Unfolding
New Fibers – New Paper
New Applications
New Markets

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Driving Forces of Change in Pulp and Paper

The Technology Explosion

About 90% of all scientific knowledge has been generated over just the last 30 years

Greater than 80% of all the scientists and engineers who have ever lived are living and working now

In 1960 < 5% of the general population in North America and Europe had completed 4 or more years of college
- In 1999 this increased to ~20%
- Demographic analysis indicates this trend will continue
- Increased technological competence of society drives change
Basic Realities of New Millennium

• Major forces of change will continually restructure all world economies

• Business now is the management of continuous change, requiring all organizations to restructure to manage change

• Wealth no longer will be measured by ownership of rapidly obsolescing fixed physical assets, but in terms of knowledge--high value-added, technology intensive proprietary systems
Hierarchical Structure of Paper Dimensions of Innovation

Molecular
- Lignin/cellulose/hemicellulose, Cellulose crystallinity/fibrils
- Hydrogen Bonds, Acid-base Interactions

Fiber Wall
- Fiber-wall thickness/layers, Cellulose fibril angle
- Bonding between fibers and response to refining

Fiber
- Fiber type & dimension, Propensity for fiber collapse, Curl/kinks, Fiber strength

Fiber Network
- Paper making, refining fiber mixtures, papermaking chemicals, fillers

Paper Properties

nm
Fiber Scale
mm
Pulp – Paper
Research Patterns

Process Research Publications: +140,000
Product-Platform Research Publications: ~9,000

What’s Next?
“The Future Ain’t What It Used To Be”

Yogi Berra
New York Yankees
New Packaging

- Origami Packaging
  - Self adapting packaging
- Transportation
- Interior
- Building
- Electronics
- Medical
- Hygienic
- Food

- Controlled Inner Environments
- Active – Passive Anti Bacterial/Fungi Defense
- Odor – Flavor Control
- Freshness Sensors
- Tamperproof Security
- Anti Counterfeiting/shoplifting
- Tamper Resistant
- No Fridge Storage
- Extended Shelf Life
- Retortable
New Packaging

• Innovative Packaging
  – Deformability
  – Cut Proof
  – Flexibility - Squeezable
  – Functional Barriers
  – Disposable Food Deliver Systems
  – Ultra-Lite Weight Containers

• Intelligent Packaging
  – Brand Authentication
  – Active Messaging - Displays
  – Environmental Responsive
  – Printed RFID
New Barriers

- Self Cleaning
- Flexible Electronics
- Conductive – Magnetic
- Controlled Inner Environment
- Optics
  - Iridescence
  - Adaptive Printing
  - New Security Features
Innovative Fibers

- Moldable
- Non hydrogen bonding fibers
- Active Release
- Environmental Sensitivity Detectors
- Conductivity
- Ion Exchange
- Odor Control
- Degradable Superabsorbers
- Superhydrophobic
- Moisture Control
- Anti-static
New Fibers - Composites

- High Fiber Composites
  - Enhanced strength properties
  - Improved life-cycle
  - Piezoelectric
- Surface Functionalization
- Construction Additives/Panel
- Moisture Stability
- Breathable
New Fibers - Composites

- High Filler Sheets
- Paper Foam Packaging
- Extrusion cellulosics
  - Disposable cookware, bottles
- Controlled Diffusion Packaging
- Polymer Templating
- Cellulosic Laminates
New Filters

- Bio-capture – Clean Air Control
  - Allergens, fungi bacterial, mold, mildew
- Odor control
- Water purification
- Environmental remediation
New Tissue

• Wiping – Cleaning - Preventative
  – Antibacterial/Fungi
  – Odor Control
  – Fluids Control
• Caring
  – Diagnostic tissue
• Nursing
  – Biosensors
  – Active Release
  – Bioactive Pretreatments
New Convenience Platforms

- Disposable Home Cleaning Platforms
- Toner Free Laser Printing
- Acoustic Tiles
- Disposable Hygiene Clothing
- Fashion Furniture
Intrinsic Cellulosic Strengths

- Readily Available Bioresource
- Consumer Convenience, Excellent Graphics
- Adaptable Manufacturing Technology
- Integratable into Biorefinery
- Environmental Compatible
- Carbon Neutral
- Biodegradable
- Sustainability
- Recyclable
- Cost
- Safe
Thank You!

“It is not necessary to change
‘But’
Survival is not mandatory”

Deming

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