

Torrefaction of biomass

ACB Technology and Overview of ANDRITZ Activities



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The ANDRITZ Group

Overview

Company

- ANDRITZ AG, Graz, Austria (Group Headquarters)
- More than 180 production and service sites worldwide
- Employees: approximately 17,000 worldwide (as of March 31, 2012)

Key figures 2011

- Order intake: 5,707 MEUR
- Sales: 4,596 MEUR
- Net income (including non-controlling interests): 232 MEUR
- Equity ratio (as of end of 2011): 21%

Products and services

Plants and services for hydropower stations, the pulp and paper industry, solid-liquid separation in the municipal and industrial sectors, the steel industry, and the production of animal feed and biomass pellets



ANDRITZ Group Company Profile

A world market leader in most business areas



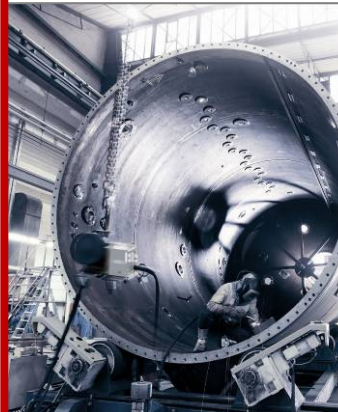
HYDRO
40-45%*

Electromechanical equipment for hydropower plants (mainly turbines and generators); pumps; turbo generators



Torrefaction
PULP & PAPER
30-35%*

Systems for the production of all types of pulp and of certain paper grades (tissue, cartonboard); boilers



Torrefaction

SEPARATION
10%*

Equipment for the mechanical and thermal solid/liquid separation for municipalities and various industries



METALS
10%*

Systems for the production and processing of stainless steel and carbon steel strips; industrial furnaces



Pelleting

FEED & BIOFUEL
5%*

Systems for the production of animal feed pellets (pet and fish food) and biomass pellets (wood, straw)

* Long-term average share of the ANDRITZ GROUP's total order intake



Torrefaction of biomass

ANDRITZ approach towards torrefaction

**ANDRITZ is targetting to provide solid solutions
for production of torrefied biomass-fuel**

Large plants: > 250.000 t/a	Small / medium plants: 50-250.000 t/a
Andritz/ECN Torrefaction Design	Andritz ACB® Torrefaction Design*
Industrial Demoplant (1t/h) in Denmark under comissioning	Industrial Demoplant (1t/h) in Austria in operation!
Pressurized, vertical reactor Andritz/DTI Pelleting plant	Rotating, indirectly heated drum reactor Briquetting plant
Key Features: Scale up to huge capacities possible (experience from pulp&paper division) Feedmaterial: chips	Key Features: Simple process concept specially developed for decentralized plants Flexibility in feedmaterial

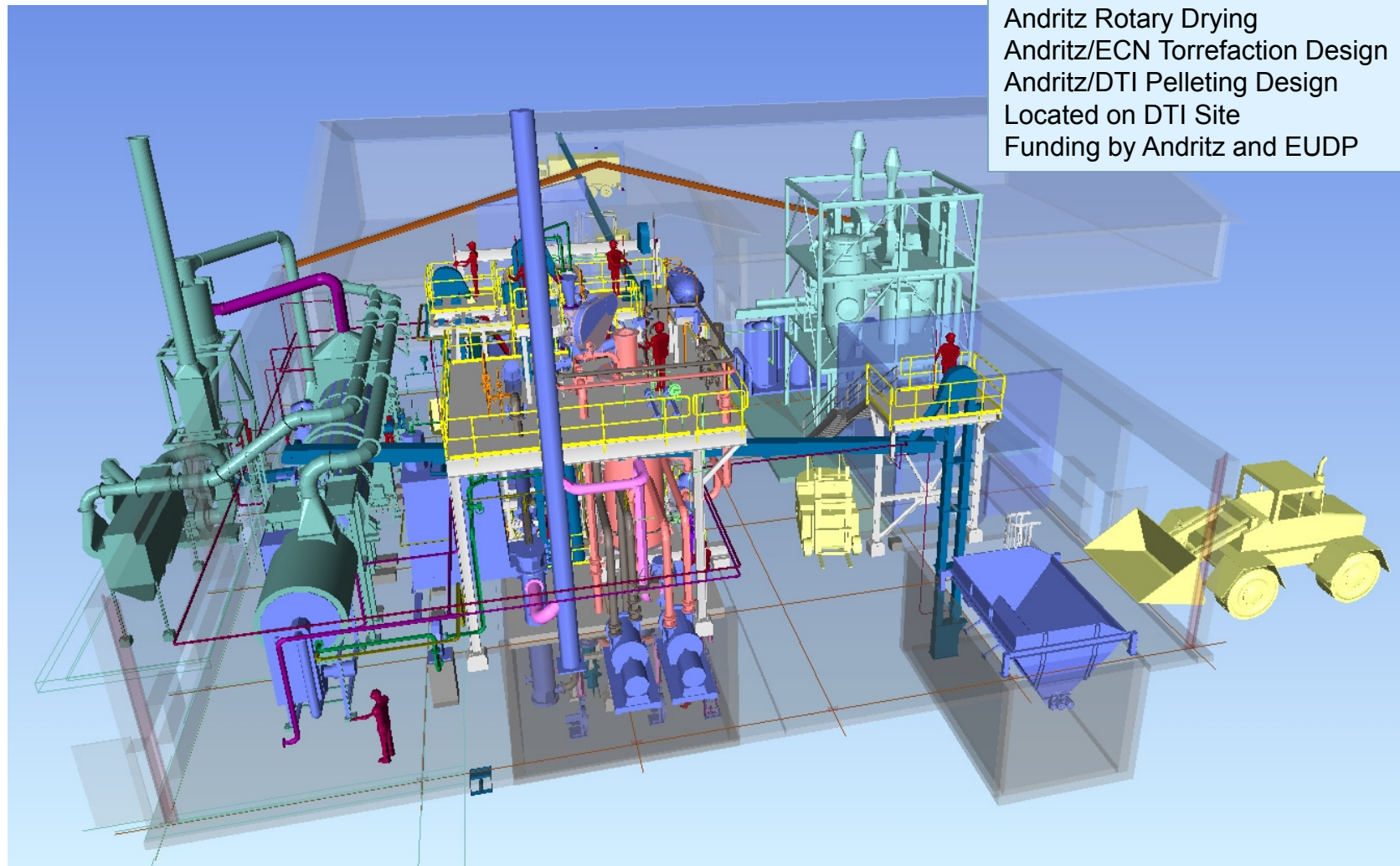
*ACB Process is developed by the ABC Entwicklungs GmbH with support from the ACB consortium consisting of **ANDRITZ** **POLYTECHNIK**

Scientific support by: **ofi**



Torrefaction of biomass

Andritz Biofuels Test Center, Sdr. Stenderup, DK; Start-up: Summer 2012



Andritz Rotary Drying
Andritz/ECN Torrefaction Design
Andritz/DTI Pelleting Design
Located on DTI Site
Funding by Andritz and EUDP

Torrefaction of biomass

Demoplant: Andritz ACB Process, Austria

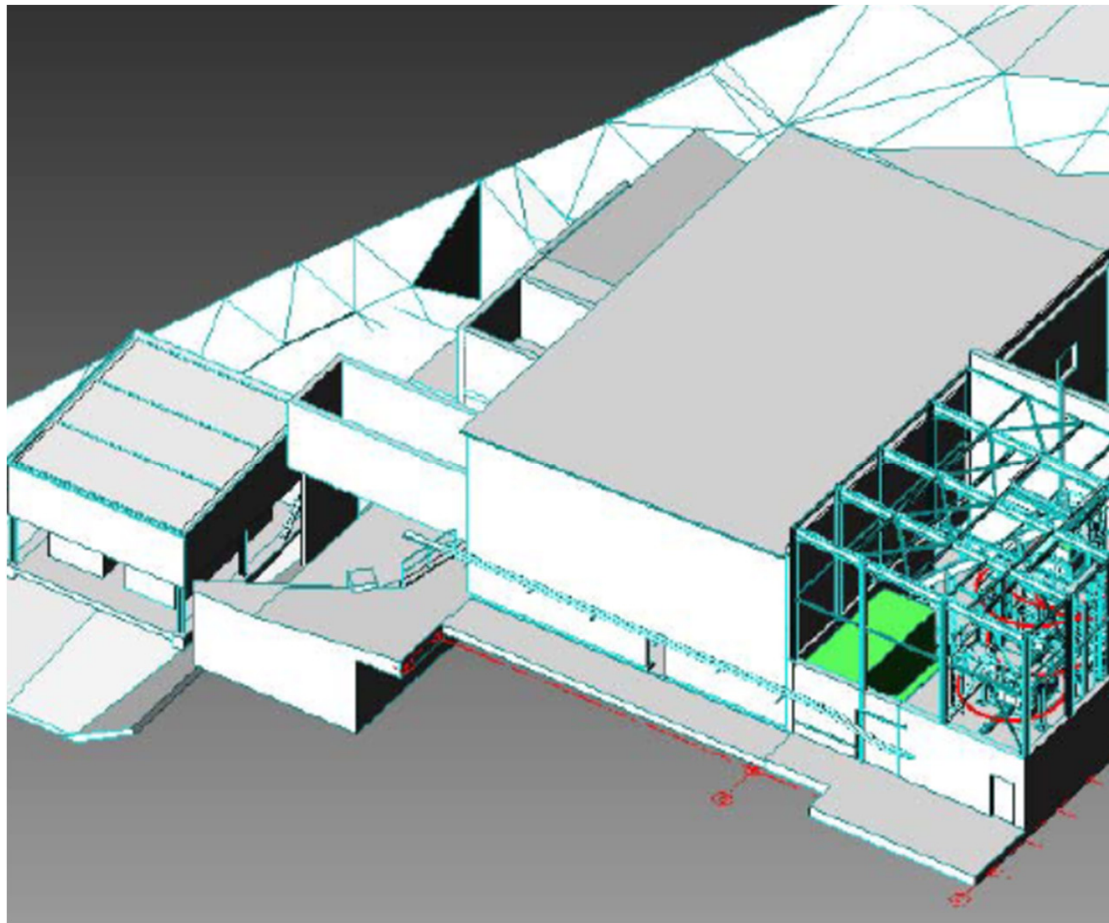
Demonstration plant in Frohnleiten, Austria for production of 1 ton/hr of torrefied material;
Phase I (drying, torrefaction, energy supply) successfully in operation



Torrefaction of biomass

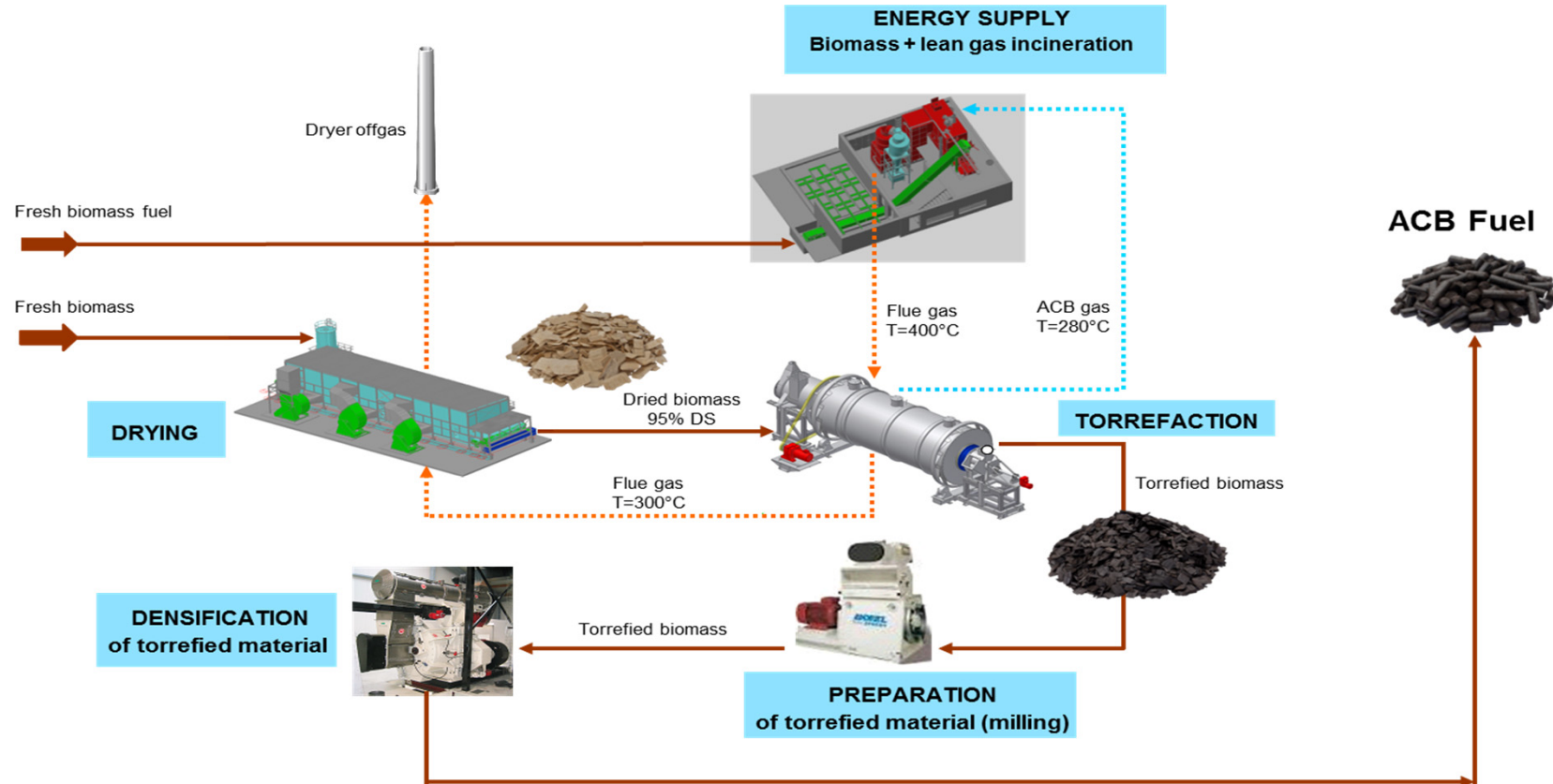
Demoplant: Andritz ACB Process, Austria

Demonstration plant in Frohnleiten, Austria for production of 1 ton/hr of torrefied material;
Phase II (briquetting): comissioning July 2012



Torrefaction of biomass

ACB process: Overview



Process Features:

- simple and robust design based on proven or modified equipment
- flexibility in feedstock (moisture, particle size, species,...)
- small to medium throughput range (50 -250 kt/a of product)

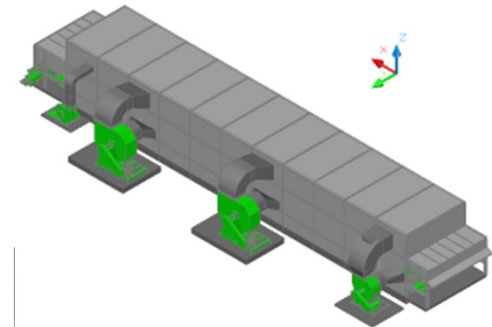
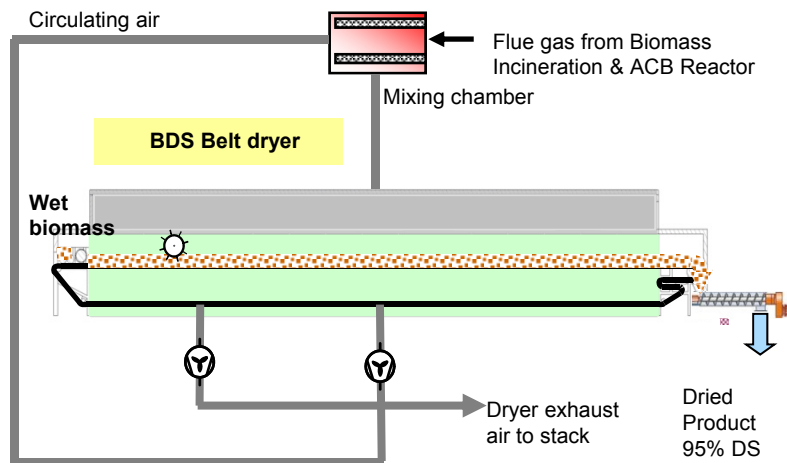
Torrefaction of Biomass

ACB Process: Drying

Pre-drying of biomass for torrefaction, up to 95% DS

BDS RD (closed air loop dryer)

- Directly heated by flue gas from biomass combustion
- Utilization of waste heat from drum reactor
- worldwide 28 references for biomass and sludge drying since 2003



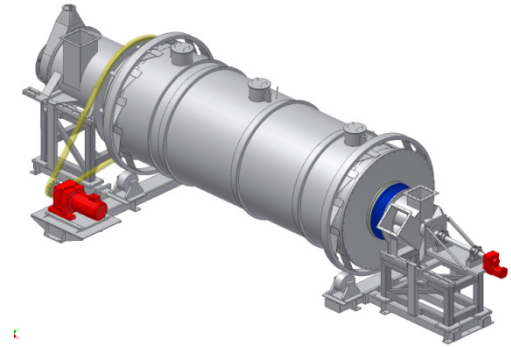
Torrefaction of Biomass

ACB Process: Torrefaction

Torrefaction of biomass at 250-300°C under inert conditions

ACB-Reactor

- Rotating, indirectly heated drum
- Prevention of condensation problems due to special flow pattern
- High flexibility in terms of allowable particle size
- No clogging, channeling or increase in pressure drop
- Avoidance of oxygen presence by ANDRITZ sealing technology
- Construction based on ANDRITZ Drum Drying System (more than 110 dryer lines installed worldwide)

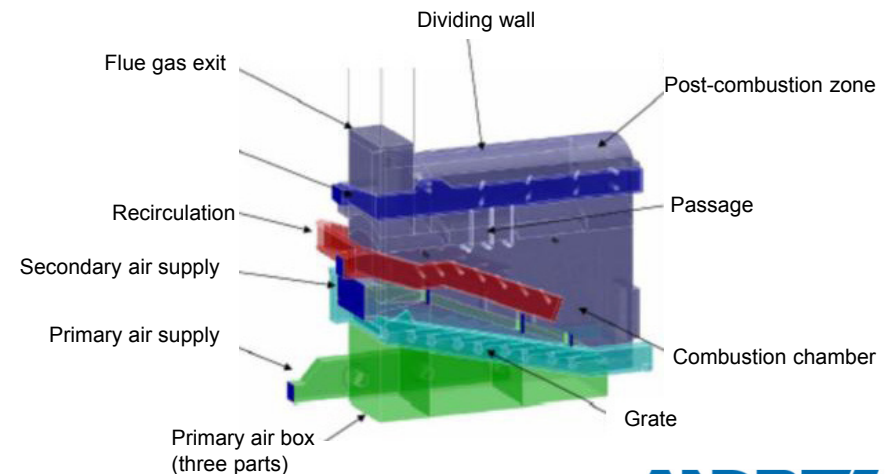
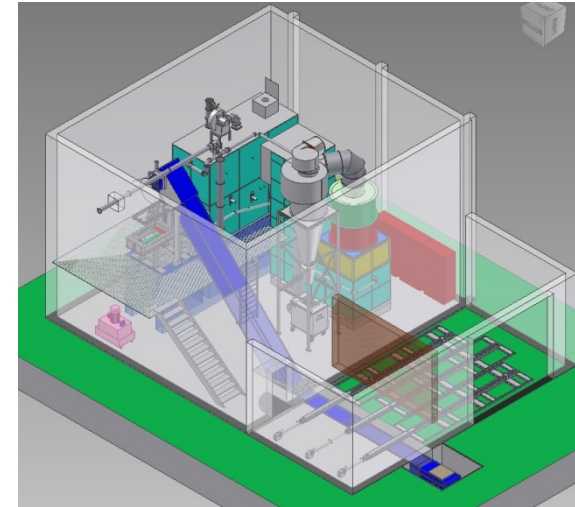


Torrefaction of Biomass

ACB Process: Energy Supply (Lean Gas Combustion)

Provision of the energy supply by Biomass Grate firing system by **POLYTECHNIK**

- Hydraulic reciprocating grate firing
- Special burner for hot lean gas (280 °C)
- Maximum heat recovery from lean gas
- Additional fuel: wood chips with 20 – 55% water content
- Long residence time for low emissions
- Mixing chamber for hot gas generation (400 °C)



ANDRITZ
Separation

Torrefaction of Biomass

ACB Pilotplant: Results

Accomplished test runs: Spruce: chips P30, mini chips;
Pine: chips P30
Saw mill residues (mixed softwood)

Example:



Raw material: mini chips from local production (spruce)



Torrefied product
approx. 280°C, 35 min
TG* = approx. 11%



6 mm Pellets (w/o binder)



Briquettes (w/o milling, w/o binder)

Torrefaction of Biomass

Densification: Briquetting

Tests made with ram extrusion press (same type of press as now installed at pilot plant)

Test: saw mill residues;

→ ~500 kg briquettes produced, smooth operation

Development project with TU Freiberg, Germany

Content:

- Analysis of sample material
- Assessment of size reduction properties; selection of preferred technology
- Evaluation of briquetting characteristic curves
- Test briquetting using technical scale ram extrusion press



Test briquetts from ACB material
source: TU-Freiberg

Torrefaction of Biomass

Densification: Pelleting



„Economically feasible pelleting of torrefied material is not straight forward“

Andritz Feed&Biofuel /DTI* research and test-programm to develop optimized pelleting process:

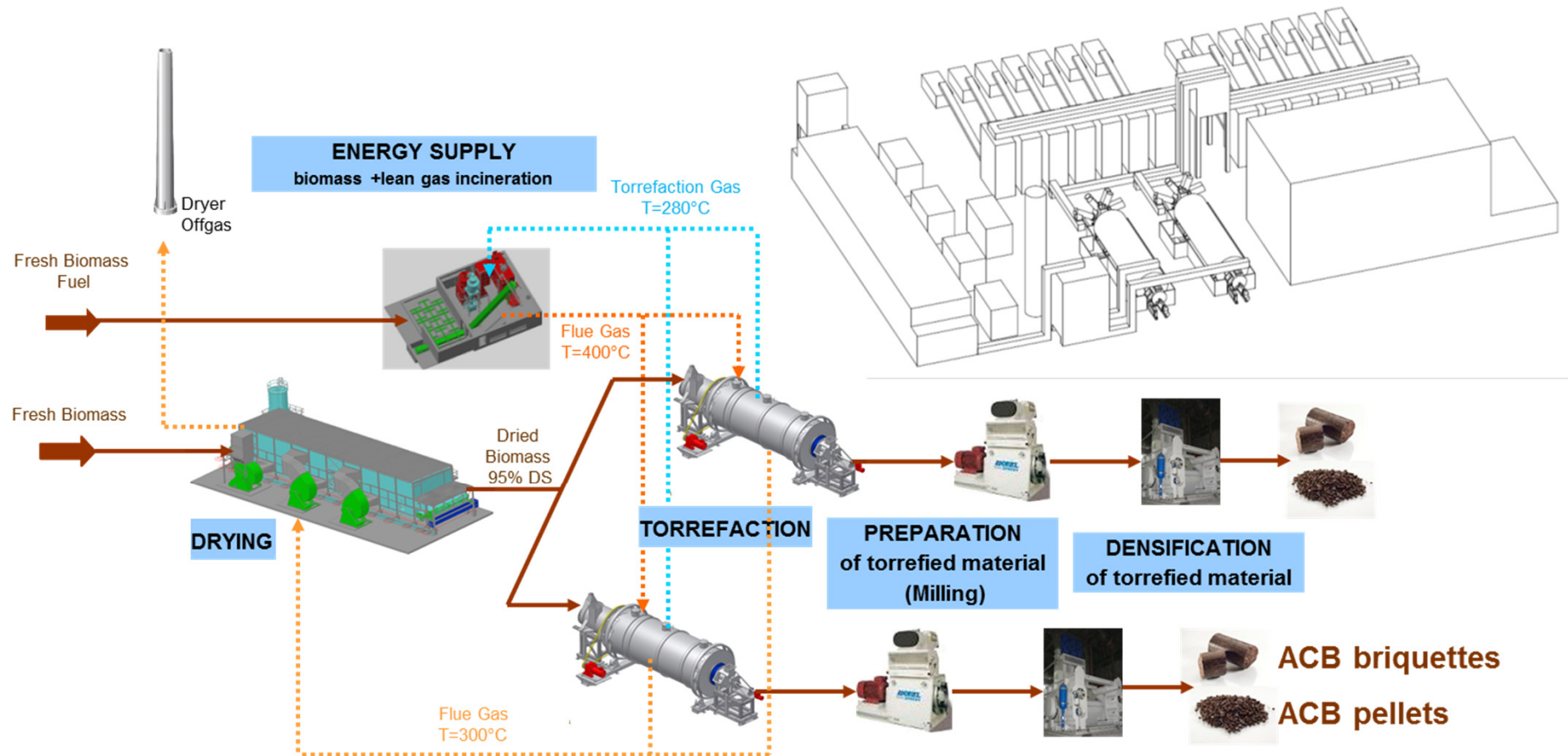
- Single pellet tests (unique facility developed at DTI to examine pelleting properties)
- Test runs with semi-industrial pellet press; using different torrefied samples
- Test runs with industrial press
- Optimization of: particle size, conditioning, die specification
- Evaluation of: energy consumption, durability, density
- Success Criteria: equal or better than „white pellets“ and some degree of hydrofobicity

→ Encouraging results available so long
but further work necessary!



ACB Torrefaction – commercial plant concepts

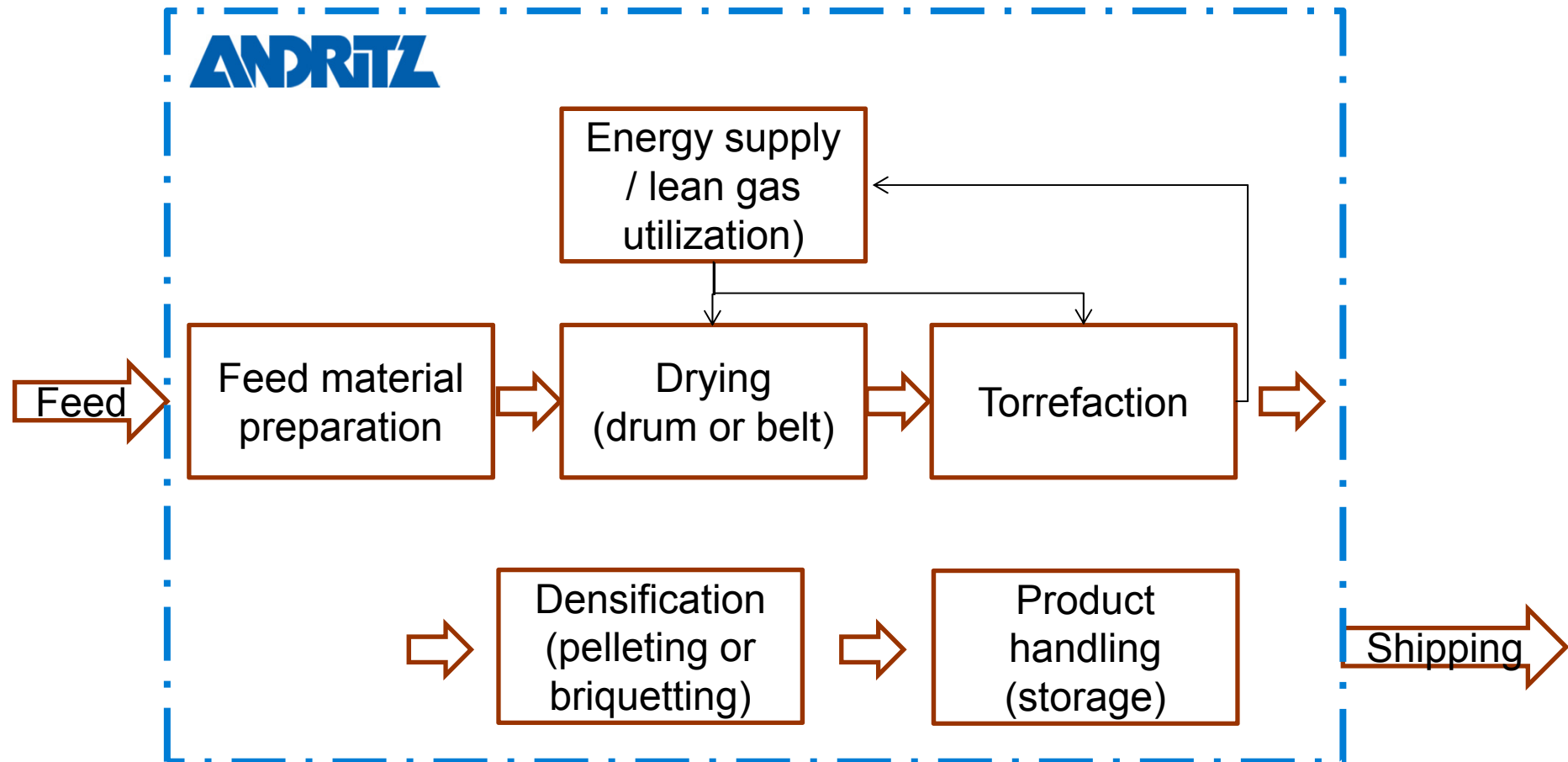
Standard plant concept for 100.000 t/a



Torrefaction of biomass

Commercial plant concepts: ACB

Scope: Andritz can supply complete electro-mechanical installation including site services (erection, commissioning,...)



Torrefaction of biomass

At last...

3 things need to be controlled/assured to make a biomass project (black or white pellets) successful:

- Raw material supply
- Product take-off
- Process / Equipment

ANDRITZ helps you controlling the last one...

Thanks for your attention!

ANDRITZ AG

SEPARATION

Stattegger Strasse 18

8045 Graz, Austria

Phone: +43 (316) 6902 2112, Fax: +43 (316) 6902 453

separation@andritz.com

www.andritz.com



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