



Grab the Next Great Opportunity in Circular Economy

WAI Environmental Solutions AS

November 2019

Company Introduction

Company

- Wai Environmental Solutions AS; Based in Horten, Norway
- Subsidiary in China

Distribution

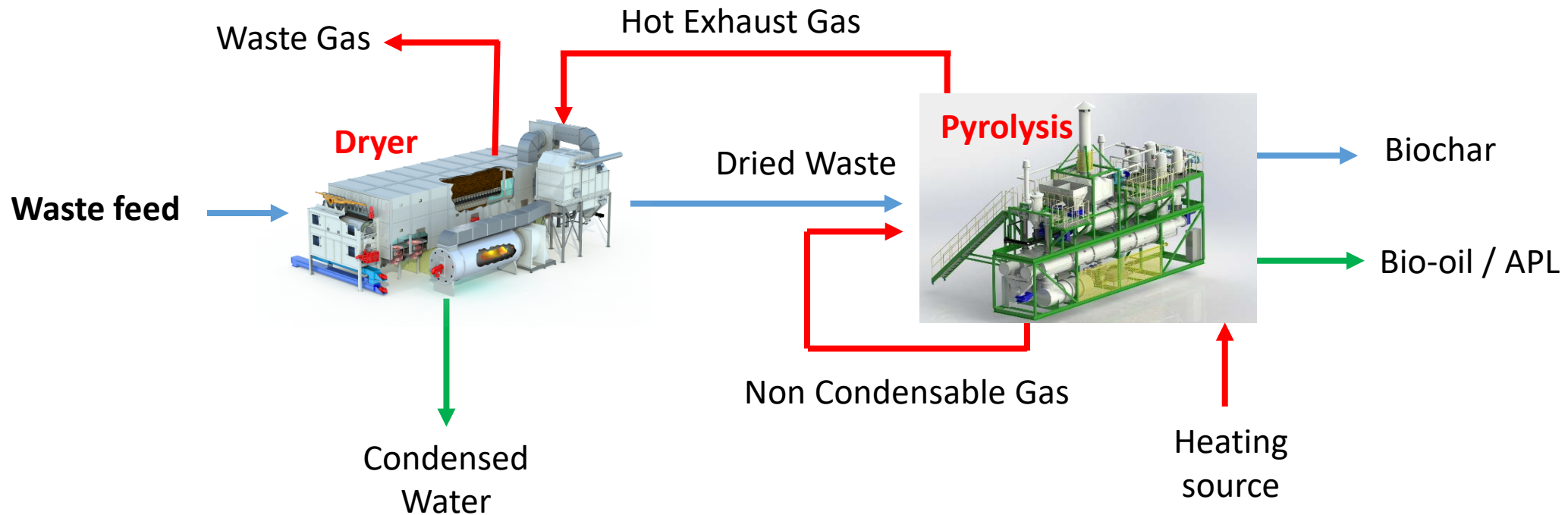
- European markets: Nordic countries
- East Asia: China and Southeast Asia

Business Models

- Technology package provider; Deliver wastewater, biosolids, sludge and soil remediation system solutions
- Turn-key package plants
- Consulting services and training

The WAI solution for the following Industries

- Food Waste Digestate
- Sewage Sludge
- Fish Farming Sludge
- Chemical/Oily Sludge
- Contaminated Soil
- Agriculture Waste



Features of Our Drying + Pyrolysis Approach

01 Resource recovery

Convert biosludge to:

- Biochar – fertilizer or soil conditioner
- Bio-oil and syngas – fuel

02 Volume reduction

- Completely remove water
- >85% volume reduction for dewatered sludge or AD digestate

03 Green outputs

- No dioxins formed
- Heavy metal fixed in biochar
- Removal of antibiotics and microplastics

04 Safety first

- Low temperature belt dryer, no fire or explosion risks
- Absolute anaerobic pyrolysis, no explosion risks
- Complete automated alarm system

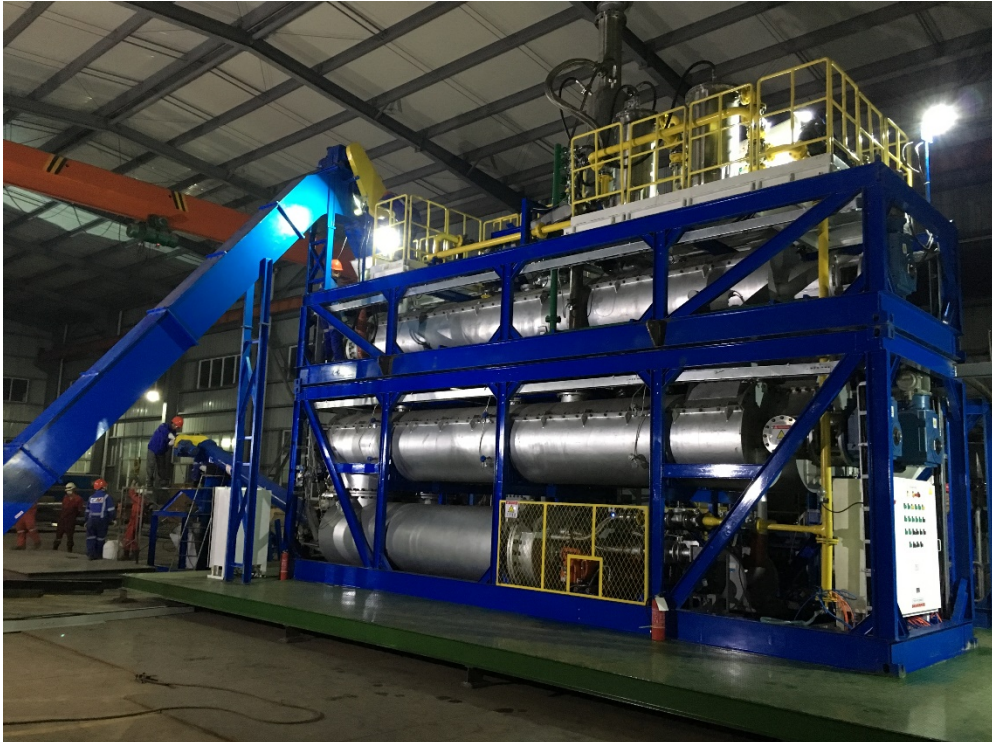
05 Small to large, containerized

- 5-150 ton/d capacity each unit
- Containerized, easy to transport
- Double-decker design for reducing energy and footprint

06 10+ references

- Standardized, modular design
- 10+ references for both technologies
- Stable, good performance

Pyrolysis



Our pyrolysis technology is operated at moderate temperatures (450-650°C), under absolute anaerobic environment, converting organics to syngas (CO , H_2 , CH_4 , CO_2), bio-oil and biochar.

Indirect heating, syngas separate from exhaust gas

Double decker design to reduce energy inputs and footprint

Dual auger self-cleaning system

High efficiency syngas and bio-oil recovery systems

Excellent anti-corrosion material under high temperatures

Containerized design, easy to transport



48 ton/day Pyrolysis Skid for Oily Sludge



144 ton/day Pyrolysis Skid for Soil Treatment

Pyrolysis Installations



2t/h Oily Sludge
Thermal Desorption



1.5t/h Drilling Cuttings
Thermal Desorption



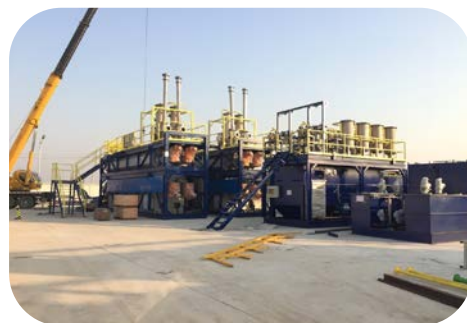
4t/h Oily Soil
Thermal Desorption



1.5t/h Oily Sludge
Thermal Desorption



0.5t/h Oily Sludge



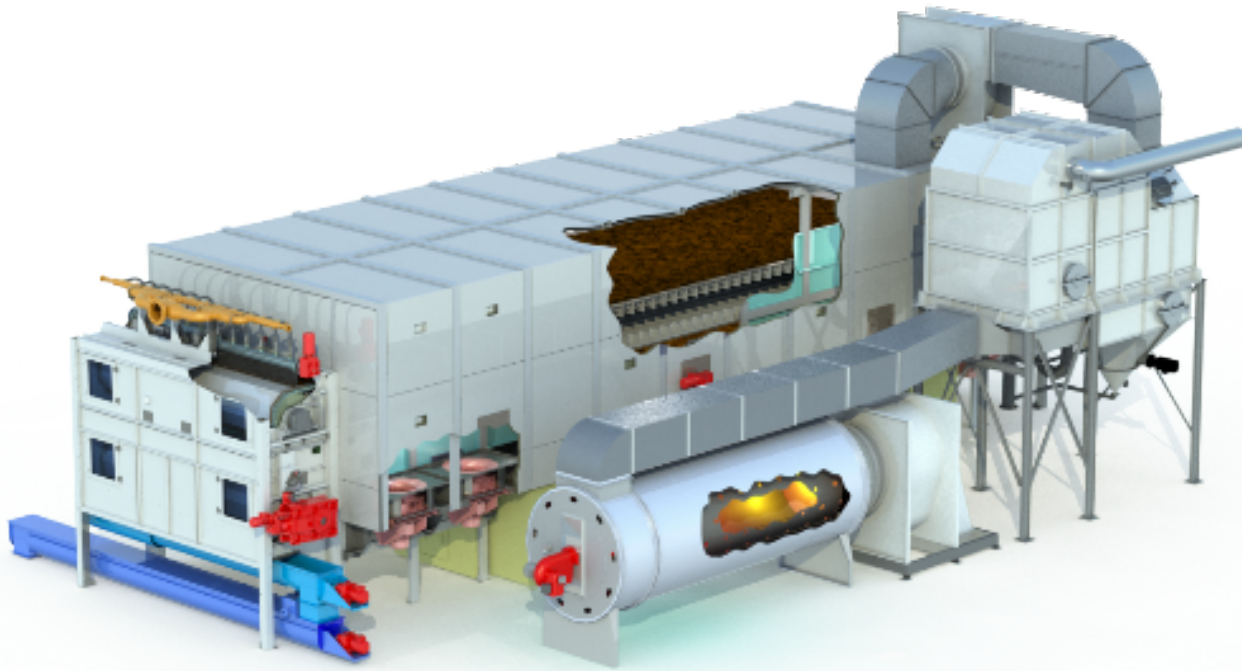
6t/h Double
installation



6t/h Soil Thermal
Desorption



3t/h Dual Plant Thermal
Desorption



Low temperature belt dryer

- Focus on belt drying
- Special feeding device
- References with over 10-year operational history
- Flexible handling capacity
- Very low maintenance costs
- Low energy consumption
- Can use multiple heating sources
- Safe, stable operation
- Continuous process

Why Low Temperature Belt Dryer?

Low energy consumption:
Thermal insulation, efficient
internal heat circulation with
CO2 heat pump

Low maintenance costs: Low
component moving speed,
low maintenance costs

Low gas emissions: High gas
circulation efficiency, little
gas for odour removal

Low COD destruction: Low
drying temperature makes
condensable water COD less
than 200mg/L

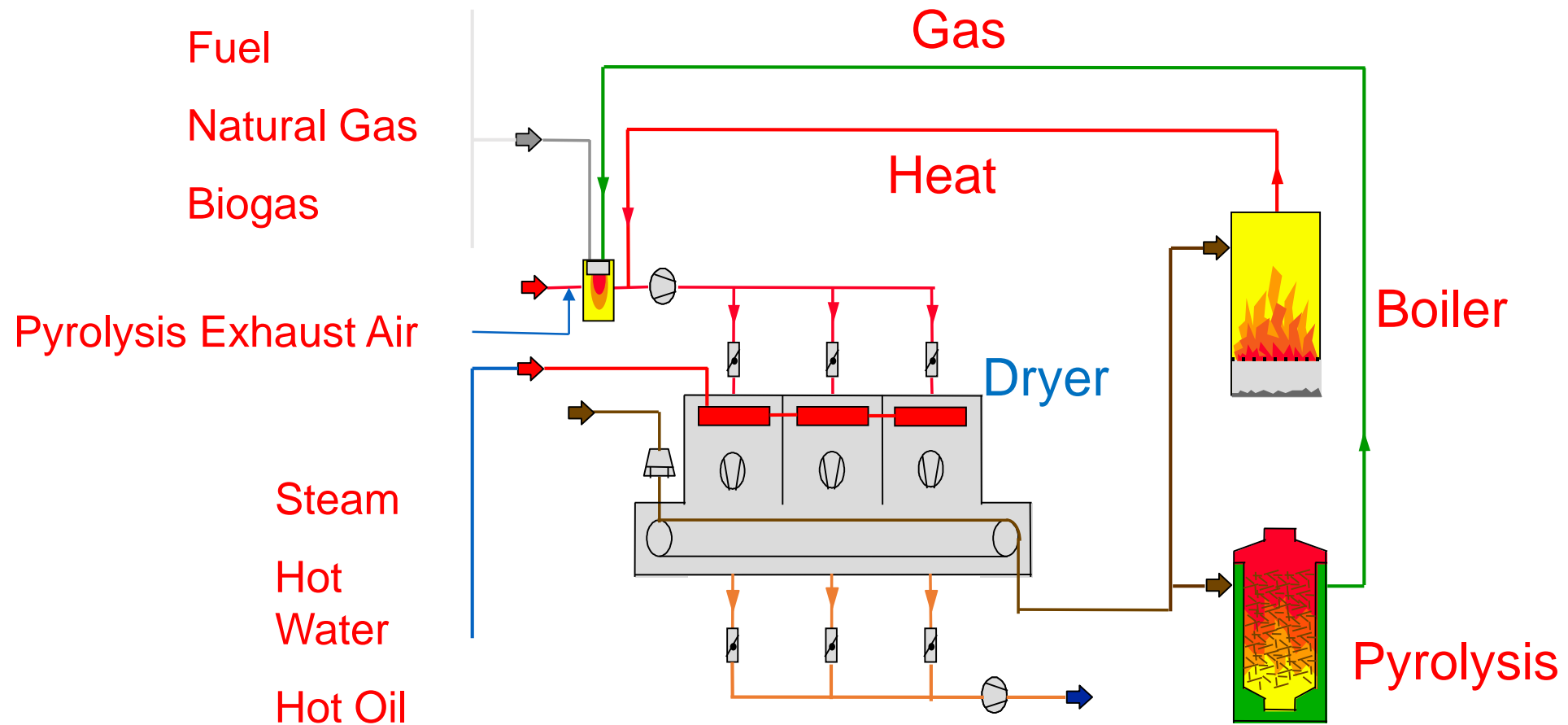
Low dust load: $<5 \text{ mg/Nm}^3$,
no mechanical force on dried
material

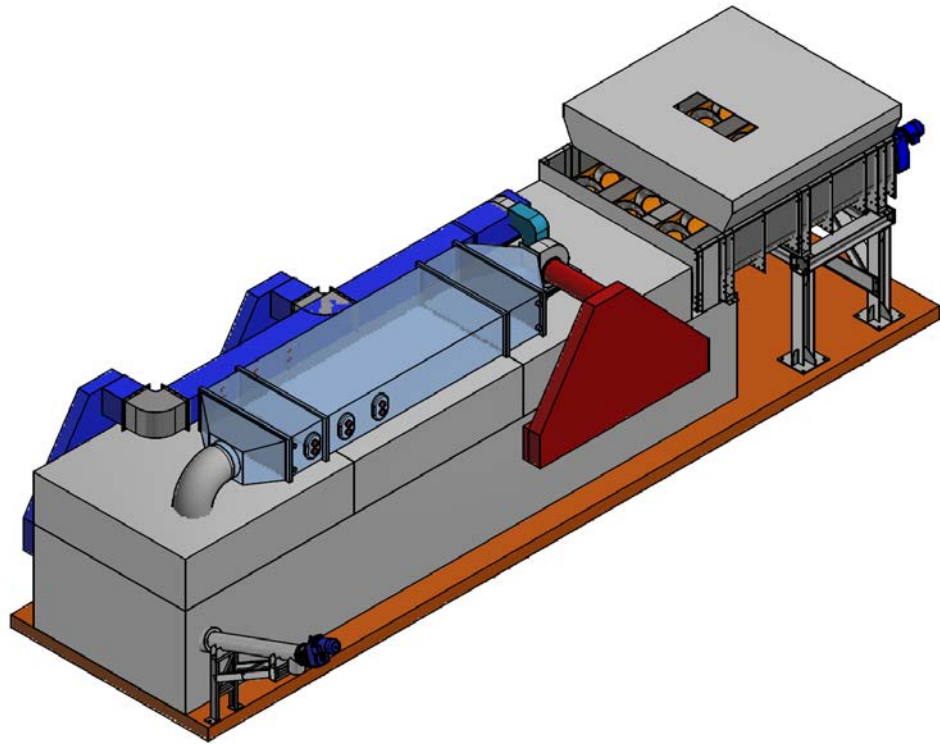
Easy start/stop: From start to
full load within 15 minutes,
complete shutdown within
20 minutes



Extruder

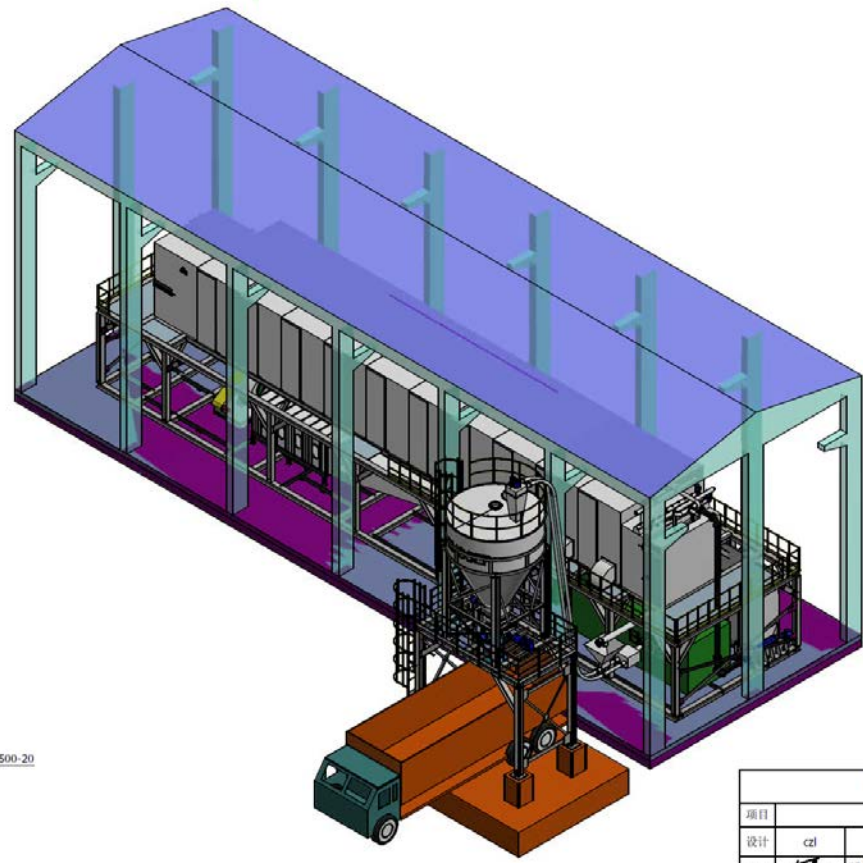
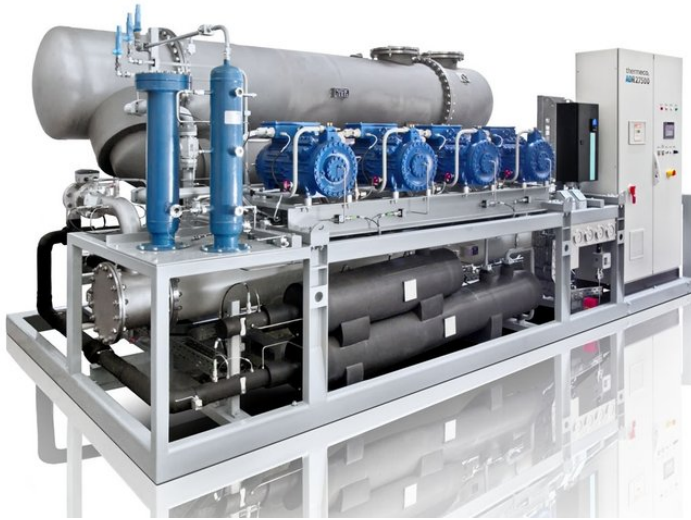
Various Heating Methods





Biomass dryer

CO2 heat pump dryer



- 318 kWh overall consumption per ton water evaporated
- Verified in 2 full-scale installations, 40 ton/d and 16 ton/d sludge

Sludge Drying Case 1

24 Ton/Day

- Refinery waste water treatment unit, Sludge drying System
- Scale: 24 ton/Day
- Evaporation Capacity: 820 kg/hr
- Heat Source: Steam
- Run Time: Since August 2010



Sludge Drying Case 2

16 Ton/Day

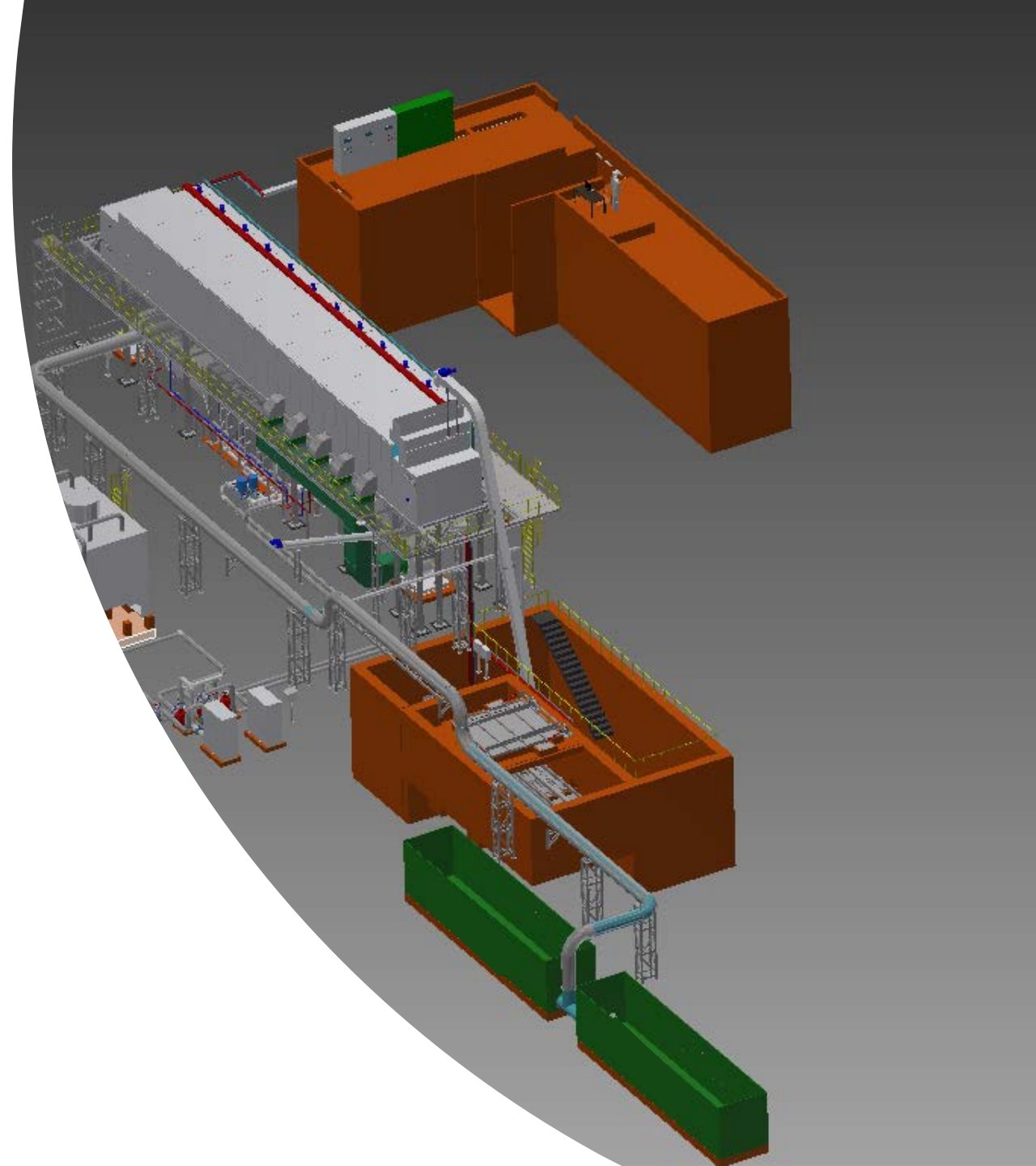
- Chemical sludge drying System
- Scale: 16 ton/day
- Evaporation Capacity : 550 kg/hr
- Heat Source: Steam
- Run time: Since 2014



Sludge Drying Case 3

100 Ton/Day

- Steel plant sludge
- Scale: 100 ton/day
- Evaporation Capacity: 3200 kg/hr
- Heat Source: Nature Gas
- Run Time: Since October 2014





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