Torrefaction of biomass
ACB Technology and Overview of ANDRITZ Activities
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- Overview on ANDRITZ activities in torrefaction
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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

<table>
<thead>
<tr>
<th>Business Area</th>
<th>Share (%)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYDRO</td>
<td>40-45%*</td>
<td>Electromechanical equipment for hydropower plants (mainly turbines and generators); pumps; turbo generators</td>
</tr>
<tr>
<td>PULP &amp; PAPER</td>
<td>30-35%*</td>
<td>Systems for the production of all types of pulp and of certain paper grades (tissue, cartonboard); boilers</td>
</tr>
<tr>
<td>SEPARATION</td>
<td>10%*</td>
<td>Equipment for the mechanical and thermal solid/liquid separation for municipalities and various industries</td>
</tr>
<tr>
<td>METALS</td>
<td>10%*</td>
<td>Systems for the production and processing of stainless steel and carbon steel strips; industrial furnaces</td>
</tr>
<tr>
<td>FEED &amp; BIOFUEL</td>
<td>5%*</td>
<td>Systems for the production of animal feed pellets (pet and fish food) and biomass pellets (wood, straw)</td>
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</tbody>
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* 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

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

*ACB Process is developed by the ABC Entwicklungs GmbH with support from the ACB consortium consisting of Scientific support by:
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): commissioning 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)
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-Reacto**r

- 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)
**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)
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
“Economically feasible pelleting of torrefied material is not straightforward”

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!

*DTI.. Danish technological institute, Sdr. Stenderup pilotplant project partner of Andritz FB
ACB Torrefaction – commercial plant concepts

Standard plant concept for 100,000 t/a
Commercial plant concepts: ACB

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

Feed material preparation → Drying (drum or belt) → Torrefaction → Densification (pelleting or briquetting) → Product handling (storage) → Shipping
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

helps you controlling the last one…
Thanks for your attention!