INNOVATIVE PURIFICATION PROCESSES FOR BIO-BASED CHEMICALS
EURODIA designs and implements process solutions for purification and fractionation

- Established in 1988
- Total staff of 75
- 15% of expenditures for R&D
DEVELOPING A PURIFICATION PROCESS

Selecting purification equipment may seem straightforward, except

...compared to chemical-based parallel, bio-process solutions are notoriously complex & variable.

- Meet stringent purity specifications
- Give high product yield
- Have low operating costs
- Minimize capital investment
- Minimize water, energy, waste and by-products
- Be reliable, robust
- Many types of impurities
- Contamination potential

Developing the right process can be anything but simple.
PRIMARY PURIFICATION TECHNIQUES

- Evaporation
- Filtration MF / NF / UF
- RO
- Chromatography
- Crystallization
- Precipitation
- Extraction
- Distillation
- Centrifugation

Methods:
- ED / EDBM / CDI
- IX / IX / UIX

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MAIN TECHNOLOGIES

FILTRATION
- Ceramic membranes
- Organic membranes
- Zeolite membranes (gas separation)

ELECTRODIALYSIS
- Conventional ED
- Bipolar membrane ED
- MCDI

IX / UIX / CHROMATOGRAPHY
- Conventional ion exchange
- Preparative chromatography
- Uninterrupted ion exchange
Raw material

First Generation (Glucose / Sucrose)

Sugars Purification

Biomass Fractionation

2nd Generation (Cellulose/Hemicellulose)

Monomer

Fermentation

DSP

Polymer

Food Applications

Polymers (Plastics)

Bio-chemistry (solvents, detergents, etc...)

Agro-industry

Chemistry

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- Organic acids purification
  - Gluconic, Lactic, Succinic, Acetic, Ketogulonic, etc.
- Amino acids demineralization & purification
  - Glycine
- Plant proteins purification
  - Peas
  - Potatoes
  - Soy
- Cellulosic sugars purification
WHY CELLULOSIC SUGARS?

• New biofuel Ethanol plants cannot compete with food
• Plenty of wood biomass, e.g. in the US and Canada: value from lignin and sugars
• Bio-based Chemistry requires non-food sugars as feed to fermentation processes
• Fermentation Industry looks for “green” products derived from non-food feedstock and lower costs
• Incentives for farming communities
• Sustainable development: less fossil fuel consumption

...“SECOND GENERATION” SUGARS
PROCESSES TO CELLULOSIC SUGARS

• Two main types of processes:
  o Upfront Separation of C5 (from hemicellulose) and C6 (from cellulose) sugars: steam or mechanical treatment
    Followed by hydrolysis
  o Direct Hydrolysis: Enzymatic or Chemical (e.g. NaOH, H₂SO₄)

• Quality is variable:
  o C6 content can vary from 50% to >90% (C5, oligosaccharides)
  o Organic salts (acetates and other): >>30 g/l
  o Mineral salts (sulfates, phosphates, etc.): ~1000-1500 ppm
  o Heavy metals (Fe, Cu, Mn, etc.): 5-10 ppm
  o Suspended solids (lignin, etc.)
Biomass fractionation for BIOCHEMICALS production is different from bioethanol production where mixed C5/C6 can be fermented.

It is necessary to separate lignin / C5 / C6 (e.g. C6-only is of interest for most organic acids, while C5 can lead to Xylitol, and other products).
Focus on 2G Sugars

2G Sugars solution

- Suspended solids, macromolecules, sugars, salts, organics

Sugars C6+C5 + Non Sugars:
- Salts, organic acids, color

Sugars (C6+C5)

- Sugars C6: Glucose
- Sugars C5: Xylose

Suspended solids, proteins...

Suspended solids, macromolecules, sugars, salts, organics

Salts; organic acids

CLARIFICATION
- Centrifugation, DE filters, + MF/UF

DEMINERALIZATION
- Electrodialysis or SSAC® Chromatography

PURIFICATION
- SSAC® Chromatography
- Polishing IEX/GAC

Ethanol

Xylitol; Pentose derived chemicals

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Inherent cost disadvantage compared to corn or cane sugars:
  - Bio-based Chemical / Biofuel Industry is used to work with pure sugars; no “green premium”
  - Lower sugar content, additional conversion steps, higher CAPEX
  - Biomass collection radius limits plant scale (mixed refineries)
  - Biomass variations: robust process or limited source focus.

Keys to process attractiveness:
  - Low (no-) cost biomass
  - Value from by-products: uses for C5 and for lignin
  - New processes: demonstration facilities (10-100 T/D) to be funded
  - ....AND low-cost purification steps
PURIFICATION STEPS: INDUSTRIAL EXPERIENCE

Separation/clarification of lignin

C6 sugars demineralization

C5 - C6 sugars desalting

Separation of C5 from C6 sugars

Recovery of chemicals (acids)
Chemistria specializes in providing industrial purification processes…. efficient, cost effective, reliable!

Turnkey and Tailor-made Process Solutions For Green Chemistry

• Your specialty is your bio-process and your products
• Our specialty is separation processes
• Together, your manufacturing process will meet your commercialization needs – quality, yield, cost effectiveness, delivery – at each stage of development

We look forward to seeing you at Booth #117 in the Exhibit Hall to learn more
EDBM / ED Units

EQUIPMENT DELIVERY
Filtration, IEX & Chromatography Units
Merci pour votre attention!

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