Fluidised Bed Combustion

TBU Stubenvoll GmbH
Engineering, consulting, supervision and start-up for
waste combustion and biomass incineration plants

Basic engineering, detail engineering, delivery of technology components and
supervision of production, commissioning and start-up for
fluidized bed combustion for fuels such as
waste fuels, biomass and sewage sludge

and

dry, semi-dry and wet flue gas cleaning plants
Stationary Fluidised Bed (bubbling bed) with Staged Incineration

- **Optimised fuel- and bed material system for biomass and waste fuels**
  - Dosing screw for fuels with equalisation
  - Pneumatic fuel feeding
  - Open nozzle grid
  - Screening, recirculation and discharge of coarse ash particles system

- **Optimised air and flue gas system**
  - Controlled composition for fluidising gas consisting of air and recirculation gas
  - Two different levels for secondary air for staged combustion
  - Controlled temperature profile of combustion chamber for low emissions
Fuel Dosing System with Equalizer and Injector

- Dosing system for fuels up to 300 mm feed size
- Precise and constant dosage
- Pneumatic fuel feeding onto the bed surface
- Burn-back protection: temperature monitoring, sub-pressure, burn-back double valve (open under normal operation)
- Additional burn-back protection by water sprinkling system
Open nozzle grid

✓ Open nozzle grid suitable for discharge of coarse particles up to 300 mm
✓ Low pressure drop for fluidisation gas
✓ Optimised distribution of primary air

Mechanical bed material (bottom ash) discharge

✓ Pneumatic screening
✓ Continuous recirculation of fine bed material to combustion chamber
✓ Discharge of coarse particles
✓ Transport of fresh sand together with re-circulated fines
Stationary Fluidised Bed Combustion for sewage sludge without flue gas recirculation - optimised in view of low additional firing

Firing system for wet, low heating value fuels

- Air preheating to high temperature
- Adiabatic combustion chamber
- Low excess air in the combustion chamber
- Temperature is controlled for all zones of the combustion chamber
- No unprotected metal surfaces in the combustion chamber
Dosing System for Sewage Sludge

- Mechanical atomisation
- Pneumatic transportation
- Self-cleaning due to air system
Advantages - Stationary Fluidised Bed with Staged Combustion

Process Advantages

✓ Small amount of unburned components in residues and flue gas
✓ Low NOx production
✓ Wide range for calorific value and water content
✓ Wide range for superheating power due to low combustion temperature and high recirculation gas flow

Commercial advantages

✓ Reduced space requirement
✓ Reduced cost for boiler + combustion chamber
✓ Low fouling and corrosion risks
✓ High availability
✓ High electrical efficiency
Hot water boiler with baghouse filter
Adiabatic combustion chamber with heat recovery boiler (small scale unit)
References - Fluidised Bed Combustion

<table>
<thead>
<tr>
<th>Projects</th>
<th>Capacity (MW)</th>
<th>2000</th>
<th>2005</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade of existing plants 4-110 MW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAG 8 (AT)</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAG 7 (AT)</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABRG WSO (AT)</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamburger Pitten (AT)</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altenstadt (DE)</td>
<td>40,4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niklasdorf (AT)</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heiligenkreuz (AT)</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSO1 Fernwärme Wien (AT)</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Villas II (AT)</td>
<td>4,3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVA Höchst (DE)</td>
<td>3 x 90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSO 4 Fernwärme Wien (AT)</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own technology 2,8-45 MW (projected up to 60 MW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neubrücke (DE)</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Villas (AT)</td>
<td>2,8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVN (AT)</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basel (CH)</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthey (CH)</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABRG WSO new (AT)</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zurich / Aubrugg (CH)</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bern (CH)</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fluidised Bed Incineration Plant Höchst for RDF (Germany 2011-2013)

**Project Description:**
- Fluidised bed incinerator for RDF
- Production of electrical energy and steam

**Capacity:**
- 3 x 90 MW fuel heat capacity

**Plant Concept:**
- Fuel feeding
- Fluidised bed combustion with SCNR-system
- Steam boiler
- Baghouse filter, semi-dry adsorption

**TBU:** basic engineering for staged combustion and boiler reconstruction (retrofit of EBARA-process), combustion control system
**Project Description:**

- Redesign of fluidised bed incineration concept WSO4 for municipal waste

**Capacity:**

- 39 MW fuel heat capacity

**Project objectives:**

- Risk minimizing for boiler fouling and corrosion
- Increase of range of fuel
- Improvement of incineration stability

**TBU:** Adaptation of combustion control system, design engineering for air- and recirculation air system
Stationary Fluidised Bed Combustion for:
✓ Production wastes
✓ Sewage sludge
✓ Treated waste fuels

The produced energy is used to:
✓ heat supply of production of Villas Austria GmbH

Installation of a wet flue gas cleaning plant

Capacity:
✓ Capacity increase from 2.8 MW to 4.3 MW

TBU: concept engineering, approval procedure, procedural engineering, processing and start-up for combustion and flue gas cleaning
Fluidised Bed Incinerator ABRG Arnoldstein (Austria 2008-2011)

**Project Description:**
- Fluidised bed incinerator for solid, fluid and pasty hazardous and nonhazardous waste fuel
- Production of electrical energy and steam for steam network on-site

**Capacity:**
- 11 MW fuel heat capacity
- Total capacity: 42,000 tons per year

**Plant Concept:**
- Fuel feeding
- Fluidised bed combustion with SCNR-system
- Heat recovery steam boiler
- Baghouse filter, two stage scrubber, dry adsorption

**TBU:** Approval procedure, basic engineering, detail engineering, supervision of production and assembly, as well as start-up of the whole plant with own know-how for combustion and flue gas cleaning
Project Description:

- Fluidised bed incinerator for biomass
- Production of electrical energy and steam for district heating

Capacity:

- 44 MW fuel heat capacity
- Emissions according to Swiss law

Plant Concept:

- Storage of biomass
- Boiler with integrated fluidised bed incineration
- Dry flue gas cleaning plant

TBU: basic engineering, know-how provider of combustion and start-up assistance
Biomass Power Plant Bern (Switzerland 2009 - 2013)

Project Description:
- Fluidised bed incinerator for biomass
- Production of electrical energy and steam for district heating

Capacity:
- 27 MW fuel heat capacity

Plant Concept:
- Storage of biomass
- Boiler with integrated fluidised bed incineration
- Dry flue gas cleaning plant

TBU: basic engineering, know-how provider of combustion and start-up assistance
Revamp of Fluidised Bed Incinerator WSO1 for Fernwärme Wien GmbH (Austria 2008-2009)

**Project Description:**
- Revamp of fluidised bed incinerator WSO1 for sewage sludge and solid fuels

**Capacity:**
- 16 MW fuel heat capacity

**Revamp concept and project objectives:**
- Modification of adiabatic combustion chamber geometry
- Additional high-pressure steam air pre-heater
- Combustion control concept
- Increased sewage sludge throughput
- Reduction of need for high calorific secondary fuel

**TBU:** Basic engineering, detail engineering, supervision of start-up after revamp
Project Description:

✓ Fluidised bed incinerator for biomass
✓ Production of electrical energy and process steam

Capacity:

✓ 48 MW fuel heat capacity
✓ Emissions according to 17 BImSchV

Operating company: Bewag und Begas
Combustion: Babcock Wilcox
Boiler: Marcegaglia

TBU: simulation of combustion, improvement actions for combustion for prevention of depositions at the same time with capacity increase of 10%
**Project Description:**
- Fluidised bed incinerator for sewage sludge and solvents
- Production of process steam for an industrial plant

**Capacity:**
- 7 MW fuel heat capacity

**Plant Concept:**
- Intermediate storage and dosing of sewage sludge
- Stationary fluidised bed with SNCR-plant
- Heat recovery boiler
- Semi dry and wet flue gas cleaning plant

**TBU:**
- Basic engineering, detail engineering, delivery of special parts and supervision of production, assembly and start-up
**Project Description:**

- Fluidised bed combustion for waste fuels and sewage sludge
- Production of electrical energy and process steam

**Capacity:**

- 32 MW fuel heat capacity

**Operating company:** Enages

**General Contractor:** Siemens AG

**Combustion and Boiler:** AE

**TBU:** simulation of combustion, improvement actions for combustion for prevention of depositions
IWB Biomass Power Plant Basel (Switzerland 2006 - 2008)

**Project Description:**
- Fluidised bed incinerator for biomass
- Production of electrical energy and steam for district heating

**Capacity:**
- 30 MW fuel heat capacity
- Emissions according to Swiss law

**Plant Concept:**
- Storage of biomass
- Boiler with integrated fluidised bed incineration
- Dry flue gas cleaning plant
- Existing water steam cycle with turbine

**TBU:** basic engineering, detail engineering, supervision of production and assembly of combustion as well as start-up of the whole plant
Pilot Plant for Straw Pyrolysis Dürnrohr (Austria 2006 - 2008)

**Project Description:**
- Pyrolysis of straw
- Combustion of pyrolysis gas
- Combustion of straw and pyrolysis coke in a fluidised bed combustion
- Project objective: Confirmation of design data and technology demonstration for use of straw in a large power plant

**Capacity:**
- 5 MW fuel heat capacity,
- Emission limits to Austrian law

**Plant Concept:**
- Indirect heated rotary kiln
- Fluidised bed incinerator
- Spray cooler
- Spray absorber
- Baghouse filter

**TBU:** approval procedure, basic engineering, detail engineering, supervision of production and commissioning, start-up
Project Description:
✓ Fluidised bed incinerator for industrial waste and sewage sludge
✓ Energy transfer to thermal oil system

Capacity:
✓ 2.8 MW fuel heat capacity
✓ Emission limits according to Austrian law

Plant Concept:
✓ Fluidised bed combustion with boiler and flue gas air pre-heater unit
✓ Baghouse filter and existing scrubber with NaOH-dosing station

TBU: approval procedure, basic engineering, detail engineering, supervision of production and commissioning, start-up
Waste Wood Fluidised Bed Incineration Plant ALTENSTADT-SCHONGAU (Germany 2004-2005)

**Project Description:**
- Upgrade of the existing fluidised bed incinerator
- Production of electrical energy and steam for district heating from biomass

**Capacity:**
- 40,4 MW fuel heat capacity
- Emissions according to 17 BimschV

**Plant Concept:**
- Storage of waste wood
- Boiler with integrated fluidised bed combustion
- Dry flue gas cleaning plant
- Water steam cycle with turbine

**TBU:** basic and detail engineering, supervision of production and assembly of combustion as well as the start-up of the whole plant
Waste Wood Fluidised Bed Incineration Plant OIE Neubrücke (Germany 2002/03)

**Project Description:**
- Fluidised bed incinerator for biomass and waste wood
- Production of electrical energy and steam for district heating

**Capacity:**
- 30 MW fuel heat capacity
- Total capacity 60,000 tons per year

**Plant Concept:**
- Storage of waste wood
- Boiler with integrated fluidised bed combustion
- Selective non-catalytic NOx-reduction
- Semi-dry flue gas cleaning plant
- Water steam cycle with turbine

**TBU:** basic engineering, detail engineering, supervision of production and assembly of combustion and flue gas cleaning and start-up of the whole plant
Fluidised Bed Incineration Plant  HAMBURGER PITTEN (Austria 2001)

**Project Description:**
- Upgrade of existing fluidised bed boiler for combustion of coal and sewage sludge
- New design for combustion control system

**Capacity:**
- 60 MW fuel heat capacity

**Plant Concept:**
- Fuel treatment
- Boiler with integrated fluidised bed combustion
- Baghouse filter
- Boiler plant with water steam cycle

**TBU: Engineering, supervision of assembly and start-up**
**Project Description:**
- Fluidised bed incinerator for hazardous and nonhazardous waste
- Upgrade of incinerator, boiler and flue gas cleaning plant

**Capacity:**
- 6 MW fuel heat capacity
- Total capacity: 30,000 tons per year

**Plant Concept:**
- Stationary fluidised bed reactor with waste heat boiler
- Electrostatic precipitator, two stage scrubber, dry adsorption system with coke powder and lime and selective catalytic reduction of NOx
- Waste water treatment plant

**TB:** approval procedure, basic engineering, detail engineering, supervision of production and assembly, start-up
Waste Fluidised Bed Boiler 1K7 Lenzing AG (Austria 2000)

**Project Description:**
- Upgrade of existent fluidised bed boiler for combustion of bark, coal, internal waste fuels and sewage sludge
- New concept for combustion control system

**Capacity:**
- 110 MW fuel heat capacity

**Plant Concept:**
- Fuel transport
- Boiler with integrated combustion
- Baghouse filter

**TBU:** Process engineering and start-up
**Project Description:**
- Fluidised bed incinerator for RDF and sewage sludge
- Production of electrical energy and process steam

**Capacity:**
- 110 MW fuel heat capacity
- Total capacity: 250,000 tons per year

**Plant Concept:**
- Mechanical treatment of RDF
- Circulating fluidised bed incinerator
- Waste heat boiler
- Dry, wet and catalytic flue gas cleaning plant
- Waste water treatment plant

**TBU:** Concept engineering, tender engineering, supervision of basic engineering, detail engineering and start-up
Detail engineering of the fluidised bed bottom, combustion control system and scrubber
Our engineering for your success is based on many years of experience in the field of advanced environmental plants all over the world. We have successfully engineered projects in:

- Austria
- Australia
- China
- Croatia
- Czech Republic
- France
- Germany
- Great Britain
- Greece
- Hungary
- Italy
- Korea
- Malta
- Netherlands
- Russia
- Switzerland
- Slovakia
- South Africa
- Taiwan
Contact:

TBU Stubenvoll GmbH

Pyhrnstrasse 16, 4553 Schlierbach, AUSTRIA
Tel: +43 7582 90803
Fax: +43 7582 90803-309
E-Mail: office@tbu.at
www.tbu.at