	Biogas Digester					2.000	10.000	2000

Our StR process is well referenced:

Between the first digestion plants in 1995 and combination plants from disintegration, digestion and drying in 2015 as well as digestion, drying and syngas incineration in 2017, a total of 38 plants are built. Each part of the plant included in the StR concept is referenced multiple times, in many cases several parts of the StR process have been implemented.

The reference list shows that wherever a plant was built, whether in Germany, Poland or other countries, other plants were built in consequence on short term. Our clients had got what we have promised.



Incineration plant 40 MW - Kronospan, Menznau, Swiss



Fully automatic process

German engineering and core components

Syngas Incineration



German engineering and core components

Plant of Alba Iulia, Romania, Europe



WWTP
2 Digester
Biogas

21500 m³/d
2 x 1300 m³ Volume
1400 m³/day

Cogen-Unit 150 kW = 167 Wh/m³ WW
Benchmark 130 Wh/m³ electrical



Plant of Orzegow, Poland



by partner company Suelzle-Klein

WWTP 54.000 m³/d
Sludge capacity 7.880 to/y (DS)

Evaporation capacity of dryer
2 x 1.100 kg/h

Plant of Rostok, Germany



WWTP 80.000 m³/d
2 Digester 2 x 5000 m³ Volume
Biogas 8300 m³/day

2 Cogen-Units Output 900 kW
Benchmark 270 Wh/m³ electr.

Incineration plant 65 MW



Incineration plant 25 MW



StR® - How we work in China

Slenderness and Cost Efficiency at best available Technology (BAT)

BHU Umwelttechnik GmbH has been a successful technology partner in China since 2006. We have been able to contribute technical advantages and the resulting added value in such a way that the costs for our services are lower in OPEX and CAPEX compared to other projects. We limit ourselves to the services that are necessary to generate the technical added value and to strictly adhere to the warranted properties and guarantees. We have a team of experienced German and Chinese engineers.

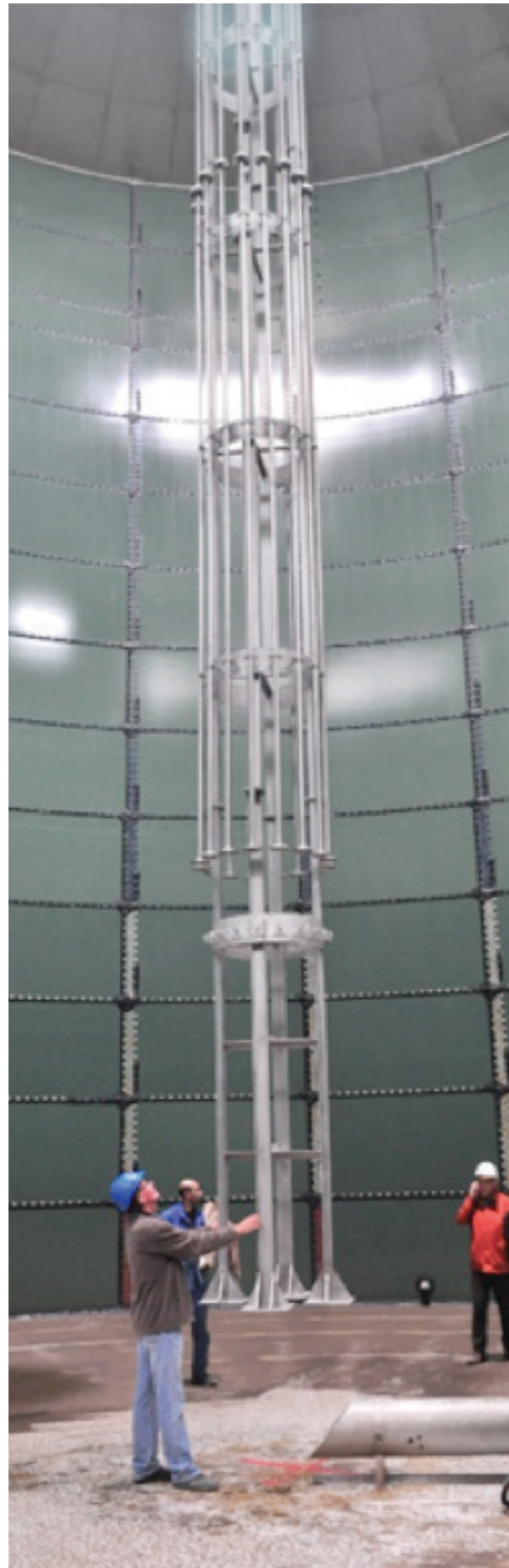
In the basic package of our services we deliver:

■ Basic Engineering

- Conceptual design for the entire system
- Process Schemes and P & ID's
- Space management
- Accompaniment of the Chinese Design Institute

■ Individual components that are subject to our know-how

- Manufactured as far as possible in China through our subsidiary in Qingdao
- As far as quality reasons reasonably imported from our suppliers in Europe
- We implement necessary supplementary technologies, such as low-temperature dryers or syngas combustion. This can also be done in the context of a direct procurement accompanied by us.
- Supervision for assembly and commissioning



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