NIPPON STEEL & SUMIKIN ENGINEERING Group’s
Waste to Energy System
Your most reliable partner for Waste to Energy

REFERENCES
- 1900:
  - NIPPON STEEL Established
- 1950:
- 1970:
  - NIPPON STEEL builds first gasification plant
- 1974:
  - NIPPON STEEL’s engineering department Established. Development for gasification begins.
- 1979:
  - NIPPON STEEL builds first gasification plant
- 1980:
  - NIPPON STEEL builds first gasification WtE plant with heat recovery system
- 2006:
  - NIPPON STEEL & SUMIKIN ENGINEERING is established from NIPPON STEEL
- 2008:
  - NSEP: 103 Projects
  - USA: 10 Projects
  - S.Korea: 12 Units
  - China: 5 Units
  - Singapore: 2 Units
  - Taiwan: 1 Unit
- 2015:
  - NSENGI signs Comprehensive Partnership Agreement with City of Kitakyushu (1st Asian city selected by OECD as model city for urban green growth) for business and government promotion of WtE overseas.

Milestones for our Gasification and Combustion WtE technologies:
- Gasification: 30 years, appx 80 Units = 10 thousand tpd
- Combustion: 50 years, appx 500 Units = 150 thousand tpd

Globally Proven Technologies of Japan and Germany Integrated into One
Stable and Thorough Combustion Sequence

- From high to low calorific values, our system can treat a wide range of waste.
- Highly reliable because of its simple combustion control system, able to adapt to changes to waste properties.
- By creating efficient air cyclones in the secondary combustion zone, less air is required for full combustion.
- Currently holds the record for largest operating plant per line at 864t/d. Our maximum design capacity is at 1,200t/d, which is also the largest in the world.

High Energy Generation Efficiency

Various technologies (e.g. High steam condition boiler and regeneration / reheating cycle of steam) allow us to achieve higher power generation efficiency. Our reference plants are as follows:

- **Napoli Plant**
  - Steam Conditions: 500°C, 90 bar
  - Generation Efficiency: 30.2% (Highest in the world)
- **Rüdersdorf Plant**
  - Steam Conditions: 420°C, 90 bar
  - Generation Efficiency: 29.9% (Uses Reheating Cycle)

Advanced Flue Gas Cleaning

- We comply with even stricter emission regulations than standard Japanese and EU regulations.
- We provide various treatment methods that fit your flue gas cleaning needs.
- Dioxin is dealt with by destruction through complete combustion of flue gas and removal using activated carbon or further destruction with catalyst.

Easy Maintenance and Long Continuous Operation

- **Furnace**: Minimize shutdown to prevent clinker blockage.
- **Grate**: Minimize replacement needs by choosing optimum grate type (air or water cooled).
- **Boiler**: Maximize lifespan by optimizing temperature settings and equipment design/material.

References

- **NSENGI Group’s Standard Spec**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Standard Spec</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grate Combustion rate</td>
<td>250-360kg/m³/h</td>
<td>Depends on waste. Able to conserve space.</td>
</tr>
<tr>
<td>Range of calorific value (LHV)</td>
<td>5.0 to 18.0 MJ/kg</td>
<td>Waste of lower and higher values (including RDF) is also acceptable</td>
</tr>
<tr>
<td>Acceptance size</td>
<td>Under 600m x 600m x 600m</td>
<td>Lengths up to 1200m also acceptable</td>
</tr>
<tr>
<td>Throughput Capability</td>
<td>50 to 1200t/d</td>
<td>Largest so far is 864t/d(largest in the world)</td>
</tr>
<tr>
<td>Flue gas cleaning method</td>
<td>Dry, Semi Dry, Wet</td>
<td>Depends on customer needs</td>
</tr>
<tr>
<td>Flue gas type (NOx)</td>
<td>Catalytic, Non-catalytic, Activated Carbon</td>
<td>Depends on customer needs</td>
</tr>
<tr>
<td>Start up time</td>
<td>Appx 8 hrs</td>
<td></td>
</tr>
<tr>
<td>Shut down time</td>
<td>Appx 4 hrs</td>
<td>Emergency shutdown available</td>
</tr>
<tr>
<td>Energy generation efficiency</td>
<td>26% (90.3%)</td>
<td>EU standard achievable. Max is world’s best.</td>
</tr>
<tr>
<td>Availability</td>
<td>8,000hrs (10,000hrs)</td>
<td>EU standard</td>
</tr>
<tr>
<td>Steam temperature</td>
<td>~400°C (560°C)</td>
<td>Designed based on LCC preference of customer</td>
</tr>
<tr>
<td>Fluctuation of Steam</td>
<td>Below 3%</td>
<td>Important factor for PPA</td>
</tr>
<tr>
<td>Utilities</td>
<td>Water, electricity, fuel</td>
<td>Fuel for start-up and shut down</td>
</tr>
<tr>
<td>Ignition Loss</td>
<td>Below 3%</td>
<td>Reference around 1-2%</td>
</tr>
</tbody>
</table>
Global Presence in WtE Business

Combustion: 50 years, appx 500 Units = 150 thousand tpd
Gasification: 30 years, appx 80 Units = 10 thousand tpd

Globally Proven Technologies of Japan and Germany Integrated into One

W.EU : 164 Projects
- Germany: 163 Units
- France: 22 Units
- Switzerland: 22 Units
- Netherlands: 14 Units
- Norway: 1 Unit
- Austria: 1 Unit
- Belgium: 1 Unit

N.EU : 23 Projects
- UK: 10 Units
- Sweden: 7 Units
- Denmark: 3 Units
- Finland: 2 Units
- Lithuania: 1 Unit

E.EU : 17 Projects
- Russia: 9 Units
- Ukraine: 4 Units
- Slovakia: 2 Units
- Czech: 1 Unit
- Hungary: 1 Unit

S.EU : 17 Projects
- Italy: 15 Units
- Spain: 2 Units

USA : 10 Projects

Asia : 20 Projects
- S.Korea: 12 Units
- China: 5 Units
- Singapore: 2 Units
- Taiwan: 1 Unit

References

Rüdersdorf, Germany
Ruhleben, Germany


**Combustion System**

**NSENGI Group’s State of the Art**

- **Napoli, Italy**
  - **Amount generated**: [Data provided]
  - **Capacity**: [Data provided]
  - **Calorific value**: [Data provided]
  - **Start of operation**: [Data provided]
  - **Generation Efficiency**: 29.9% (Uses Reheating Cycle)
  - **Steam Conditions**: 420, 90 bar

- **Rüdersdorf Plant**
  - **Currently holds the record for largest operating plant per line at 864t/d**
  - **Our maximum design capacity is at 1,200t/d, which is also the largest in the world**
  - **Generation Efficiency**: 30.2% (Highest in the world)
  - **Steam Conditions**: 500, 90 bar

- **Dioxin is dealt with by destruction through complete combustion of flue gas and removal using activated carbon or further destruction with catalyst.**

**References**

- **Boiler**
  - Maximize lifespan by optimizing temperature settings and equipment design/material.

- **Furnace**
  - Minimize shutdown to prevent clinker blockage.

- **Advanced Flue Gas Cleaning**
  - We provide various treatment methods that fit your flue gas cleaning needs.

- **Easy Maintenance and Long Continuous Operation**
  - Simple (bolts and nuts not required) structure allows easy maintenance.
  - Highly reliable because of its simple combustion control system, able to adapt to changes to waste properties.

- **Throughput Capability**
  - From high to low calorific values, our system can treat a wide range of waste.

- **Grate Combustion rate**
  - 250-360kg/m²h

- **Grate Combustion Efficiency (max)**
  - 26% (30.2%)

- **Grate Shut down time**
  - Appx 4 hrs

- **Grate Fluctuation of Steam**
  - Below 3%

- **Grate Utilities**
  - Water, electricity, fuel

- **Grate Waste of lower and higher values (including RDF)**
  - Able to conserve space.

- **Grate Waste of lower and higher values (including RDF)**
  - Depends on waste.

- **Grate参考 around 1~2%**
  - Designed based on LCC preference of customer

- **Grate EU standard**
  - EU standard achievable. Max is world’s best.

- **Grate Emergency shutdown available**

- **Grate Largest so far is 864t/d (largest in the world)**

**FLOW**

1. **Platform**
2. **Waste Pit**
3. **Waste Crane**
4. **Waste Hopper**
5. **Waste Chute**
6. **Waste Feeder**
7. **Stoker Furnace**
   - The well designed [2 ‘Steps’] and [Declination Angle] of the furnace allows stable and thorough treatment of a wide range of waste.
8. **Primary Air Fan**
   - Waste is combusted with air fed into the furnace. The air is designed to also dry incoming waste and cool the grate.
9. **Secondary Air Fan**
   - A cyclone to effectively and thoroughly combust flue gas within the furnace is created with a low ‘excess air ratio’
10. **Slag Extracter**
11. **Boiler**
    - Steam generated with the heat from the combustion of waste. Corrosion of boiler tubes and build-up of clinkers and fouling are prevented through our technology and experience.
12. **Secondary Combustion Zone**
    - The secondary air helps combustion and maintain the temperature above 900°C for more than 2 seconds. This prevents Dioxin generation.
13. **Super heater**
14. **Economizer**
15. **Boiler Drum**
16. **Steam Turbine / Generator**
17. **Low Pressure Steam Condenser**
    - The turbine exhaust steam is condensed and recirculated to the boiler.
18. **Ammonia/Urea**
    - If selective non catalytic reduction (SNCR) system is applied, Ammonia water or urea water is injected into the Secondary Combustion zone to remove NOx.
19. **Gas Cooler**
    - For additional needs
Various technologies (e.g. High steam condition boiler and regeneration / reheating cycle of steam) allow us to achieve higher power generation efficiency. Our reference plants are as follows:

- **Rüdersdorf Plant**: Currently holds the record for largest operating plant per line at 864t/d. Our maximum design capacity is 107MW, 90 bar.
  - Generation Efficiency: 30.2% (Highest in the world), 90 bar

- **Napoli Plant**: By creating efficient air cyclones in the secondary combustion zone, less air is required for full combustion.
  - Generation Efficiency: 29.9% (Uses Reheating Cycle), 90 bar

**References**

- **Hefei, China**
- **Klaipeda, Lithuania**
### History

**Milestones for our Gasification and Combustion WtE Technologies.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1898</td>
<td>Deutsche Babcock Established</td>
</tr>
<tr>
<td>1874</td>
<td>Steinmüller Established</td>
</tr>
<tr>
<td>1961</td>
<td>Deutsche Babcock builds first combustion WtE plant</td>
</tr>
<tr>
<td>1962</td>
<td>Steinmüller builds first combustion WtE plant</td>
</tr>
<tr>
<td>1965</td>
<td>Deutsche Babcock's first WtE plant in Japan is built (licensed)</td>
</tr>
<tr>
<td>1970</td>
<td>NIPPON STEEL Established</td>
</tr>
<tr>
<td>1979</td>
<td>NIPPON STEEL builds first gasification plant</td>
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<td>2006</td>
<td>NSENGI signs Comprehensive Partnership Agreement with City of Kitakyushu (1st Asian city selected by OECD as model city for urban green growth) for business and government promotion of WtE overseas.</td>
</tr>
<tr>
<td>2014</td>
<td>NSENGI builds Ruhleben Plant Line A, the largest combustion WtE line in the world.</td>
</tr>
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<td>2015</td>
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**References**

1979 | NIPPON STEEL builds first gasification plant |
1980 | NIPPON STEEL builds first gasification WtE plant with heat recovery system |
1997 | Steinmüller Babcock Environment (presently known as Steinmüller Babcock Environment GmbH, or SEBNG) Established from Noel, Steinmüller, and Deutsche Babcock. |
2002 | Noel develops and patents water cooled grate. |
2008 | NSENGI signs Comprehensive Partnership Agreement with City of Kitakyushu (1st Asian city selected by OECD as model city for urban green growth) for business and government promotion of WtE overseas. |
2014 | NSENGI signs Comprehensive Partnership Agreement with City of Kitakyushu (1st Asian city selected by OECD as model city for urban green growth) for business and government promotion of WtE overseas. |

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