
Utilizing Biosolids As Packaging or Building Material

Methods and equipment necessary to produce value added products from biosolids for packaging and building material applications.

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Presentation Overview

- Post-processing options
- Manure vs. Wood Fiber Comparison
- Packaging products
- Building materials
- Possible processing methods
- Considerations
- Summary

Post-Processing Options

“So in the case of a biogas plant treating energy crops, substrates high in lignin, cellulose and hemi-cellulose, hydrolysis becomes the speed determining process. Therefore for these plants, implementing a hydrolysing unit makes a lot of sense. In the case of a biogas plant treating wastes such as fats, oils, grease, vegetable or meat processing wastes or mixed food wastes acetogenesis and methanogenesis are the speed determining processes. Therefore a plant utilizing primarily food waste will not benefit from hydrolysing feedstocks prior to digestion.

As you can see the composition of the substrates (feedstock) that you are planning to use for your biogas plant determines the rate of anaerobic digestion from the decomposition rates of each substrate.”

Biogas-ology September 2010 Edition

Post-Processing Options

So The output of the digestate is also important where fiber characteristics impact performance. You will need to pay attention to what you feed and the duration in the digester to get the type of fiber out that you want.

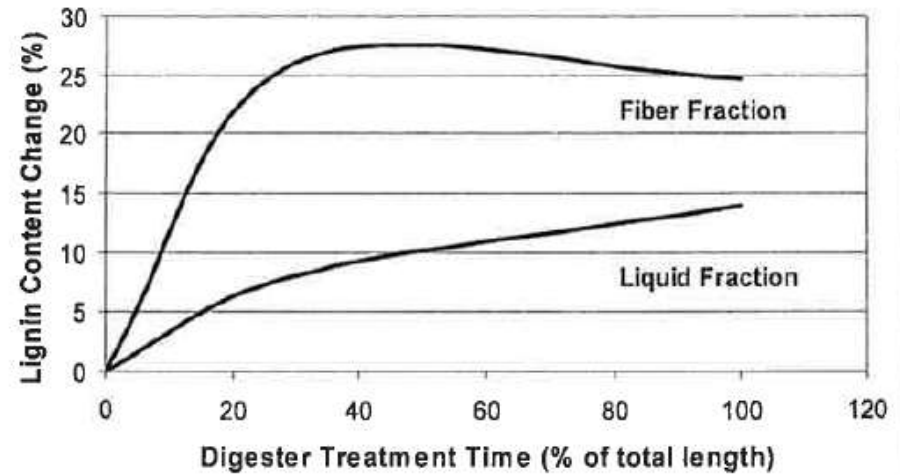
If you plan to make consistent products, then you also need to think about the output from the digestate which begins with the input.

As the Manure Passes through Digester

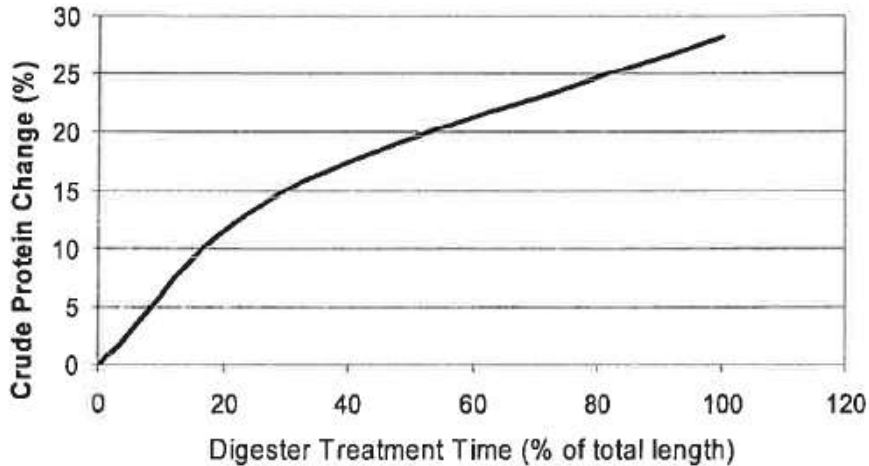
- % Lignin increases
- % Crude protein increases
- % Starch decreases

The fiber characteristics change and you need to understand what you have at the end.

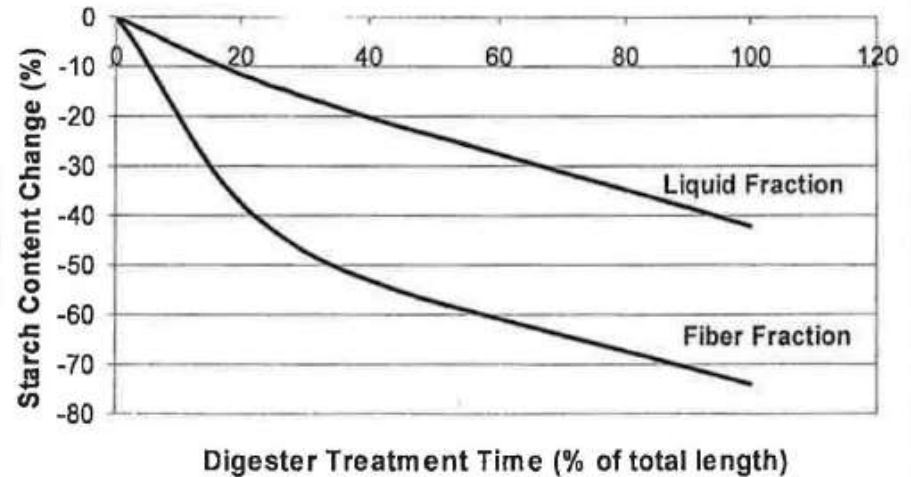
Liquid and Fiber Fraction of Dry Material



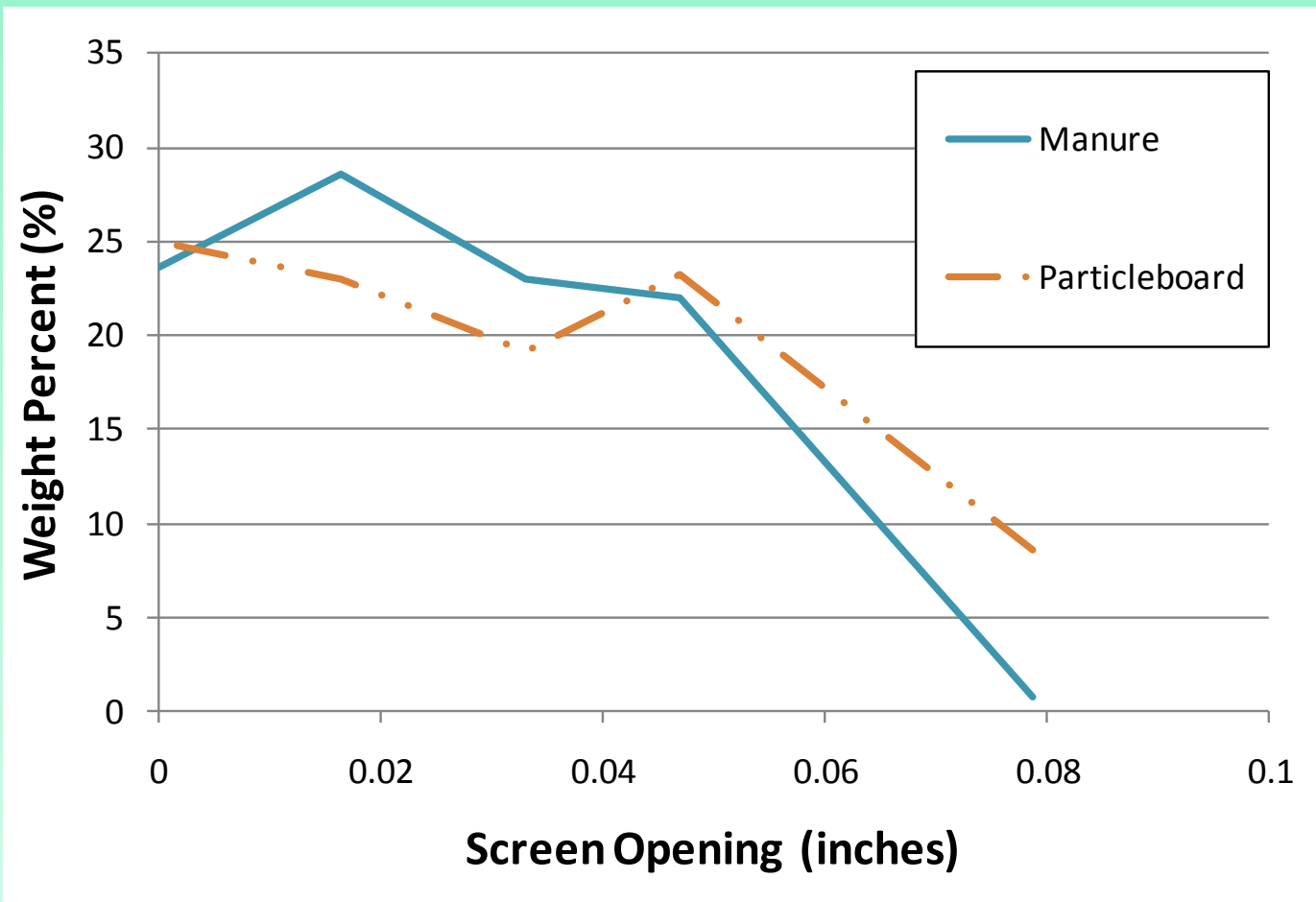
Liquid Fraction



Liquid and Fiber Fraction of Dry Material



Wood vs. Manure Comparison



Classification by weight percent vs. particle size for digested bovine manure and wood particles from a commercial particleboard operation.

Wood vs. Manure Comparison



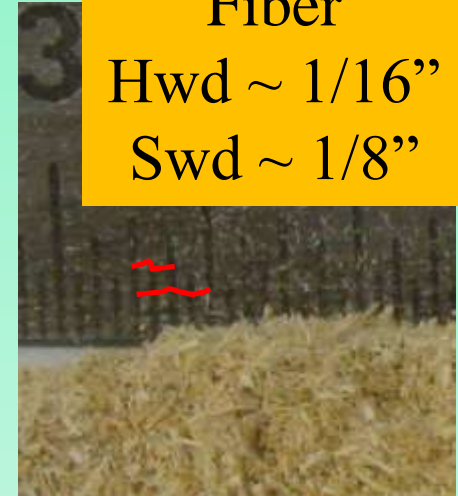
16 Mesh



20 Mesh



40 Mesh



Fiber
Hwd ~ 1/16"
Swd ~ 1/8"

<40 Mesh - Fines



Manure



?% Fines

Wood, Paper, vs. Manure Fiber

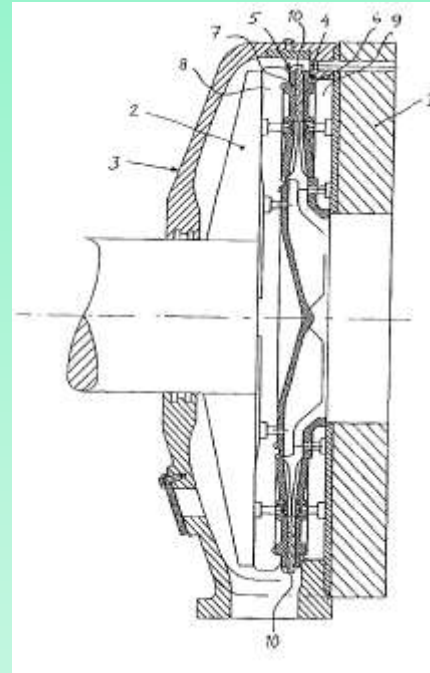
- Paper fiber is very different than particleboard or manure. Chemical digestion makes paper fiber flexible.
- Paper fiber's surface energy level is very high for virgin and high for recycled paper fiber. Hence fiber-to-fiber bonding is higher.
- Paper fiber bonds well with other cellulosic fibers.
- Digested fiber has a lower surface energy.
- Digested fiber has a natural bonding protein on the surface of the fiber and in the liquid fraction.
- Digestate fiber is very stiff.
- Digestate has other "roughage" that needs to be reduced in size.

Post-Processing Options

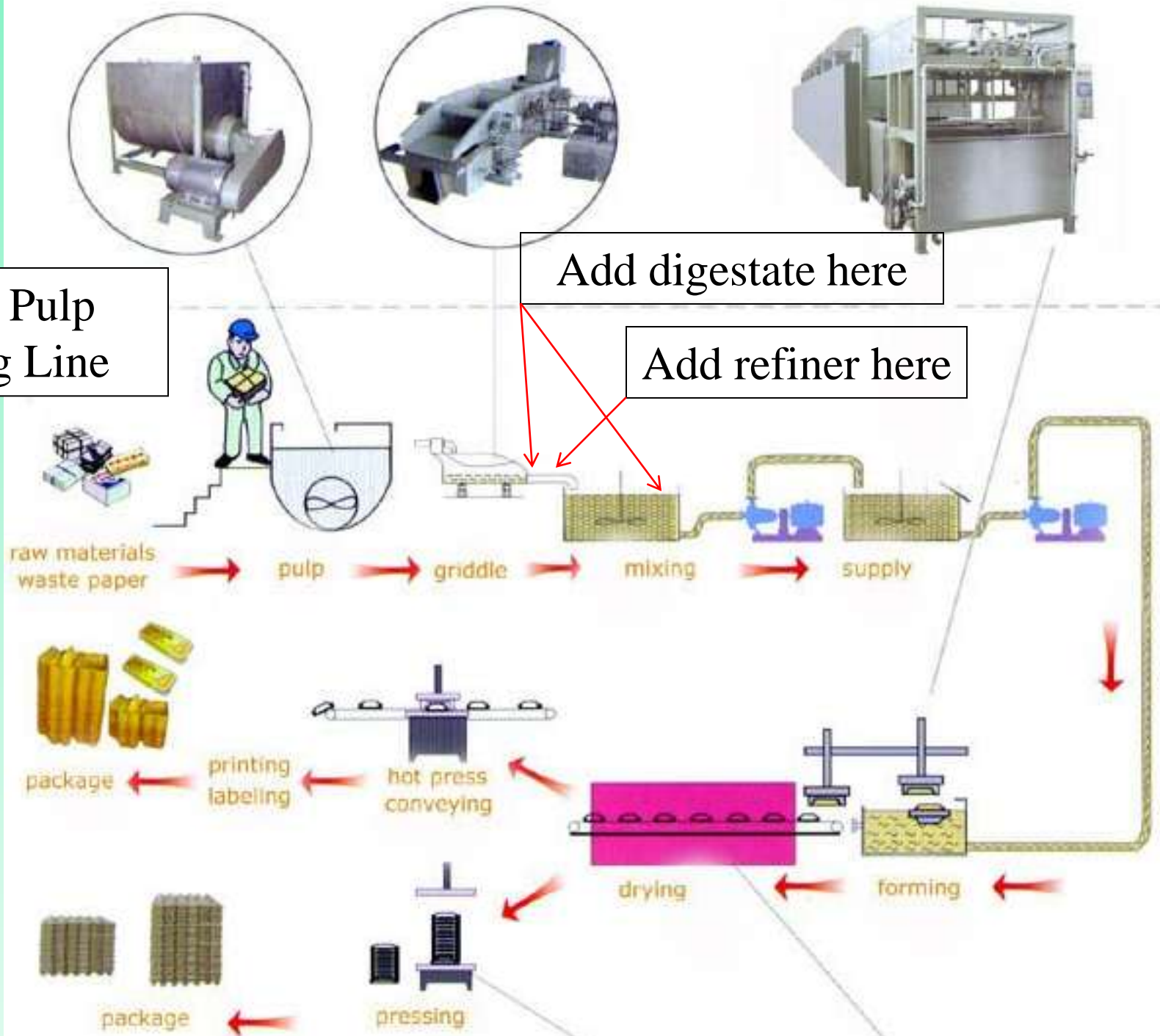
Wet-forming Refiner:

A refiner is necessary to break up larger particles, seed hulls, and fiber bundles into a more homogeneous mixture of cellulosic material.

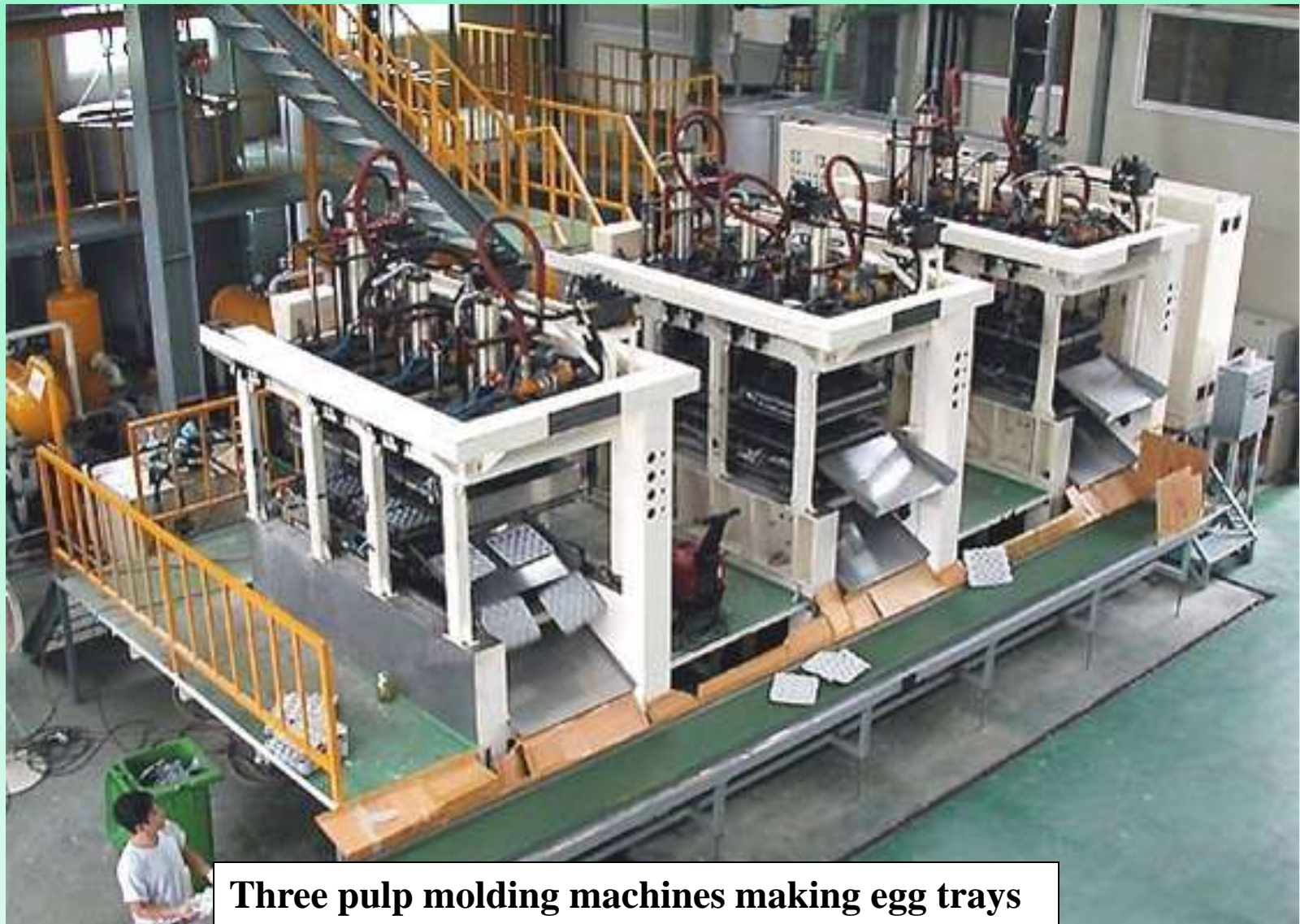
Material flows into the middle and passes between spinning disks that have an adjustable gap. The gap sets the particle size.



Simple Pulp Molding Line



Packaging Products



Three pulp molding machines making egg trays

Midwest Manure Summit, February 16, 2011

Molded Pulp Packaging Products



CowPots Help the Planet
Made with 100% Renewable
Composted Cow Manure!

CowPots for Business

- Commercial Grower Benefits
- Start Selling CowPots
- Buy CowPots Wholesale
- Technical Specifications

CowPots for Gardeners

- Home Gardening Benefits
- Buy CowPots Online
- Find a Local Retailer

All About CowPots

- What Are CowPots?
- Why Are CowPots Better?
- How to Use CowPots
- Growing Tips
- Frequently Asked Questions
- Our History
- CowPots in the News
- Contact Us

CowPots Specifications

Cowpots are available in all typical popular seed starter pot sizes. To purchase wholesale quantities of CowPots, contact us via email at info@cowpots.net. For smaller orders, consider purchasing from one of our many [retail partners](#).

3" Round

275 ml
16 cu in



3" Square

200 ml
12 cu in



4" Square

450 ml
27 cu in



Packaging Products

Manure,
recycled
paper

Ag Prod.
Digestate 80%
recycled paper
20%

JOHN F. ALT, OF NEW YORK, N. Y.

IMPROVEMENT IN FLOWER-POTS.

Specification forming part of Letters Patent No. **193,908**, dated August 7, 1877; application filed August 31, 1876.

(12) **United States Patent**
Freund et al.

(10) **Patent No.:** **US 7,594,356 B2**
(45) **Date of Patent:** **Sep. 29, 2009**

(54) **AGRICULTURAL PRODUCTS DEVELOPED
FROM MANURE**

(76) Inventors: **Matthew R. Freund**, 324
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(US) 06024

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 79 days.

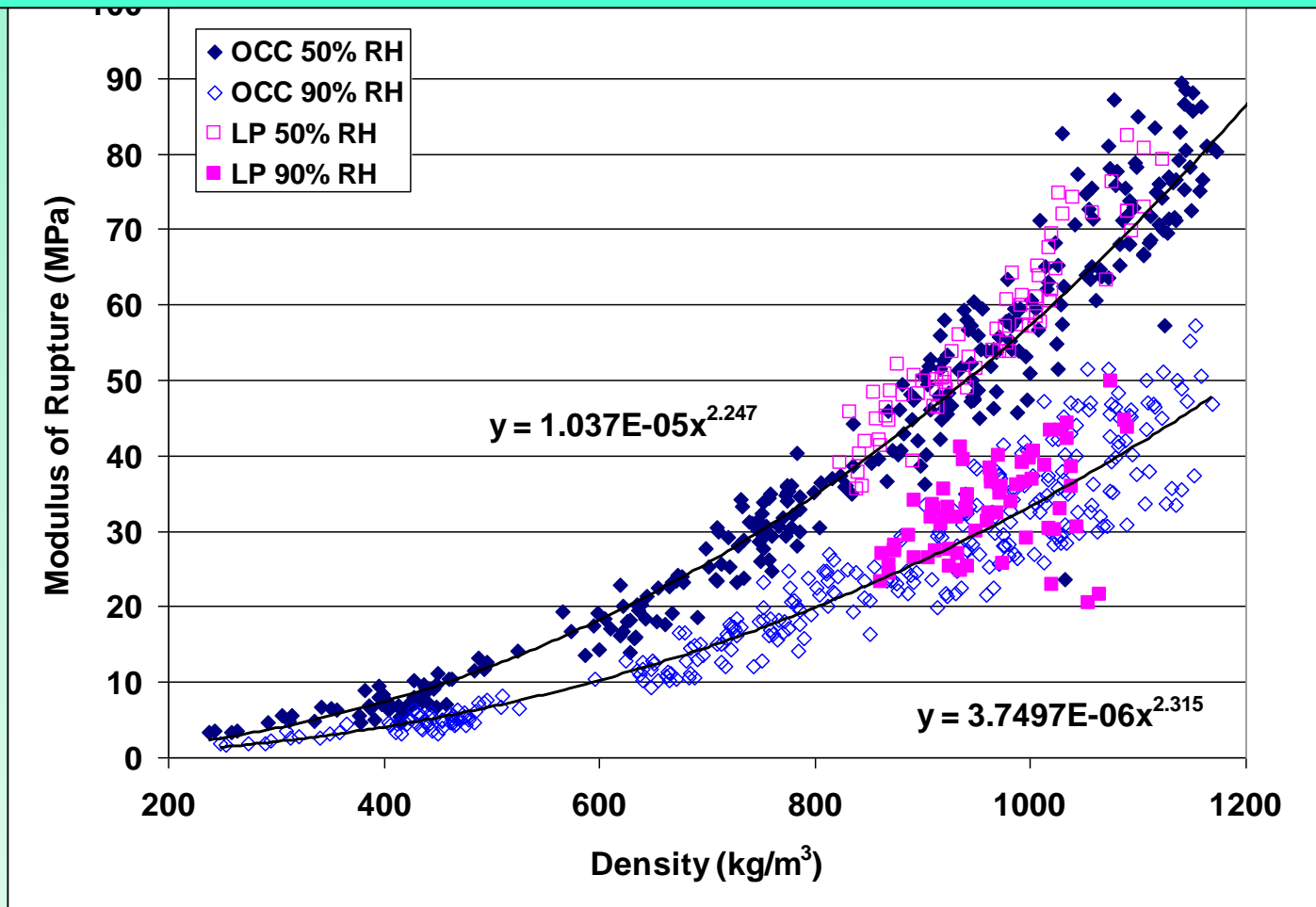
2,094,513	A *	9/1937	Wilson et al.	47/74
2,132,837	A *	10/1938	Talbot	210/180
2,202,772	A *	5/1940	Durdin, Jr.	210/603
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3,877,920	A *	4/1975	Carlberg	71/21
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2003/0041516	A1 *	3/2003	Cook	47/65.7

FOREIGN PATENT DOCUMENTS

Pulp molding patents with manure or digestate.

Packaging Products

Increasing density or increasing fiber-to-fiber contact has a significant impact on strength of a fiber product.



Packaging Products

Low-Density (Usually made from paper fiber)

- Egg Cartons – ~2oz./per
- Agricultural plant pots
- Paper
- Absorbent Items

Mid-to-High-Density

- Pallets
- Misc. material distribution containers
- Spacers
- Paper
- ?

Fiber Filled Plastic Composites

- Non-food contact applications

Building Materials

Low- Medium Density < 45lb/ft³

- Insulation panels
- Shear panels
- Concrete slab spacers
- Core material (between laminates)

High-Density > 45 lb/ft³

- Particleboard like (3/8 to 3/4 inch)
- Hardboard like (1/10 to 3/16 inch)
- Sheathing
- Specialty (3D shapes)

Digestate-Fiber Filled Plastic Composites

- Decking

Building Materials

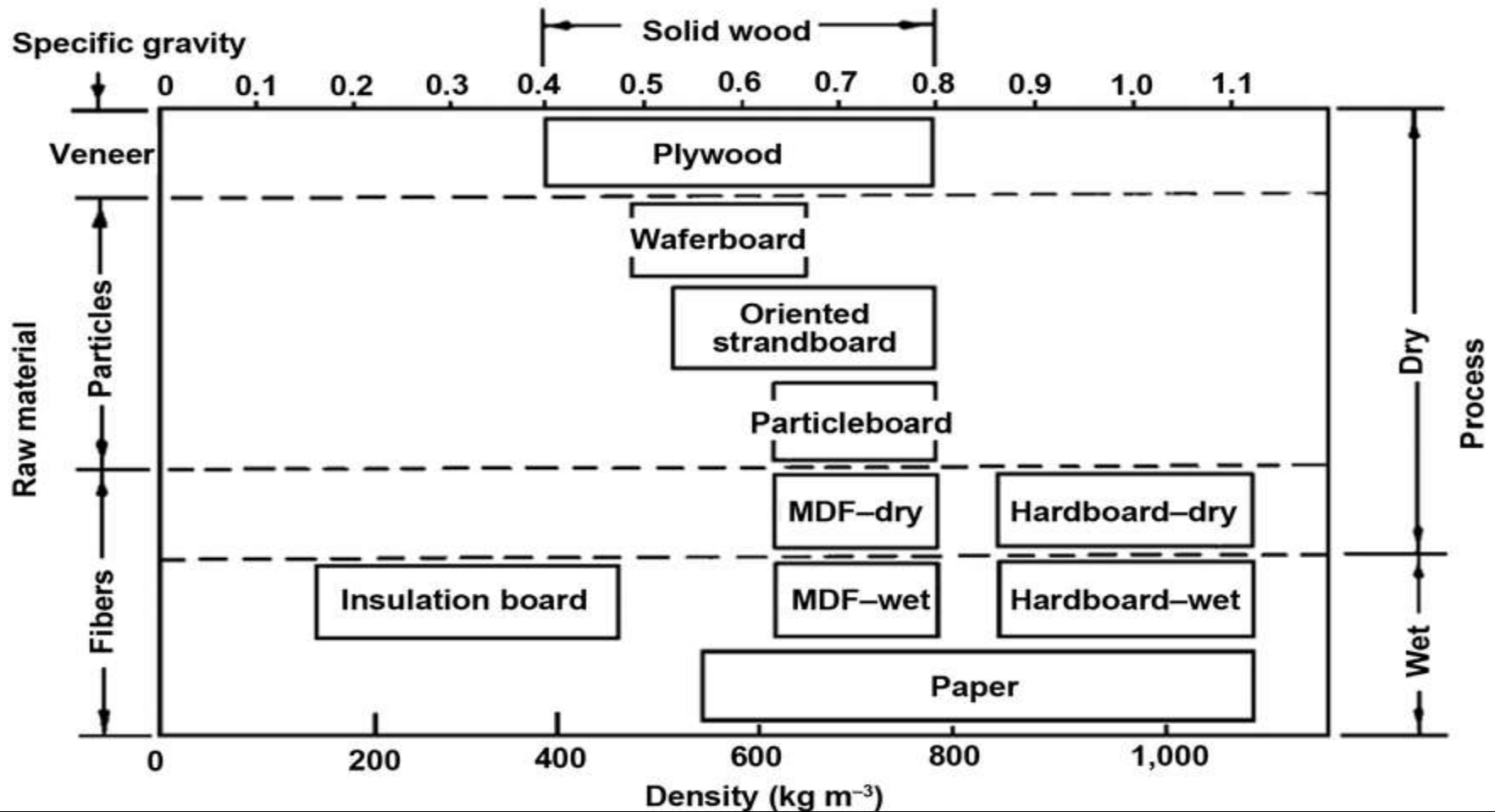


Figure 11–3. Classification of wood composite panels by particle size, density, and process (Suchsland and Woodson 1986). Note that insulation board is now known as cellulosic fiberboard. (Wood Handbook: 2010)

Building Material Certification

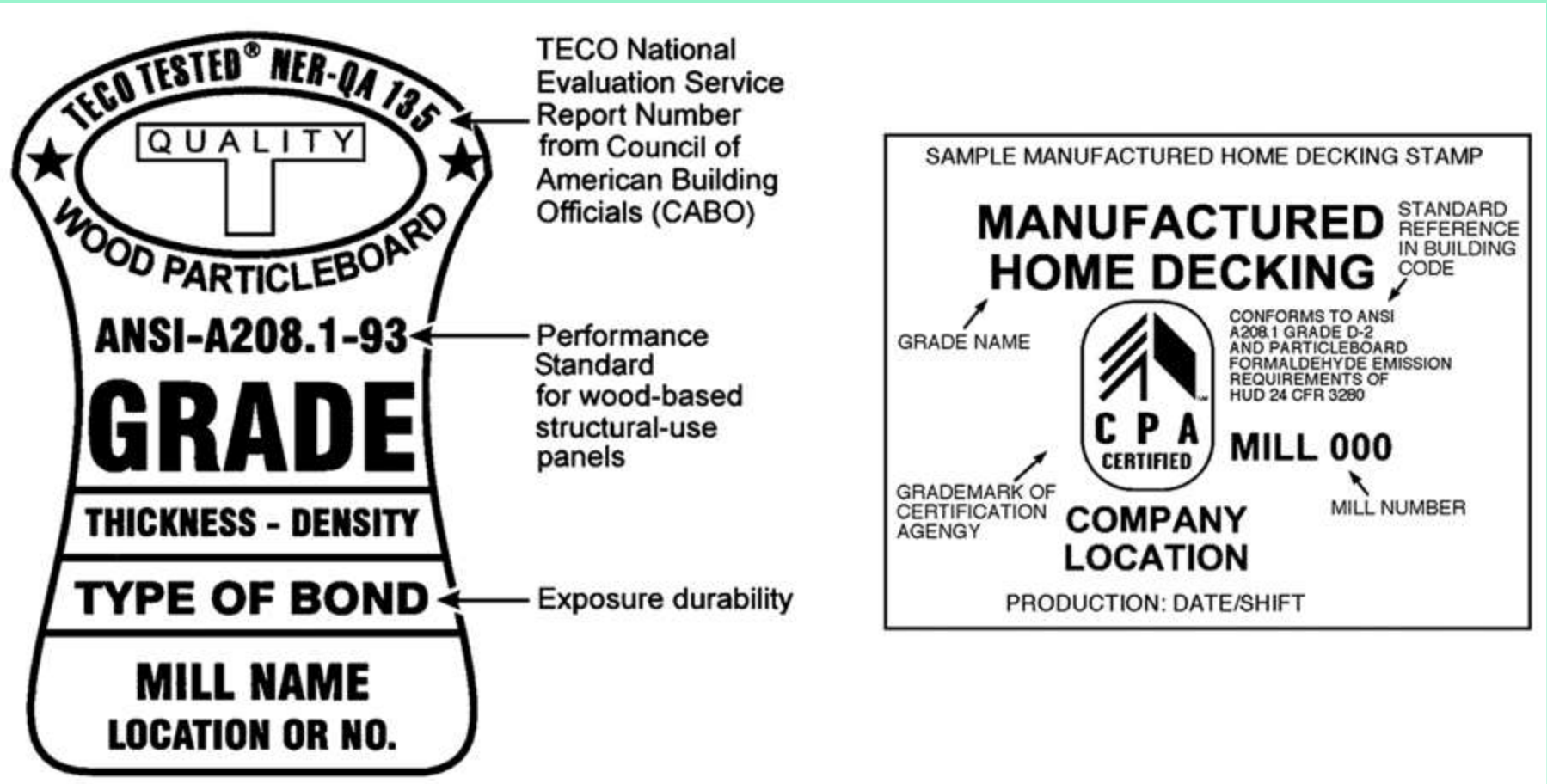


Figure 11–9. Examples of grade stamps for particleboard. (Courtesy of TECO, Sun Prairie, Wisconsin, and Composite Panel Association, Leesburg, Virginia. Used by permission.) (Wood Handbook: 2010)

Building Material Standards

The screenshot shows the Composite Panel Association (CPA) website. At the top, the CPA logo is on the left and the text "COMPOSITE PANEL ASSOCIATION" is on the right. Below this is a navigation bar with links for Home, About CPA, Testing-ITCC, Members Only, and Contact Us. A search box is located on the right side of the navigation bar. On the left side of the page, there is a vertical menu with the following items: Tools + Resources, About CPA, Products, Buyers Guide, Testing + Certification, Standards, Public Policy, Education + Resources, Continuing Education Units, and Bookstore. Below the menu is a Member Login section with fields for User Name and Password, and a Log-in button. The main content area features a "Return to Resources" link and a section titled "CPA Publications" with a note that items available electronically will be emailed separately. Below this is a shopping cart area with buttons for Shopping, Search, and Account, and a "Shop By Category" dropdown menu. The selected category is "Standards". The product being viewed is the "ANSI 208.1-2009 Particleboard Standard", described as the "Industry standard for particleboard". A note states that this item is not available electronically. The price is listed as "Your Price \$50.00" and there is an "Order" button. A small image of the standard's cover is also visible.

COMPOSITE PANEL ASSOCIATION

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CPA Publications
(The following items are available for purchase. Items that are available electronically are noted and will be emailed separately)

Shopping Search Account

Shop By Category »

Category: [Standards](#)

ANSI 208.1-2009 Particleboard Standard

Industry standard for particleboard

** This item is not available electronically.*

Your Price \$50.00

Order

Building Materials

Annex B (Informative)

General use and grades

Use	Grade	Table
Commercial	M-1, M-S	A
Industrial	M-2, M-3	A
High density industrial	H-1, H-2, H-3	A
Door core	LD-1, LD-2	A
Interior Stair Tread ¹	M-3	A
Exterior construction	M-1-Exterior glue, M-S-Exterior glue, M-2-Exterior glue, M-3-Exterior glue	A
Exterior industrial	M-1-Exterior glue, M-S-Exterior glue, M-2-Exterior glue, M-3-Exterior glue	A
High density exterior industrial	H-1-Exterior glue, H-2-Exterior glue, H-3-Exterior glue	A
Underlayment	PBU	B
Manufactured Home Decking	D-2, D-3	B

Figure 11–9. Examples of grade stamps for particleboard. (Courtesy of TECO, Sun Prairie, Wisconsin, and Composite Panel Association, Leesburg, Virginia. Used by permission.) (Wood Handbook, 2010)

Building Materials

Panel Processing Options

- Air-Dried Fiber Forming – will need adhesive
- Semi-dry Forming
- Wet-Forming Direct Digestate
- [Wet-Forming](#) with Wood Particles or Paper Fiber
- Air-Dried Fiber/Plastic Composites
- ?

The Product Defines the Process

Output of the digestate is important where fiber characteristics impact performance. You need to pay attention to what you feed and duration in the digester to get out what you want.

If you plan to make consistent products, then you also need to think about the output from the digestate which begins with the input.

Considerations

Sell Fiber as a Raw Material

- Fiber processing (fiber fractionation, refining, material handling)
- Minimal additional effort

Develop On-site or Coop Products:

- Fiber processing (fiber fractionation, refining, material handling)
- Pumps
- Water management
- Forming Equipment
- Hydropulper
- Cold press
- Hot Press (Including hot-oil or steam boiler from heat exchanger)
- Hydraulics
- Dedicated personnel

Considerations

On-site Farmer Benefits:

- Energy (Heating, electricity, waste energy)
- Water
- Biological control through the digester.
- Source of fiber (24/7 – 365)
- Land (Buildings)

Considerations:

- Focus on value added products not commodity products for better return on investment.
- Partner with someone in the business for niche market(s) that have existing market distribution channels.

Summary

- Digested Manure Fiber – Similar but different than wood. Higher crystalline cellulose, lower hemicellulose which is more hydrophobic.
- Digested Manure Fiber – stiffer, less flexible than paper fiber
- Size distribution impacts packing, flow, and bonding, consider fiber fractionation to separate into various fiber uses.
- Refining is necessary for homogeneity (reduce seed hulls and long fiber bundles).
- Digesters provide valuable resource: energy, fiber, water.
- Consider developing a coop to pool resources.
- Consider partnership with a company to provide expertise in fiber forming and distribution channels.