Challenges for Research and Development in biomass and biorefinery from an industrial point of view

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THE BIOREFINING TECHNOLOGY CORPORATION

Chempolis is private independent medium sized company (est. 1995) who supplies sustainable globally patented biorefining technologies, which has been acknowledged by World Bank, DoE, UPM, BASF & many customers

- **formico**fib™ the non-wood fibre technology
- **formico**bio™ the cellulosic ethanol technology

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BUSINESS IDEA

Deliver **formico**® biorefineries, which make

Sustainable Results using Non-Wood* and Non-Food** biomasses

***** Non-Wood biomasses are mostly residues from agriculture, or naturally available fast growing plants: straw, bagasse, grasses, bamboo etc.

****** Non-Food biomasses are mostly residues from food production: straw, corn, cotton & cassava stalk, bagasse, empty fruit bunches, wood residues etc.

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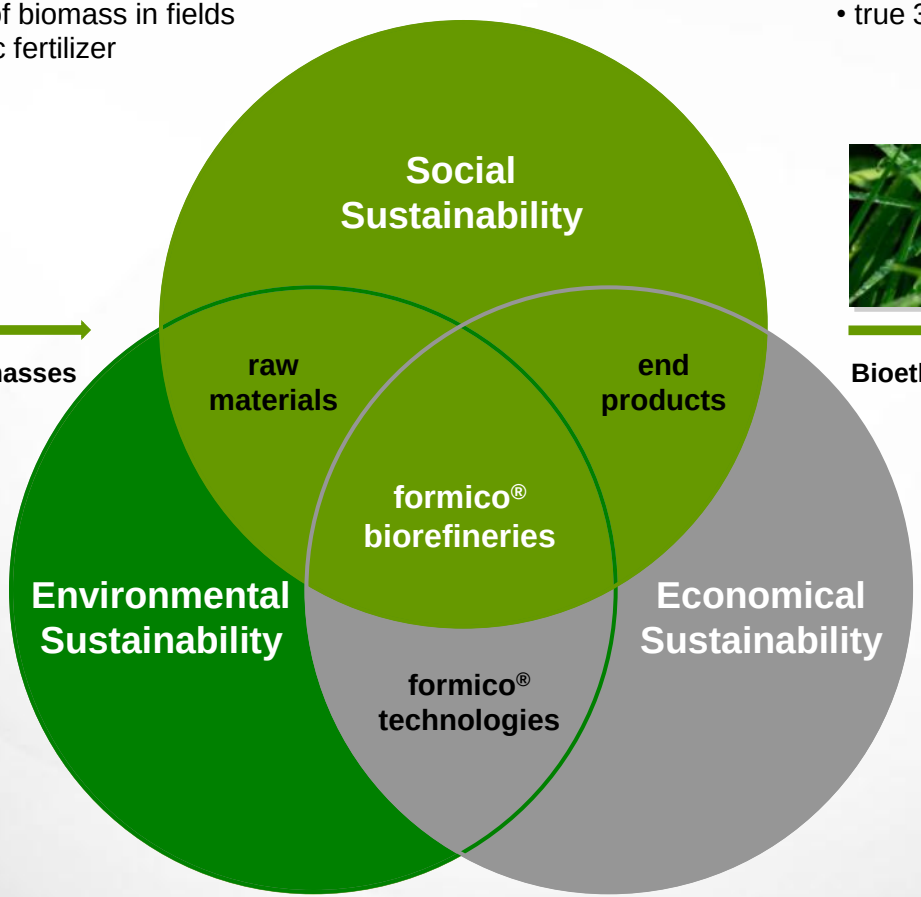
3G formico® BIOREFINERIES MAKE SUSTAINABLE RESULTS

Environmental sustainability
- use of residual biomasses
- preservation of food, forests, water & fossils
- effluent free and reduction of CO_2
- reduction of pollute burning of biomass in fields
- nutrient circulation as organic fertilizer

Social sustainability
- food for people not for cars
- local farming and supply of biomass
- local production and use of products

Economical sustainability
- highly profitable
- low operating and investment costs
- many high quality products
- true 3G platform

Non-wood and Non-Food biomasses



Bioethanol, Biochemicals and Paperfibres

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GLOBAL OPPORTUNITIES OF CHEMPOLIS

- Attractive market outlook with significant volume potential
  - Global market potential for end-products with accelerating demand for non-food based bioethanol and biofuels as well as for non-wood based pulp
  - Logistically a large number of suitable places for production with access to residual raw materials both in the developed and emerging countries
- Strong momentum
  - Globally recent commitments of several states to increase energy efficiency, reduce greenhouse gas emissions and increase the share of renewables in overall energy consumption as well as biofuel components in vehicle fuel
- Sustainability
  - Opposite to prevailing technologies, **formico**® technologies are able to utilize food chain residuals and thus do not compete with food production resources (both food chain and arable land) and help to preserve forests
  - Energy self-sufficient production process and hence no fossil CO_2 –emissions, effluent free technology

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formico® technologies

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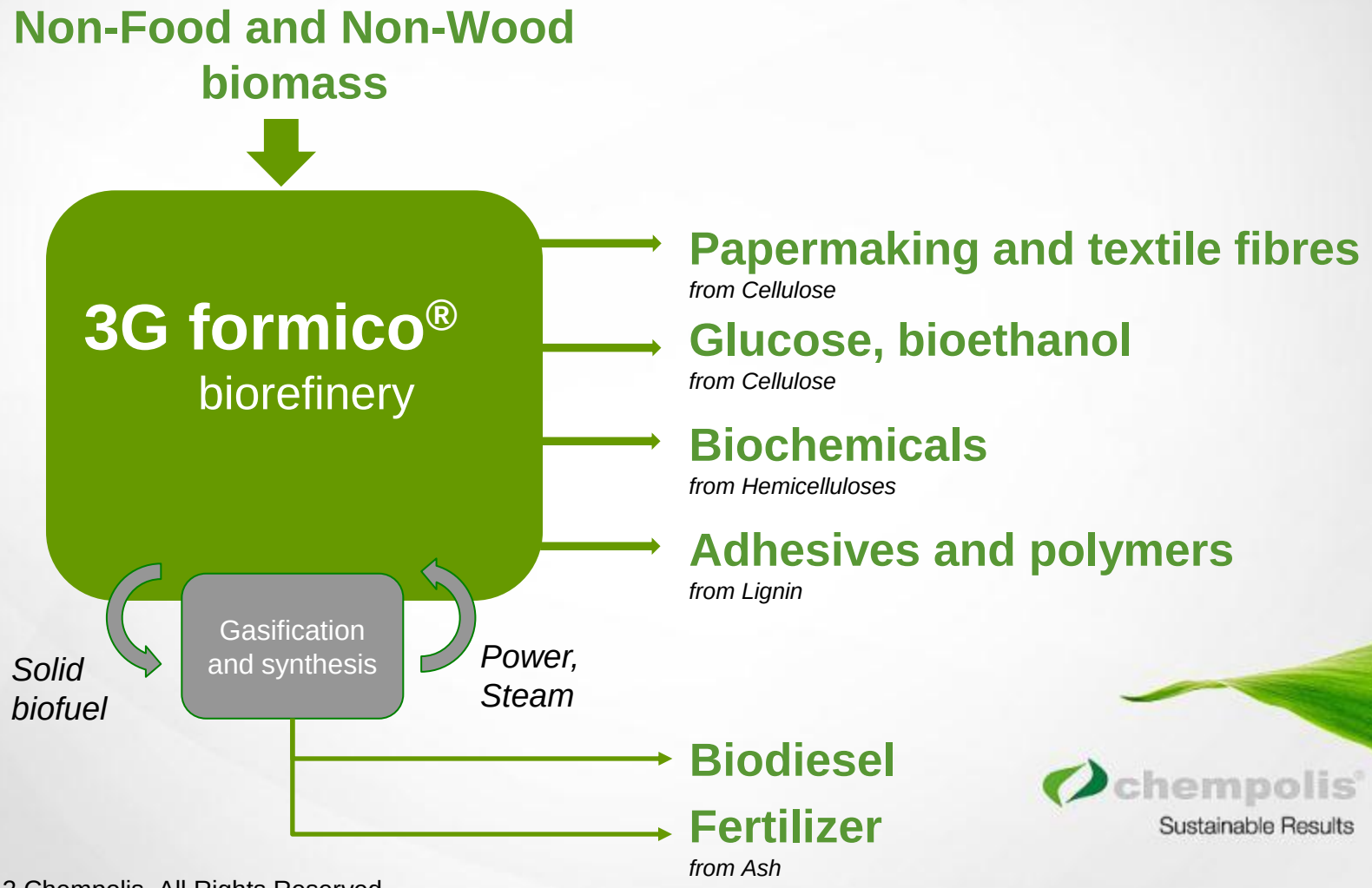
3G formico® BIOREFINERY



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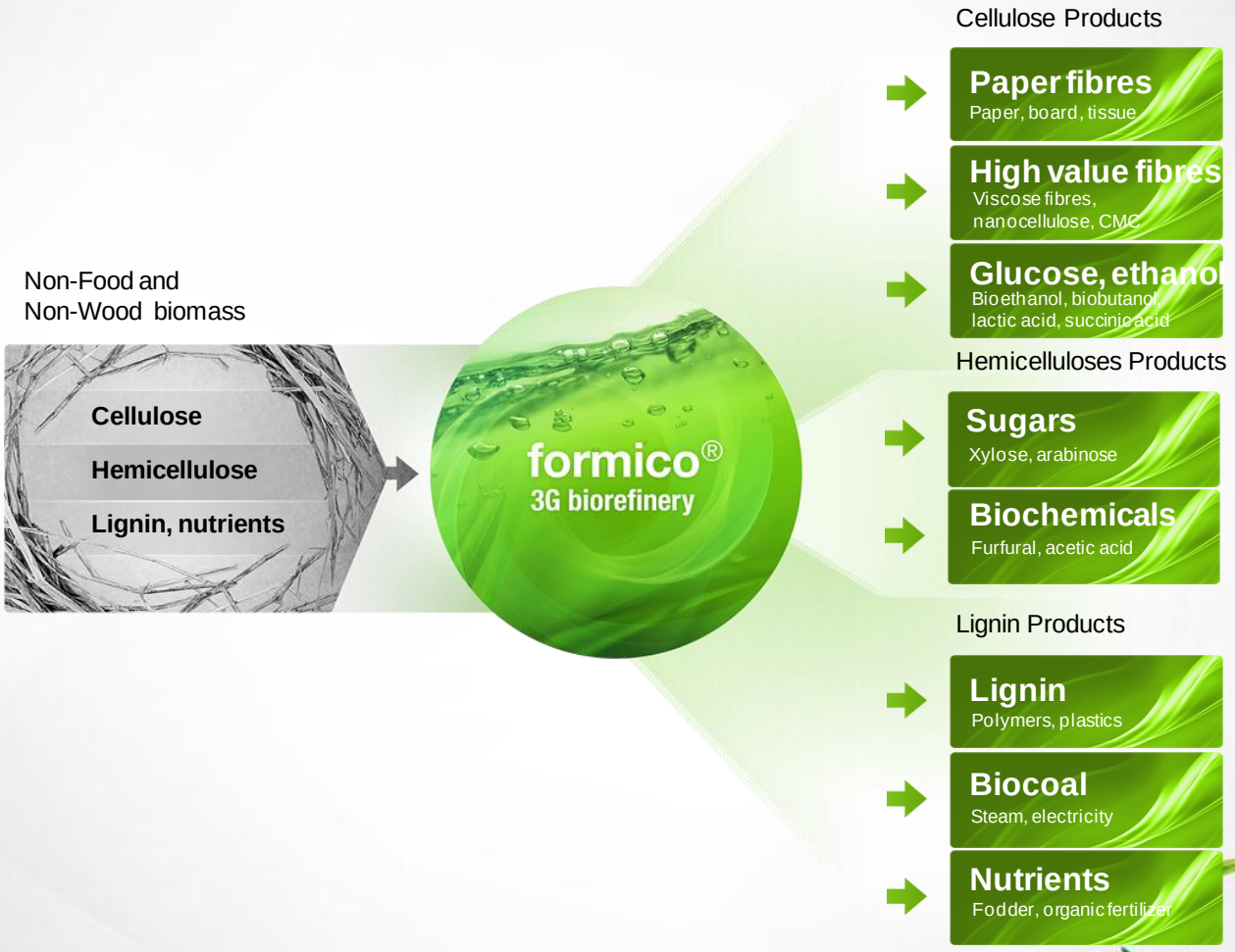
formico® PLATFORM



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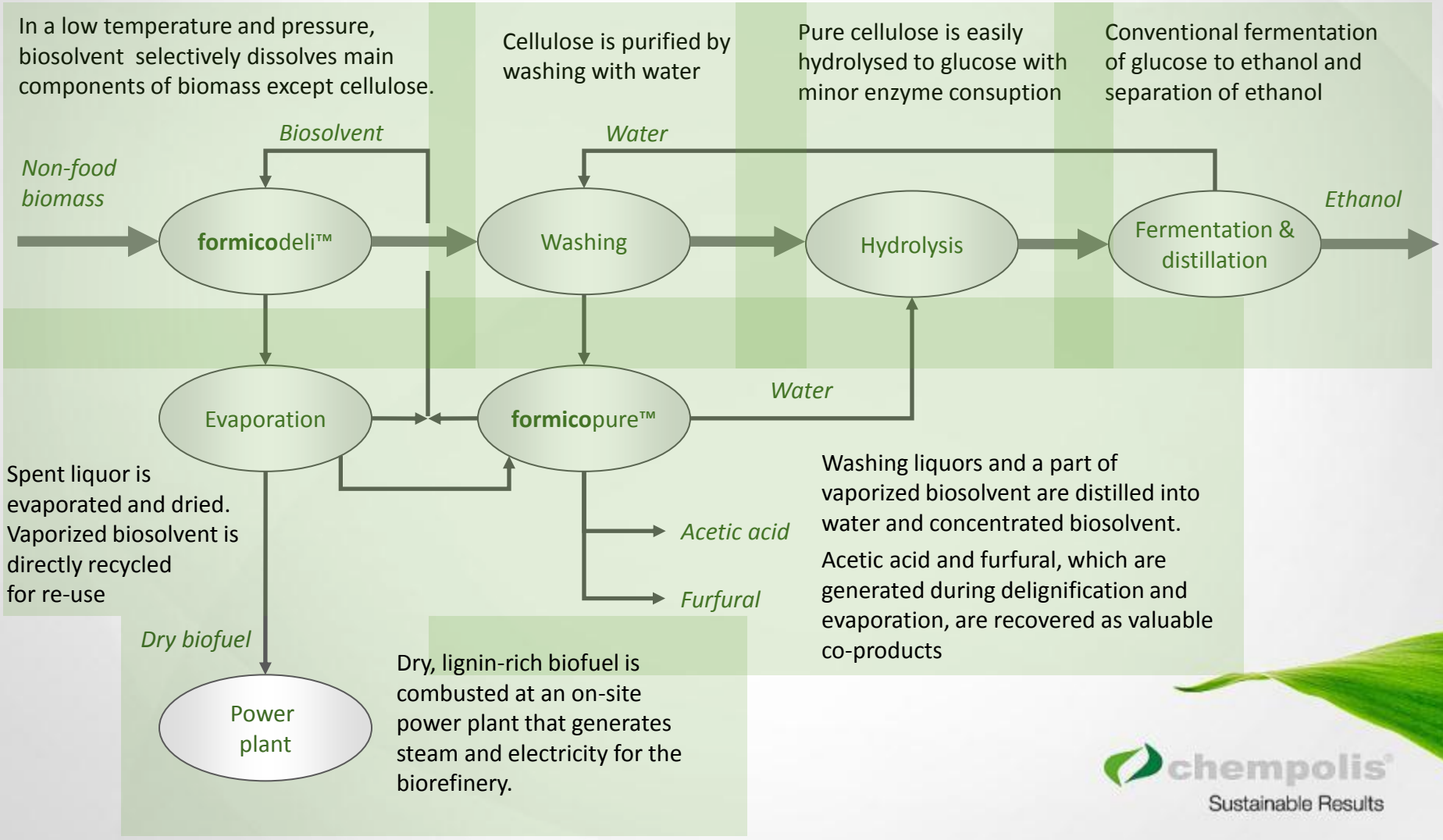
formicobio™ TECHNOLOGY



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HYDROLYSIS

- Cellulose is enzymatically hydrolyzed into glucose
- Commercial enzymes
  - Independence
    - Enzyme producers
    - Research parties
- Better possibilities for quicker improvements by tailoring own process

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FERMENTATION

- Substrate glucose only, possibility to use conventional yeasts, e.g. *Saccharomyces cerevisiae*
- Commercial yeasts
  - Independence
- Better possibilities for quicker improvements by tailoring own process
  - Control of inhibits etc.

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formico® TECHNOLGIES SUMMARY -

- 3G **formico®** biorefining technolgies are the future
  - High conversion of products give 25-40 % more revenues than competing technologies
  - Approx 20-50 % lower operation cost than competing technologies
  - Energy self-sufficient, low carbon technologies
  - Effluent-free with minimal water use
- Integrates social, environmental and economical sustainability

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R&D challenges and possibilities

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INDUSTRIAL PARTNERS

- Industrial integrates are important
  - Sugar, alcohol, energy industries
- Party that has raw material (e.g. agricultural residue/waste)
- Possibility to improve industrial production
  - Energy efficiency
  - More efficient raw material utilization
  - Waste reduction
- Production of e.g. ethanol (synergy)
- Production of some fiber product (paper)

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R&D CHALLENGES IN CONSORTIA

- Research scopes are very spesific
- Difficult to match R&D for various research programs
- Needs are specific for companies
- Difficult to focus on important areas (leading the consortium)
- Own research is needed for securing IPR protection

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R&D POSSIBILITIES

- Chempolis research co-operation
  - Long term confidence
  - High enough quality and the background knowledge
  - Flexibility
  - Common interest
- Possibilities are wider when the focus is not in the core area of the technology or the products
- Important to find research parties that truly can mutually benefit
- Networking important
  - Find out possible parties
  - Find out possible co-operation

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R&D POSSIBILITIES

- Chempolis experience
- Careful evaluation when the core technology or products are involved in the development (co-operation)
- Possibilities are wider in value added products
  - End products for consumer use
  - Platform chemicals
    - Value added products for our customers
    - Glucose fermentation for various products
    - Lignin modification/use for various products
  - Co-operation with equipment suppliers (testing, equipment engineering)

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formico® biorefinery in Oulu

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BIOREFINERY - SERVING CUSTOMERS AND VISITORS

TOP: NDRC, China, 1.9.2010

RIGHT: Minister of New and Renewable Energy, India, 1.4.2011

- Overall investment cost ~20MEUR
- Customer trials
- Dimensioning of **formico**® processes & systems
- Continuous operations, industrially proven solutions
- Modern DCS (**formico**cont™)

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RAW MATERIALS

Customer-sourced non-wood and non-food biomass

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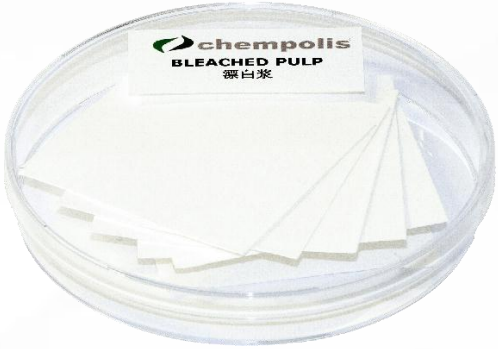
PRODUCTS PRODUCED BY formico® TECHNOLOGIES



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CHEMPOLIS BIOREFINERY

Control room with
control system **formico**cont™

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Raw material prerefining

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Prerefined wheat straw

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Delignification system **formico**deli™

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Delignification system **formico**deli™

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Washing section

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Washing section

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Pulp washing

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Chemical recovery with
purification system **formico**pure™

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Chemical recovery with
purification system **formico**pure™

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Chemical recovery and
pulp loading

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The future is

NON-FOOD CELLULOSIC

ETHANOL

formicobio™

The cellulosic ethanol technology

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