DIEFFENBACHER
MOVE FORWARD. TOGETHER.

Advanced combustion technology
for power and heat generation

MORE EFFICIENT ENERGY GENERATION

Securing a reliable energy supply is increasingly important for economic success. With DIEFFENBACHER as your partner, you can implement advanced power plant systems for efficient electricity and heat generation. The result is a plant tailored to your specific needs that can meet your energy requirements with various energy sources and fuels.

How can we take your production and regional energy supply further?

CONTENT

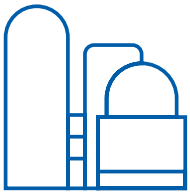
1. MOVING TOGETHER TOWARD EFFICIENT AND SUSTAINABLE ENERGY SOLUTIONS

Achieve the next level of sustainable energy generation with DIEFFENBACHER at your side

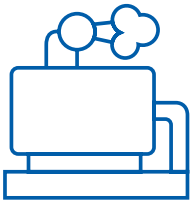
- Customized concept development derived from comprehensive technological know-how
- Compliance with emission limits with low consumption of operating resources
- High flexibility due to high load-change speeds during plant operation
- Water-steam cycle optimized for maximum efficiency
- High fuel-choice flexibility
- High system availability

Our employees' expertise is based on delivering more than:

110
power plants



2,700
process equipment components



90
heat recovery systems

* Data as of 01/2023

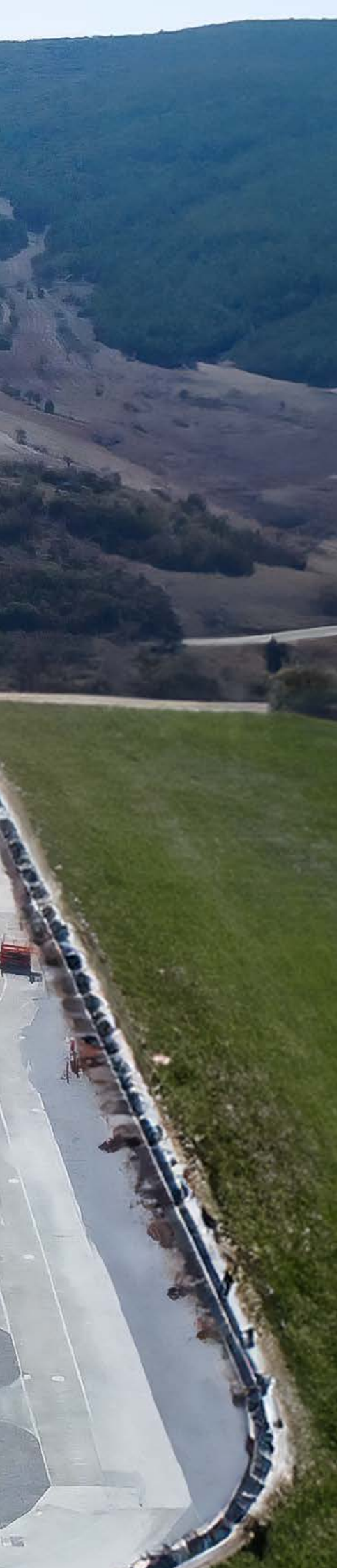
EXPERTISE AND TECHNOLOGIES FOR YOUR ENERGY GENERATION

Tap our years of experience and record of effective implementations of power plants, process equipment and heat recovery solutions to become more profitable. Our experts use their comprehensive engineering and manufacturing skills to successfully implement your energy project.

To help you achieve your goals, we support you with:

- Project development by technical experts, taking into account normative and legal requirements
- Plant design and engineering according to your specific requirements and site specifications
- Project and procurement management for smooth processes in compliance with the highest quality, safety and environmental protection standards
- Commissioning, including electrical grid connection and electrical switchgear integration
- Comprehensive lifecycle management

Minimal emissions and optimum efficiency: Realize your energy solution with us using advanced bubbling fluidized bed and reciprocating grate technologies.



2. BUBBLING FLUIDIZED BED

Bubbling fluidized bed combustion system is the right choice for

- Fuel particle sizes up to P100[1]
  - Biogenic residues
  - Waste fuels
- Co-firing of fine-grained fuels such as sawdust. These can be blown directly into the fluidized bed without a special dust burner.
- Wet or moist fuel (up to 60% water content)
- Very low calorific values (down to 4 MJ/kg)
- If a large calorific value range needs to be covered

[1]According to DIN EN ISO 17225-1

Fuel suitable for bubbling fluidized bed combustion

Biogenic residues
such as wood, waste wood (A1-A4), sawdust, chicken manure, etc.

Agricultural waste
such as olive pomace, shells, kernels, etc.

Waste fuels
such as rejects, fiber sludge, sewage sludge, RDF (Refuse Derived Fuel), etc.

Lignin

DECISIVE ADVANTAGES OF AN ADVANCED BUBBLING FLUIDIZED BED BOILER SYSTEM

Achieve **greater flexibility** in fuels (calorific value band) derived from renewable raw materials while reducing CO_2 emissions. You can generate electricity and heat from biogenic residual and waste fuels, for example. This reduces your disposal and transportation costs, as the residual materials from your production processes are incinerated directly on site and converted into steam and electricity.

Our bubbling fluidized bed boiler systems contain a boiler-integrated bubbling fluidized bed with an open nozzle grid. The bubbling fluidized bed is fluidized with a mixture of combustion air and recirculated flue gas. The fuel in the bubbling fluidized bed is converted sub-stoichiometrically. This allows the bed temperature to be precisely set and controlled regardless of the calorific value and load. This mode of operation significantly reduces nitrogen oxide emissions. Introducing the secondary air above the bubbling fluidized bed achieves complete combustion with low excess air for maximum efficiency. Our delivery spectrum ranges from individual power plant components to complete power plant solutions. We're your **reliable partner**, providing support from the initial planning stage through to the handover.

Due to our bubbling fluidized bed technology, you benefit from a high degree of flexibility in your fuel choice. Burning challenging fuels such as lignin and chicken manure with a **high level of efficiency** becomes possible. Read about our successful projects in the Fluidized Bed Firing Success Stories section.

Operate your DIEFFENBACHER Energy power plant efficiently, even with rapid consumer load changes. That's because our advanced firing capacity control quickly follows the load specification. Fast load-change capability is particularly important in heat-led processes. Load changes of ±5 load %/min are the standard for our power plants. We have successfully implemented ±10 load %/min for particularly high requirements in the 50-90% load range.

Operate your entire system more **efficiently** by reducing flue-gas losses: Due to the good mass and heat transfer in the bubbling fluidized bed, the excess air can be kept very low (4% O2 humid) with low emissions at the same time.

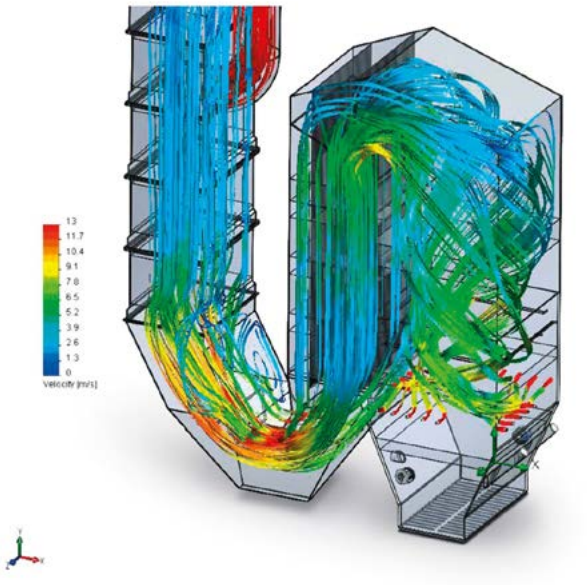
Due to the heat stored in the bubbling fluidized bed, even **very wet fuels** such as fibrous and biological sludge can be burned. This extends the calorific value range down to 4 MJ/kg. Higher calorific fuels can also be burned in the same bubbling fluidized bed. Thanks to a controlled mixture of combustion air and recirculation gas, the fluidization and combustion conditions are automatically adapted to the respective fuel by the combustion capacity control during operation. This ensures optimal combustion conditions. Fuel flexibility with a bubbling fluidized bed combustion system ideally prepares you to accommodate future fuel changes due to fuel availability or market price fluctuations.

High availability, lower maintenance costs:

Your power plant with a bubbling fluidized bed furnace produces less wear in the combustion chamber, as there are no moving parts in the combustion system.

Reduce investment costs:

The fluidized bed has lower NOx emissions than a grate firing system due to the optimal combustion conditions. This reduces the costs for additives (urea, ammonia), and simpler, cheaper denitrification technologies can be used.

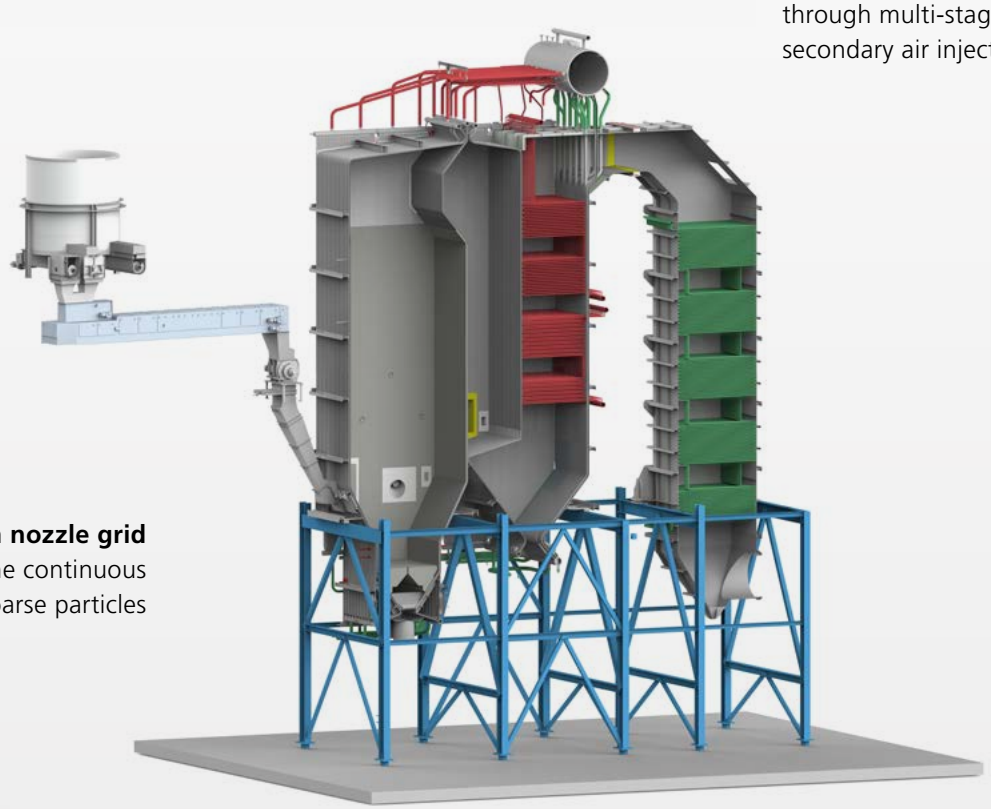


Using the latest fluid dynamic simulations, our experts achieve an optimal introduction of combustion air into the combustion chamber, complete combustion with low emissions and reliable achievement of the 2s residence time temperature >850°C required for waste.

BUBBLING FLUIDIZED BED INTEGRATED IN BOILER

Mixture of air and recirculation gas
for optimum fluidization conditions
over the entire load range

Staged combustion
through multi-stage
secondary air injection



Open nozzle grid
allows the continuous
removal of coarse particles

Continuous bed material removal
and bed material preparation to
remove coarse particles

ADVANTAGES OF BUBBLING FLUIDIZED BED COMBUSTION

Lower emissions,
especially NOx and CO

Longer cleaning intervals
(sootblower intervals) and, therefore, lower sootblower steam consumption

Large fuel calorific value band

Co-combustion of fine-grained fuels
(e.g., grinding dust, sawdust, sawdust) without additional dust burner

High availability and reliability

Co-combustion of wet fuels
(calorific value of the mixture >4 MJ/kg)

Higher load change speed
compared to grate-firing systems

Lower maintenance costs
as there are no moving parts in the combustion chamber

Higher firing efficiency
due to lower excess air

Highly efficient combustion of demanding fuels
such as lignin and chicken manure

3. SUCCESS STORIES: BUBBLING FLUIDIZED BED

A&U Wielsbeke
Belgium

Power plant details and performance parameters

Fuels: Waste wood A1-A4, wood dust (up to 50%), railroad ties (up to 5%)
Fuel heat output: 90.35 MW
Live steam parameters: 75 bar(a) / 463°C / 100 t/h
Electrical output of steam turbine: 20 MW
Heat output thermal oil: 10 MW
Secondary steam thermal output: 22 MW
NOx emission: 80 mg/Nm^3 @ 11%O2,dry yearly avarage value with SNCR (without SCR (catalytic converter)) at 13 mg/Nm^3 @ 11%O2,dry hourly average NH3 slip

Challenges:

- Complete power plant with complex steam interconnections for the provision of secondary steam and thermal oil with maximum efficiency and simultaneous electricity production
- Very low NOx emissions only with SNCR denitrification

Solution:

- Bubbling fluidized bed combustion with low NOx emission values with complex water-steam cycle. Steam extraction directly from the boiler for thermal oil generation, bleed steam from the steam turbine for secondary steam generation
- Very high system availability of >99%

99.5 MW bubbling fluidized bed boiler Turkey

Power plant details and performance parameters

Fuels: Chicken manure
Fuel thermal output: 99.5 MW
Live steam parameters: 72 bar(a) / 473°C / 127 t/h
Electrical output of steam turbine: 34 MW

Challenges:

- Chicken manure is a demanding fuel: Due to the high alkali and ash content, this fuel leads to very heavy fouling of the boiler heating surfaces, which must be taken into account in the boiler design
- Very large plant: 99.5 MW fuel heat output and high installation altitude at 785 m above sea level
- High earthquake load

Solutions:

- Bubbling fluidized bed boiler with an efficient water-steam cycle for maximum electrical efficiency
- Tube cleaning system for the first and second boiler passes, sootblowers for the superheater heating surfaces in the third pass and a shot cleaning system for the economizer heating surfaces
- Large-dimensioned ash discharge and transport systems

4. RECIPROCATING GRATE

Reciprocating grate firing is the right choice for

- Fuel particle sizes up to P200[2]
  - Untreated biomass
  - Waste wood
- For fuels of different sizes, for almost complete combustion
- Moist fuel with a moisture content of up to 150% atro (60% wet)

[2]According to DIN EN ISO 17225-1

Fuel suitable for reciprocating grate

Biogenic residues
such as bark, wood and wood waste, W25-W60 (33-150% atro), etc.

Wood dust via dust burner

Prunings from landscape maintenance
Date palm leaves, etc.

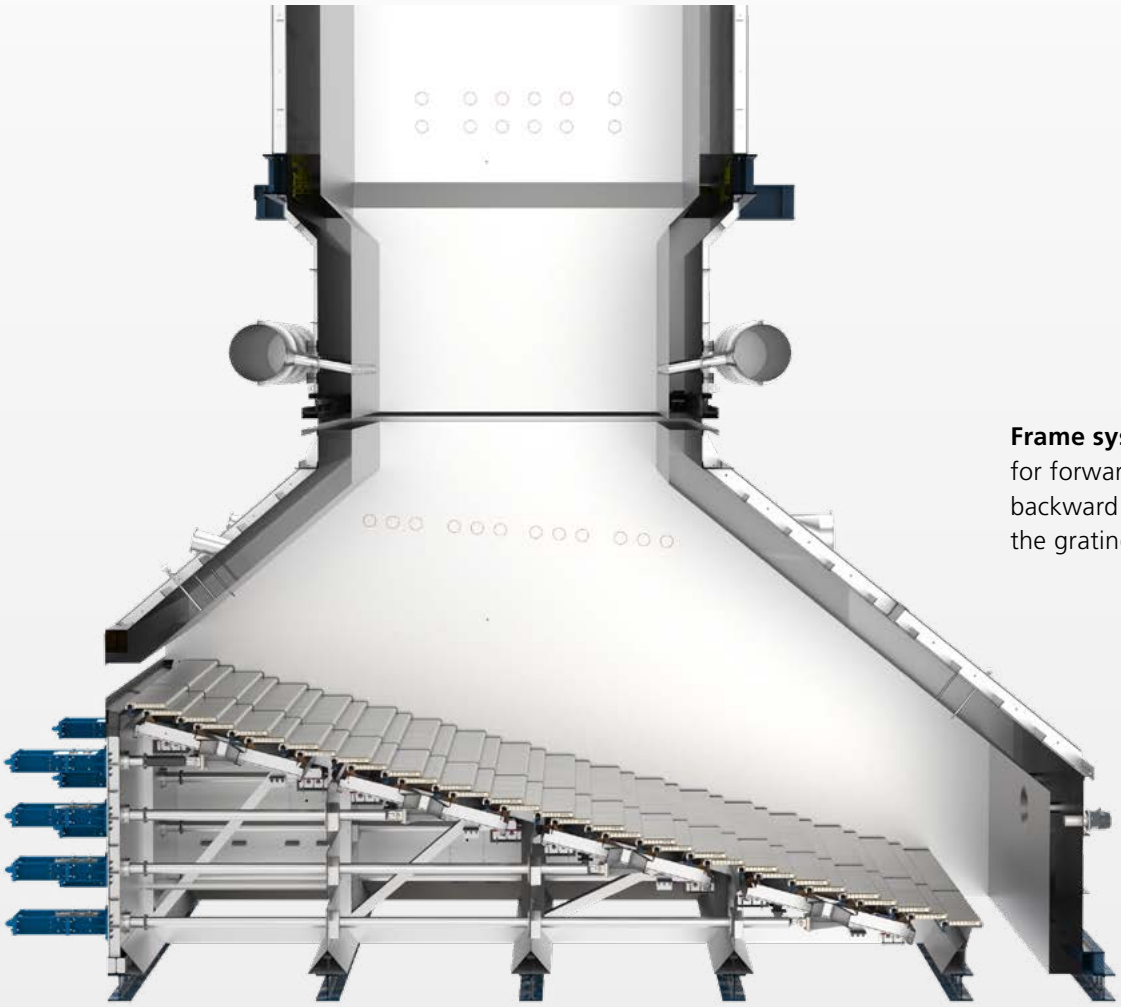
DECISIVE ADVANTAGES OF A RELIABLE RECIPROCATING GRATE

Use the **efficient combustion** process of a reciprocating grate for your energy generation: Individualized control of the grate zones ensures **almost complete fuel combustion**. Our grate systems are air-cooled and burn biogenic residues in one to three lanes, each divided into three to five zones. The primary air and recirculation gas supply and the grate bars' feed rate are controlled individually for each zone. We design and integrate grate sizes from 16-120 m^2.

Reduce your **CO_2 emissions** and the use of fossil fuels: Generate sustainable electricity and heat from biogenic residues and waste materials and reduce your disposal and transportation costs simultaneously with your own DIEFFENBACHER Energy power plant.

In our grate systems, the reciprocating grate is either integrated into the combustion chamber of the natural circulation boiler or is used in refractory lined combustion chambers of process heat generators—for example, for the wood-based panel industry. As a **reliable partner**, we support you with everything from individual power plant components to complete power plant solutions, from initial planning to handover.

RECIPROCATING GRATE IN REFRACTORY LINED COMBUSTION CHAMBER



Frame system
for forward and backward stroke of the grating bars

Stiffened sheet metal partitions
underneath the grate to divide the zones for individual air supply

Complete grate surface
consisting of fixed and movable, replaceable cast chrome grate bars

ADVANTAGES OF RECIPROCATING GRATE COMBUSTION

Lower pressure loss of the combustion air, leading to lower power consumption

Co-combustion of wet fuels

Dust burners and granulate nozzles compensate for load fluctuations

Suitable for hot, recirculated flue gas under the grate

Large fuel calorific value range within the same plant

Good accessibility for maintenance and inspection

High availability and reliability

Patented design of the grate bars makes it easy to replace individual grate bars

5. SUCCESS STORIES: RECIPROCATING GRATE

Camsan Ordu
Turkey

Power plant details and performance parameters

Process steam via thermal oil
Lined combustion chamber with large thermal oil heater
Firing capacity: 65 MW
Thermal oil output: 39.5 MW

Challenges:

- Regular fluctuations in the fuel posed a challenge when engineering this power plant. The grate had to extract the maximum energy from both very dry and very wet fuel. In addition, there was a high level of contamination with stones.
- Power plant was built in an earthquake-prone region, and the geological conditions had to be considered when planning for earthquake safety.
- Power plant was integrated into an existing facility.

Solutions:

- Three thermal oil trains were connected in series to achieve the high required thermal oil output and simultaneously keep the flue-gas volume flow low.
- Thanks to careful 3D planning, the solution was able to be well integrated into the existing system while complying with all safety requirements.

6. LIFECYCLE MANAGEMENT AND SERVICE

MAXIMUM POWER PLANT AVAILABILITY WITH PARTNERSHIP-BASED LIFETIME SERVICE

To ensure the maximum availability of your power plant, our highly qualified service personnel provide lifecycle support. The entire range of technical services applies to our own and third-party systems:

Consulting
- Mass and energy balances
- Thermal engineering calculations
- Process check
- Flow analyses
- Preliminary planning of revamp projects
- Advice on upcoming inspections and plant shutdowns

Basic support
- Recording and assessing the plant status
- Development of an extended maintenance strategy
- Development of improvement options

Spare and wear parts management
- Ensuring the availability of spare parts
- Plant-specific spare and wear parts

Revamp and modernization
- Replacement or adaptation of existing systems to changed framework conditions
- Simplification of existing system's operations

Optimization
- Projects for operational and plant optimization

Repair
- Root cause analysis and rectification
- Root cause analysis reports
- Restoring functionality

Maintenance and inspection work
- Checking the system for operational safety and functionality
- Systematic identification of potential faults
- Replacement with original spare parts

Remote service
- Advice on application and operating problems
- Telephone fault diagnosis and situation analysis
- System support via remote connection

NOTES

DIEFFENBACHER
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Discover how we can help you reach next-level energy efficiency

DIEFFENBACHER Energy GmbH, based in Bludenz, develops, designs and sells energy plants. As part of the DIEFFENBACHER Group, we offer advanced, energy-efficient and resource-saving solutions. In the energy-transition era, we also contribute to lower emissions and reduce energy costs.

DIEFFENBACHER is an international group of companies in the field of mechanical and plant engineering. With 1,850 employees and 19 production and sales locations worldwide, we are a leading manufacturer of press systems and complete production plants for the wood-based materials, automotive, aviation and recycling industries. We design and build power plants and heat recovery systems for sustainable energy generation. As an independent family business in its fifth generation, we have stood for reliable partnership and continuous progress for over 150 years.

Your contact person
How can we help you move forward? Contact us.

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