Fluidised Bed Combustion

TBU Stubenvoll GmbH

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TBU Services

Engineering, consulting, supervision and start-up for

waste combustion and biomass incineration plants

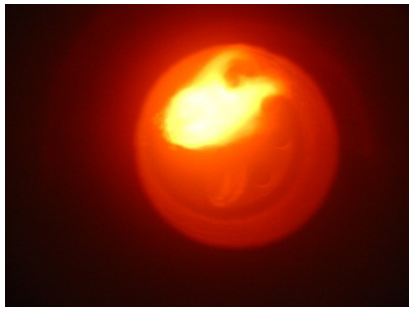
Basic engineering, detail engineering, delivery of technology components and supervision of production, commissioning and start-up for

fluidized bed combustion for fuels such as

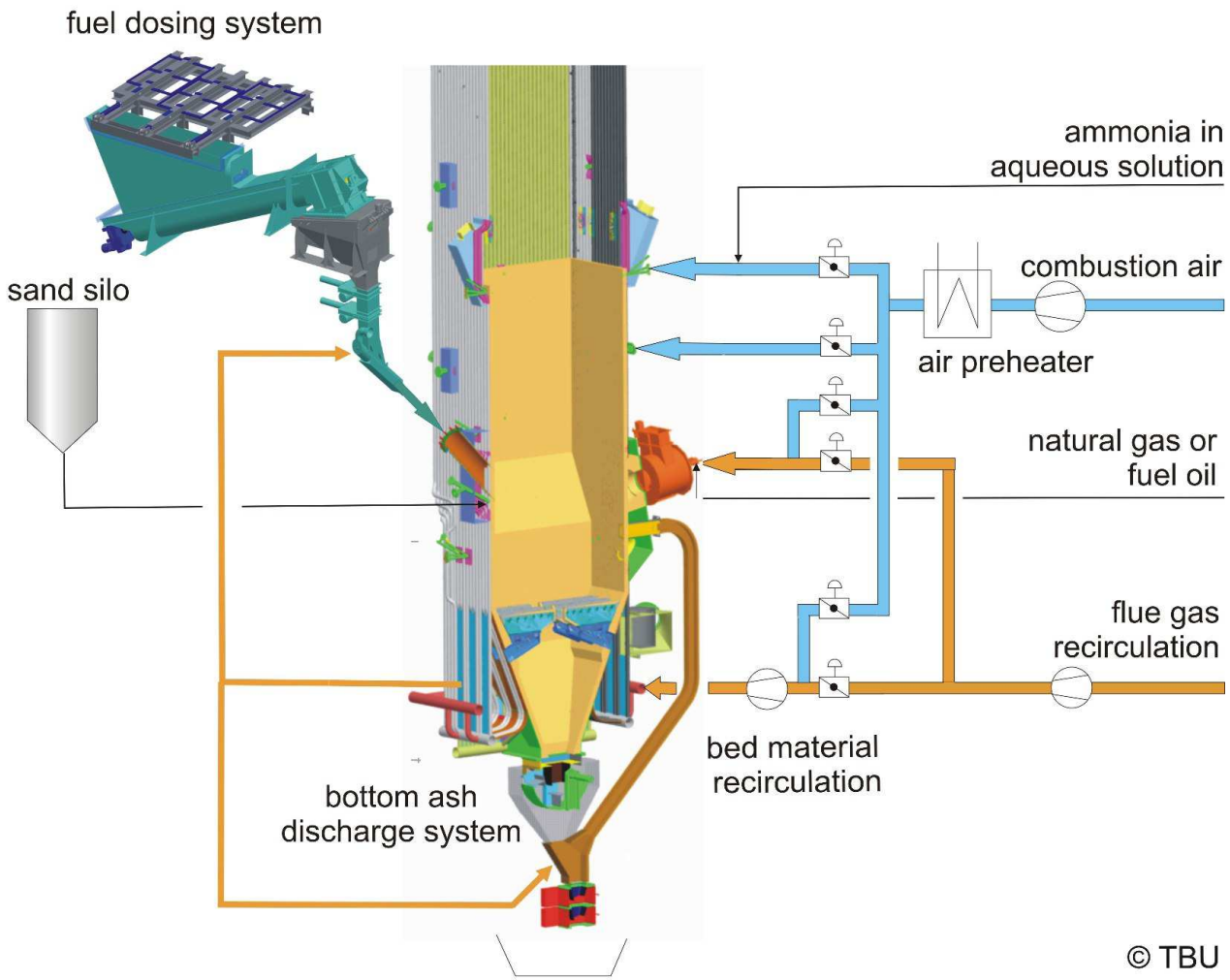
waste fuels, biomass and sewage sludge

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

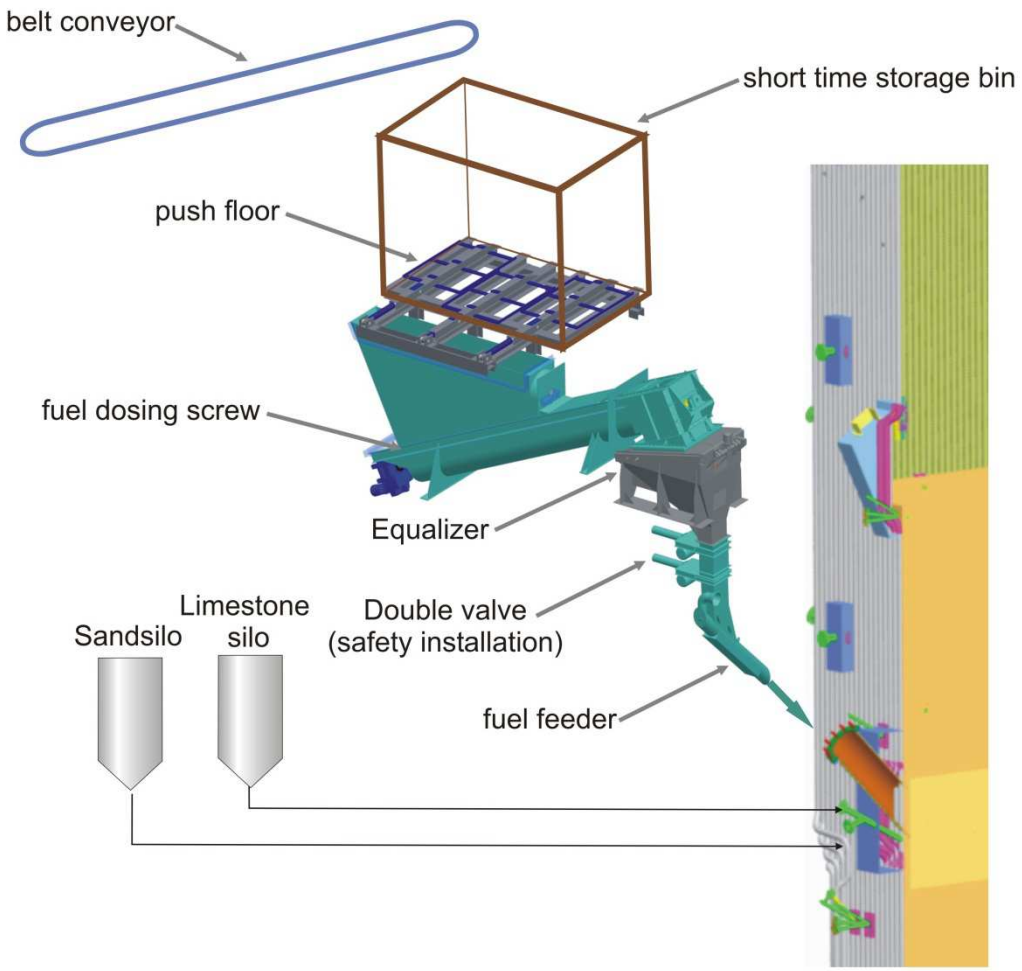
- ✓ Dosing screw for fuels with equalisation
- ✓ Pneumatic fuel feeding
- ✓ Open nozzle grid
- ✓ Screening, recirculation and discharge of coarse ash particles system

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



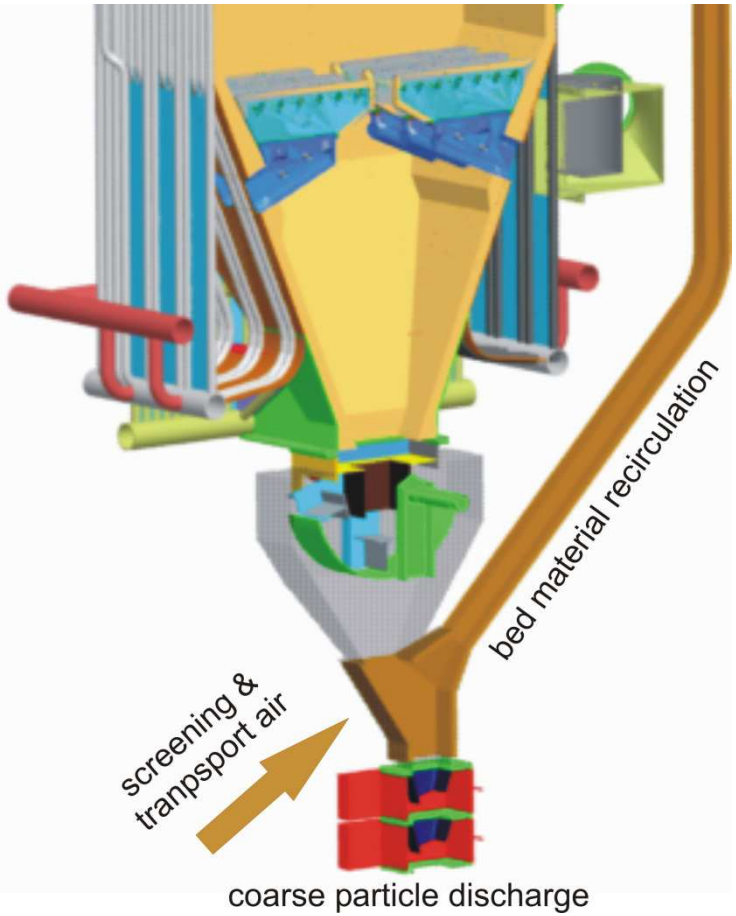
Open Nozzle Floor and Pendular Discharge

Open nozzle grid

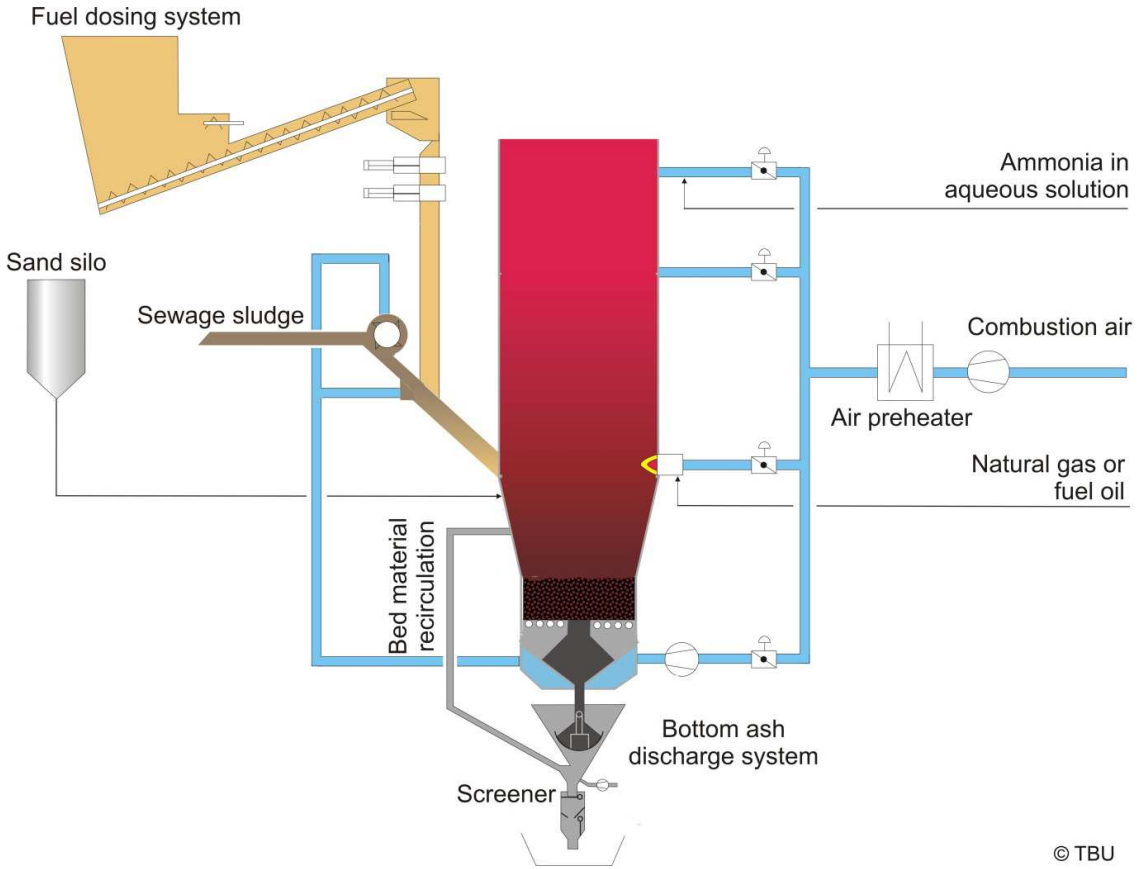
- ✓ Open nozzle grid suitable for discharge of coarse particles up to 300 mm
- ✓ Low pressure drop for fluidisation gas
- ✓ Optimised distribution of primary air

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

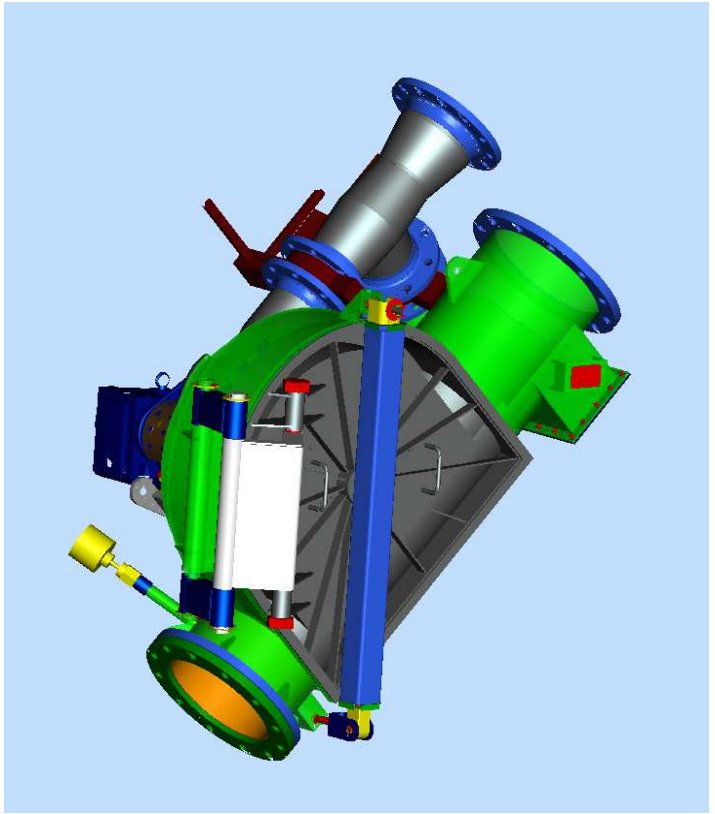


Firing system for wet, low heating value fuels

- ✓ 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



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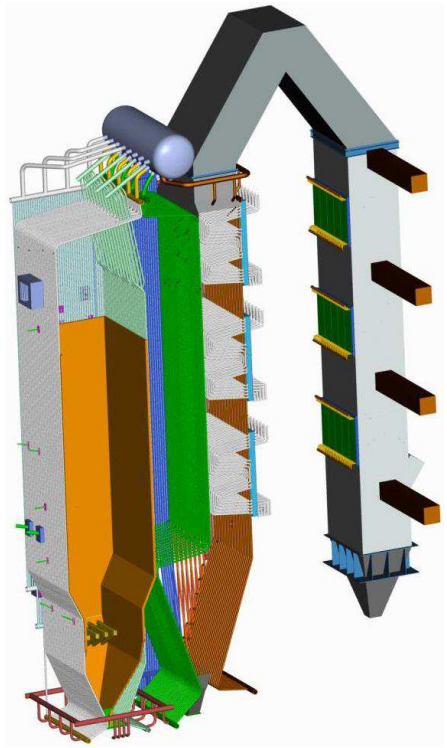
Advantages - Stationary Fluidised Bed with Staged Combustion

Process Advantages

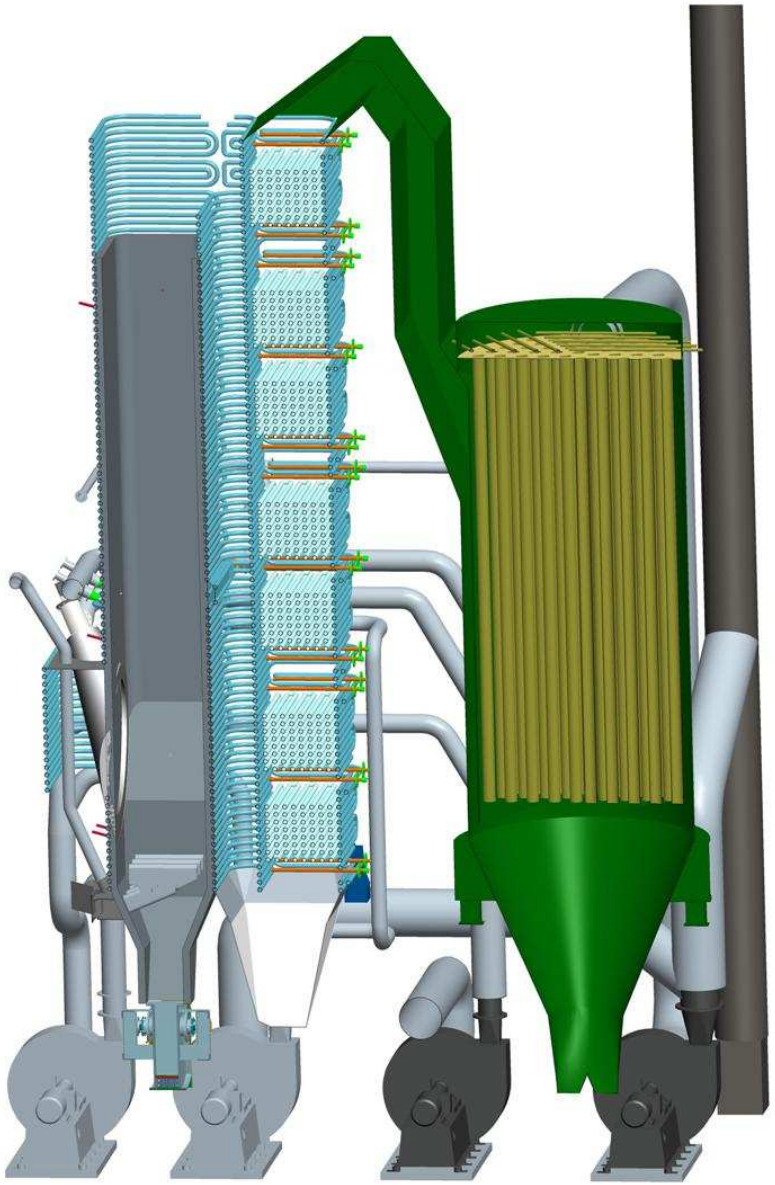
- ✓ Small amount of unburned components in residues and flue gas
- ✓ Low NOx production
- ✓ Wide range for calorific value and water content
- ✓ Wide range for superheating power due to low combustion temperature and high recirculation gas flow



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



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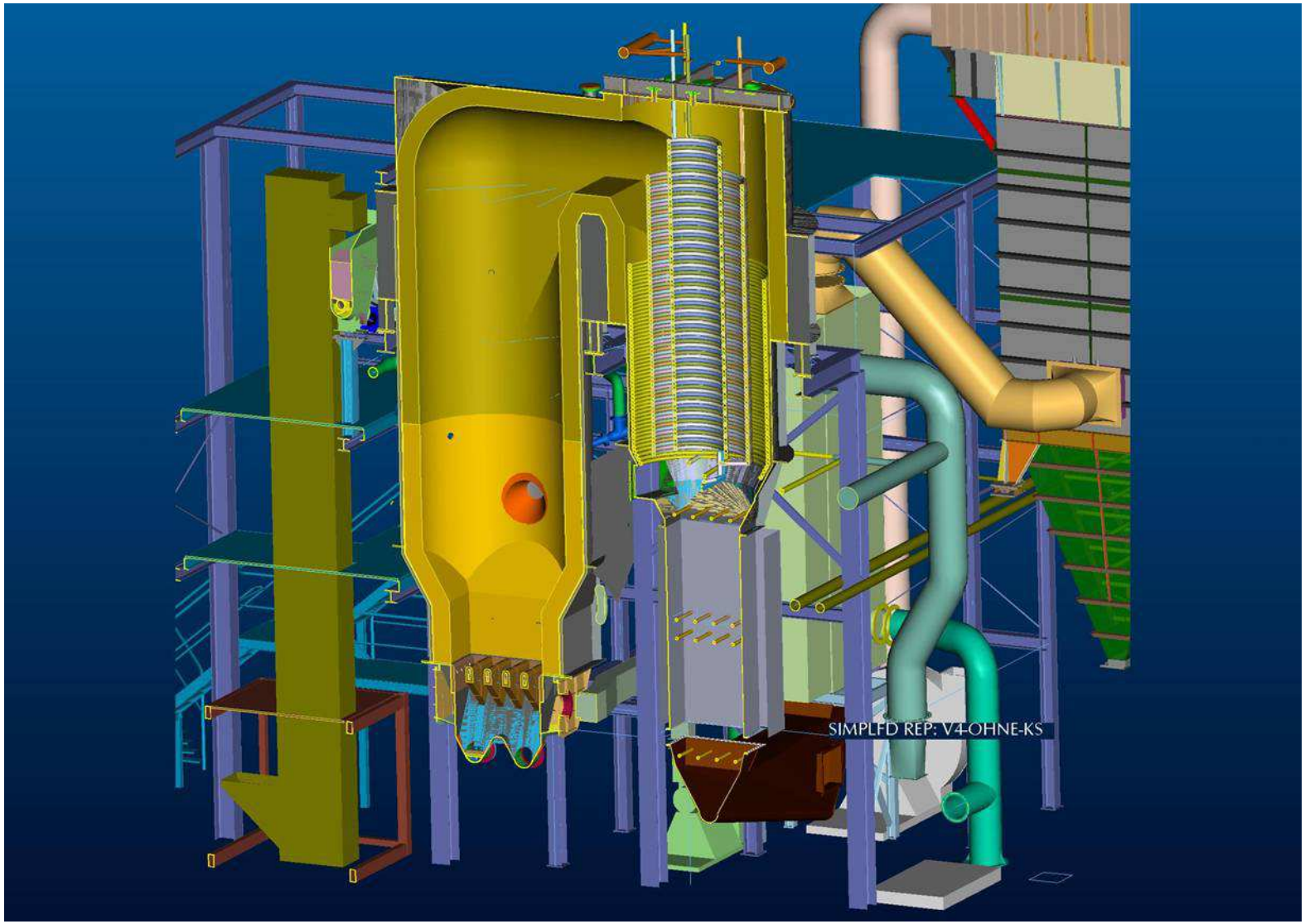
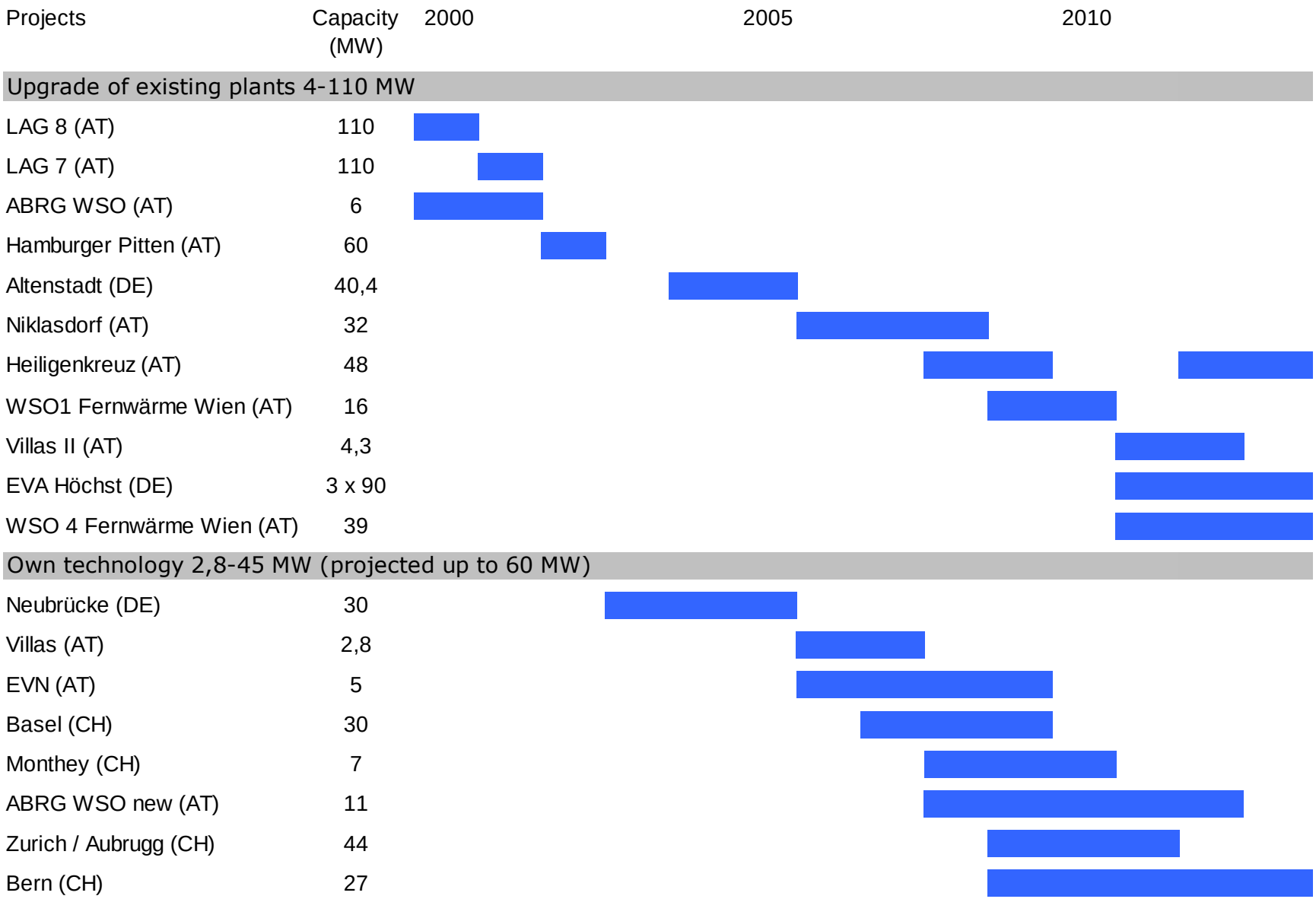
Adiabatic combustion chamber with heat recovery boiler (small scale unit)



References - Fluidised Bed Combustion



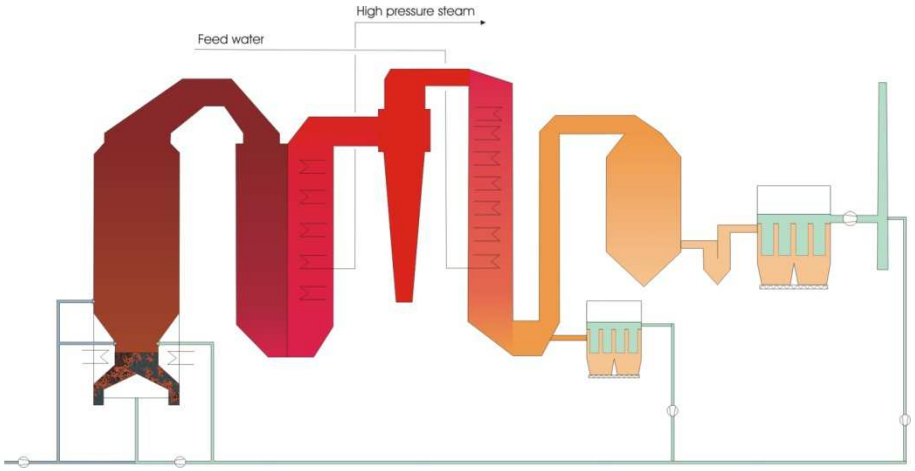
Fluidised Bed Incineration Plant Höchst for RDF (Germany 2011-2013)

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

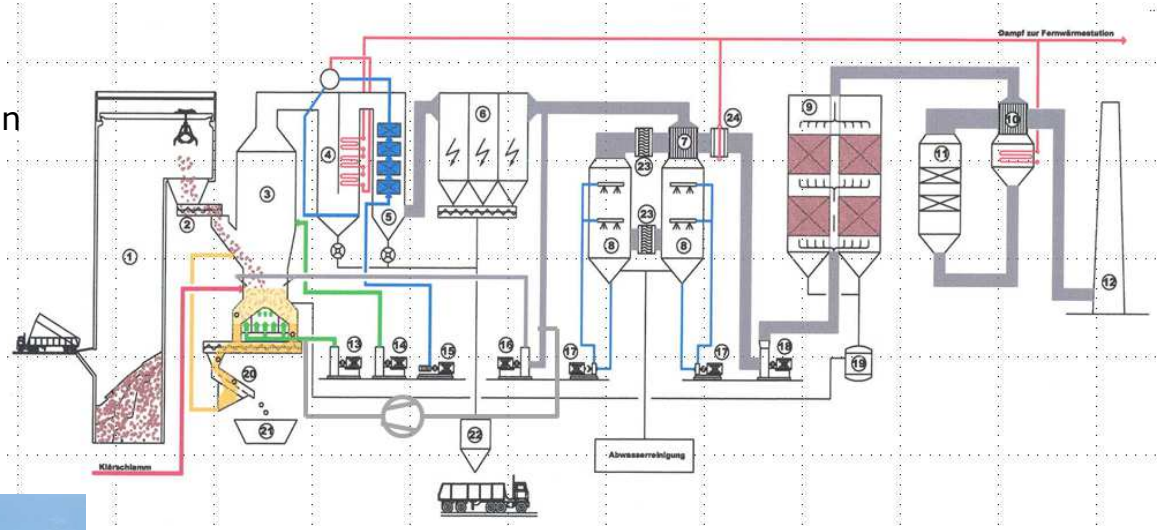
Redesign of Fluidised Bed Incineration Concept WSO4 / Fernwärme Wien GmbH (Austria 2012-2013)

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

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Capacity Increase of Fluidised Bed Incinerator Villas Energie GmbH (Austria 2011-2012)

Stationary Fluidised Bed Combustion for:

- ✓ Production wastes
- ✓ Sewage sludge
- ✓ Treated waste fuels

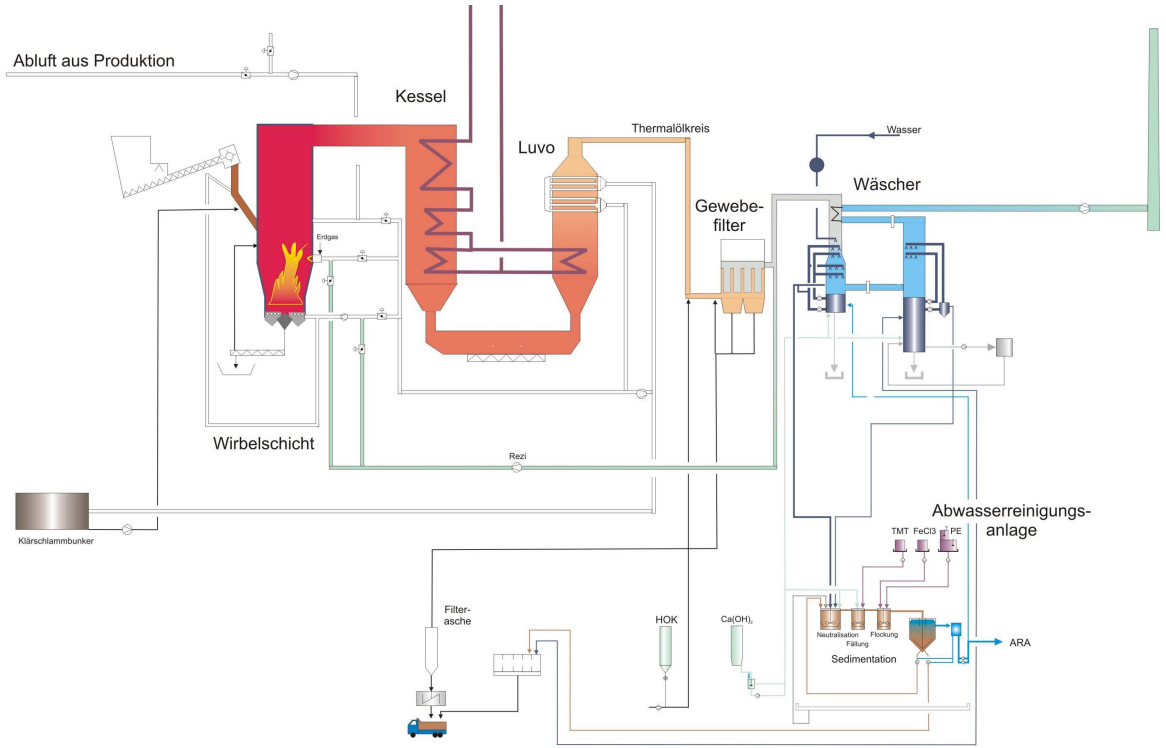
The **produced energy** is used to:

- ✓ 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

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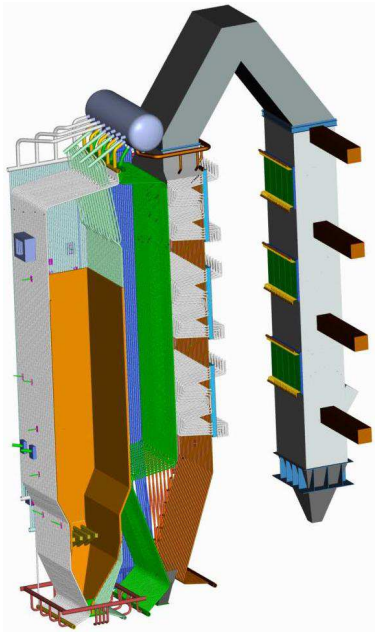
Fluidised Bed Incinerator ABRG Arnoldstein (Austria 2008-2011)

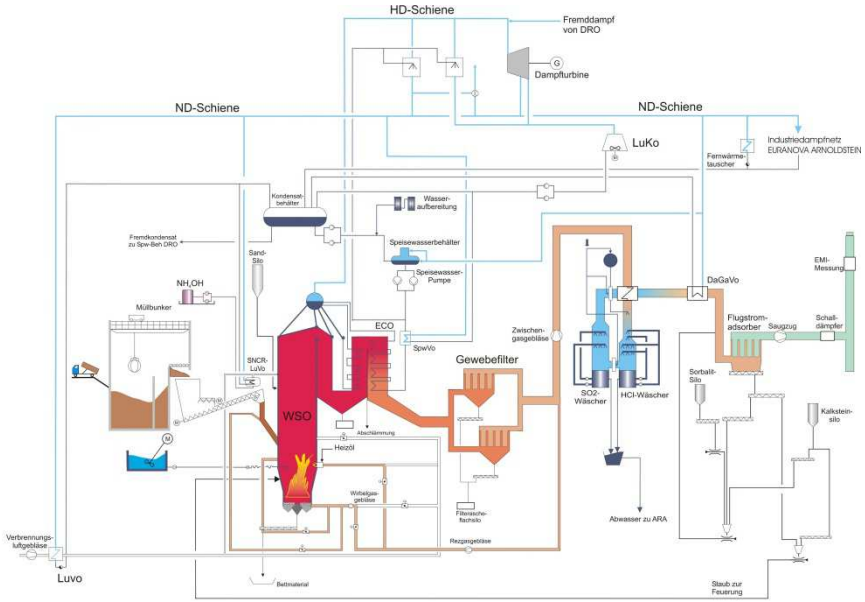
Project Description:

- ✓ 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

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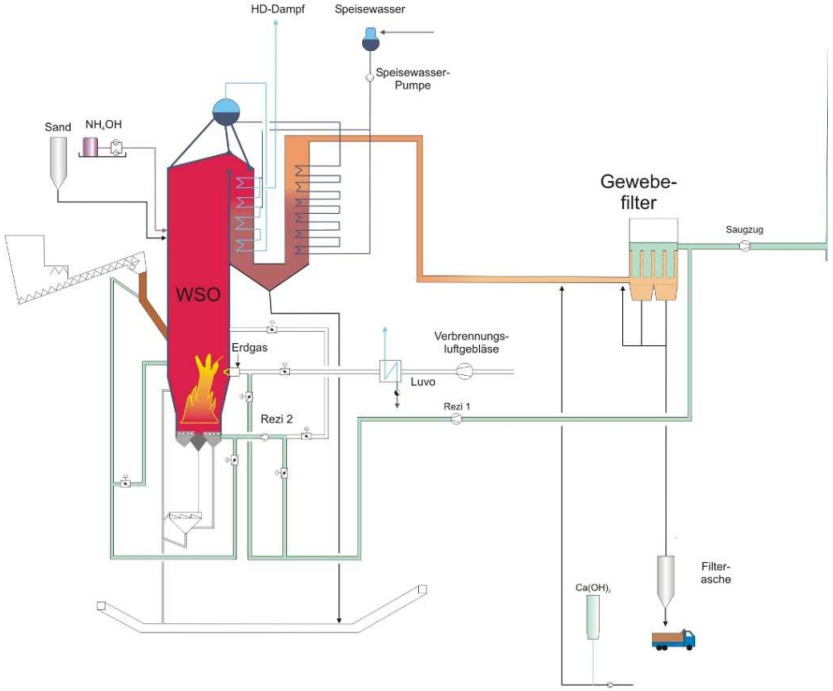
Biomass Power Plant Zurich / Aubrugg (Switzerland 2009 - 2010)

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

TBU Stubenvoll GmbH

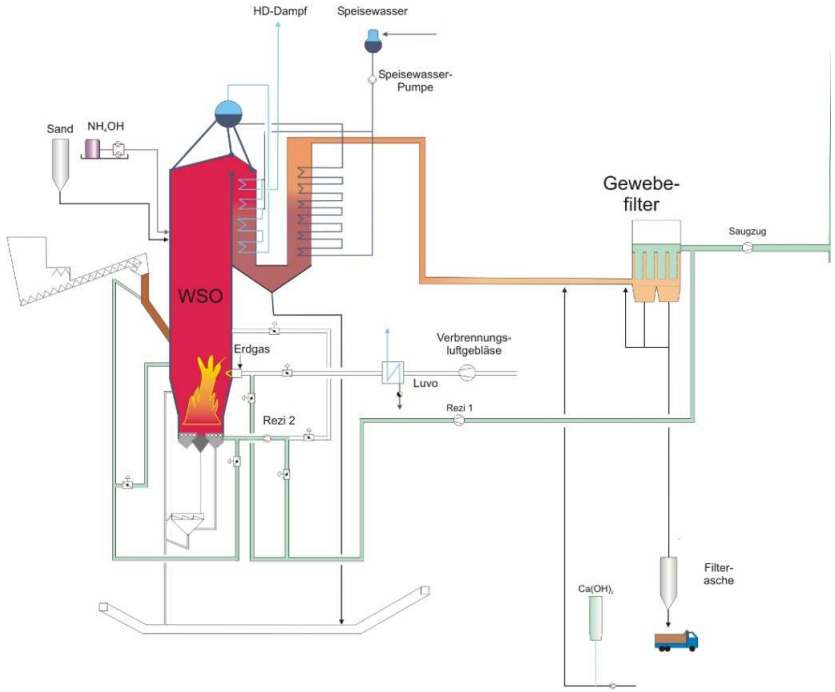
Biomass Power Plant Bern (Switzerland 2009 - 2013)

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

Biomass Power Plant Heiligenkreuz (Austria2008-2009)

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 %

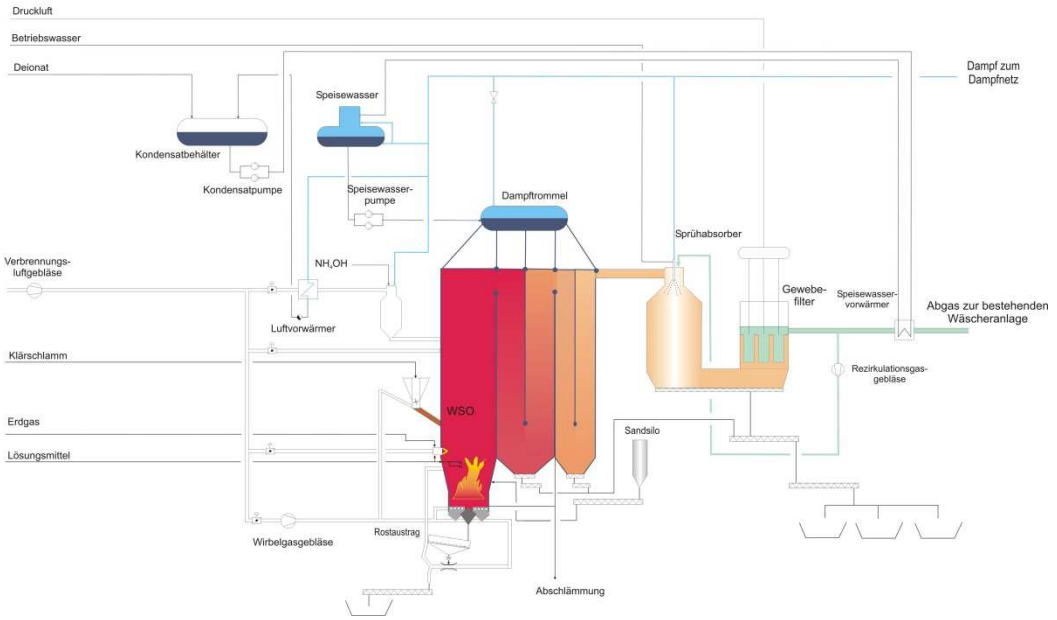
Waste Fluidised Bed Incineration Plant McSTEP (Switzerland/Monthey 2007-2010)

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

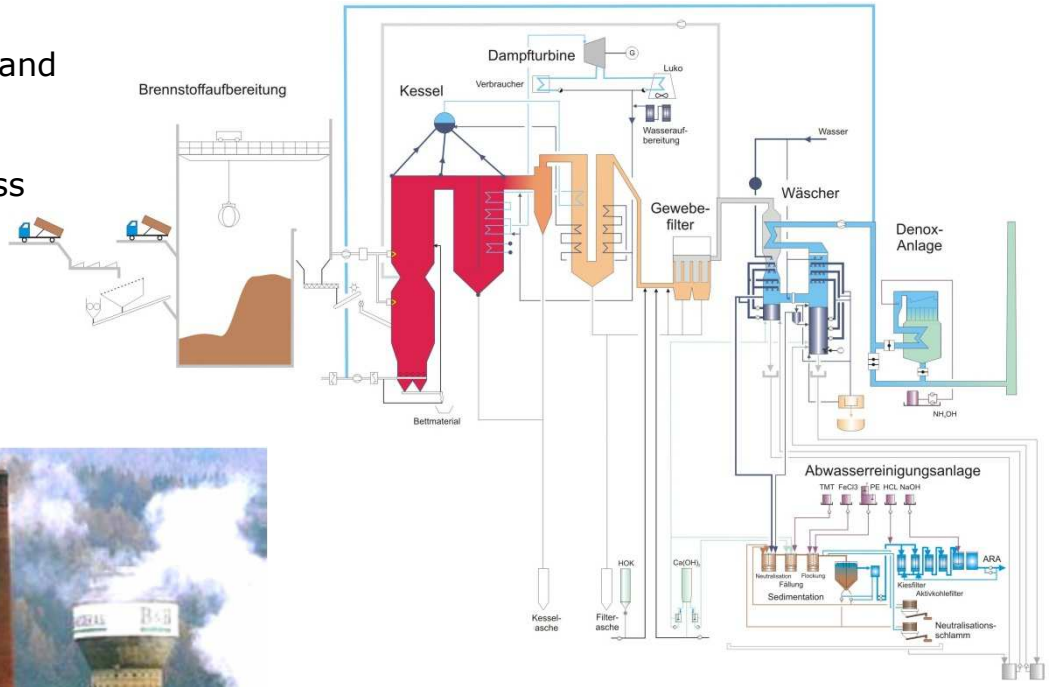
Fluidised Bed Incinerator Niklasdorf (Austria 2006-2008)

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

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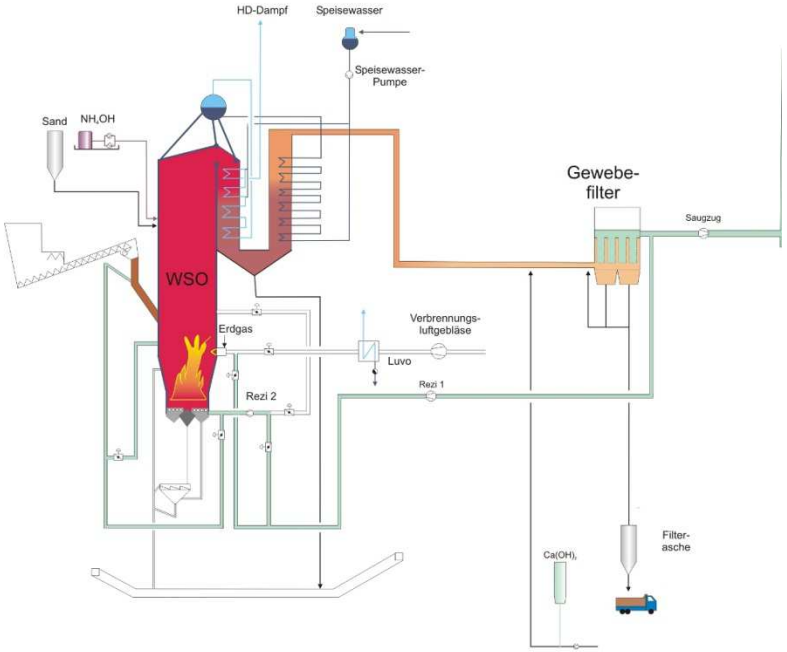
IWB Biomass Power Plant Basel (Switzerland 2006 - 2008)

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:

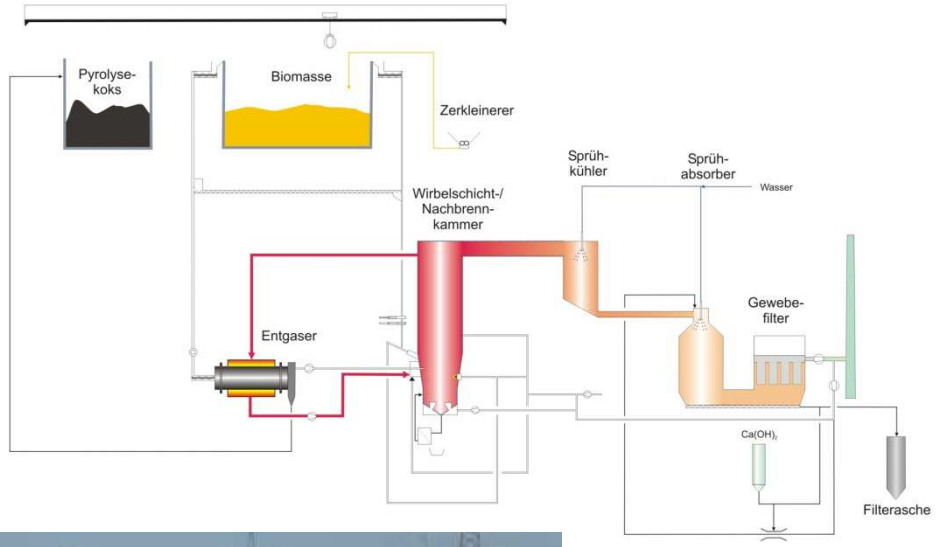
- ✓ Storage of biomass
- ✓ Boiler with integrated fluidised bed incineration
- ✓ Dry flue gas cleaning plant
- ✓ Existing water steam cycle with turbine

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

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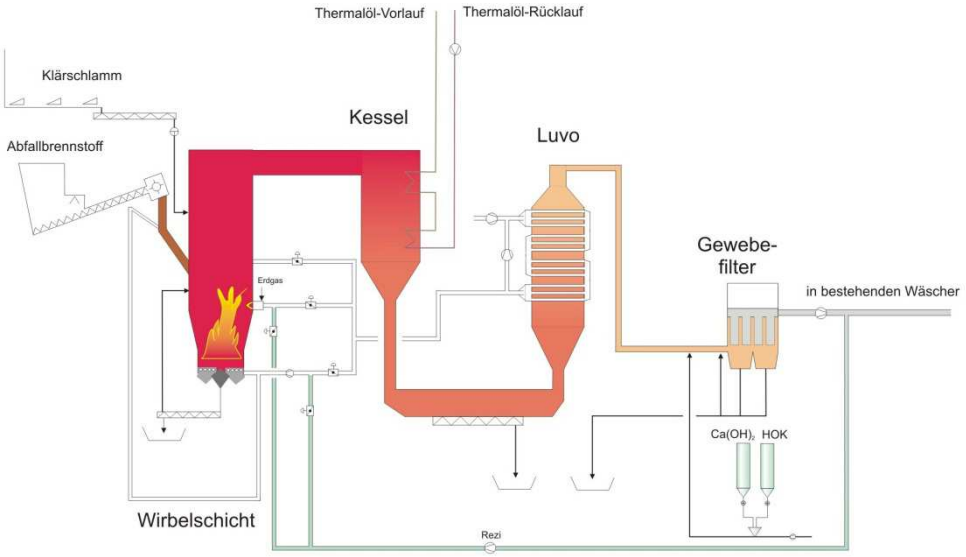
1st Fluidised Bed Incineration Plant VILLAS Austria GmbH (Austria 2005-2006)

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

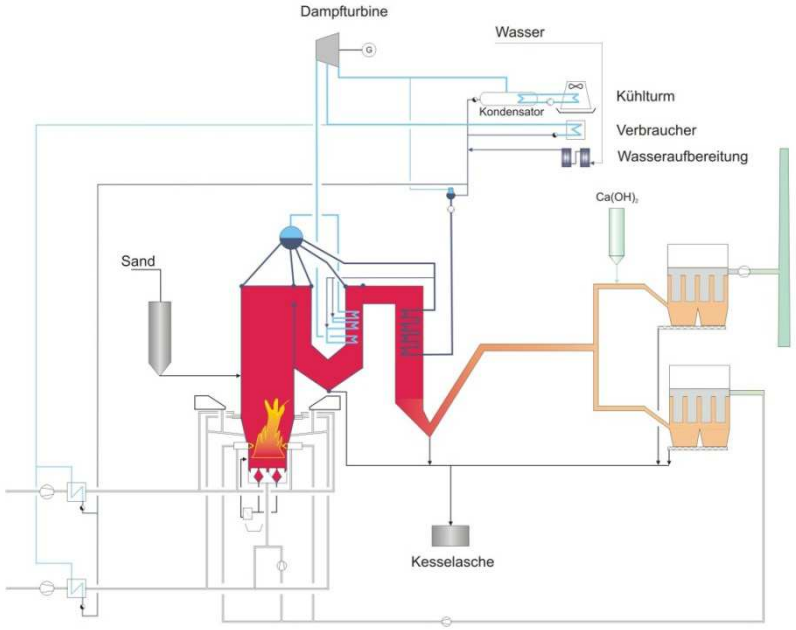
Waste Wood Fluidised Bed Incineration Plant ALTENSTADT-SCHONGAU (Germany 2004-2005)

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

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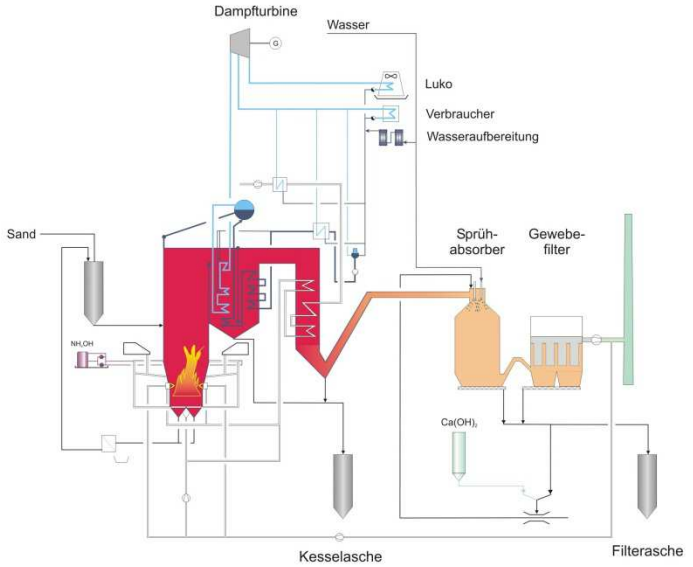
Waste Wood Fluidised Bed Incineration Plant OIE Neubrücke (Germany 2002/03)

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

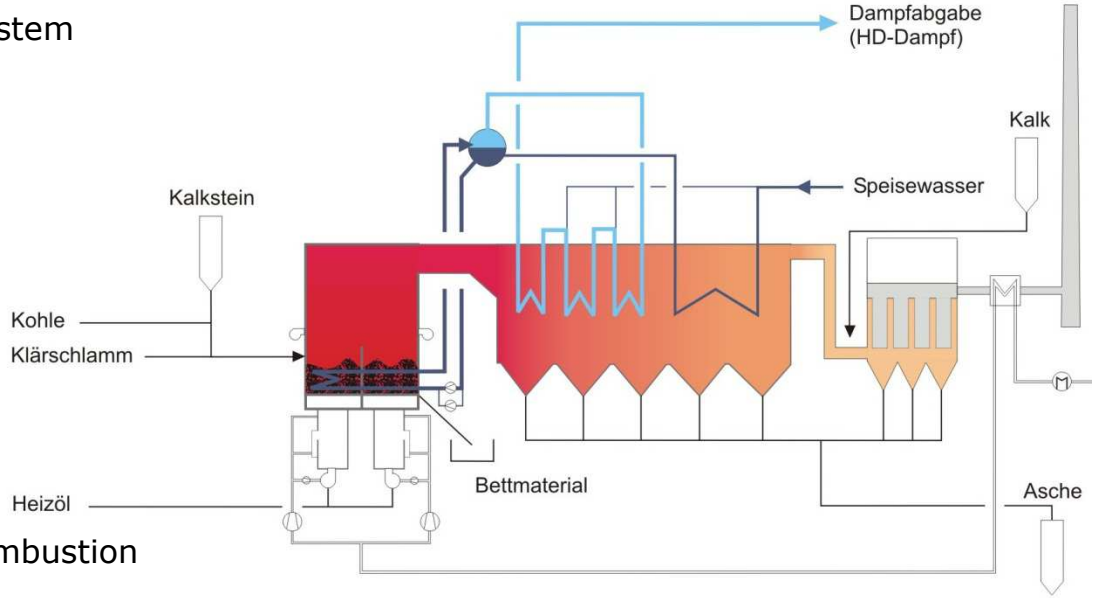
Fluidised Bed Incineration Plant HAMBURGER PITTEN (Austria 2001)

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

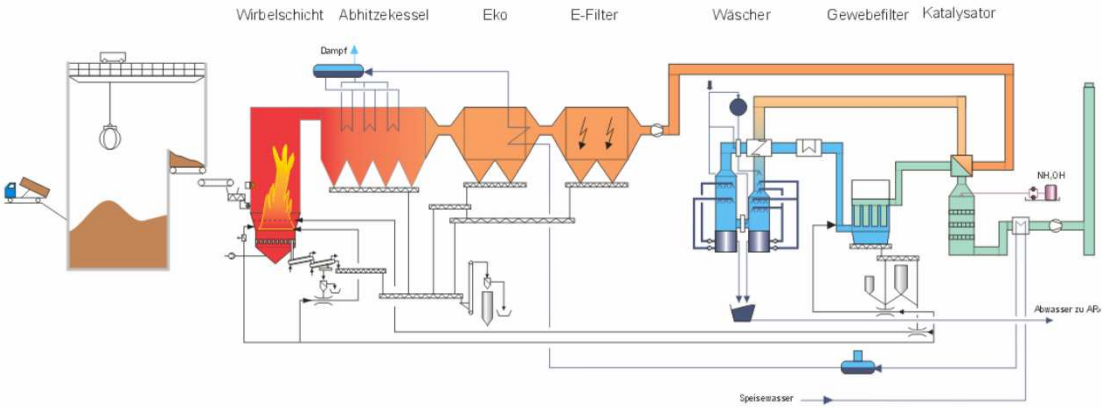
Waste Fluidised Bed Incineration Plant ABRG Arnoldstein (Austria 2000-2001)

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

TBU: approval procedure, basic engineering, detail engineering, supervision of production and assembly, start-up

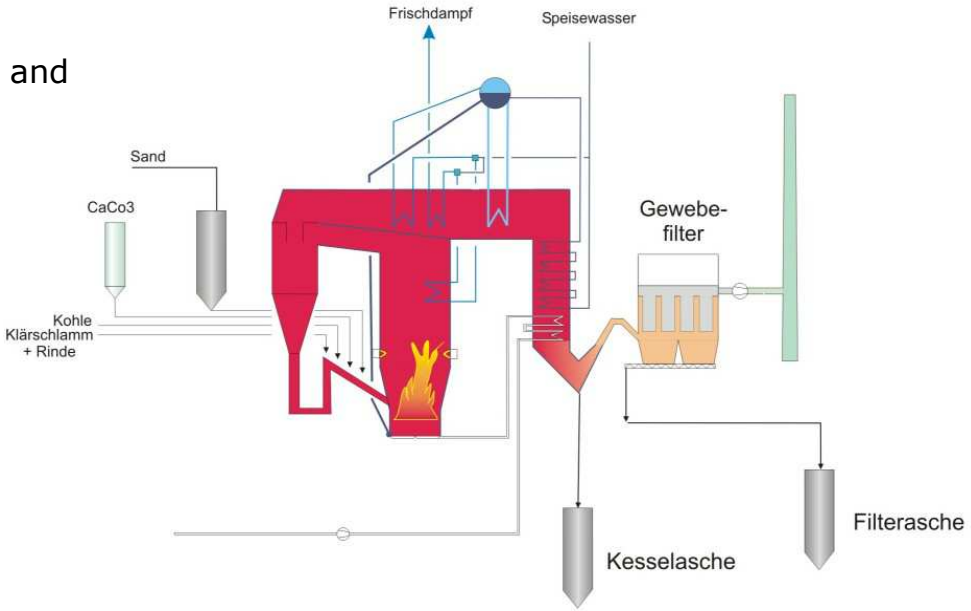
Waste Fluidised Bed Boiler 1K7 Lenzing AG (Austria 2000)

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

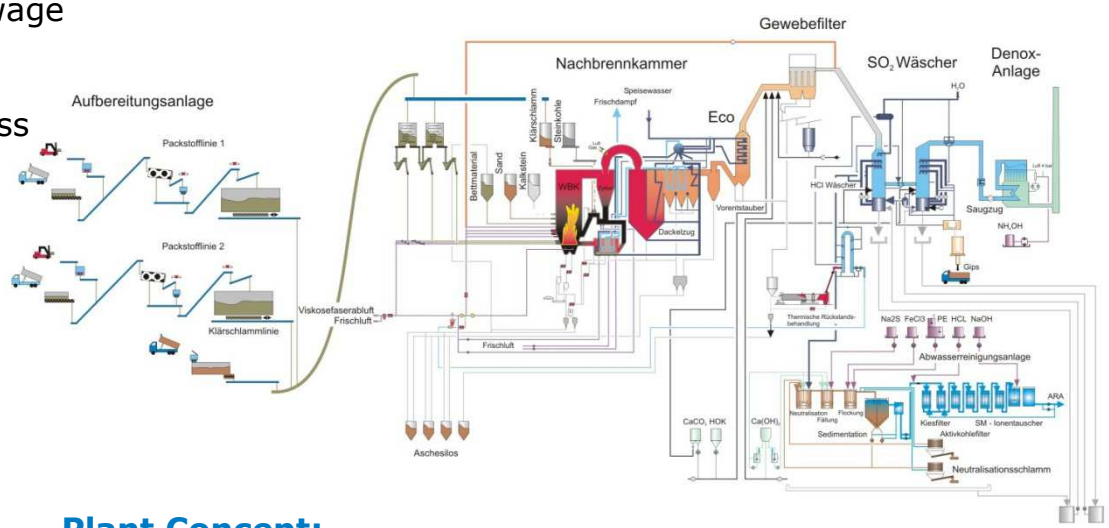
Circulating Fluidised Bed Incineration Lenzing (Austria 1993-2002)

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

Experiences with Different Technologies in Different Countries

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:

Dürnrohr(Austria)

Marsa (Malta)

Frankfurt (Germany)

Zürich / Aubrugg (Switzerland)

- Austria
- Australia
- China
- Croatia
- Czech Republic
- France
- Germany
- Great Britain
- Greece
- Hungary

- Italy
- Korea
- Malta
- Netherlands
- Russia
- Switzerland
- Slovakia
- South Africa
- Taiwan

Kaucuk Kralupy (Czech Republic)

Neubrücke (Germany)

Moscow (Russia)

Lenzing (Austria)

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