Avantium

Commercialization update of biobased chemicals

Washington, March 12, 2015
Avantium introduction

- Renewable chemistry company with strong expertise in catalysis
- Started in 2000 as spin-off from Royal Dutch Shell
- Headquarters in Amsterdam, the Netherlands; pilot plant operations in Geleen, the Netherlands
- 140 employees
- Awarded “European Cleantech Company of the Decade” in 2014
- Backed by strong VC investors (Sofinnova, Capricorn, ING)
- Financing round of $50 million completed in June 2014
- New investors: Coca-Cola, Danone, Alpla and Swire
Activities

YXY technology:
FDCA & PEF

Development of next generation bio-based FDCA monomer and polymers using proprietary YXY technology

New development projects:
a.o. BioMEG

Discovery and development of innovative routes from renewable feedstock to bio-based chemicals

Catalysis R&D

Leading catalysis service and systems provider for (petro-)chemical industry
YXY technology to make FDCA and PEF
Avantium’s YXY technology

- a cost competitive, chemical-catalytic process proven at pilot plant scale

- Avantium’s YXY technology: recognized as world#1 technology to make FDCA and PEF. Protected through an extensive IP portfolio.

- (Bio) chemical industry activity in FDCA is intensifying:
  - Companies including ADM, Eastman, BASF, Corbion, AVA Biochem
Drop in and new

“The Jesus Molecule”

Bio-based PX

“The Sleeping Giant”

Bio-based FDCA

ABLC 2015
FDCA
a key building block for the biobased economy

Plasticizers

Coating resins

Polyesters:
- PEF
- PBF
- PEIF

Polyamides
Polyurethanes

Other monomers

ABLC 2015
PEF
A new polyester with blockbuster potential

- PEF: poly-ethylenefuranoate
  - Biobased FDCA monomer
  - Biobased MEG monomer

- Superior performance over PET:
  - Game changing barrier performance
  - Improved thermal stability
  - Excellent mechanical properties

- Broad application potential:
  - Bottles
  - Film
  - Fiber

- Significant reduction in carbon footprint
  - 70% lower carbon emission
  - 65% lower NREU
PEF performance benefits
Loading the value equation

Examples of PEF applications that can’t be achieved with conventional PET:

CO₂ barrier:
- Small volume Carbonated Soft Drink bottles

O₂ barrier:
- Packaging of fruit juices (with decent shelf life)
- Beer bottles (with decent shelf life)
- Food packaging (e.g. ketchup) in mono-layer bottles
- Film for food packaging (replace multi-layer films with mono-layer)

Thermal properties:
- Hot filling of bottles

ABLC 2015
Commercialization of YXY
Market pull strategy, partnered with brand-owners

- Creating market demand by working with major FMCG companies:
  - Signed Joint Development Agreements in 2011-2012
  - Committed to equity investment in Avantium in 2014
  - Working towards off-take commitments and planning market launch

- Building the first commercial supply chain:
  - Engineering, scale, site location
  - Partnering (feedstock, manufacturing, polymerization)
  - Financing (mix of grants, loans, equity)
Avantium: new development projects
Bio-MEG
One step catalytic process to Bio-MEG

- Market opportunity:
  - Current MEG market is: 27 million ton / year
  - PlantBottle™ program by Coca-Cola has started to create a vast demand for bioMEG (at least 1 million ton per year by 2020); other brand-owners are following this approach

- Technology:
  - Today Bio-MEG is produced in a four-step process that was optimized for fossil feedstock, leading to significant price premium over fossil-MEG
  - Avantium has developed a one-step, highly selective hydrogenolysis conversion from C6 sugars (cellulose, starch and glucose) to MEG, enabling high carbon efficiency (>2 MEG per C6) leading to a significant saving versus today’s bioMEG routes and competitive to NAFTA-based-MEG

- Avantium is open for partnering for scale-up to pilot-demonstration scale and commercial scale
Bio-MEG
One step catalytic process to make Bio-MEG

Current process (via ethanol)

C6
↓  1. Fermentation
↓  2. Dehydration
↓  3. Oxidation
↓  4. Hydration

MEG

Feedstock:
sucrose, glucose

Avantium process (direct)

C6
↓

1. Hydrogenolysis

MEG

Feedstock:
glucose, starch, cellulose

ABLC 2015
Many 2G technologies are geared towards ethanol market.

To feed the biobased chemicals market there is a need for highly pure 2G glucose.

Avantium is developing a high-acid, low temperature technology to produce high quality glucose from cellulosic biomass.

Avantium is seeking investors and partners to complete the development and for commercial implementation.

Developing 2G Glucose technology

Novel high-acid, low temperature technology

2G Glucose

Biobased chemicals
Conclusions

- YXY: world leading technology to produce FDCA and PEF
- PEF has unique performance characteristics
- Commercializing PEF in high-value applications to leverage unique product properties
- Partnered with Coca-Cola, Danone and ALPLA to create market pull and launch PEF bottles on the market
- Looking for partners on a select number of new renewable chemistry projects