DMS plant Hiroshima

WASTE GASIFICATION TECHNOLOGY (DIRECT MELTING SYSTEM)

WE MAKE THE WORLD A CLEANER PLACE

Steinmüller Babcock Environment

SBENG

NIPPON STEEL & SUMIKIN ENGINEERING GROUP

Waste gasification with Direct Melting System

WE MAKE THE WORLD A CLEANER PLACE

Steinmüller Babcock Environment (SBEng) – a name that stands for cutting-edge technology in thermal waste treatment and flue gas cleaning. Our company develops, plans, builds and manages complete plants as well as individual key components. Over 1,600 references worldwide stand testament to our expertise. Worldwide, our plants offer solutions to the increasingly pressing question: "How can the quantities of waste arising be treated in an environmentally friendly and energy-efficient manner?"

Steinmüller Babcock Environment is part of Nippon Steel & Sumikin Engineering Co., Ltd., one of the leading environmental technology companies in Asia and part of Nippon Steel & Sumitomo Metal, one of the largest steel producers in the world. Our roots stretch back more than 150 years to the environmental technology know-how of three famous German companies: L & C Steinmüller GmbH, Deutsche Babcock Anlagen GmbH and Noell KRS Energie- und Umwelttechnik GmbH.
We plan and implement plants for treatment of a wide range of different waste materials. Our services are specifically tailored to the respective requirements of our clients. Irrespective of whether we are supplying the entire process chain or just individual components, we are constantly optimising our products and processes to ensure we always offer long-lasting, efficient and cost-effective solutions. In waste treatment we offer the complete range of solutions:

- grate incineration
- rotary kiln
- waste gasification (Direct Melting System)
- anaerobic digestion

Direct Melting System – safe and proven technology

Gasification as a technology for energy recovery from waste has been researched intensively worldwide, especially in Japan. The technology was developed in the 1970s, the oil crisis of those years increased interest in Japan in converting household waste into energy and recycling resources. The Direct Melting System (DMS), a gasification and melting technology developed by Nippon Steel & Sumikin Engineering Co., Ltd., was introduced for the first time in 1979, in the city of Kamaishi. To this day it has prevailed against all other gasification technologies of the time. Steinmüller Babcock Environment offers the coveted DMS method in Europe under license from the parent company Nippon Steel & Sumikin Engineering. Thus we are bringing this unique technique and decades of expertise to Europe.

The DMS is a shaft furnace type gasification and melting technology. In contrast to pyrolysis, oxygen is added to this process. The technique has been used commercially for 40 years at more than 50 sites.

The capacities range from 10,000 to 230,000 tonnes per year. Thanks to the almost complete reusability of the end products, the DMS actually facilitates a zero-waste policy. The system provides consistently high efficiency with very high energy generation and the largest capacity of all gasification technologies, at 14 t/h/line. In all: an absolutely reliable and durable technology – with 50 reference plants in Japan and South Korea.

Your advantages
Highest waste flexibility

Waste flexibility is one of the greatest advantages of the DMS. The high temperatures, up to 1,800 degrees, enable the treatment of all types of waste, from household waste to bottom ash, special waste to clinical waste and the co-gasification of sewage sludge. In contrast to a fluidised bed gasifier, it is not necessary to pre-treat the waste.

Minimise landfill, maximise recycling

A high-temperature reducing atmosphere volatilises toxic heavy metals such as lead and zinc, and produces high-quality slag and metal, which can be completely recycled and sold. The produced slag is 100% recycled and sold as „Eco-sand“ not only for secondary materials but also as marine block or soil.

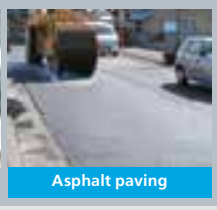
Further R&D projects are started for further application of Eco-Sand, esp. as fertiliser, because of the good effect of the contained silica. In March 2017, Eco-sand is ad interim registered as „Fertiliser“. In addition to Eco-sand and metal recycling, recycling fly ash leads to „Zero Waste“.


High quality Eco-sand

Conventional Application


Concrete blocks


Interlocking blocks


Asphalt paving


Marine blocks

Soil


High quality metal

Further Application (Fertiliser)


With Eco-sand


Without Eco-sand

R&D activities for further application of Eco-Sand, esp. as fertiliser, because of the good effect of contained silica. In March 2017, Eco-sand is ad interim registered as “Fertiliser”.

Significant reduction of pollutants

The DMS produces very few pollutants. The use of limestone in the gasification process minimises the emission of hydrogen chloride and sulphur dioxide, and a reduction in dioxins and furans is enabled by a homogeneous syngas combustion in a secondary combustion chamber. An optimised flue gas treatment minimises the environmental impact. Therefore considerably fewer pollutants are emitted at the stack than are allowed by strict European regulations.

Energy from Waste

Power generation is the most important issue in Energy from Waste plants. Although the main priority of the waste processing in the DMS is volume reduction, we can offer the best available boiler technologies and efficiencies. Our boiler systems are adapted to the respective operating conditions, right down to the finest details. As well as the material concept, which guarantees a long boiler service life, the interval between services is also a decisive quality aspect.

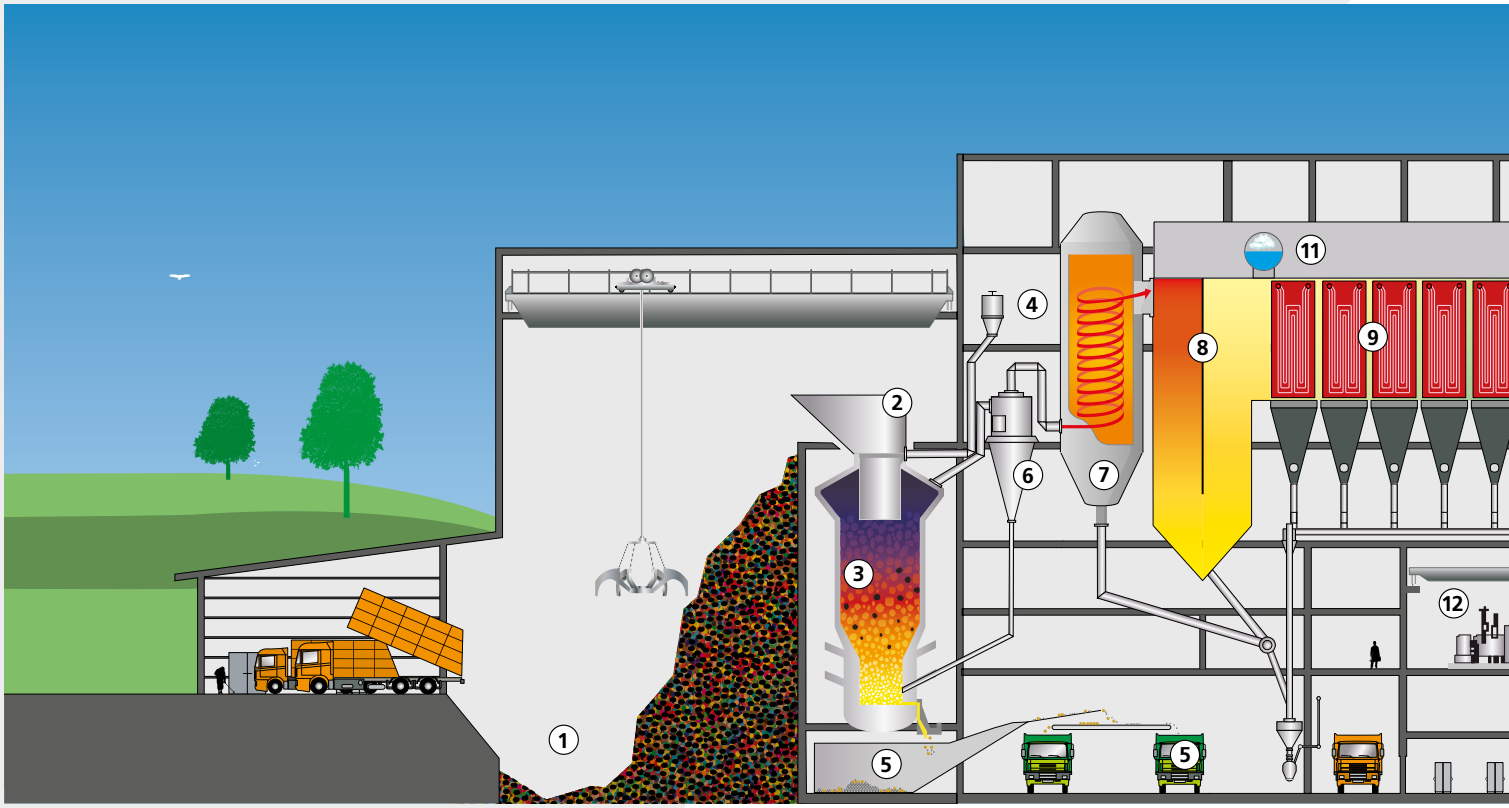
Fast erection and safe operation

We work as a general contractor for turnkey plants, as well as developing and supplying individual components. Regardless of which area we manage for you: from planning to material logistics, from the breaking ground to commissioning – our departments work interlocked, highly structured and with the highest degree of transparency. We fulfil orders according to schedules or faster. This is also made possible by more than 50 years of experience. We know how to plan and organise!

Comprehensive After Sales Service

As part of a plant manufacturer, our After Sales Service offers the entire knowledge of our development, engineering and construction departments. Our comprehensive know-how is available to you for studies, optimisation of plant concepts, modernisation of plants and also forms the basis for maintenance work at the highest quality level.

The process of waste gasification – Direct Melting System



Waste bunker: The waste delivered is stored in the waste bunker (1) and homogenised by the crane. The crane then transports the mixed waste to the waste charging equipment (2). A double damper system is used for waste charging. Air and syngas, which are introduced during waste charging, are purged by nitrogen. This system avoids a syngas leakage from gasifier and maintain the gasification system safe.

Gasifier: Via waste charging equipment, the waste is charged into the integrated gasification and melting furnace, the gasifier (3). The waste is melted at temperatures from 1,700° C to 1,800° C and converted into slag (Eco-sand), metal and syngas; to be turned into resources. Syngas measurement is arranged at the duct just above the gasifier. The gasifier is working as a packed-bed and consists from top to bottom of the following zones:

1. Drying and preheating zone
In the upper drying and preheating zone of the gasifier, the waste is dried and preheated gradually. The temperatures are 300 - 400° C.

2. Thermal decomposition zone
Combustible waste is decomposed thermally in the second zone at 400 – 1,700° C. Non-combustible waste continues to the combustion and melting zone. Syngas is produced during the process, with the main components CO, CO_2, H_2, CH_4, and N_2. The syngas is fed to a secondary combustion chamber downstream of the gasifier and completely burnt there.

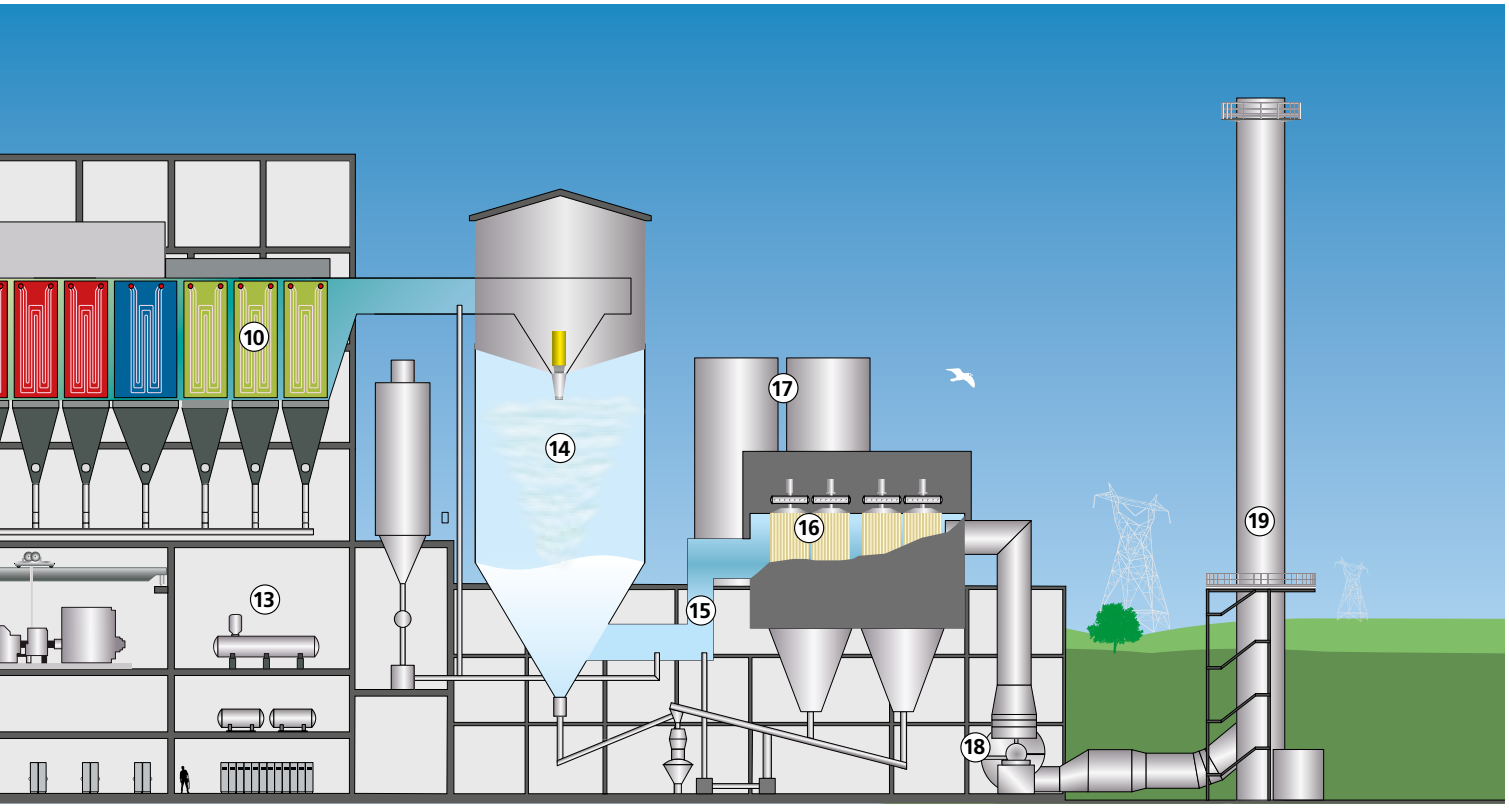
3. High temperature zone (combustion and melting zone)
The high temperature zone at the bottom of the gasifier allows stable gasification and the melting of all waste at 1,700 – 1,800° C. Here, inert materials such as glass, wires or cans are melted by the heat of the burning coke and converted into valuable materials. A high-temperature and reducing atmosphere forms at the bottom of the gasifier, in which toxic heavy metals vaporise. The melted material is discharged discontinuously through a tap hole, cooled and separated into metal and slag by a magnetic separator. The limestone added with the waste regulates the viscosity of the melted materials and prevents any clogging of the process. Thanks to the very small quantities of heavy metals, the slag (Eco-sand) and metal can be fully recycled and 100% sold.

Water granulating equipment: molten materials are discharged intermittently at the bottom of the gasifier into the water granulating equipment. This produces homogeneous molten materials (slag and metals), which are quenched by jet-water in the granulating equipment (5), and then passing a magnetic separator to achieve two very clean fractions: the slag (Eco-sand) and the metal fraction.

Sub-material charging equipment: Parallel to the waste Coke and Limestone are fed from the sub-material charging equipment (4) into the gasifier. In the standard configuration, sub-material charging equipment also has an independent double seal damper and purging system.

Cyclone: The syngas produced in the gasifier is entering a cyclone (6) for de-dusting purposes. The combustible dusts (solid particles) are fed back to the gasifier. This patented cyclone system has several advantages: reduction of APC residues, homogeneous combustion in the combustion chamber, and reduction of coke

1. Waste bunker
2. Top charging equipment
3. Gasifier
4. Sub-material charging equipment
5. Water granulating equipment (slag/metal discharge)
6. Cyclone
7. Combustion chamber
8. Evaporator
9. Superheater
10. Economiser
11. Boiler drum
12. Turbine
13. Feed water tank
14. Spray absorber
15. Flow reactor
16. Fabric filter
17. Silos
18. ID-fan
19. Stack



consumption. A cyclone captures combustible dusts from the syngas produced and fed them back to the gasifier. The returned combustible dusts can function as a substitute of coke, reducing the coke consumption in the gasifier. In addition, thanks to the removal of the dusts, homogeneous (gas-gas) combustion can be achieved, leading lower NOx and PCDD/DFs generation and less APC residue in the flue gas cleaning system.

Combustion chamber: The syngas is combusted by air in the combustion chamber (7). A homogeneous gas-gas combustion can significantly reduce the dioxin and NOx generation.

Boiler: The heat of the flue gases is used to heat demineralised water in the economiser heating surfaces (10). This so-called boiler feed water is then fed into the drum (11) which feeds the evaporator operated in natural circulation. The water-steam mixture arising in the walls of the boiler radiation passes (evaporator) (8) is separated in the drum into water and steam (11). The steam is directed to the superheater heating surfaces (9). After heating up to the specified temperature, the live steam is led to the turbine (12).

Turbine: Inside the turbine (12), the overheated steam is relieved to turn the rotor of the turbine and is then condensed. The energy released during this process is utilised in the attached generator to produce electricity. The electricity is fed into the public grid. The condensate is collected in the feed water tank (13) and finally returned to the boiler. Alternatively part of the energy can be fed to local or district heat networks or used as process steam (combined heat and power production).

Spray absorber: In the spray absorber top (14), water and lime milk are injected into the flue gas from the boiler. Flowing down the absorber cooling achieves optimum reaction conditions for capturing the acidic pollutants in particular. After cooling the flue gas, recyclate (reaction products separated in the fabric filter), fresh dry absorbent and activated carbon are injected into the entrained flow reactor (15).

Fabric filter: The pollutants still contained in the flue gas react chemically or are adsorbed by the solids and thereby precipitated with the fly ash in the subsequent fabric filter (16). As a filter medium several thousand filter hoses ensure that the filtered flue gas safely complies with all legal and environmental requirements. A high percentage of the reaction products is recirculated ahead of the fabric filter. The recyclate can be moistened to optimise utilisation of the feed materials. A partial flow of the reaction products is continuously discharged and conveyed into silos (17) for disposal.

ID-fan: The ID-fan (18) keeps underpressure in the process and leads the flue gas through the boiler and the flue gas cleaning system. Underpressure also ensures system tightness regarding flue gas.

Stack: The cleaned flue gas is leaving the process to atmosphere via the stack (19). In order to further improve efficiency, more and more condensation heat exchangers are installed in waste–to-energy plants. This means that clean, pure water vapour is emitted from the stack in the form of white clouds which dissolve – a sign of optimum energy utilisation.

Reference by Nippon Steel & Sumikin Engineering

Shin-Moji, Japan
Commissioning: 2007
Throughput: 3 x 10 t/h
Energy production: 23,500 kW
Fuel: municipal waste, incombustible residues
Largest waste gasification plant

Reference by Nippon Steel & Sumikin Engineering

Saitama, Japan
Commissioning: 2015
Throughput: 2 x 7.9 t/h
Energy production: 8,500 kW
Fuel: municipal waste, incombustible residues, incineration residues, sludge
Co-gasification with incineration residue (bottom ash)

Reference by Nippon Steel & Sumikin Engineering

Narumi, Japan
Commissioning: 2009
Throughput: 2 x 11 t/h
Energy production: 9,000 kW
Fuel: municipal waste, incombustible residues, incineration residues
Co-gasification with incineration residue (bottom ash), largest capacity per line under operation
BTO scheme

Reference by Nippon Steel & Sumikin Engineering

Kitanagoya, Japan
Commissioning: 2020
Throughput: 2 x 13.8 t/h
Energy production: 21,100 kW
Fuel: municipal waste, incombustible residues
Facilities under construction
BTO scheme

Reference by Nippon Steel & Sumikin Engineering

Sakai, Japan
Commissioning: 2013
Throughput: 2 x 9.4 t/h
Energy production: 13,500 kW
Fuel: municipal waste
BTO scheme

Reference by Nippon Steel & Sumikin Engineering

Okazaki, Japan
Commissioning: 2011
Throughput: 2 x 7.9 t/h
Energy production: 10,500 kW
Fuel: municipal waste, incineration residues, sludge
Co-gasification with incineration residues (bottom ash)

Reference by Nippon Steel & Sumikin Engineering

Akita, Japan

Commissioning: 2002
Throughput: 2 x 9.6 t/h
Energy production: 8,500 kW
Fuel: municipal waste, sludge,
incombustibles, incineration residues
Increased from 8.3 t/h per line to 9.6 t/h in 2012

Reference by Nippon Steel & Sumikin Engineering

Nishigaya, Japan

Commissioning: 2010
Throughput: 2 x 10,4 t/h
Energy production: 14,000 kW
Fuel: municipal waste, crushed residues

Reference by Nippon Steel & Sumikin Engineering

Kazusa, Japan

Commissioning: 2002
Throughput: 2 x 4.2 t/h
Energy production: 3,000 kW
Fuel: municipal waste, incombustible residues,
incineration residues, sludge,
2 lines with 5.2 t/h added in 2006 (5,000 kW)
PFI scheme

Reference by Nippon Steel & Sumikin Engineering

Kamaishi, Japan

Commissioning: 1979
Throughput: 2 x 2.3 t/h
Energy recovery: district heating
Fuel: municipal waste, incombustible residues, CFC gas
First plant with gasification,
disaster waste processed in 2011-2014

Reference by Nippon Steel & Sumikin Engineering

Ibaraki, Japan

Commissioning: 1980
Throughput: 3 x 6.3 t/h
Energy production: 10,000 kW
Fuel: municipal waste, incombustible residues
One additional line with 6.3 t/h added in 1996

Reference by Nippon Steel & Sumikin Engineering

Yangsan, Republic of Korea

Commissioning: 2008
Throughput: 2 x 4.2 t/h
Energy recovery: district heating
Fuel: municipal waste, incombustible residues
First gasification project in
South Korea, licensee Posco E&C

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