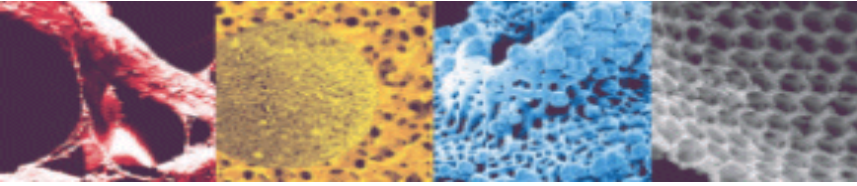


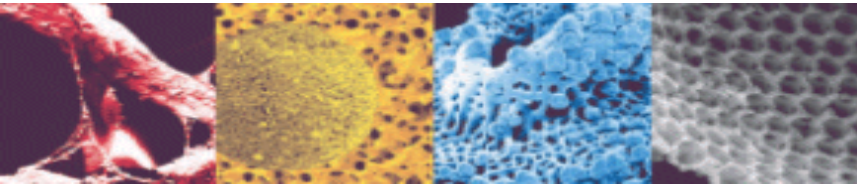
material innovation



strategy and choice



material innovation



material process

strategies

- design for new materials

- design for reduce reuse recycle

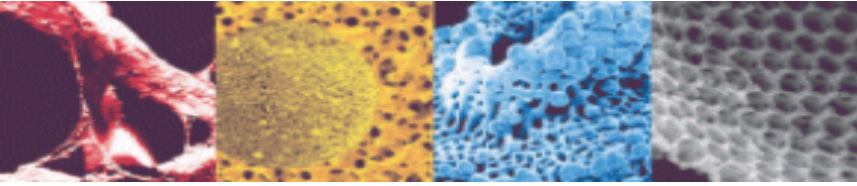
- design analysis pla-*[product life assessment]*

- design for nest gang stack

- design for multiuse

- design with aesthetics beauty

material innovation



Why are we talking about this?

environmental issues

climate change indicators on rise

mammals in decline

global ice melt accelerating

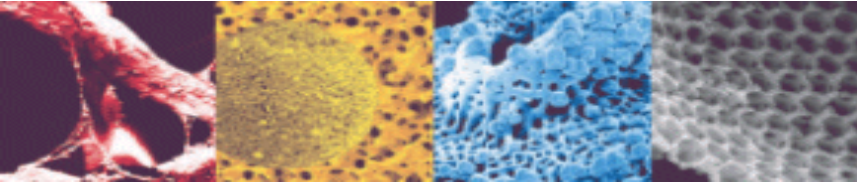
wetlands drying up

forest loss continues

air pollution still a problem

Vital Signs 2005, The World Watch Institute

material innovation



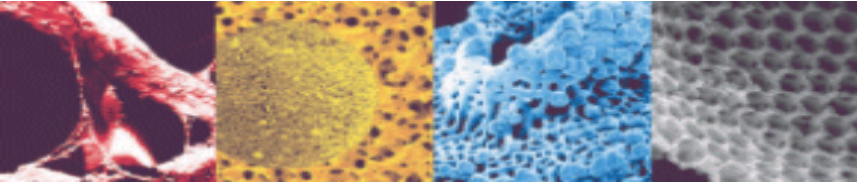
Paradigm shift

we made our materials too good [to last a lifetime]

we need materials to be “programmed degradable”

material innovation

the new materials:



What is programmed degradable?

Three factors affect how environment-friendly a material is:

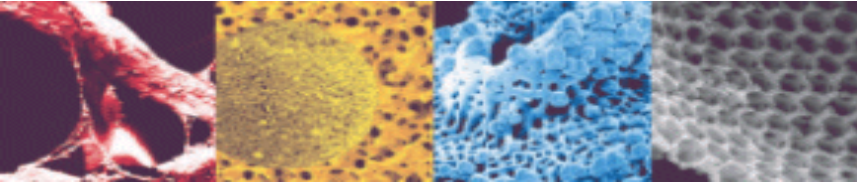
renew-ability: how quickly are the ingredients of the material created in the environment? (A material made from soybeans; more enviro friendly than one made from wood; nature produces soybeans faster than it produces trees.

degradability: how quickly can material be re-integrated into environment after it is no longer being used?

production: how much pollution/waste is created during process of making material?

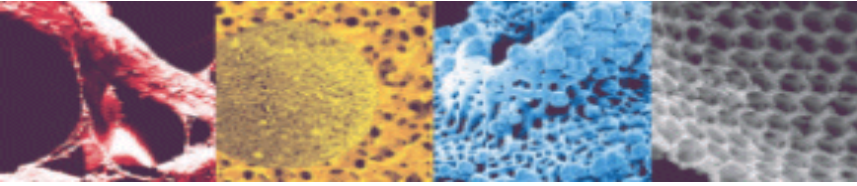
material innovation

the new materials:
bio-plastics



Wood cellulose as a source for plastic

material innovation

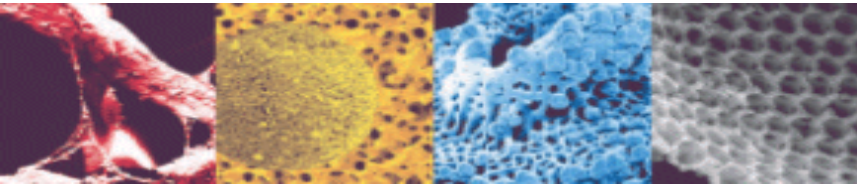


the new materials:
Bio-plastics

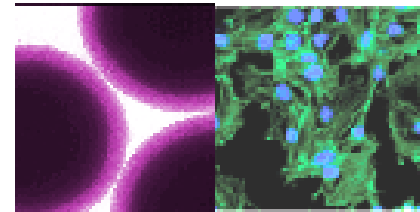


Switch grass as a source for plastic monomers

material innovation

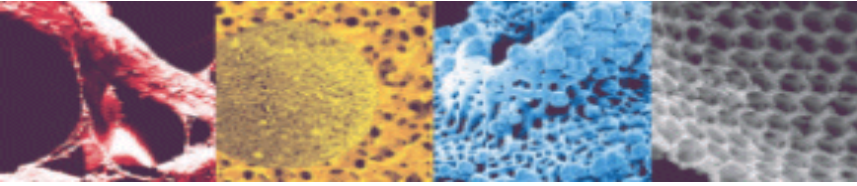


the new materials:
bio-plastics



Sugars as a source for plastic monomers

material innovation

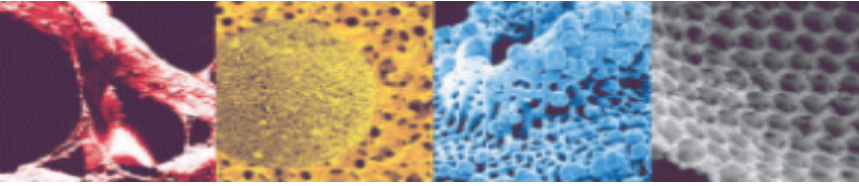


the new materials:
bio-plastics



Corn as a source for plastic monomers

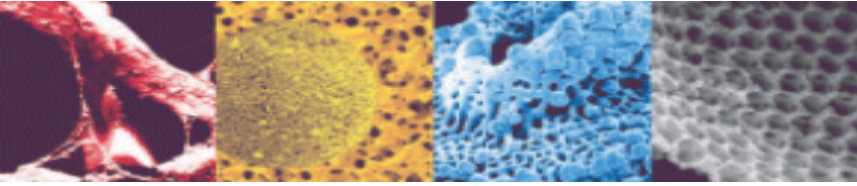
material innovation



the new materials:
bio-plastics



Soybeans as a source for plastic monomers



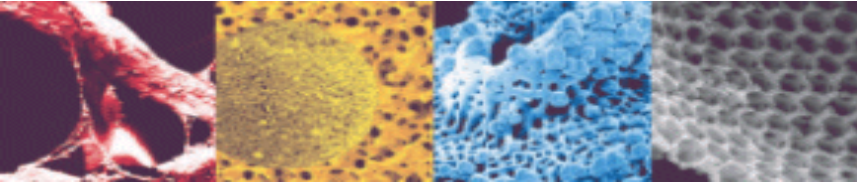
A material can be called a *plastic* if it satisfies three conditions:

- 1] it's main ingredient must be a *polymer* material.
- 2] it must be fluid at some point during processing (usually processed using heat).
- 3] it must be solid in its final form.

Plastics can be made up of many different kinds of polymer, and can be processed in many different ways.

material innovation

the new materials:
what is a polymer?



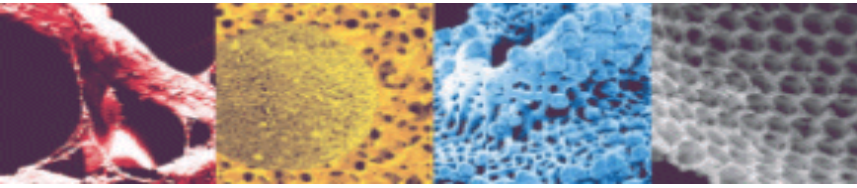
polymers: the basic ingredient

The main ingredient of any plastic is a *polymer*, a type of molecule that takes the form of a long chain.

The word **polymer** comes from two Greek words,
poly meaning *many*
mer meaning *parts*.

So, as the name implies, polymers are made of many parts,
called *monomers* or *monomeric units*, that are chained
together.

material innovation



the new materials:
what are green
plastics? bioplastics

Polymers that occur in nature: *biopolymers*.

Carbohydrates and proteins are biopolymers.

Natural raw materials are abundant, renewable, and biodegradable, making them attractive feedstocks for bioplastics a new generation of environmentally friendly plastics.

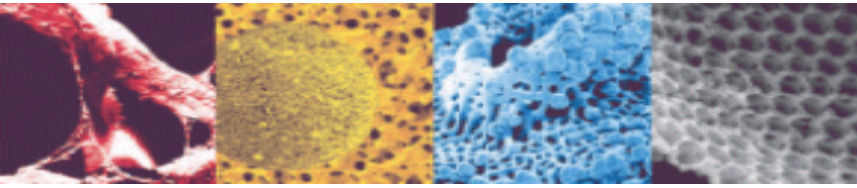
cellulose most plentiful carbohydrate in world; 40 % *organic matter* is cellulose!

starch found in corn (maize), potatoes, wheat, tapioca (cassava), and some other plants. Annual world production is over 70 billion lbs; non-food purposes, like paper, cardboard, textile sizing, and adhesives.

collagen is the most abundant protein found in mammals. Gelatin is denatured collagen.

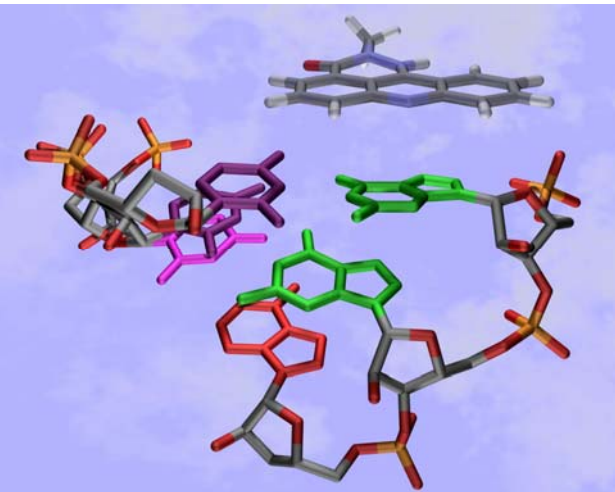
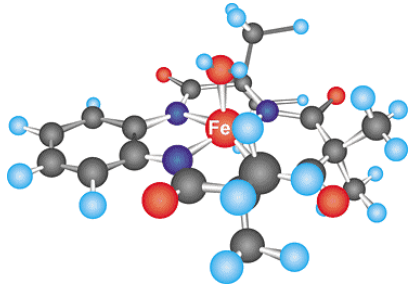
material innovation

the new materials:
what is a polymer?



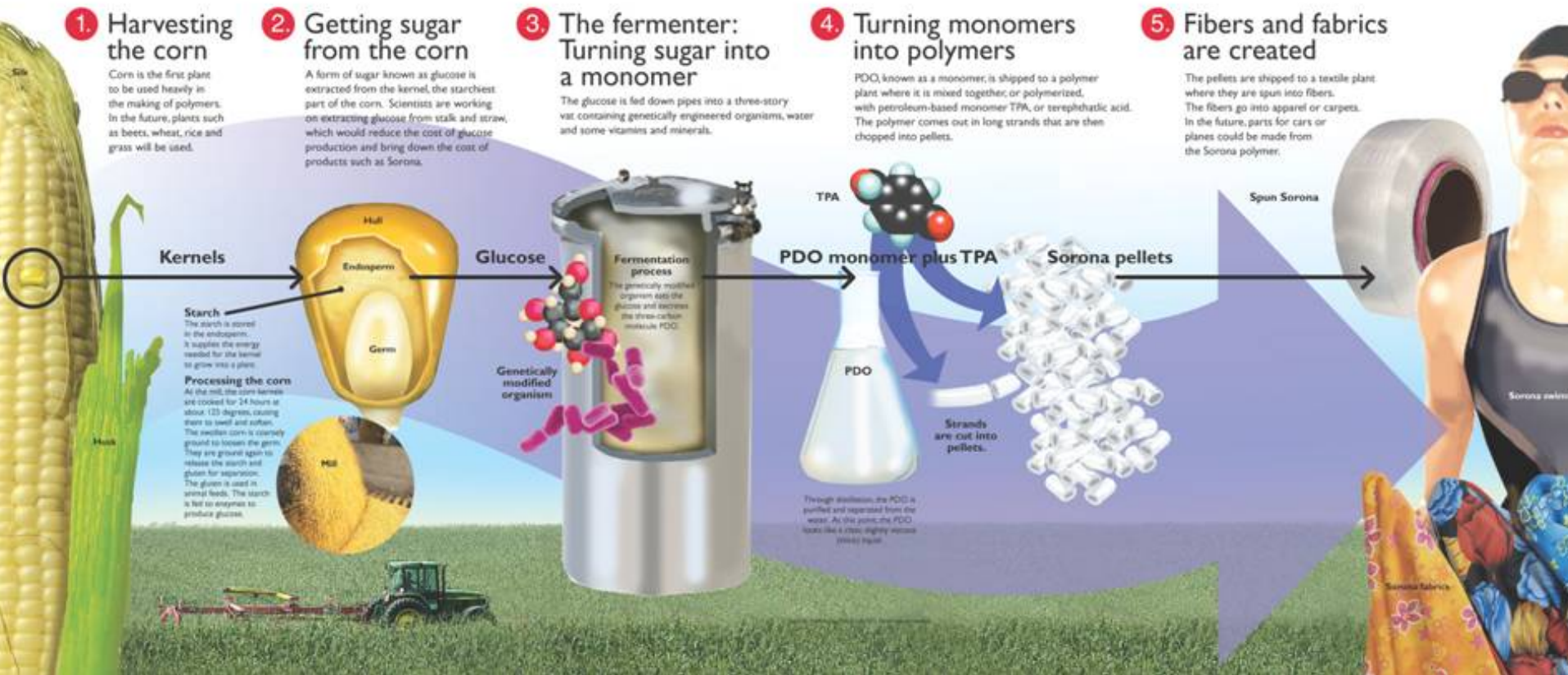
Some polymers are synthetically produced, [nylon and polyester], others can be found in nature: silk, hair, natural rubber, and starch are examples of polymers

Think of chain link fence= cross linked polymer

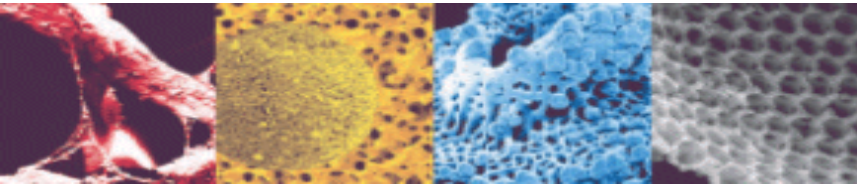


From corn to polymers and fibers

DuPont™ Sorona® is made from naturally occurring starch in the kernels of corn. In the next five years, researchers plan to find ways to use starch from the entire plant.



material innovation



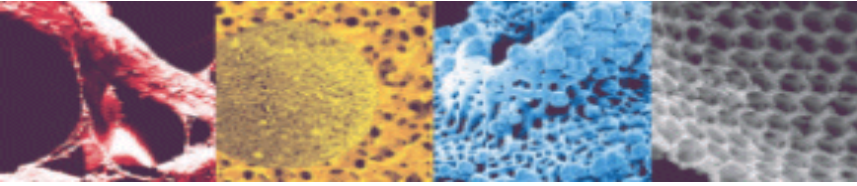
Petroleum use for plastics is relatively new 20th century due to oil boom and cost



the new materials:
bio-plastics



material innovation

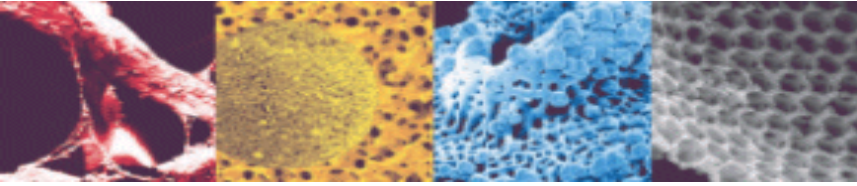


Humans have been utilizing natural materials and cross linking technology for years: weaving composite fibres; mud and straw bricks



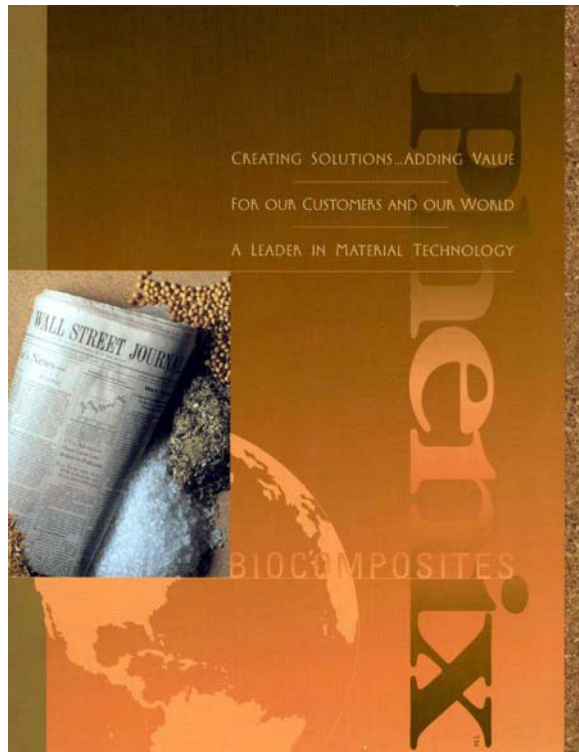
the new materials:
bio-plastics

material innovation



the new materials

reclaimed wood waste, paper, and
soybeans



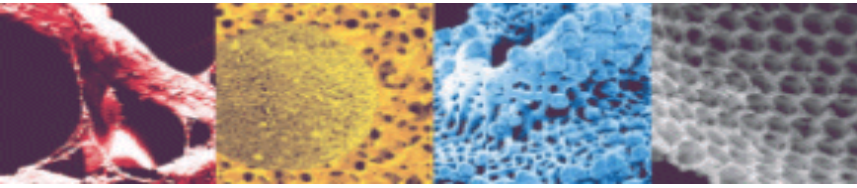
Innovation through material choice

John Caruso MIAD Milwaukee Institute of Art & Design

material innovation

the new materials

Bamboo plywood and products

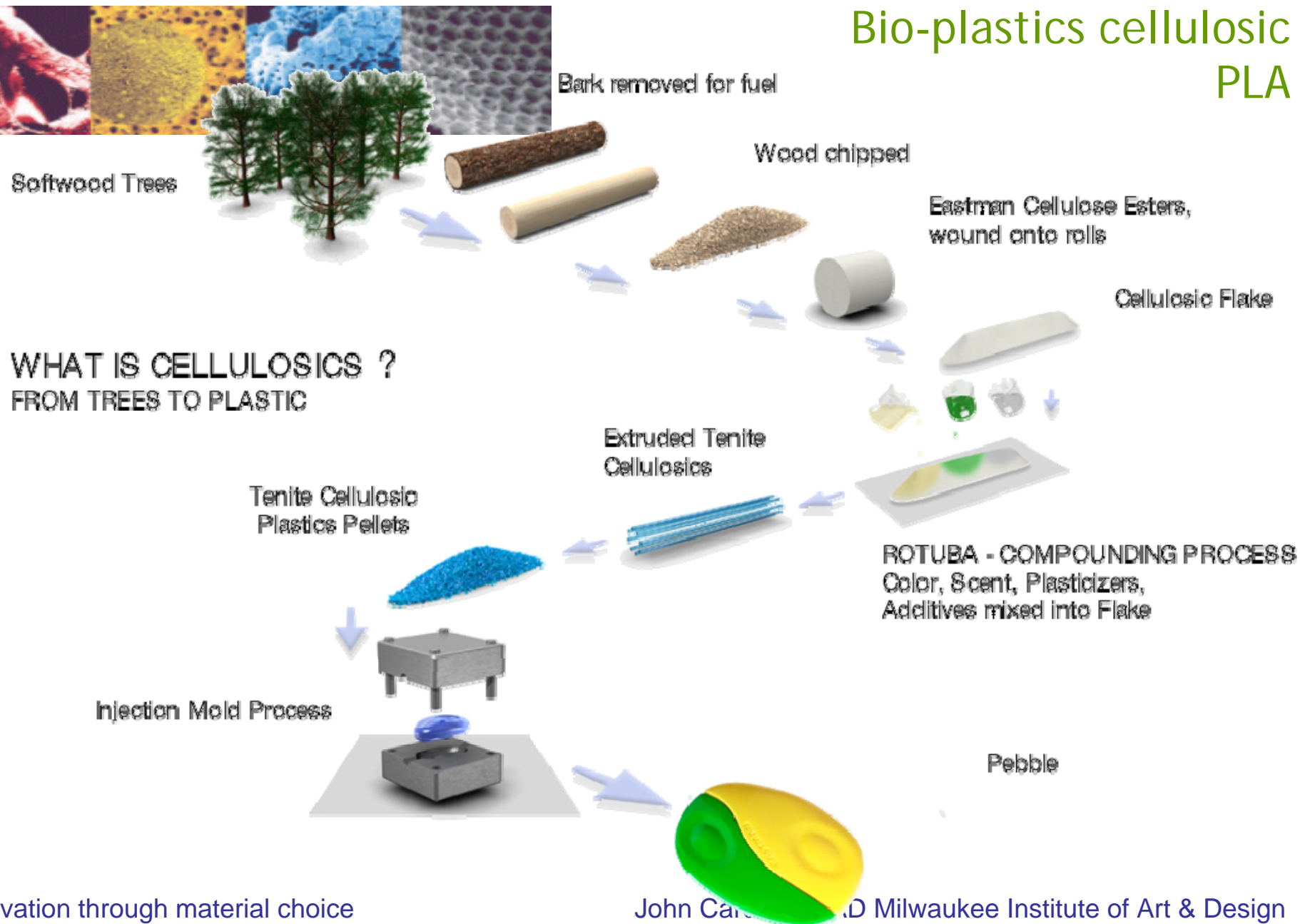


Innovation through material choice

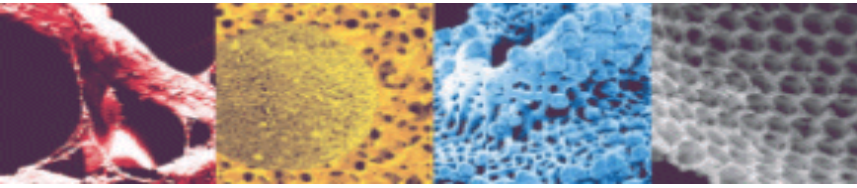
John Caruso MIAD Milwaukee Institute of Art & Design

material innovation

the new materials:
Bio-plastics cellulosic
PLA



material innovation



the new materials

Cellulosics

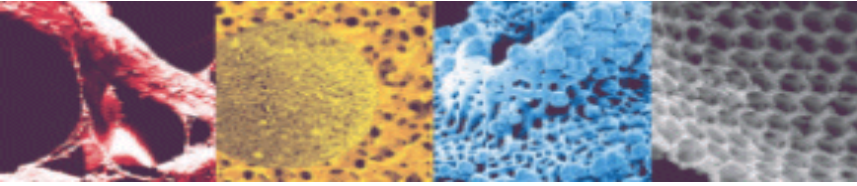
A long colorful American
design history



material innovation

the new materials:

Bio-plastics



Tenite: bio-based plastic made from cellulose.
[cellulosics]



Sensory experience

Touch - scent - visual - sound

Attribute

gloss

clarity

warm to touch

wood-like
sound

precision to
handmade
appearance

Color

0 -100 %
tint

rich
intensity
of hues

Spec. Effects

marbleizing

variegate
(tortoise shell)

fragrance
encapsulation

material
combinations

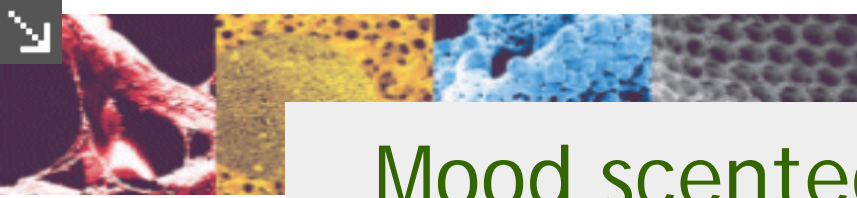
Cellulosics (Tenite™)

Family	Performance	Process
CA CAB CAP	clarity chemical resistance	Primary: molding
'natural plastic'	process flexibility	film & profile extrusion
'clear wood'	tailorable	Secondary: fabrication like wood
derived from wood pulp	weatherable	laminating

Sensory

Touch - scent - sound

Attribute
gloss
clarity
warm to touch
wood-like sound
precision to handmade appearance



Mood scented pebbles



High Energy



Tranquil
Escape

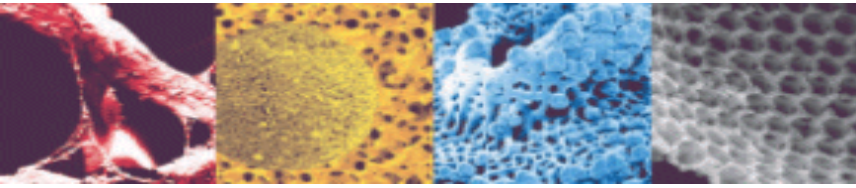


Stress Free



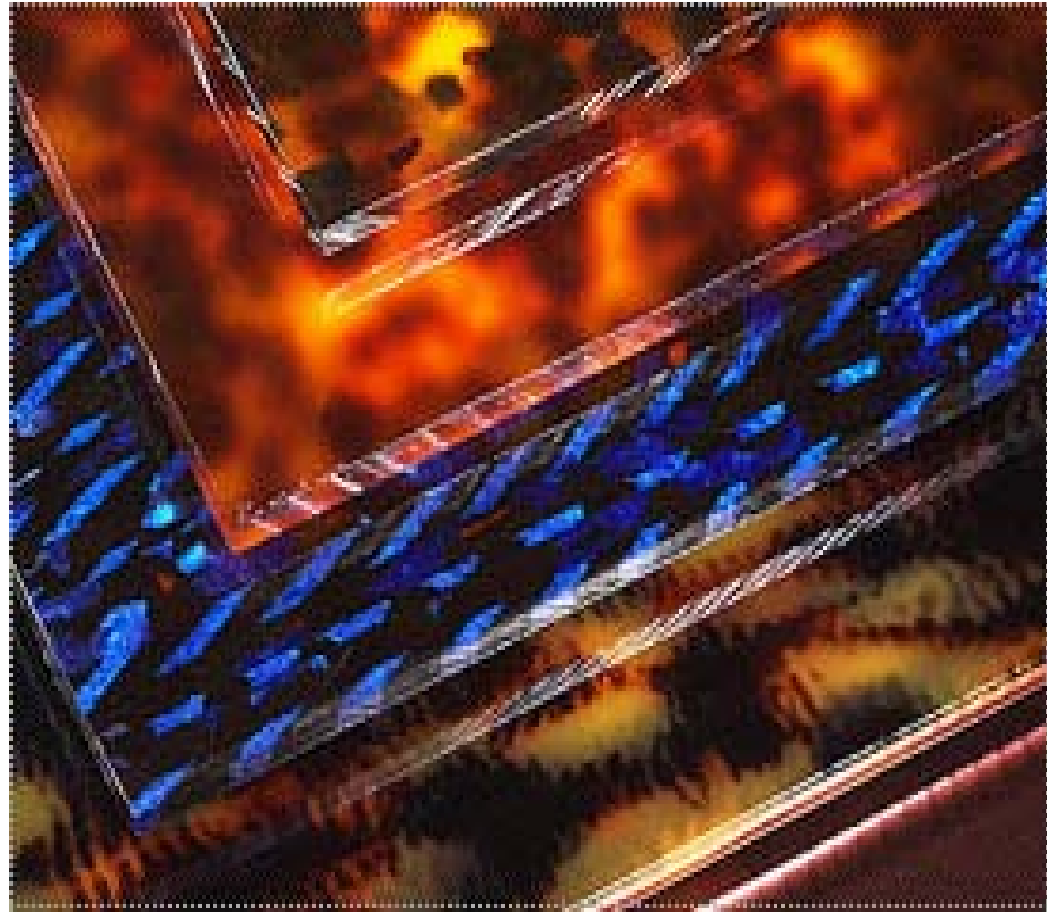
material innovation

the new materials

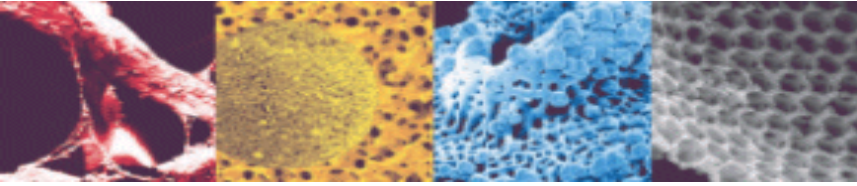


"Cellulosics lend themselves to the manufacture of products with a handcrafted look because they can imitate the nuances and colors of natural products better than other material. They are more relevant now than ever before."

Alessandro Fiocchi
General Manager, Mazzucchelli



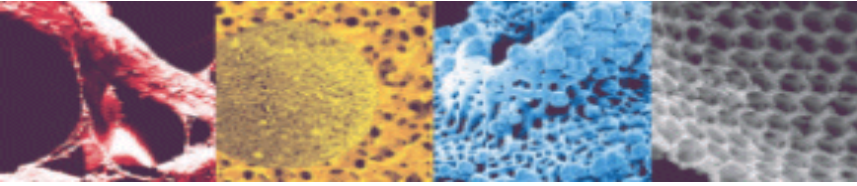
material innovation



strategies

design for reduce reuse recycle

material innovation



strategies

design for reduce reuse recycle

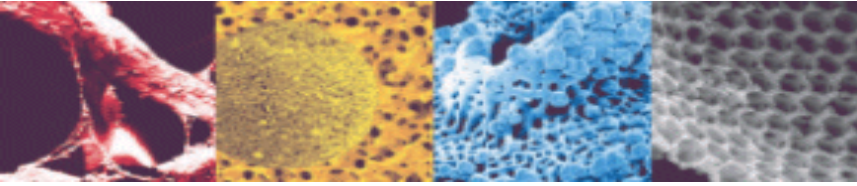
Identify what to reduce and how / why \$\$

Identify what you can reuse and how

Identify what you can recycle and how

How ?

material innovation



case study

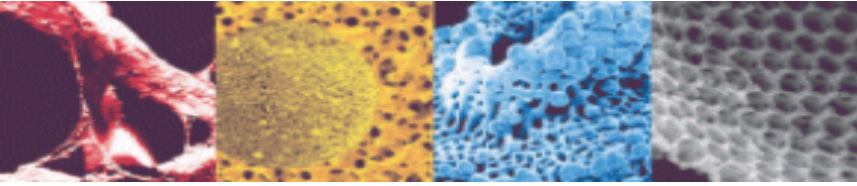
strategies

Identify

design for life cycle assessment [PLA]

Sima pro7 Pre product ecology consultants

material innovation



case study

strategies

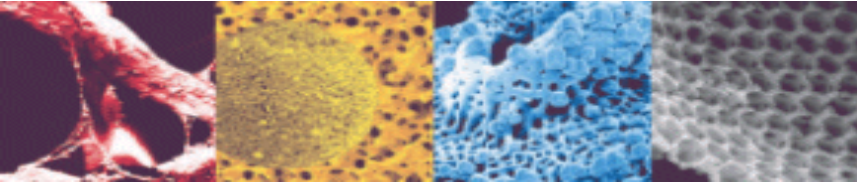
Identify

design for life cycle assessment

- 1 Classification and characterization
- 2 Normalization
- 3 Evaluation or weighting

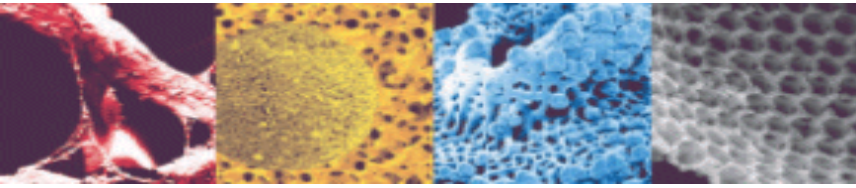
Sima pro7 Pre product ecology consultants

material innovation



case study





strategies

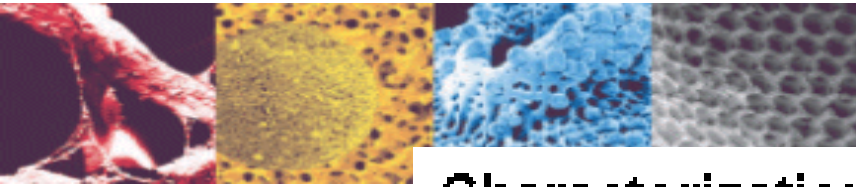
design for life cycle assessment

1. Classification and Characterization

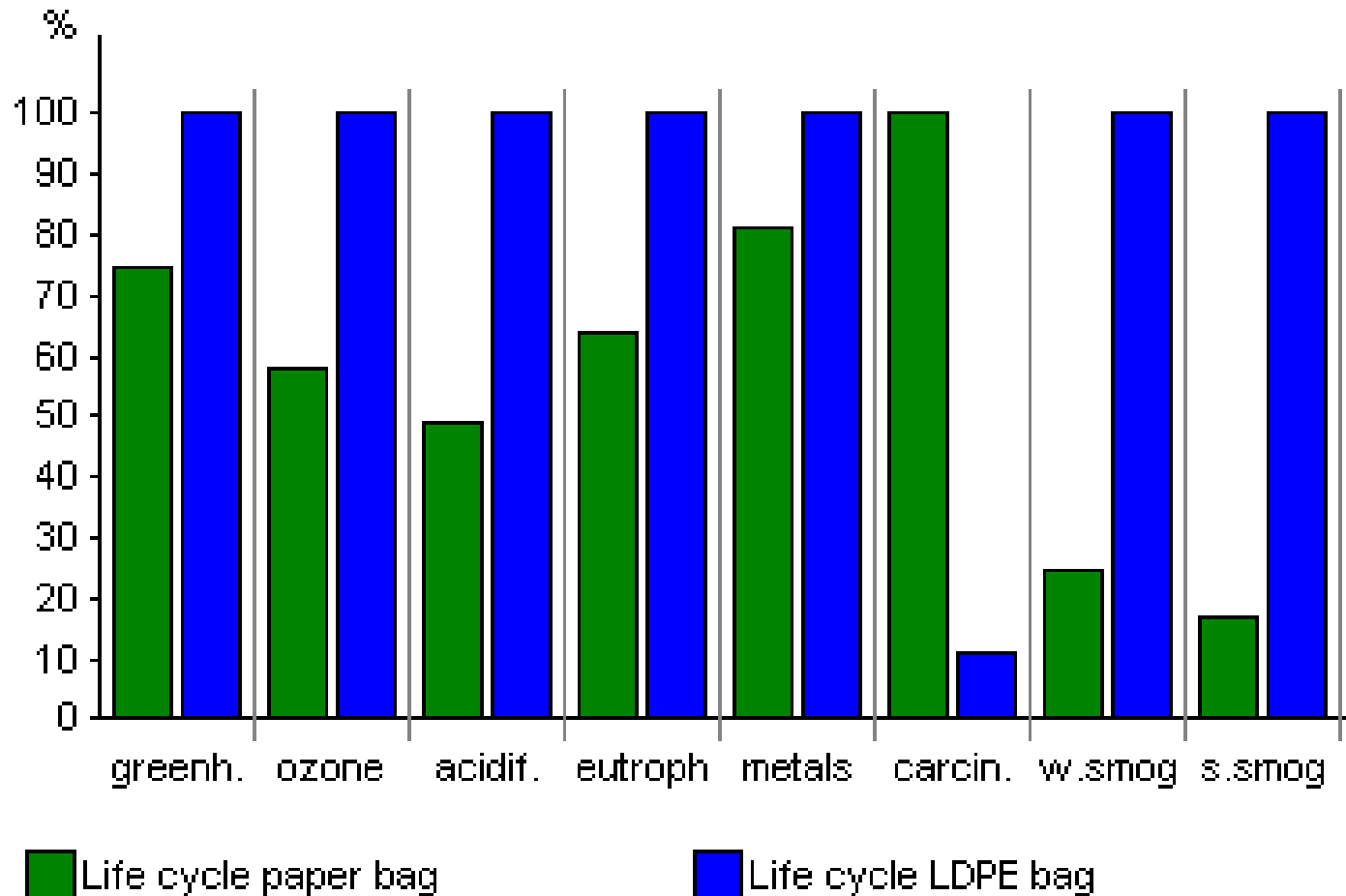
In the classification step, all substances are sorted into classes according to the effect they have on the environment.

For example, substances that contribute to the greenhouse effect or that contribute to ozone layer depletion are divided into two classes. Certain substances are included in more than one class. For example, NO_x is found to be toxic, acidifying and causing eutrophication.

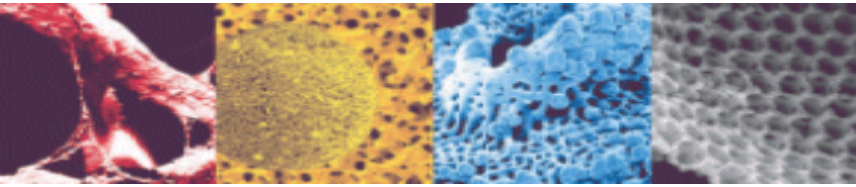
Sima pro7 Pre product ecology consultants



Characterization of paper and LDPE bag life cycles



Sima pro7 Pre product ecology consultants



strategies

design for life cycle assessment

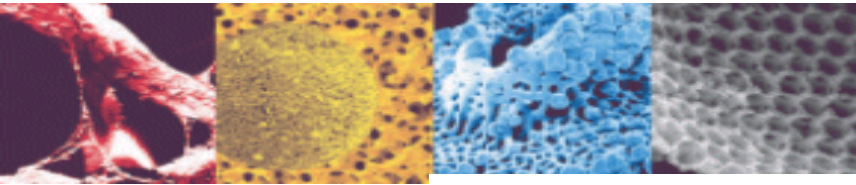
2. Normalization

Each effect calculated for the life cycle of a product is benchmarked against the known total effect for this class.

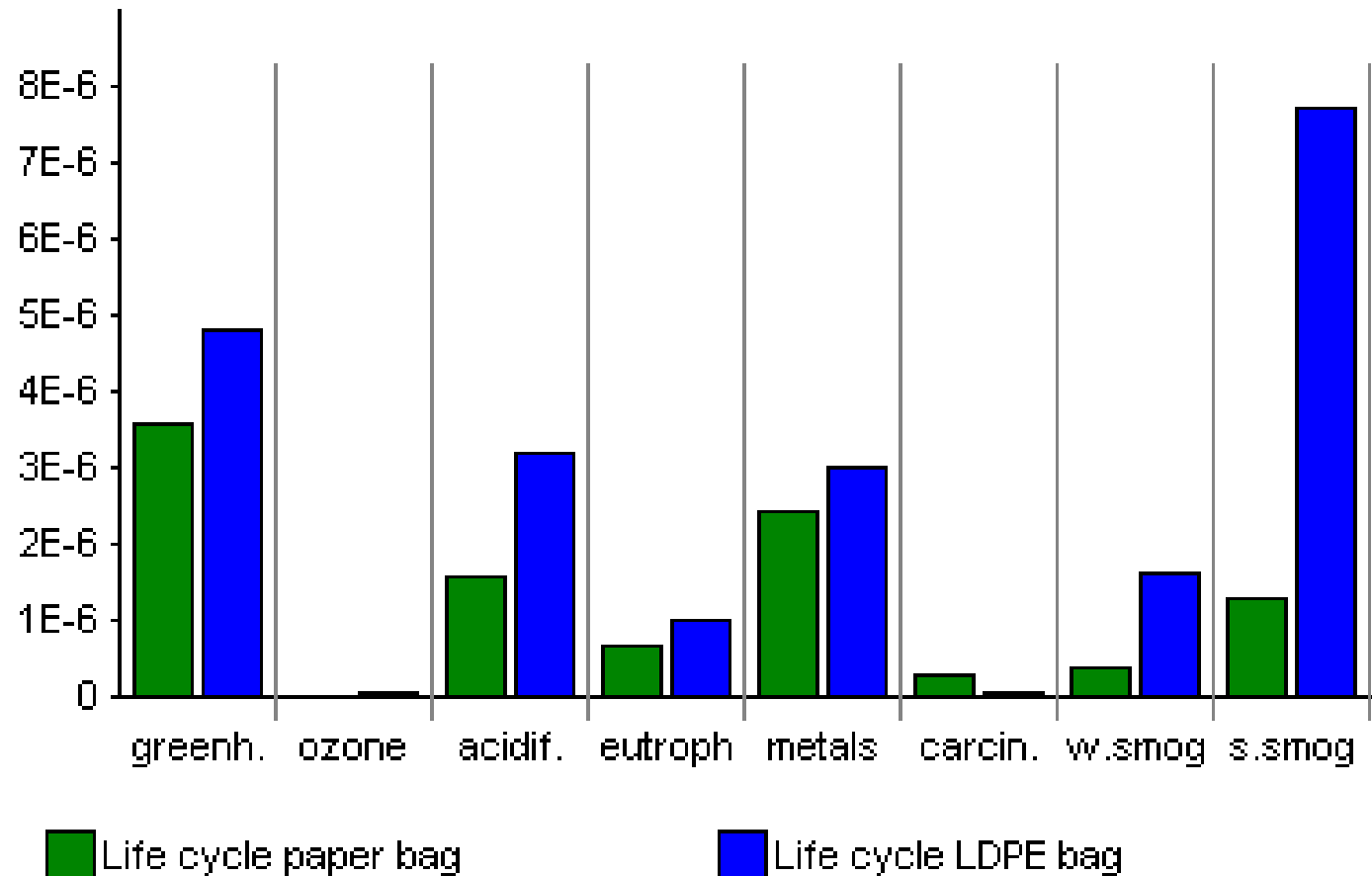
Normalization enables you to see relative contribution from material production to each already existing effect.

Normalization improves insight into results.

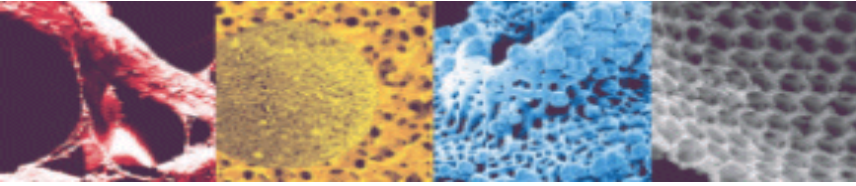
No final judgment can be made as not all effects are considered to be of equal importance.



Normalization of paper and LDPE bag life cycles



Sima pro7 Pre product ecology consultants



strategies

design for life cycle assessment

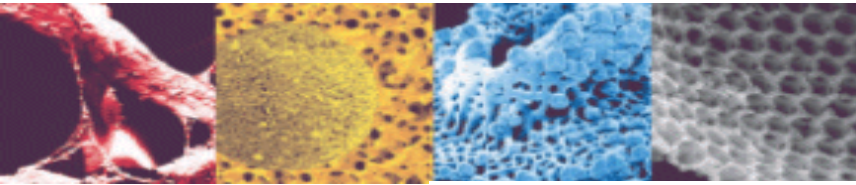
3. Evaluation and weighting

Evaluation phase: normalized effect scores are multiplied by a weighting factor representing the relative importance of the effect.

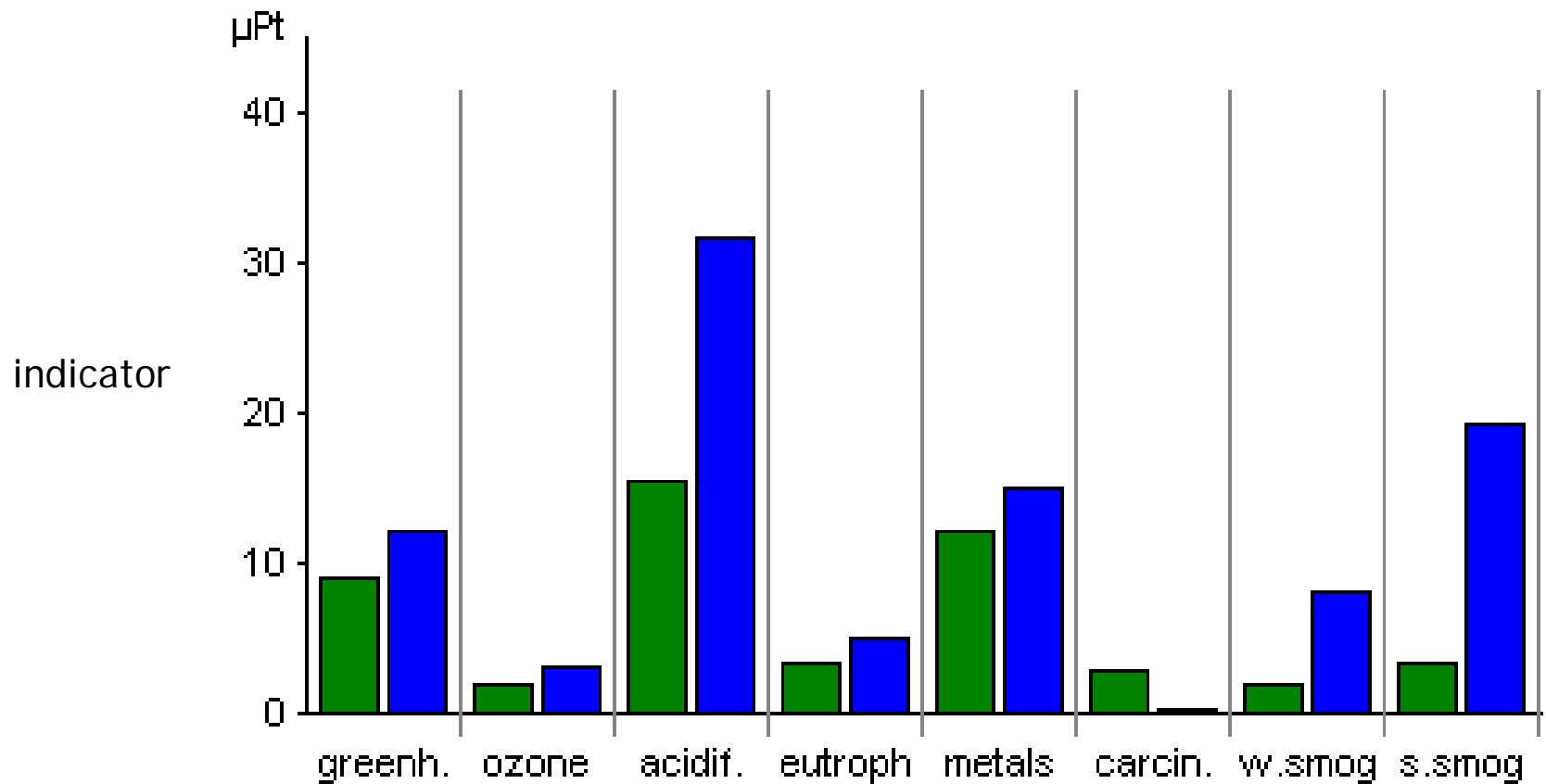
After weighting the relative importance of normalized effect scores are added.

After weighting, ecotoxicity has clearly gained in significance

The length of the columns represents the seriousness of the effects. This makes it possible to add the columns to calculate a final result.

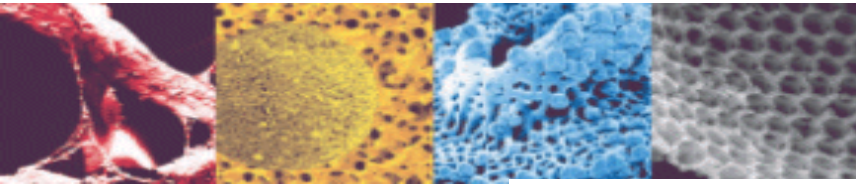


Evaluation of paper and LDPE bag life cycles

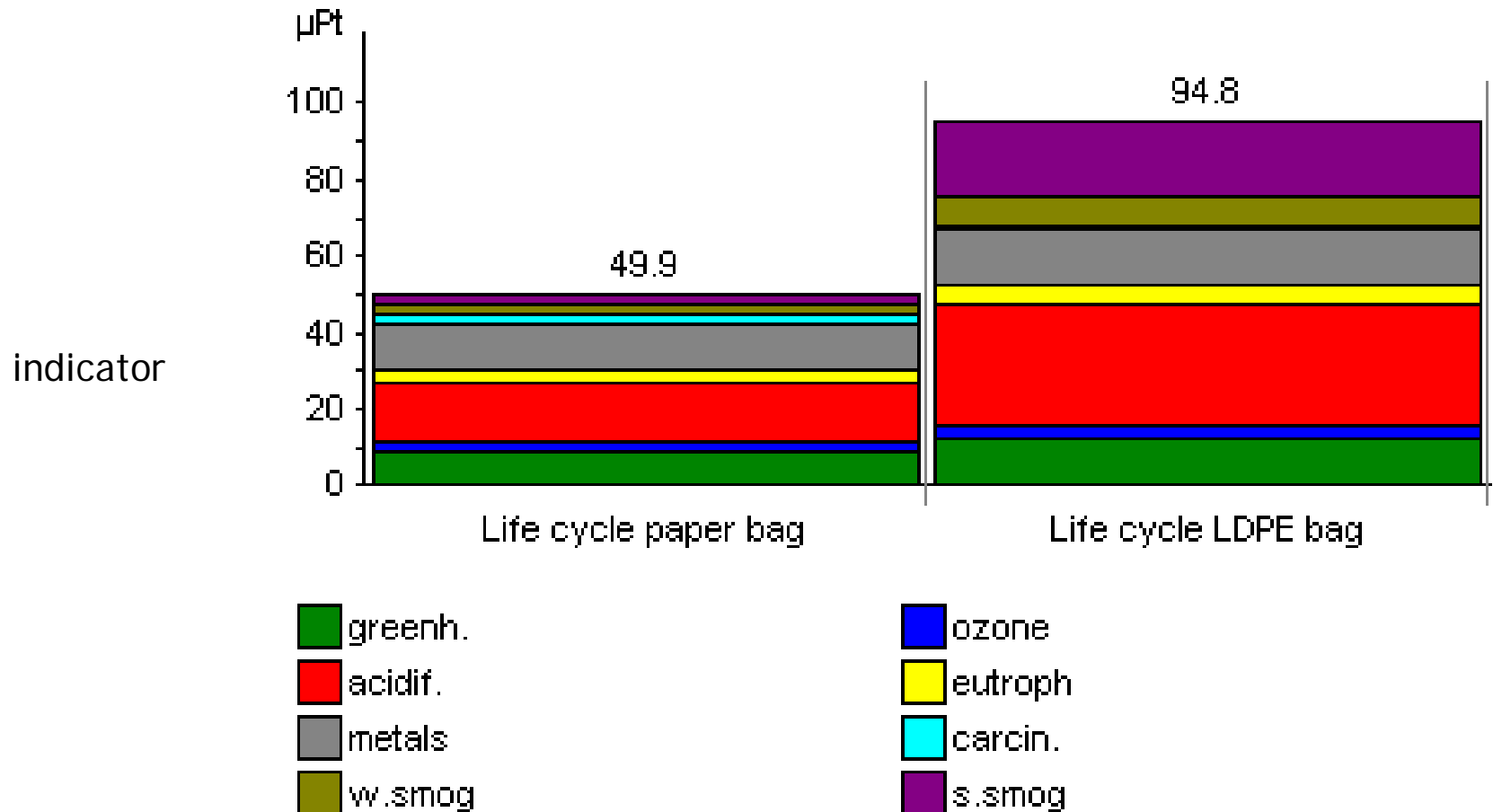


Life cycle paper bag

Sima pro7 Pre product ecology consultants
Life cycle LDPE bag

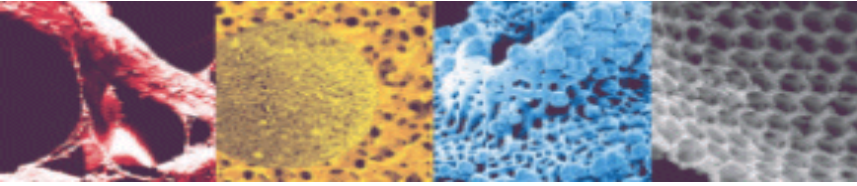


Indicator of paper and LDPE bag life cycles



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material innovation

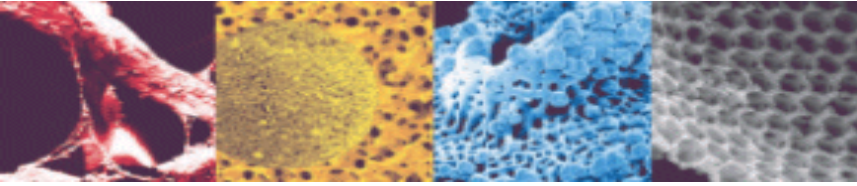


strategies

where do we go from here?

one possible future

material innovation



If we continue business as usual ...

Post apocalyptic wasteland

no trees

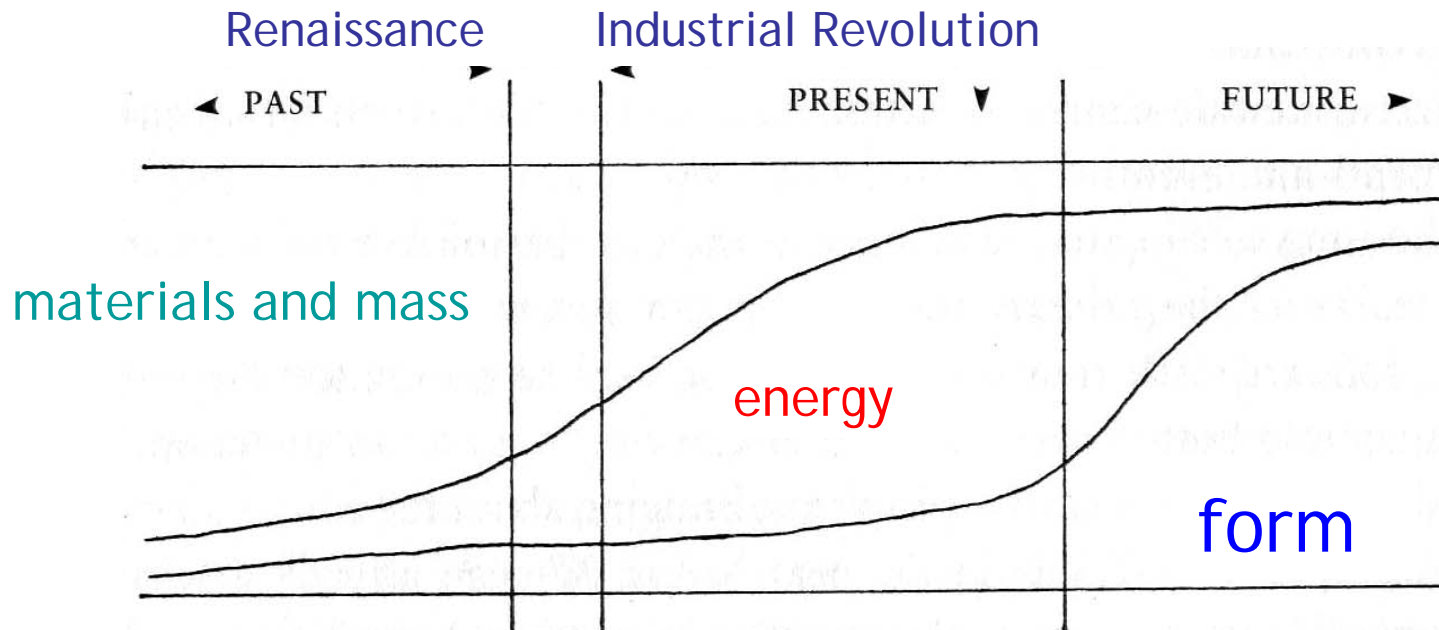
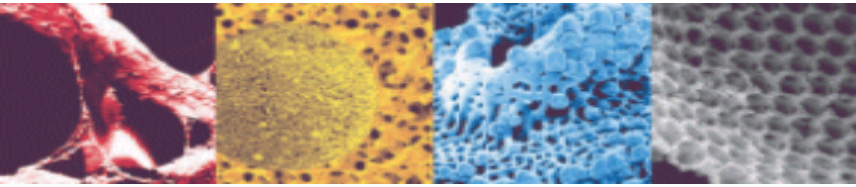
a computer controlled environment

cybernetic life support devices
implanted in our bodies



material innovation

form

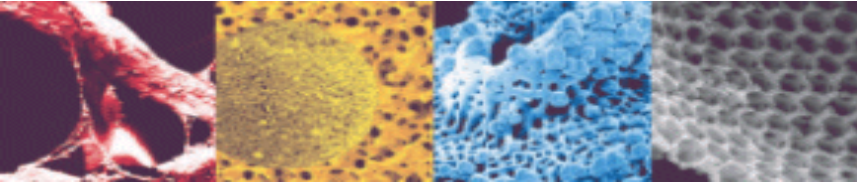


This suggests that all of civilization from its beginning through the Middle ages, was relatively unchanging in most basic ways. The materials available for human constructions remained the same. [wood stone and metals]

we are in the age of form

material innovation

form



strategies

design for reduce reuse recycle

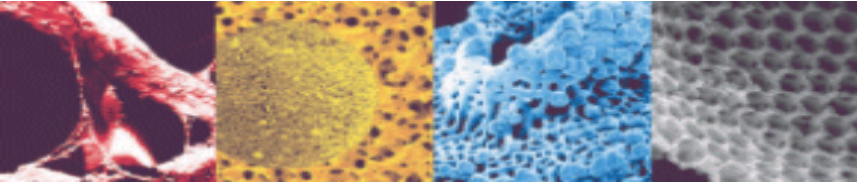
design for multi-use

design for nest gang stack

design for beauty

material innovation

the new materials



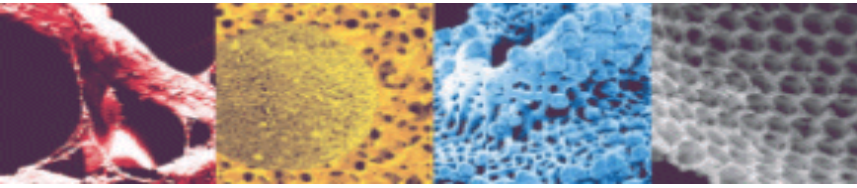
Strategies

design for reduce reuse recycle



Natura line of cosmetics

material innovation



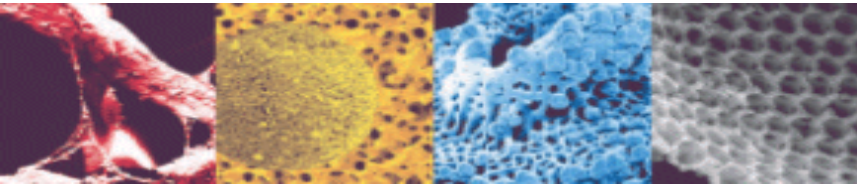
the new materials

Strategies - reduce
One time purchase of housing
refillable insert with product



Natura line of cosmetics

material innovation



Strategies - reduce
mapping parts for minimum use of
materials, blank forms the package

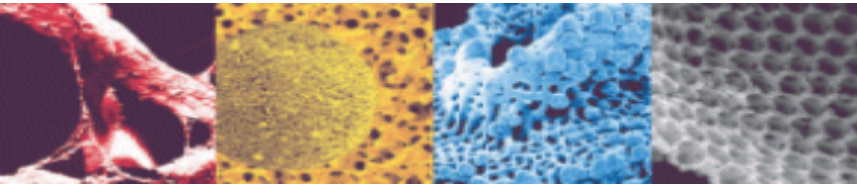
form



Innovation through material choice

John Caruso MIAD Milwaukee Institute of Art & Design

material innovation



Strategies - re-use

Remolded paper and wood waste

form

material

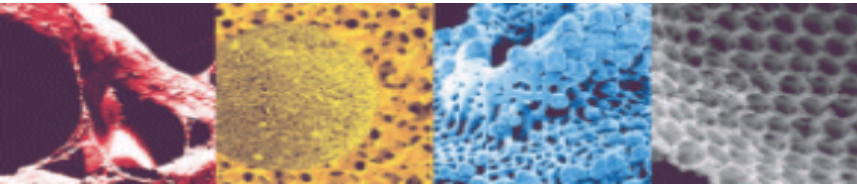


Innovation through material choice

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material innovation

form



Strategies - re-use

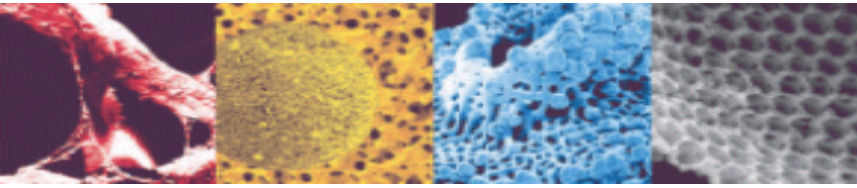
Re organizing matter

Banners and truck tarpaulins cut up
and turned into bags



material innovation

form



Strategies - re-use

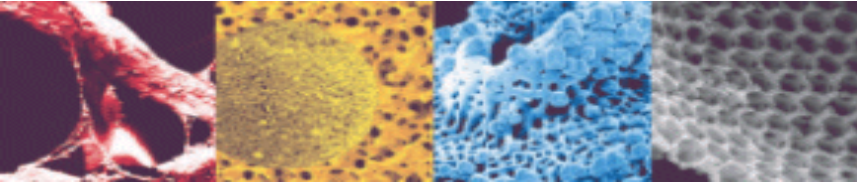
Re organizing matter

Plastic hangers arranged as
chandelier



material innovation

form



strategies

design for reduce reuse recycle

design for multiuse

design for nest gang stack

design for beauty

material innovation

form

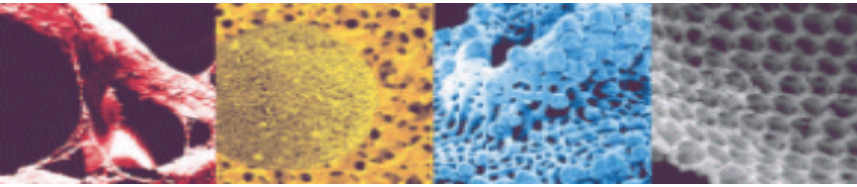


table / lamp
table / chair
Netherlands



Table lamp and table chair

Dual-function design is pared down to its ultimate simplicity in Richard Hutten's witty yet practical furniture. He demonstrates the same thoughtful economy, bordering on the austere, in the Table Lamp and Table Chair, pragmatic and lovable designs which will be cherished.

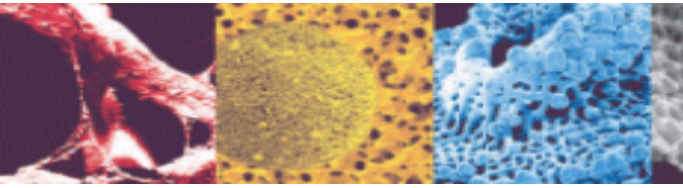
	Richard Hutten, Netherlands	307
	Limited batch production, REEEL, Netherlands	323
	Beechwood, MDF, metal	395, 339
	• Dual-function designs • Economy of materials usage	327, 323



Multifunctional

material innovation

form



Child hi chair / rocker Finland

material innovation

form

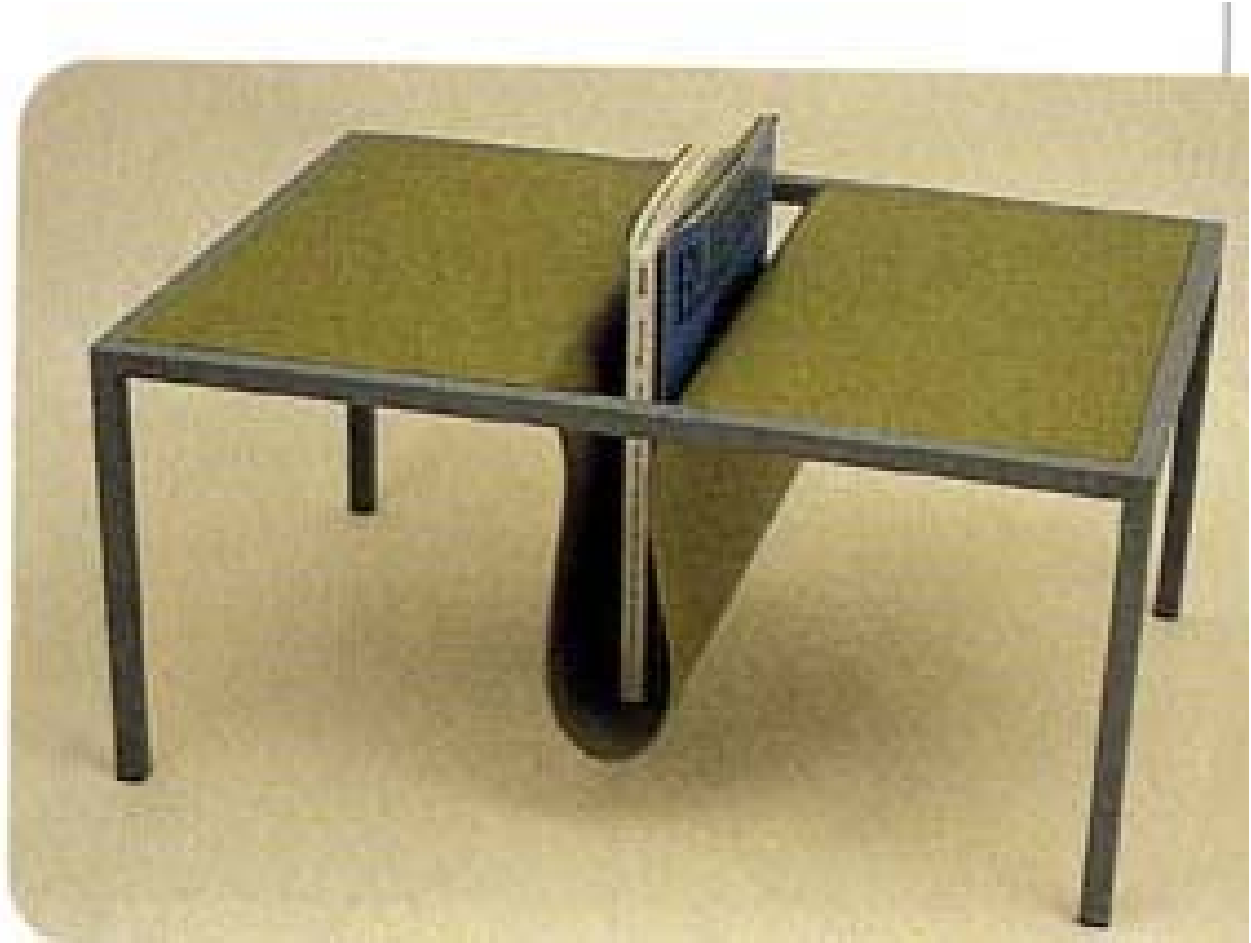
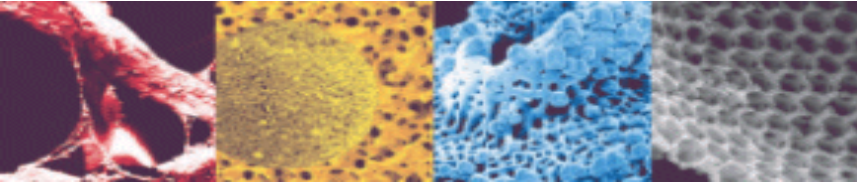
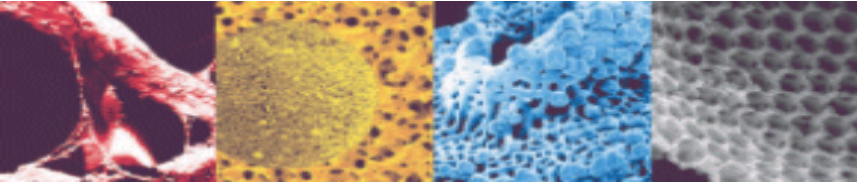


Table / magazine rack

material innovation

form



strategies

design for reduce reuse recycle

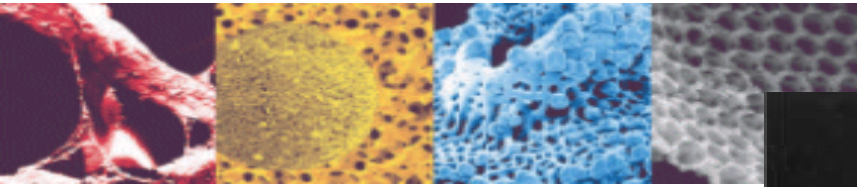
design for multi-use

design for nest gang stack

design for beauty

material innovation

form



design for nest gang stack

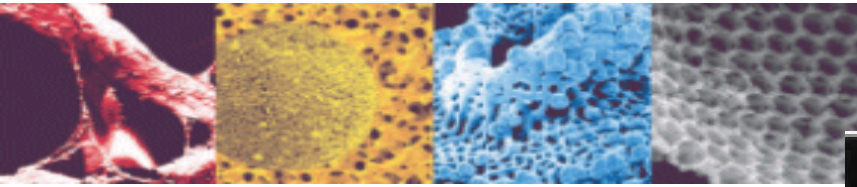


Innovation through material choice

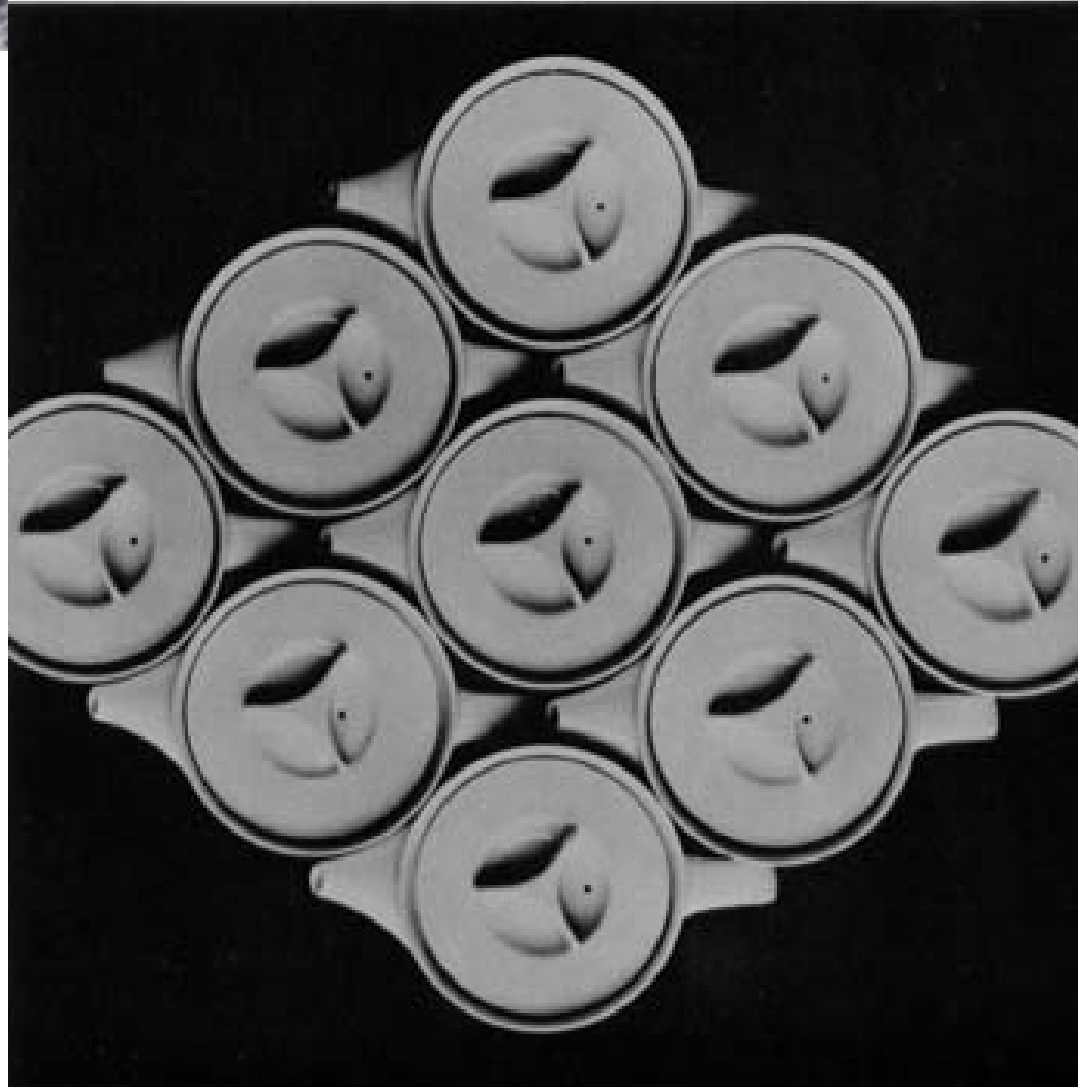
John Caruso MIAD Milwaukee Institute of Art & Design

material innovation

form

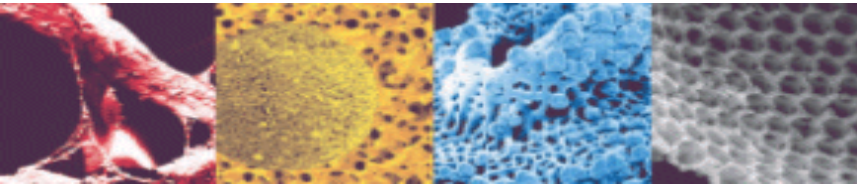


design for nest gang stack



material innovation

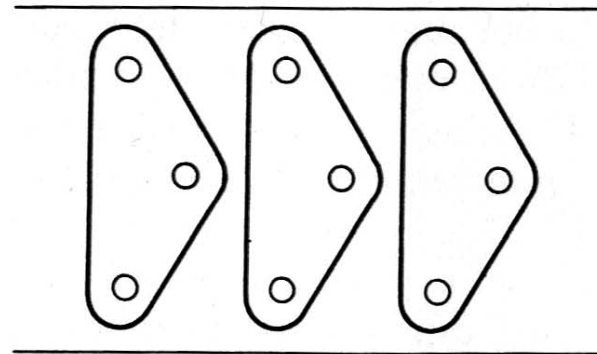
form



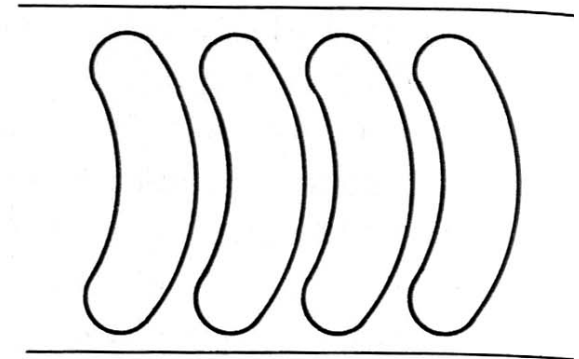
design for nest gang stack

Simple metal bracket

Stamping

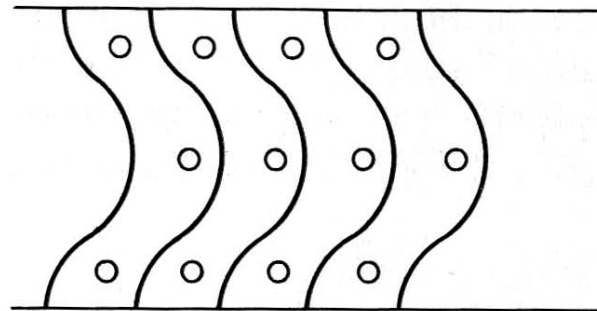


(a)

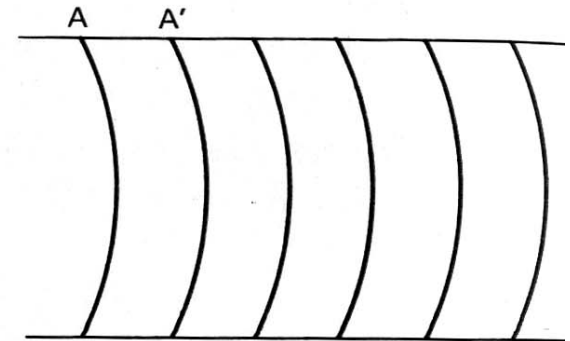


(b)

Improved for better
nesting on raw roll
sheet stock

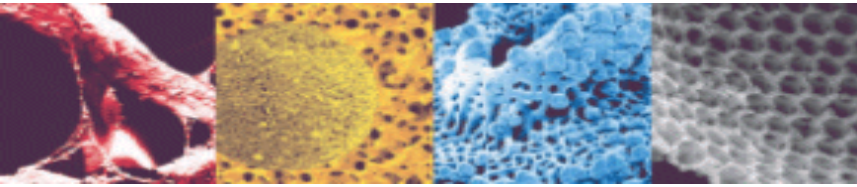


(c)

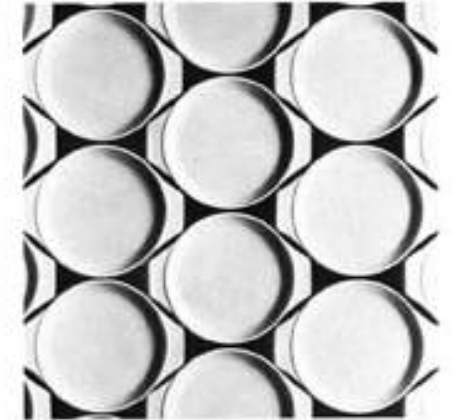
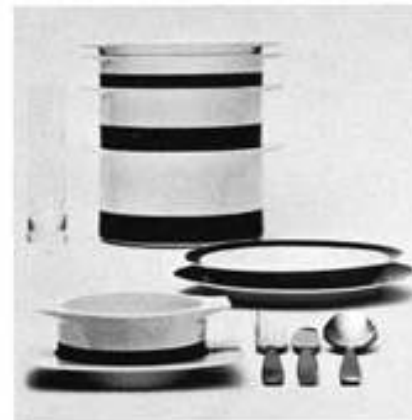


(d)

material innovation

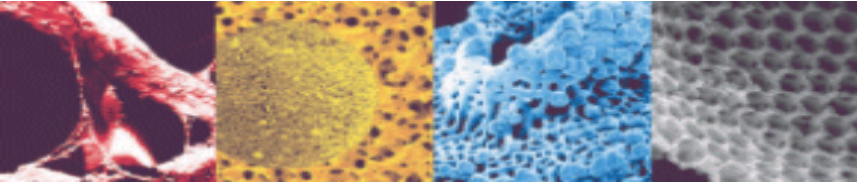


design for nest gang stack



material innovation

form



strategies

design for reduce reuse recycle

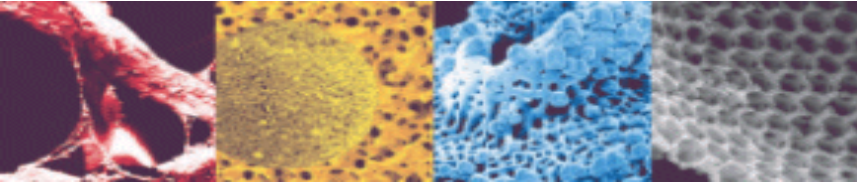
design for multi-use

design for nest gang stack

design for beauty

material innovation

form



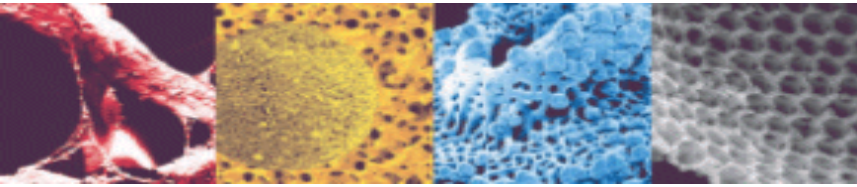
strategies

beauty

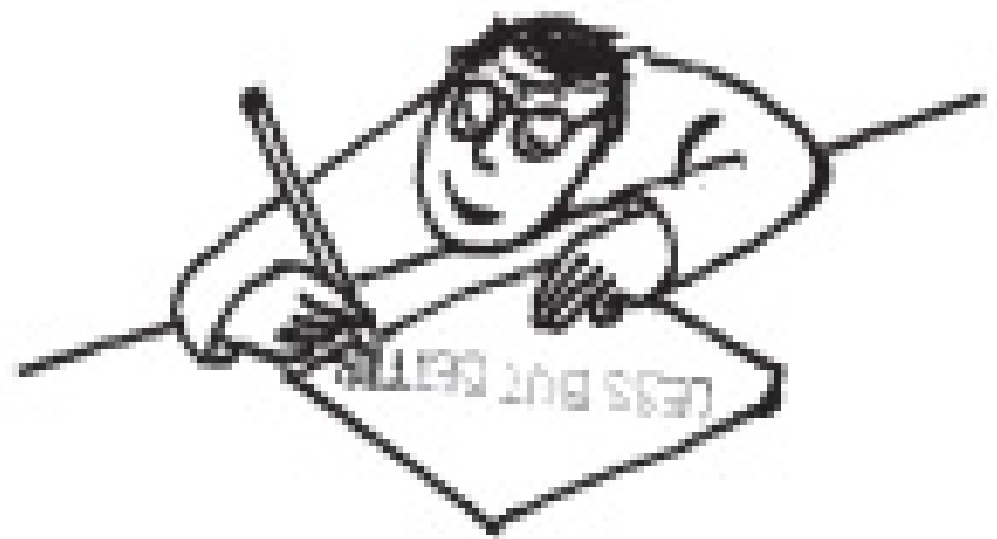
minimal use of material

weniger aber besser

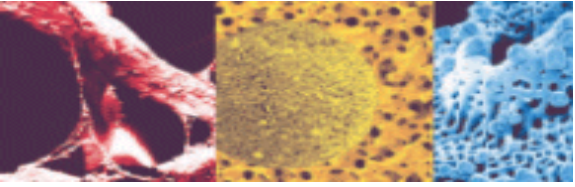
material innovation



"weniger aber besser!"
less but better - dieter rams



material innovation



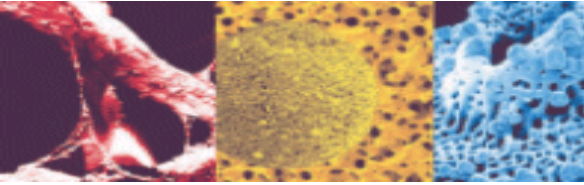
form



Kitchen tools Finland

material innovation

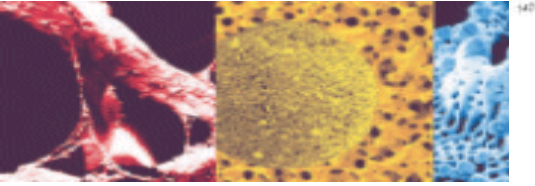
form



Wooden chair Finland

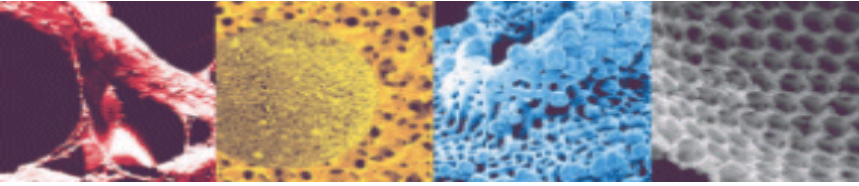
material innovation

form



Iron cook pot

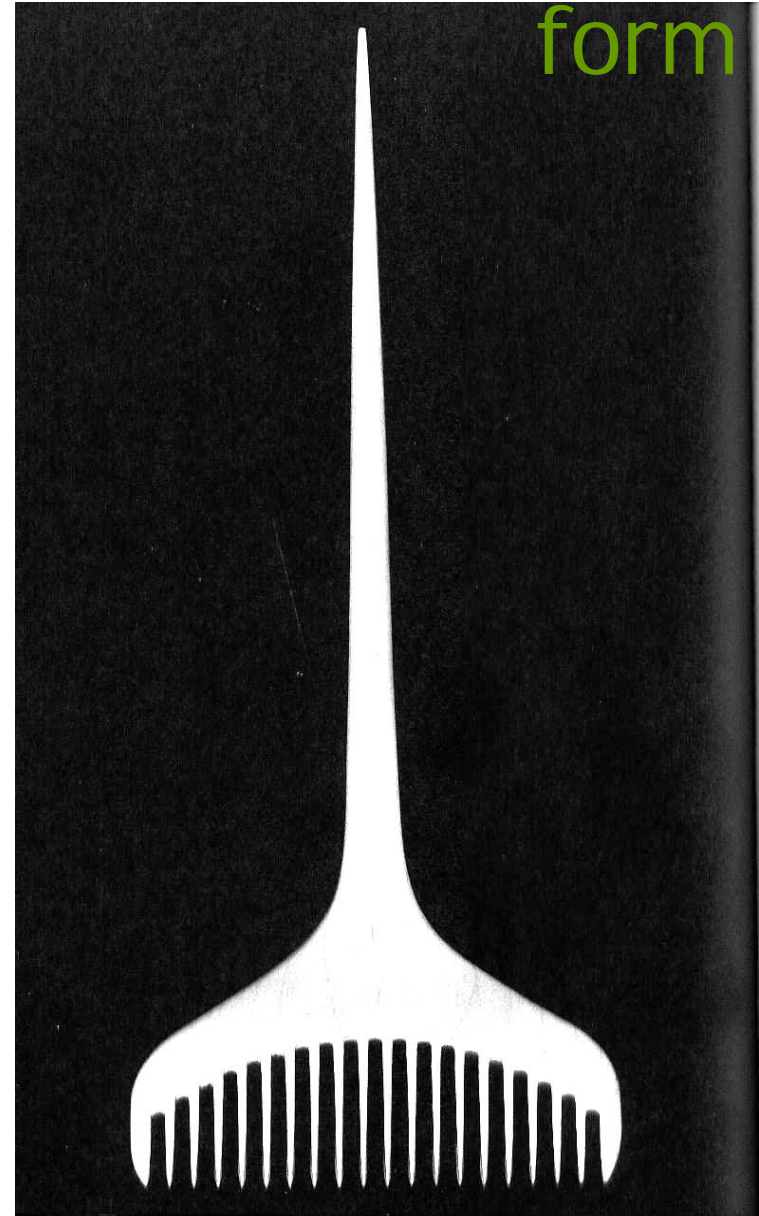
material innovation



Bamboo comb

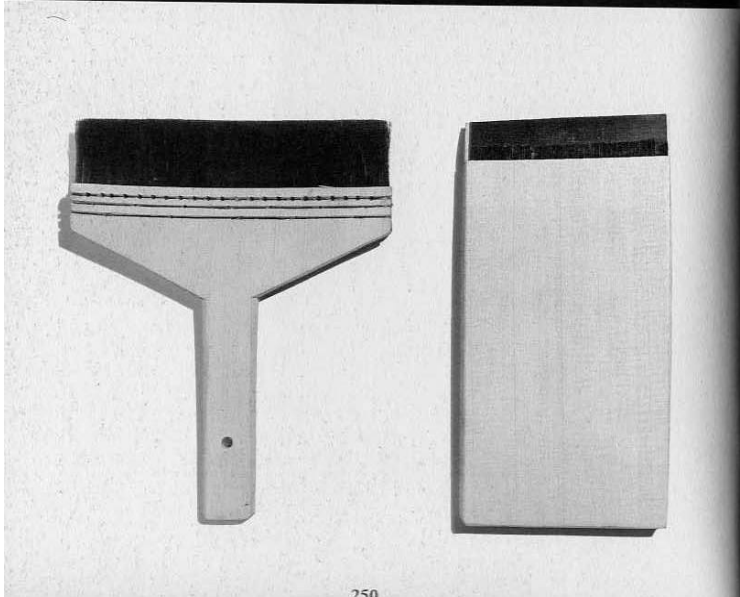
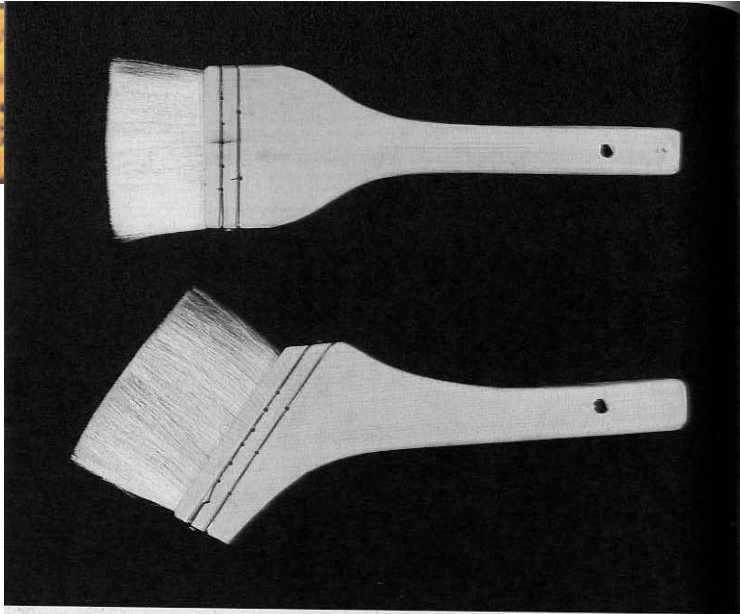
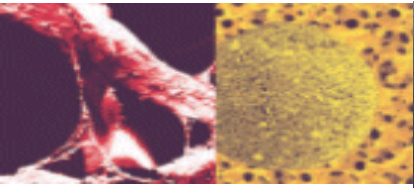
Innovation through material choice

form



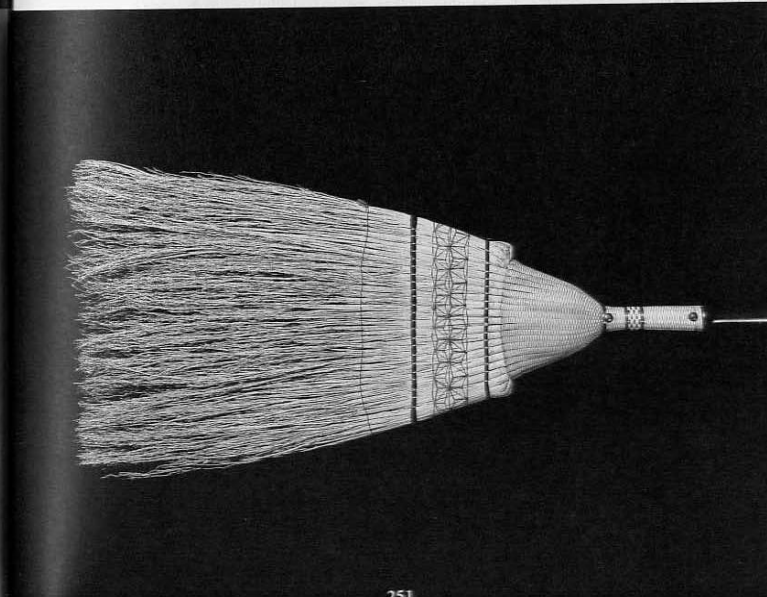
John Caruso MIAD Milwaukee Institute of Art & Design

material innovation

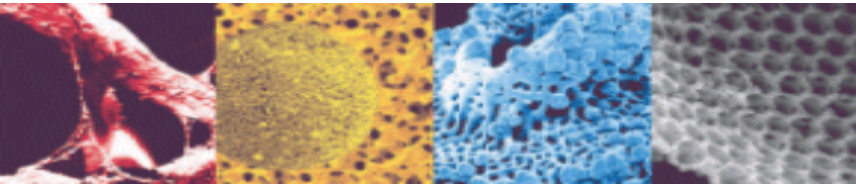


brooms
straw and wood

form



material innovation



form

Floor, Table and Miscellaneous

1.0 Objects for Living



PO/9902C-D

Framing the bulb not only focuses the viewer on the light source but also provides a protective package during distribution and retailing.

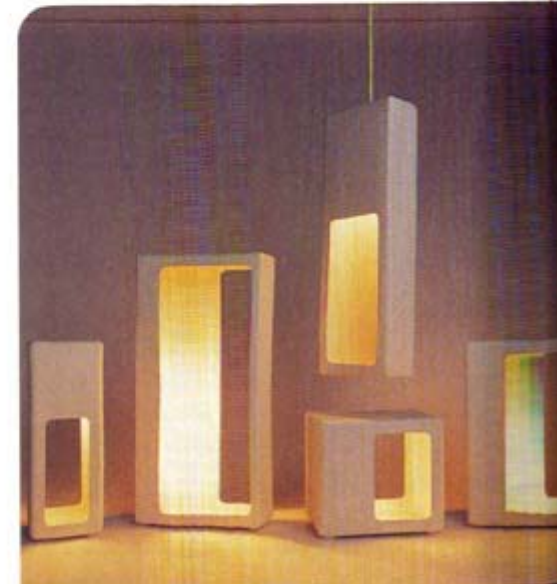
Jeffrey Bennett, UK	100%
Cappellini SpA, Italy	100%
Cardboard, lampshade	100%
Economy of materials usage	100%



Soft Box

Special clays are fashioned into durable lighting units. Ceramics are traditionally used for bases for table lamps but here the material forms the base and the shade.

Maria Miere, Netherlands	100%
Prototype	100%
Earthenware, porcelain	100%
Abundant, inorganic materials	100%

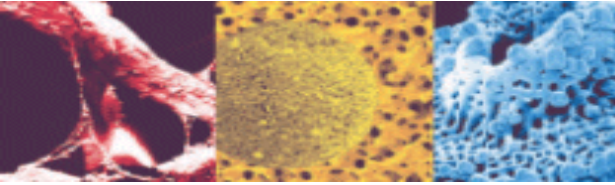


Cast ceramic housing

100

material innovation

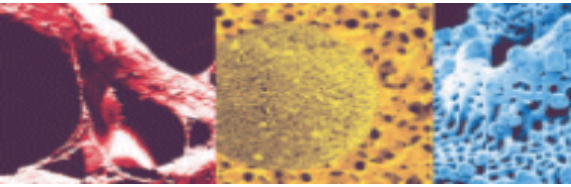
form



Glass flask with
rattan handle

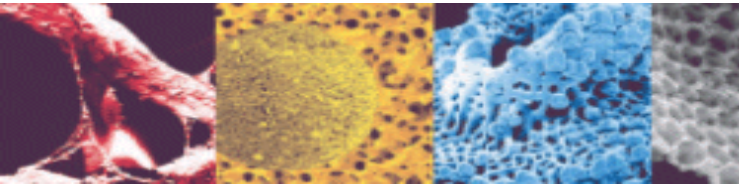


material innovation



Misc wood
and rattan
Finland

material innovation

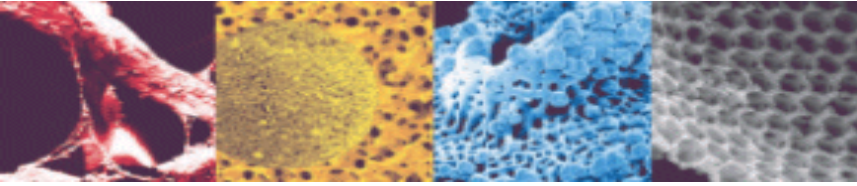


corn starch based plastics
Brain Dougherty USA

form



material innovation



“Papcorn” wheat corn starch
based plastics Denmark

Innovation through material choice

form
material

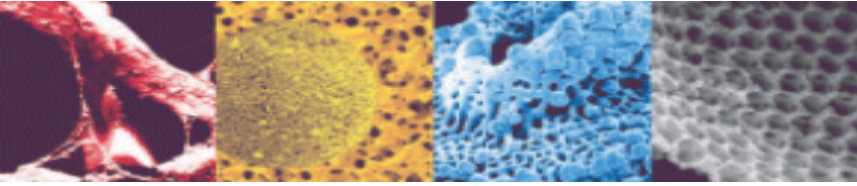


01. Sushi set
02. Papcorn is light, flexible,
and compact
03. Dinner set complete
with spoon

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material innovation

form

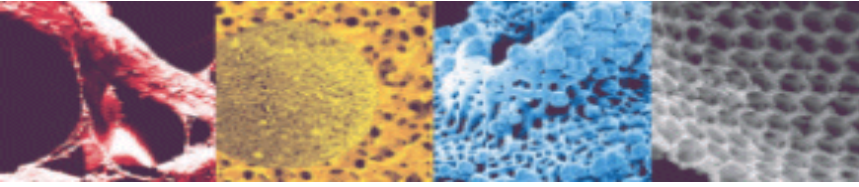


Plantation
grown
sustainable
rubberwood

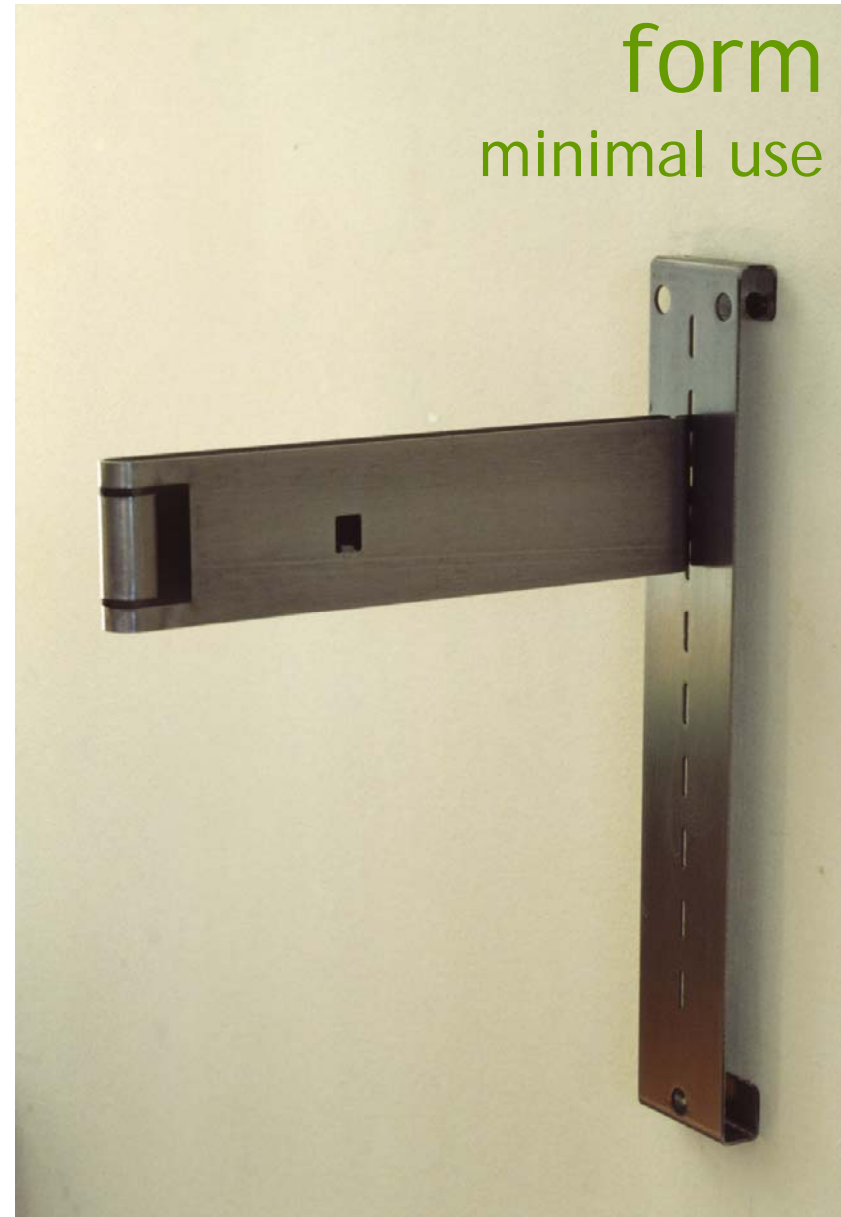


Chip n dip
Caruso for Crate & Barrel

material innovation

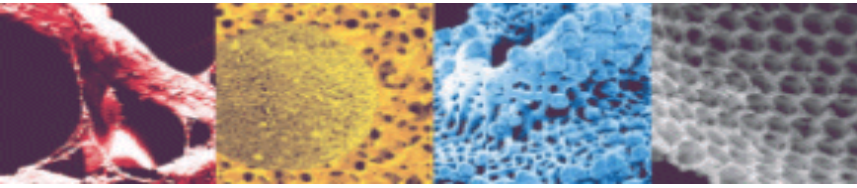


Lamp bracket steel Caruso



form
minimal use

material innovation



form

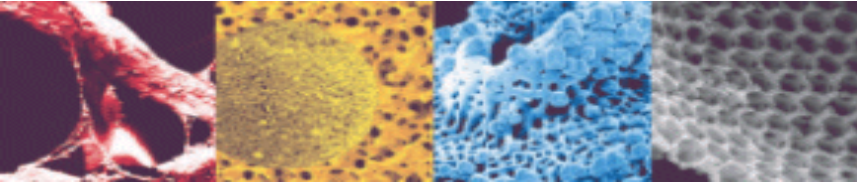
solar cell powered



Solar lights for Target Caruso

material innovation

form



Rational and minimally designed forms can be beautiful expressions of material and function. caruso 2004

I think it's more about re-organization and the removing of material than the adding of it.

caruso 2004

Solar cell powered
scale

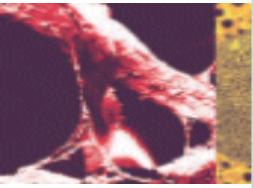
For Tanita



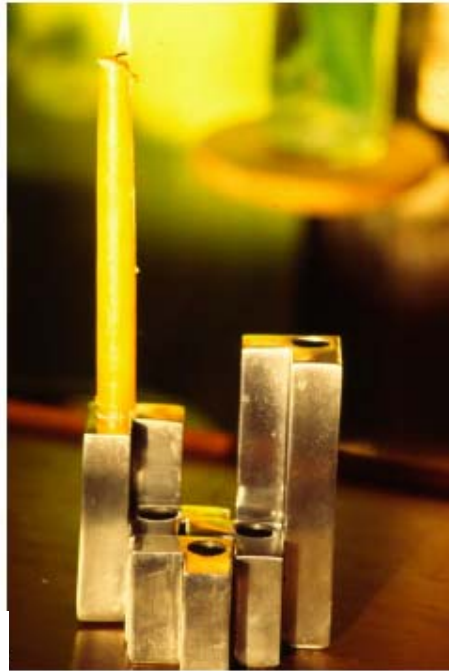
Sustainable rubber wood



Innovation through material choice



For Design Ideas



Post consumer recycled aluminum



For Design Ideas

If an object is to be made, it must be made in such a way as to have as minimal an impact on the environment as possible. Caruso 2004

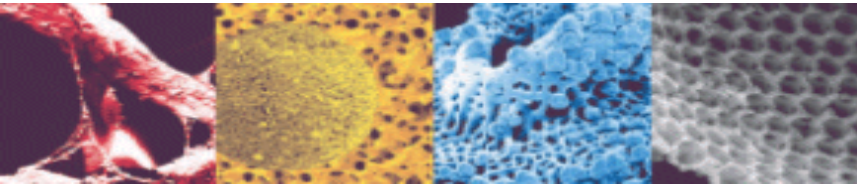
We can no longer live in the throw-away society.

The grid contains the following items:

- Row 1:** A wooden shelving unit with a checkered pattern; a beige, organic-shaped stool; a blue and black patterned bag; a wooden box and a grey, curved object.
- Row 2:** Two colorful, abstract stools; a cylindrical object made of stacked logs; a yellow bottle with a 'C' logo.
- Row 3:** A modern house with large glass windows; a white, hourglass-shaped lamp; a wooden chair with a metal frame; a wooden folding table.
- Row 4:** A dark, textured surface; a wooden stool; a patterned bag with 'MT. VERNON' text; a black bag with a white silhouette design.

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material innovation



Understanding the multidisciplinary nature of Life Cycle Assessment

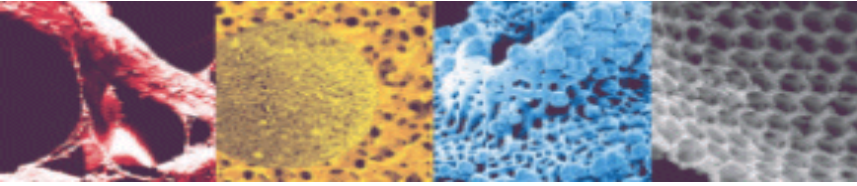
One of the complexities of LCA lies in its very multidisciplinary character. Following [Hofstetter1998] we can distinguish three spheres that are all required in an LCA. Each sphere has very different characteristics:

Technosphere

Ecosphere

Valuesphere

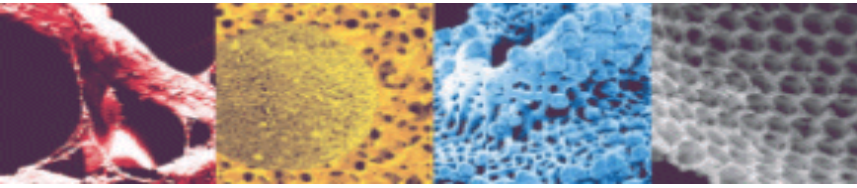
material innovation



Technosphere:

The modeling of technical systems, such as production processes, transport processes etc. Usually, uncertainties in technosphere are not greater than a factor 2, while almost all measurements are verifiable and repeatable.

material innovation

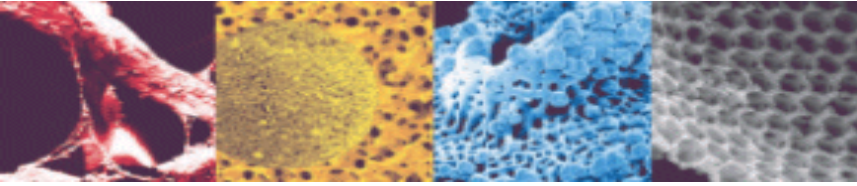


Ecosphere:

The modeling of environmental mechanisms ("what happens with an emission?").

Uncertainties are often one to three orders of magnitude, and often verification is difficult or impossible, for example one cannot test-run climate change and repeat this several times to get good measurements.

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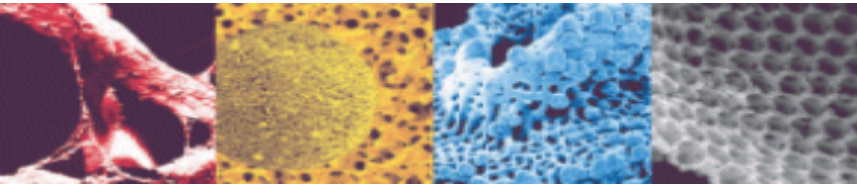
Valuesphere:

Dealing with subjective choices. This includes weighting of impact categories, but as we will see, values also play an essential role when an allocation procedure or a time-horizon is selected.

For example, in impact assessment it is important to choose if the potential damage from heavy metals is integrated over just 100 years or eternity.

Value sphere is typically in the area of social sciences. In value sphere one cannot really speak of uncertainties, as one can say a "single" truth does not exist.

material innovation



Simplified product life
assessment PLA

Identify and analyze all aspects of product

function

use

form

parts

material

environment

experience

holistic

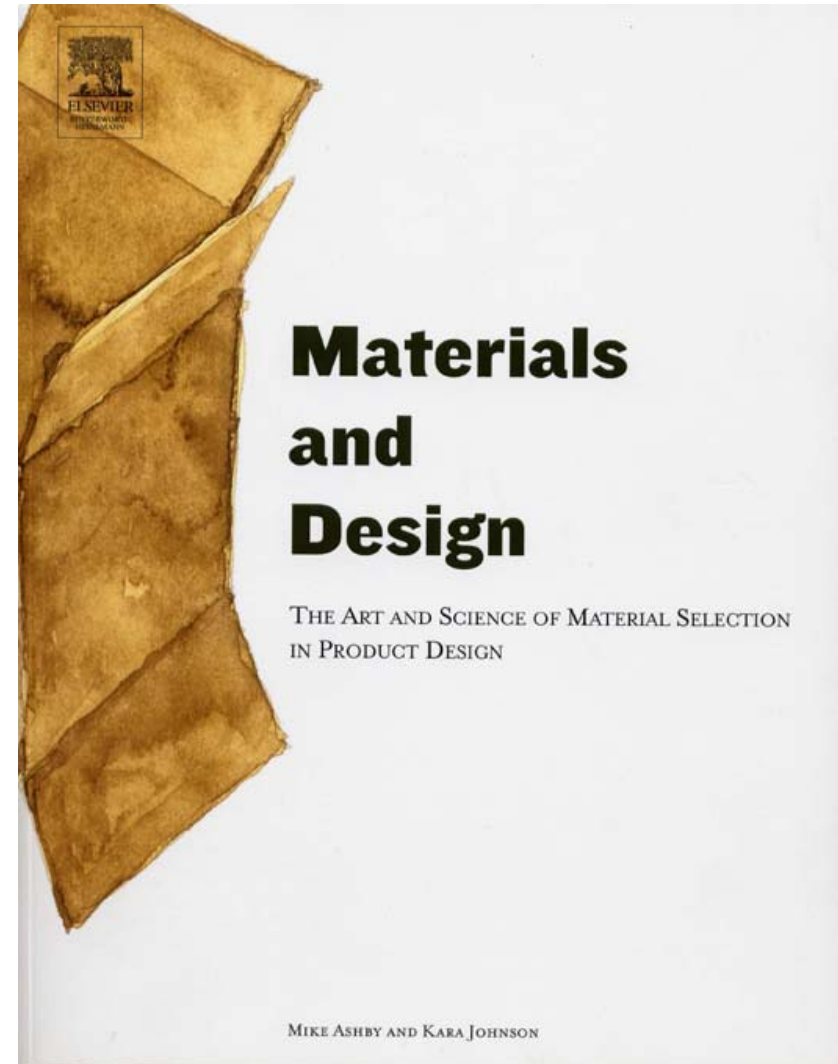
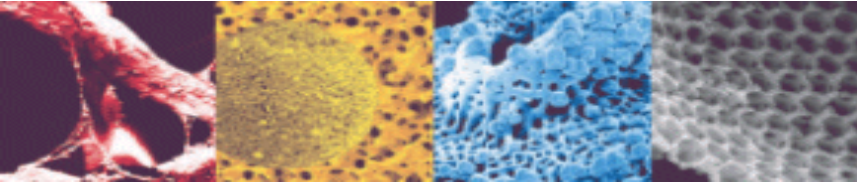
with regard to every aspect of product life from inception to delivery to store shelf to usable life to end life

c 2007 caruso

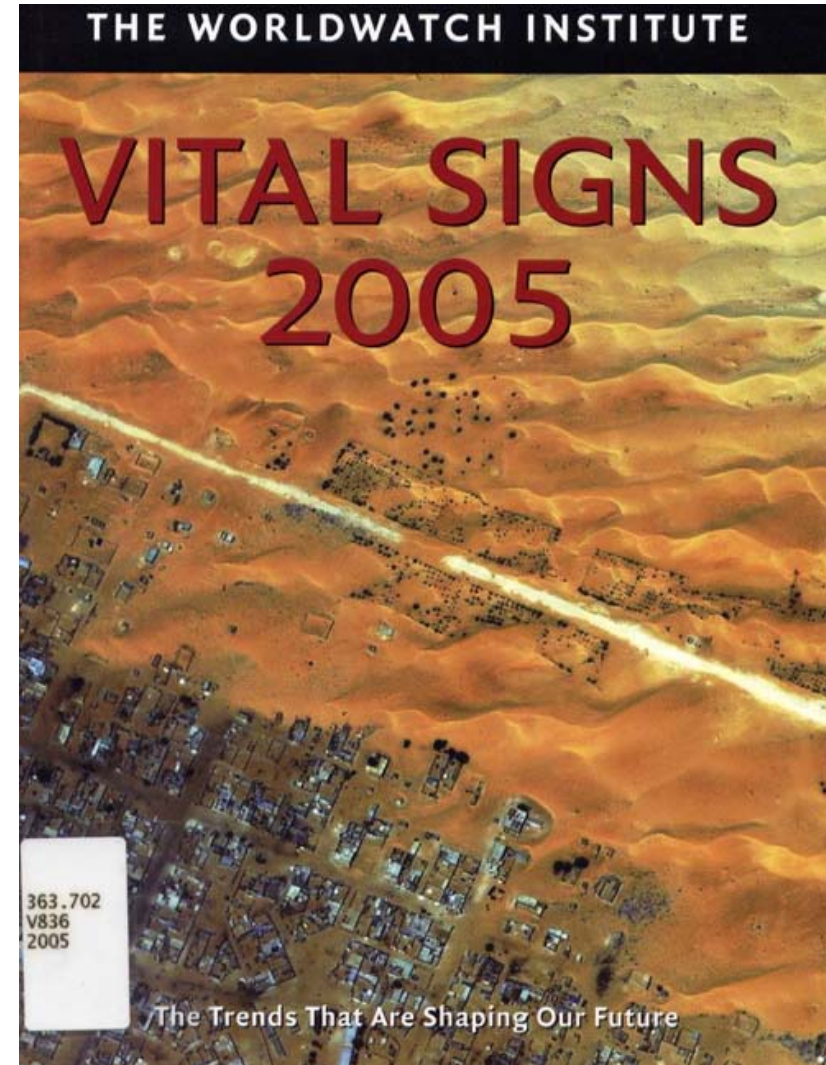
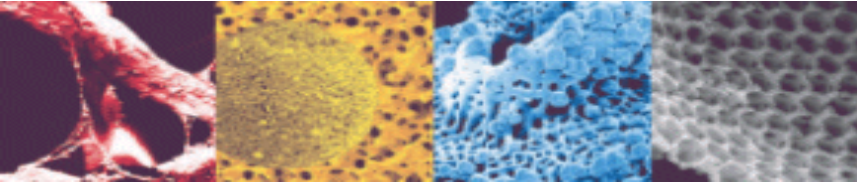
Innovation through material choice

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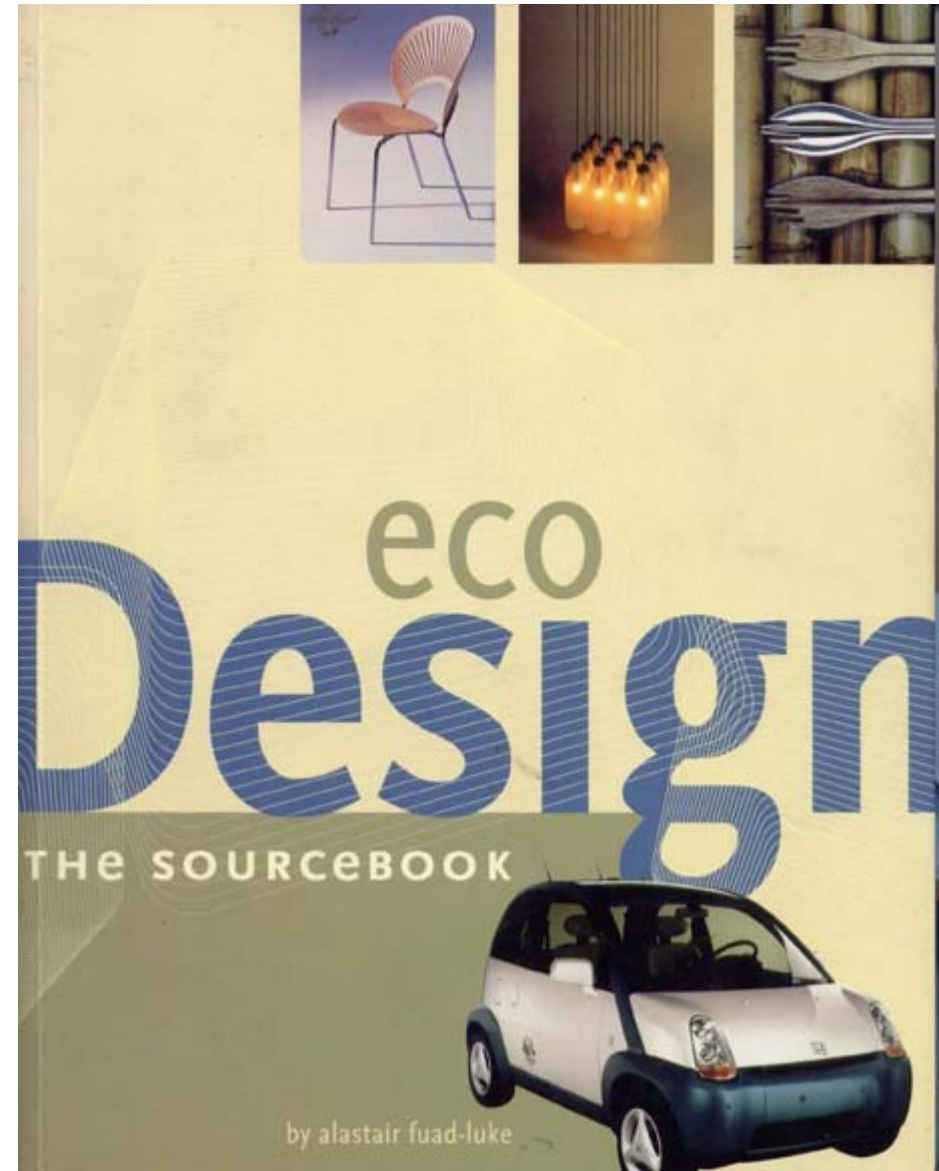
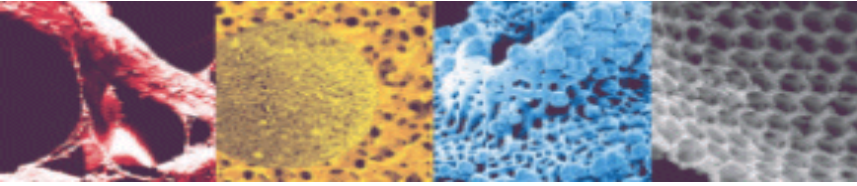
material innovation



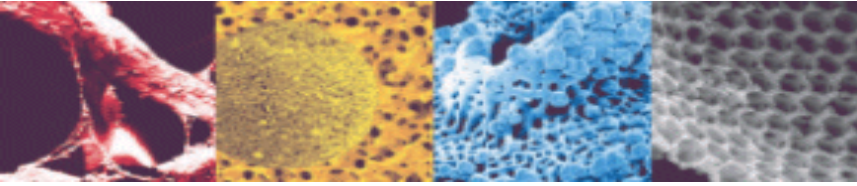
material innovation



material innovation



material innovation



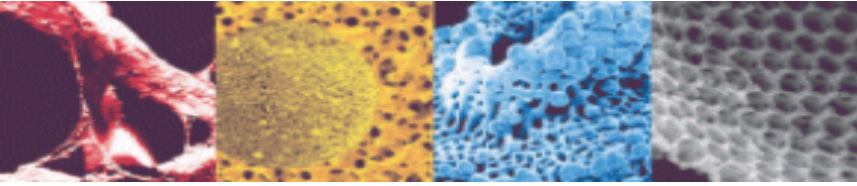
THE GREEN IMPERATIVE



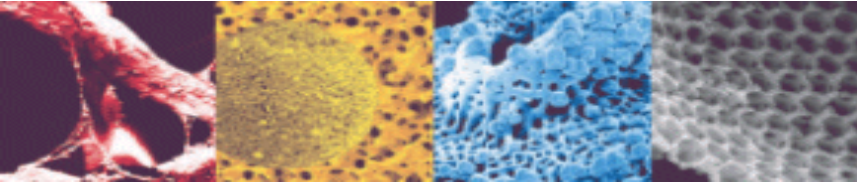
NATURAL DESIGN
FOR THE REAL WORLD

VICTOR PAPANEK

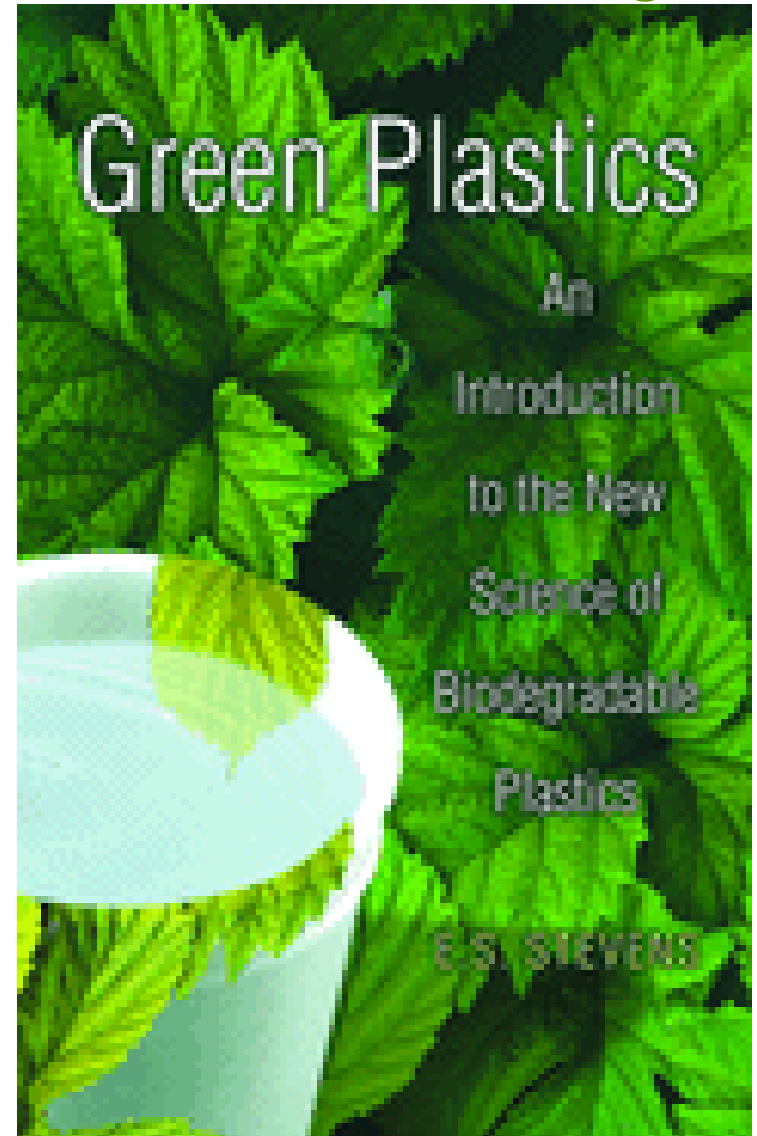
material innovation



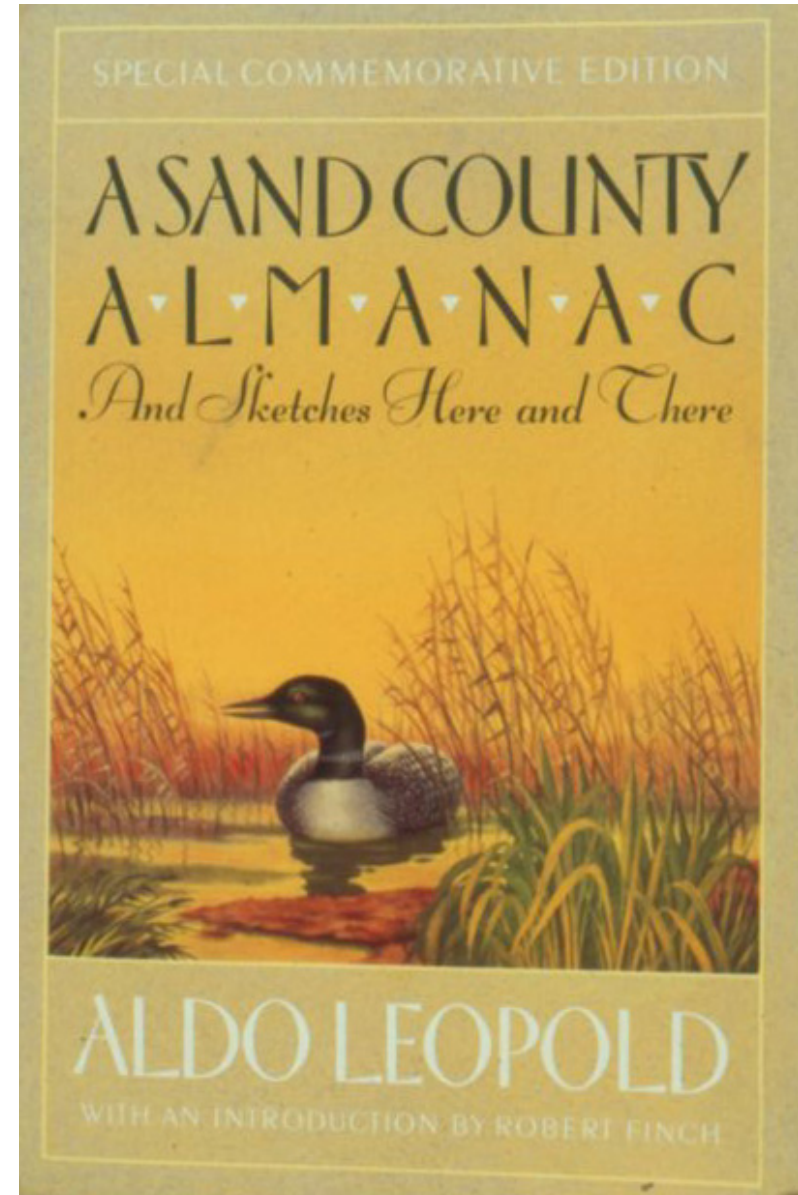
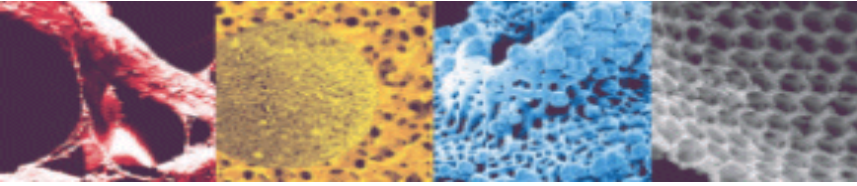
material innovation



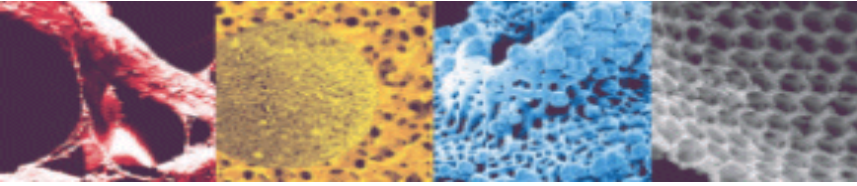
material logic



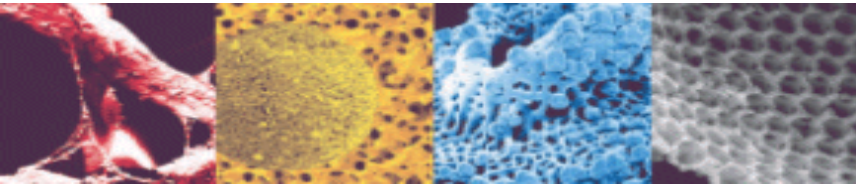
material innovation



material innovation



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February 2007

PACKAGING
DIGEST

www.packagingdigest.com

Sustainable by design

Organic juice goes PLA 42

Survey: How green are we? 39

Adhesive saves in unexpected ways 36

NEW Bottle
made from
100% CORN!

NOBLE FLASH PASTERIZED
NOT FROM CONCENTRATE
100% Pure Juice
Organic Orange Juice

CLICK HERE TO RENEW

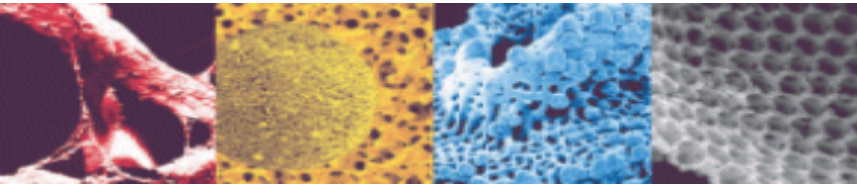
RFID PACKAGING:
2006 was a story of
extramas. p. 44

DAIRY FILLING:
Computerized filler
blends milk. p. 22

DESIGN TRENDS:
Shaped pouches target
busy woman. p. 8

Read Business
Information.

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General Informational Web Sites

The Biopolymers Web Site

www.biopolymer.net/

U. S. National Biobased Products and Bioenergy Initiative

www.bioproducts-bioenergy.gov/

Population and problems

www.peopleandplanet.net/doc.php?id=1087

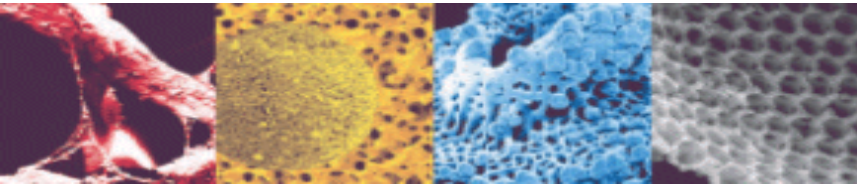
Plywood from bamboo

www.plyboo.com/neo.html

Development news on polymers

www.fbe.itu.edu.tr/polymer/news.htm

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Green Plastics Organizations

BEPS: BioEnvironmental Polymer Society

www.beps.org/

BPI: The International Biodegradable Products Institute

www.bpiworld.org/

BPS: Japanese Biodegradable Plastics Society

www/bpsweb.net/

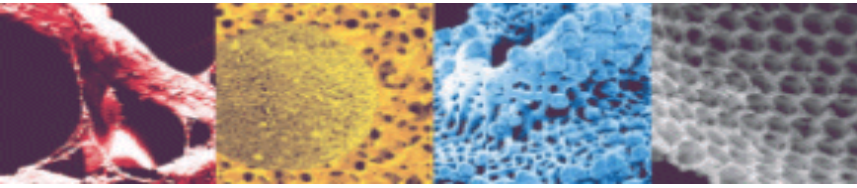
Green plastics

www.greenplastics.com/

Product Ecology consultants Sima pro Life cycle analysis software

www.pre.nl/

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Manufacturers

Eastman Chemical

www.eastman.com , eastmaninnovationlab.com

Novamont (Materbi)

www.biogroupusa.com/

Cargill Dow

www.natureworksllc.com/

ECM Biofilms, Inc.

www.ecmbiofilms.com/

Metabolix, Inc.

www.Metabolix.com/

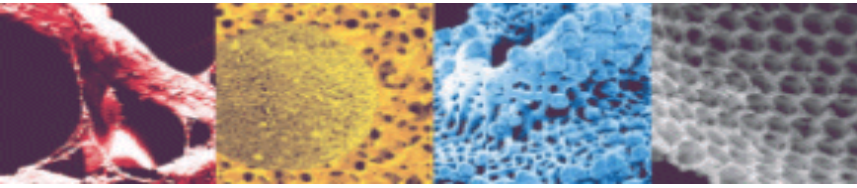
StarchTech, Inc.

www.starchtech.com/

Willow Ridge Plastics, Inc.

www.willowridgeplastics.com/

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Green Product retailers web

www.Treehugger.com

www.greenhome.com/

www.greenpeople.org/ search engine portal for green products

www.coopamerica.org/pubs/greenpages/ Resource for green products and services

Architectural building products

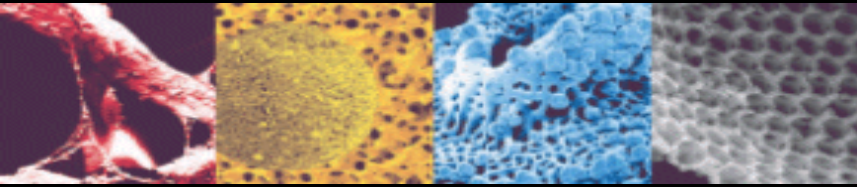
<http://www.greenproducts.net/>

www.wbdg.org/design/greenproducts.php portal for enviro building goods services

Green labeling and standards

www.greenseal.org/

material innovation



can you make it better with less?

can you make it more sustainable by changing plastics?

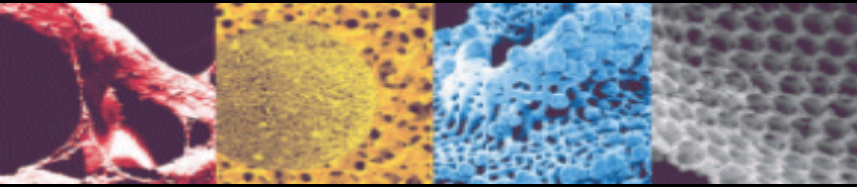
can you package it with less?

can the package be the product?

can the package be part of the product?

what if?

material innovation



can you make it better with less?

can you make it more sustainable by changing plastics?

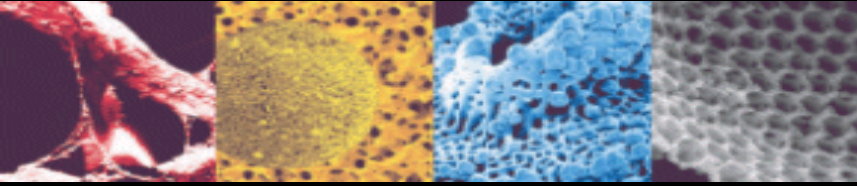
can you package it with less?

can the package be the product?

can the package be part of the product?

what if?

material innovation



summary

strategies

design for new materials

design for reduce reuse recycle

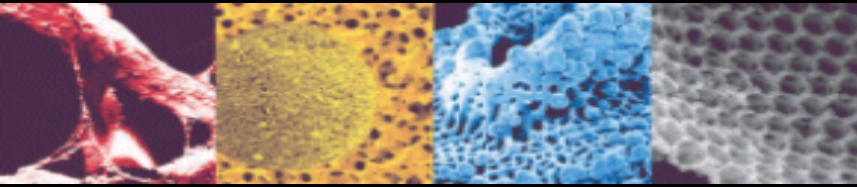
design analysis pla-*[product life assessment]*

design for nest gang stack

design for multiuse

design with aesthetics beauty

material innovation



Contact Info:

John Caruso

Associate Professor of Industrial Design

Milwaukee Institute of Art and Design MIAD

273 E Erie

Milwaukee WI 53202

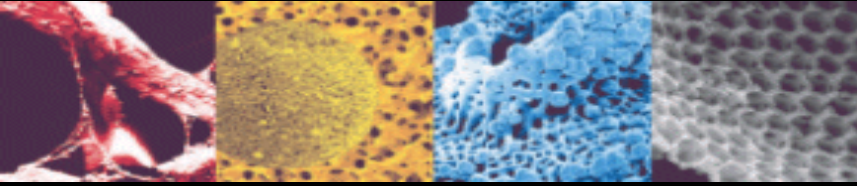
P 414.847.3362 F 414.291.3267

jcaruso@miad.edu

Presented at IHMA March 11 2007 Chicago IL USA

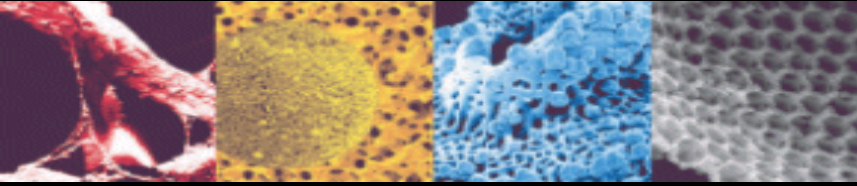
International Housewares Manufacturers Association Trade Fair

material innovation

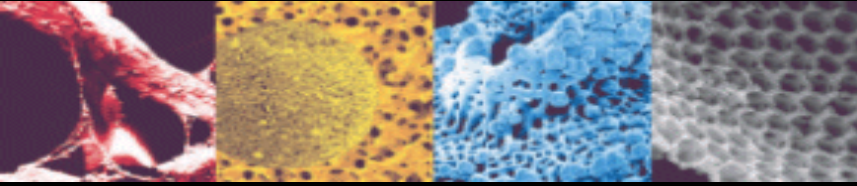


ende

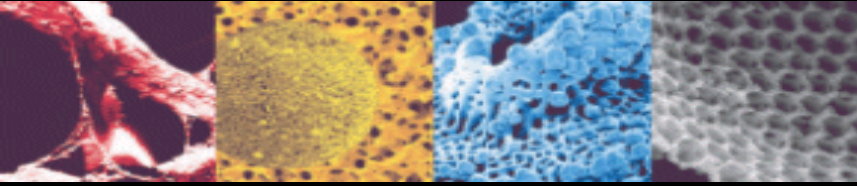
material innovation



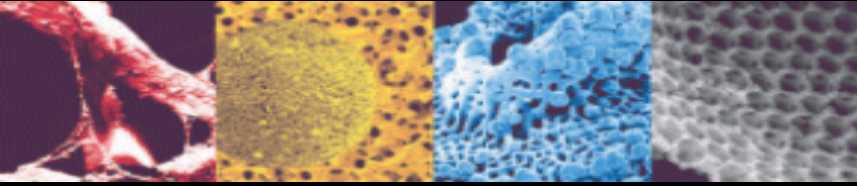
material innovation



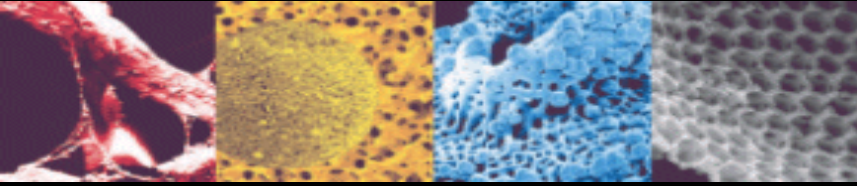
material innovation



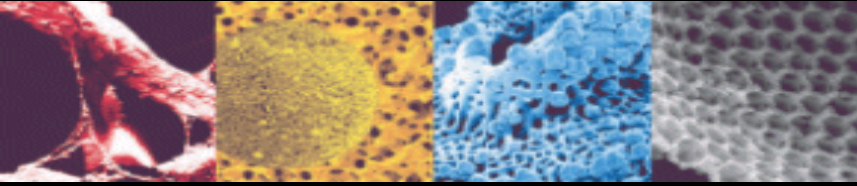
material innovation



material innovation



material innovation



material innovation

