Wood Protection Processes for Engineered Wood Products

Mark Manning

U.S. Borax Inc.

Enhancing the Durability of Lumber and Engineered Wood Products

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Outline of Presentation

- Engineered Wood vs Solid Wood
- Post-Manufacture Treatments
- In-Process Treatments (IPT)
- Chemicals used in IPT
- Quality Control Issues
- Conclusions

Engineered Wood vs Solid Wood

- Engineered Wood Products (EWP) offer different strategies for preservative treatment compared to solid wood
- Preservative addition during manufacture allow for homogeneous distribution throughout the thickness
- Selective loading can also be accomplished (surface > core)

Post-Manufacture Treatments

Pressure Treatment

- Water-borne Systems (Plywood)
  - CCA, ACZA
  - DOT (Disodium Octaborate Tetrahydrate)
  - ACQ
  - CBA (Copper Boron Azole)
- Solvent-borne Systems (Engineered Wood)
  - Creosote, Oxine Copper
  - Tribucide II, PolyClear 2000

Post-Manufacture Treatments

Surface Applied Treatment

- Spray application
- Brush Application
- Preservative incorporated into coating

Pressure Treated Plywood

Pressure Treatment of Plywood

AWPA Standard C9-00: Plywood - Preservative Treatment by Pressure Processes

- ACA, ACC, ACQ, ACZA, CBA, CCA, CC, SBX
- Creosote, Oxine Copper, Penta

- Exterior grade plywood
- Softwood veneers
- AGCPLW, Above-ground, Soil/Water use, Coastal Water

Pressure Treatment of SCL

AWPA Standard C33-00: Standard for the Preservative Treatment of Structural Composite Lumber (SCL) by Pressure Processes

- **PSL (Parallel Strand Lumber):**
  - **Coastal Douglas-fir, SYP, Yellow Poplar**
  - **ACA, ACZA, CCA**
  - **Creosote, Penta, CuNap**
- **LVL (Laminated Veneer Lumber)**
  - **SYP, Red Maple, Yellow Poplar**
  - **Creosote**

TJ Engineered Wood Products

Parallam SCL

Crossties and Bridge Timbers

Bridge Timbers

Exterior and Interior Glulam Beams Treated with Tribucide II™

I-Joists with OSB Web

Vapor Boron Treatment

- Initially investigated in the U.K. and New Zealand
- Borate ester (trimethyl borate) introduced in the vapor phase, reacts with moisture in the wood, depositing boric acid and methanol
- $B(OCH_3)_3 + 3H_2O \longrightarrow B(OH)_3 + 3CH_3OH$

Vapor Boron Treatment

Vapor Boron Treatment

Supercritical Fluid (SCF)

- Utilize SCF to deliver biocides into Engineered Wood Products
- Research being carried out at Oregon State, CSIRO and European Labs
- Plant currently being built in Denmark

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- ***In-Process Treatments (IPT)***

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In-Process Preservatives

Desirable Characteristics:

- Processing stability
- Adhesive compatability
- Low volatility
- No effect on strength properties
- Resistant to leaching/weathering
- Some degree of mobility
- Paintability
- Cost

In-Process Preservative Systems

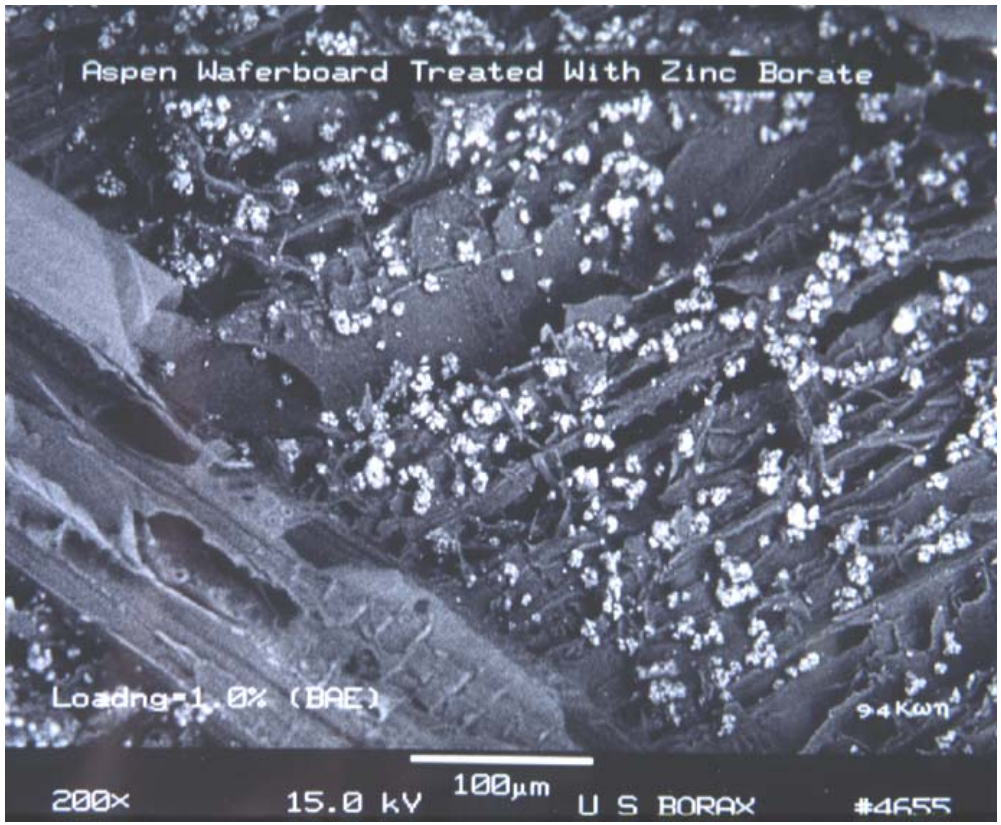
Registered and Available in U.S.

1. Zinc Borate (U.S. Borax)
2. Tebuconazole (Bayer)
3. Chlorpyrifos (Dow Agrosciences)
4. IPBC, Propiconazole, Isothiazolone, MBT (Kop-Coat)
5. Propiconazole (Janssen)
6. Cu-Bor (Copper Care)

Under Development, Registration Pending

1. Kathon 287 (Rohm & Haas)
2. Imidachloprid (Bayer)
3. Other Azole systems (Janssen)
4. Calcium Borate (Cole Research)
5. Others

Zinc Borate (ZB)

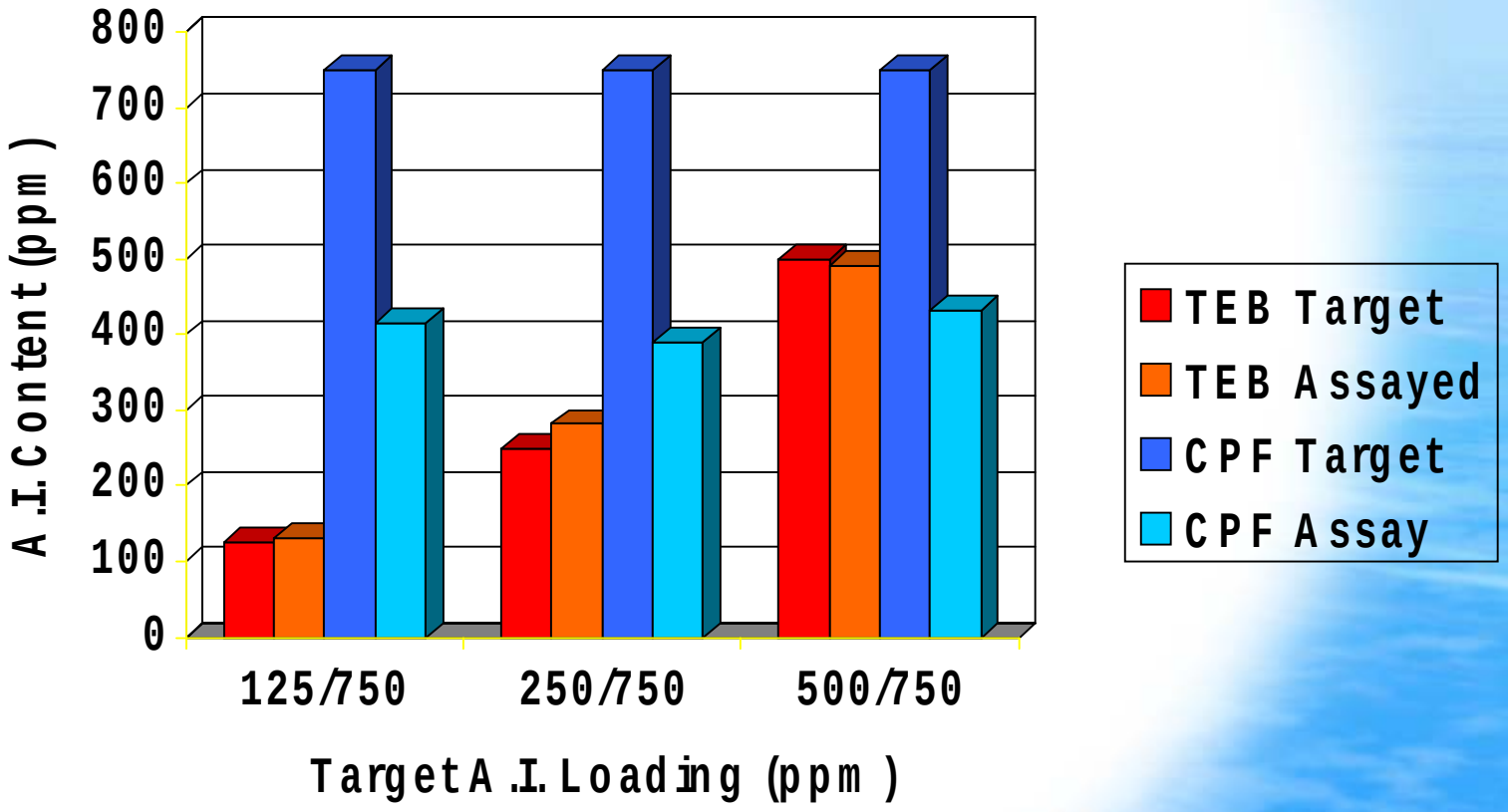


- $2ZnO{\cdot}3B_2O_3{\cdot}3.5H_2O$
- U.S. Borax Inc.
  - *Composibor*® ZB
  - *Borogard*® ZB
- Fine, dry powder
- Fungicide and Insecticide
- Loading: 0.75 - 1.5%
- “Leach Resistant”
- Diffusible
- Currently used by at least 7 major EWP manufacturers

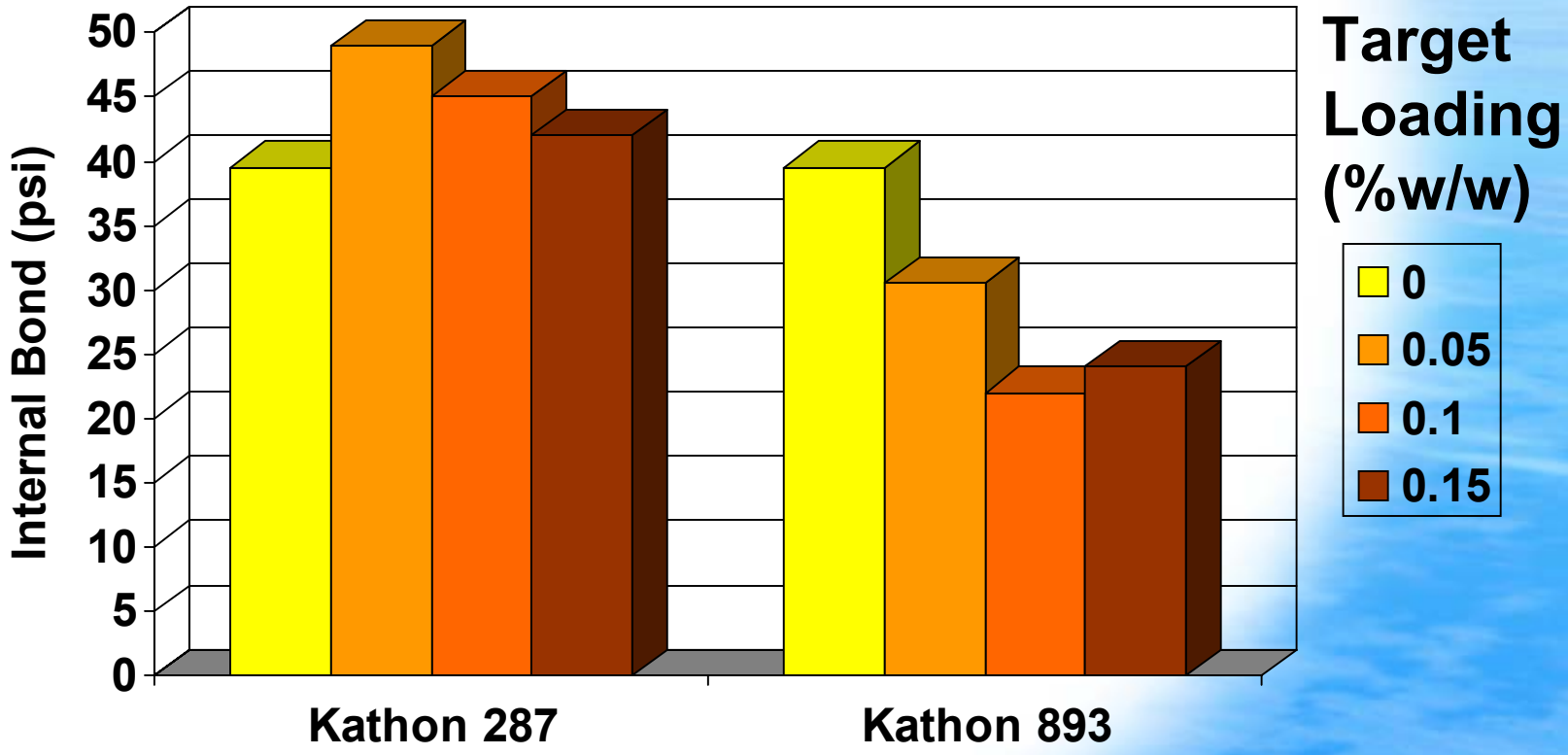
Chlorpyrifos

- O,O-Diethyl O-(3,5,6-trichloro-2-pyridyl)phosphorothioate
- Dow AgroSciences LLC
  - Lentrek®
- Emulsion or organic solution
- Insecticide only
- Loading: 0.0175 pcf
- Currently used:
  - U.S.: Fiberboard sheathing, pressure treatment in Tribucide/Hawaii (combined with IPBC)
  - Asia: glueline additive for plywood
  - Colombia: additive for MDF

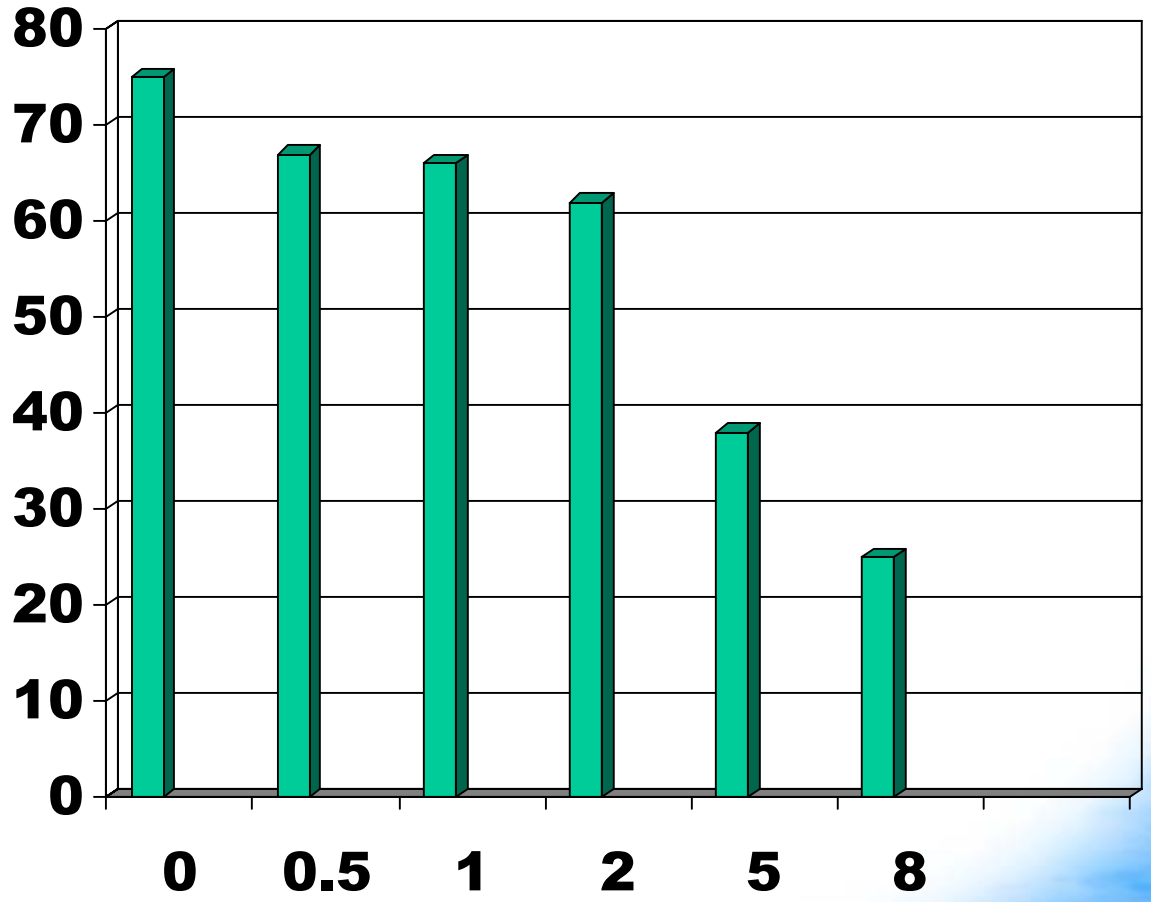
Process Stability of Tebuconazole/Chlorpyrifos in MDI Waferboard



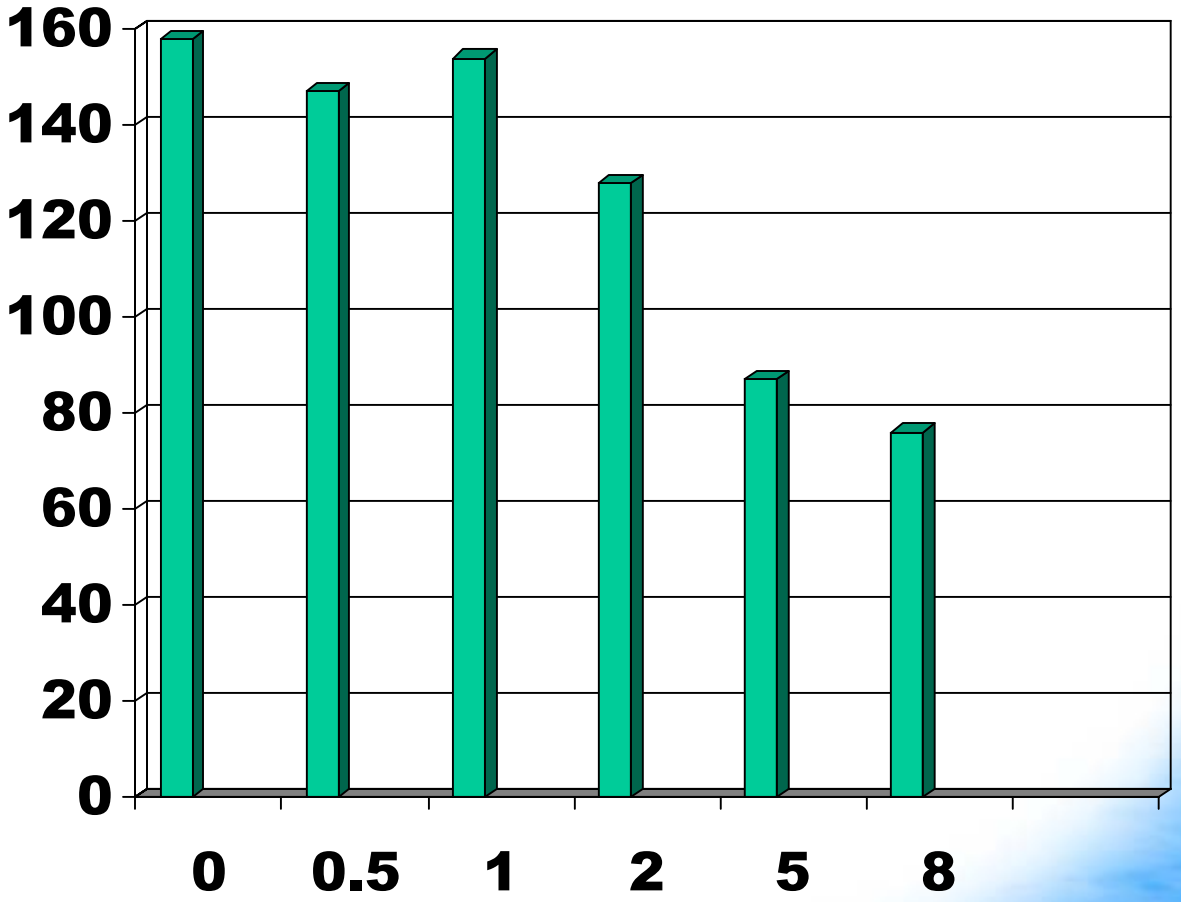
Internal Bond of MUF Particleboard with Isothiazolone Preservatives



Internal Bond(psi) vs ZB loading with 2.5%pMDI Aspen OSB



Internal Bond(psi) vs ZB loading with 7%pMDI Aspen OSB



In-Process Treatment

- Treatment of the wood furnish prior to manufacture
- Metering the powdered preservative in with the wood furnish
- Spray-addition of preservative with adhesive or wax

Addition of Powdered Preservative

- U.S. Patent 4,879,083 (November 7, 1989)
- Addition of soluble borates interfered with bonding of PF resins
- Problem overcome with Zinc Borate or Anhydrous Borax

Addition of Preservative with Wax

- U.S. Patent 5,972,266 (October 26, 1999)
- Applying a suitable aqueous dispersion of zinc borate onto the wood fibers

Addition of preservative with a flow agent

- U.S. Patent 5,763,338 (June 9, 1998)
- Use of flow agents to help disperse high levels (1-10%) of a low solubility borate (zinc borate or anhydrous borax)

Addition of powdered preservative

AWPA Nonpressure Committees

- AWPA Subcommittee N-5: Composite Wood Products
- AWPA Standard N2-00: Standard for the Preservative Treatment of Composite Wood Products by Nonpressure Processes

AWPA Standard N2-00

AMERICAN WOOD PRESERVERS' ASSOCIATION
STANDARD

(This Standard is promulgated according to a consensus procedure and is under the jurisdiction of AWPA Subcommittee N-5)

N2-00©

STANDARD FOR THE PRESERVATIVE TREATMENT OF COMPOSITE WOOD PRODUCTS BY NONPRESSURE PROCESSES

Note: AWPA Standard N2-00 consists of three pages.

1. Introduction & Scope

1.1 This standard provides information on specific nonpressure treated composite wood products, without the use of trade names or manufacturers names. Products listed in this standard are categorized using species or species mix, preservative type, adhesive type, manufacturing process and use class. All of these factors play an integral role in determining the performance of the finished product in specific applications. Users of this standard are urged to consult closely with the manufacturer of the treated composite to ensure it meets the criteria listed in section 5 of this Standard, Tables 5.1.1 to 5.1.6.

1.2 Nonpressure treated composite (NPTC) wood products are complex materials whose strength and biodegradation resistance properties depend closely on the parameters of the manufacturing process. Each manufacturer of nonpressure treated composites typically uses processes considered proprietary. While listing under AWPA cannot include trade names, the categories set-up in Tables 5.1.1 to 5.1.6 are designed to allow for a unique description of the finished product and thus protect the proprietary interests of the manufacturer.

2.2 The same treated composite product could appear in more than one use class, if it qualifies to do so. However, it is beyond the scope of this standard to ascertain the "fitness for use" of any product in a particular application outside the subject of preservative protection. For instance, adequate preservative properties may prevent decay, but the use of type II adhesives or dimensional instability may limit the end use applications to interior or protected exterior. Determination of *Fitness for Use* is the responsibility of the end user and manufacturer.

2.3 NPTC wood products include, but are not limited to products manufactured by combining adhesives, plastics, cements or other binders with lignocellulosic fibers, fiber bundles, particles, wafers, strands or veneer (either alone or in combination). Lignocellulosic resource may be virgin, recycled or both. This standard governs only those composite products containing 50% lignocellulosic material. [1] However, all manufacturers of composites who use lignocellulosic material are encouraged to investigate the effects of decay fungi and insects on their product.

2.4 Process descriptions should include all pertinent parameters so as to adequately and uniquely describe the composite product without divulging proprietary information. Basic parameters to include are: furnish type

AWPA Standard N2-00

5.1.1 Out of Ground; Protected - Use Category 1:

Parameters	COMPOSITE TYPE							
	Fiberboard		Particleboard		Waferboard. / OSB		Plywood / LVL	
Preservative								
Fiber Source								
Process Type								
Treat. Method								
Adhesive Type								
Active Ingredient Retention								

5.1.2 Out of Ground; Protected Fungal & Insect Hazard - Use Category 2:
Table structure as in 5.1.1, customized for composite types standardized.

5.1.3 Out of Ground; Exposed - Use Category 3:
Table structure as in 5.1.1, customized for composite types standardized.

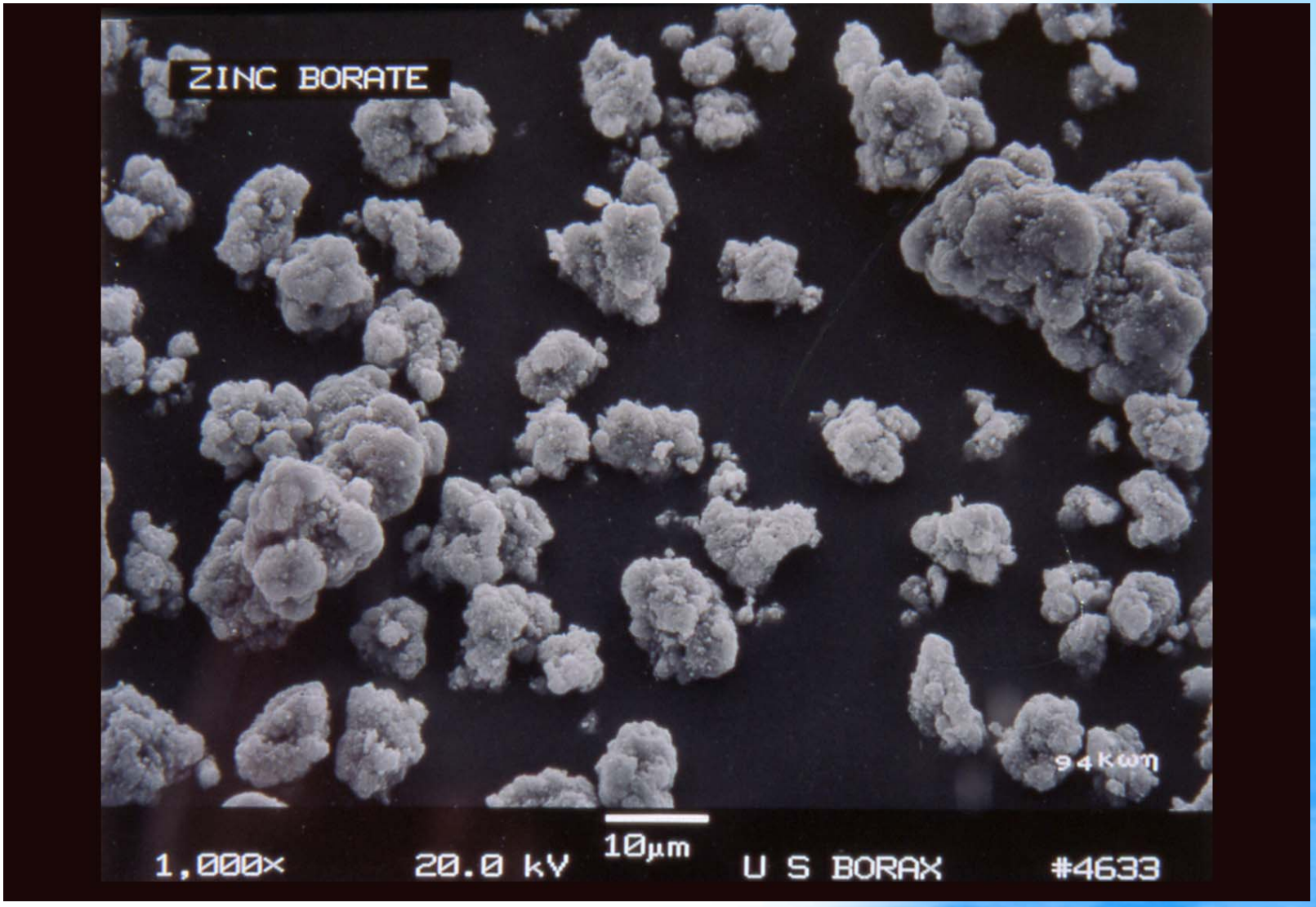
5.1.4 In Ground - Use Category 4:
Table structure as in 5.1.1, customized for composite types standardized.

5.1.5 In Ground; Severe Exposure - Use Category 5:
Table structure as in 5.1.1, customized for composite types standardized.

5.1.6 Sea Water Contact - Use Category 6:
Table structure as in 5.1.1, customized for composite types standardized.

Preservative Distribution

- Important to have adequate macro- and micro-distribution of the preservative
- Macro-distribution can be evaluated by chemical assay
- Micro-distribution can be evaluated by microscopy


ZINC BORATE
94kωη
10µm
1,000×
20.0 kV
U S BORAX
#4633

Aspen OSB treated with ZB

Aspen OSB treated with ZB

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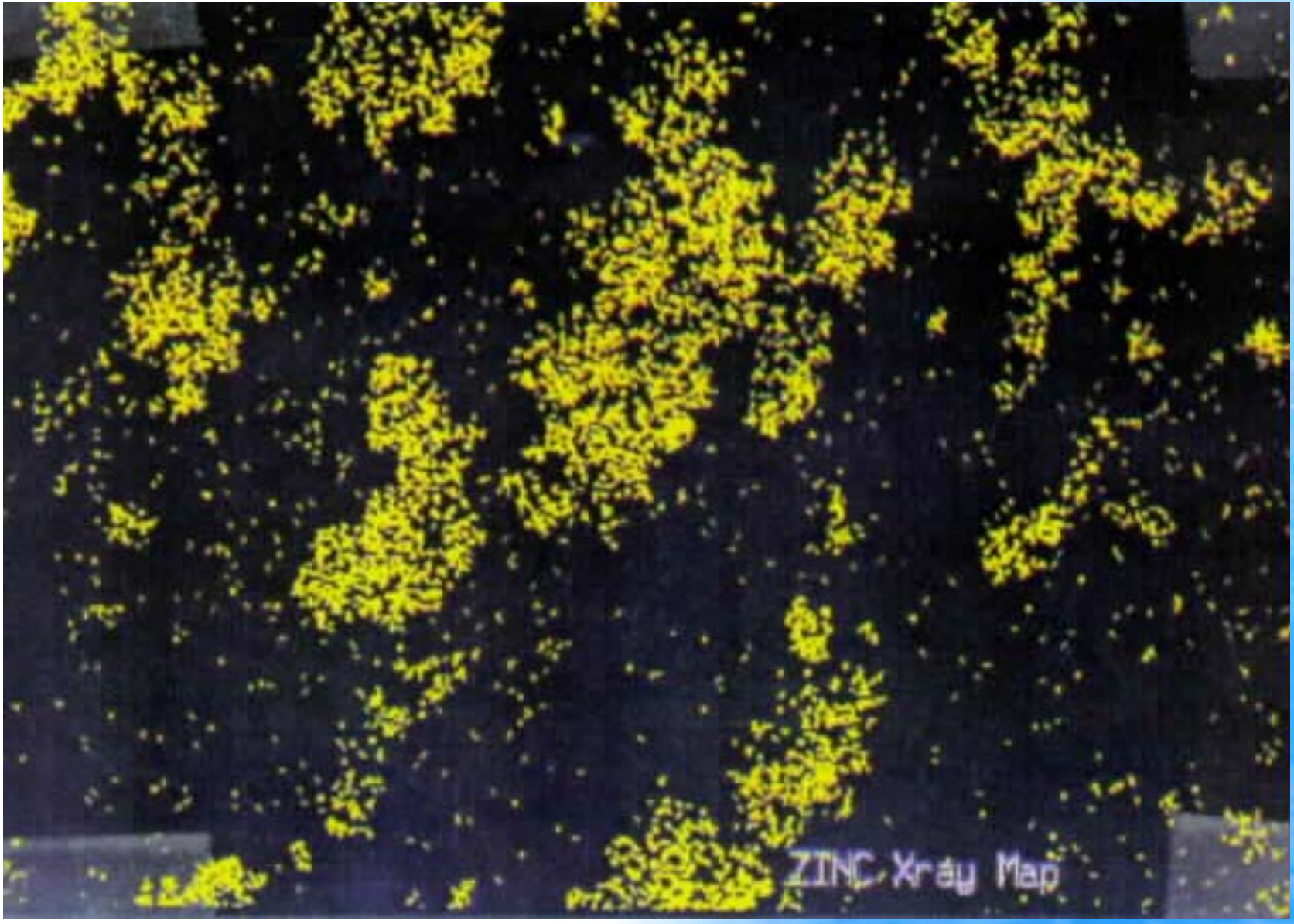
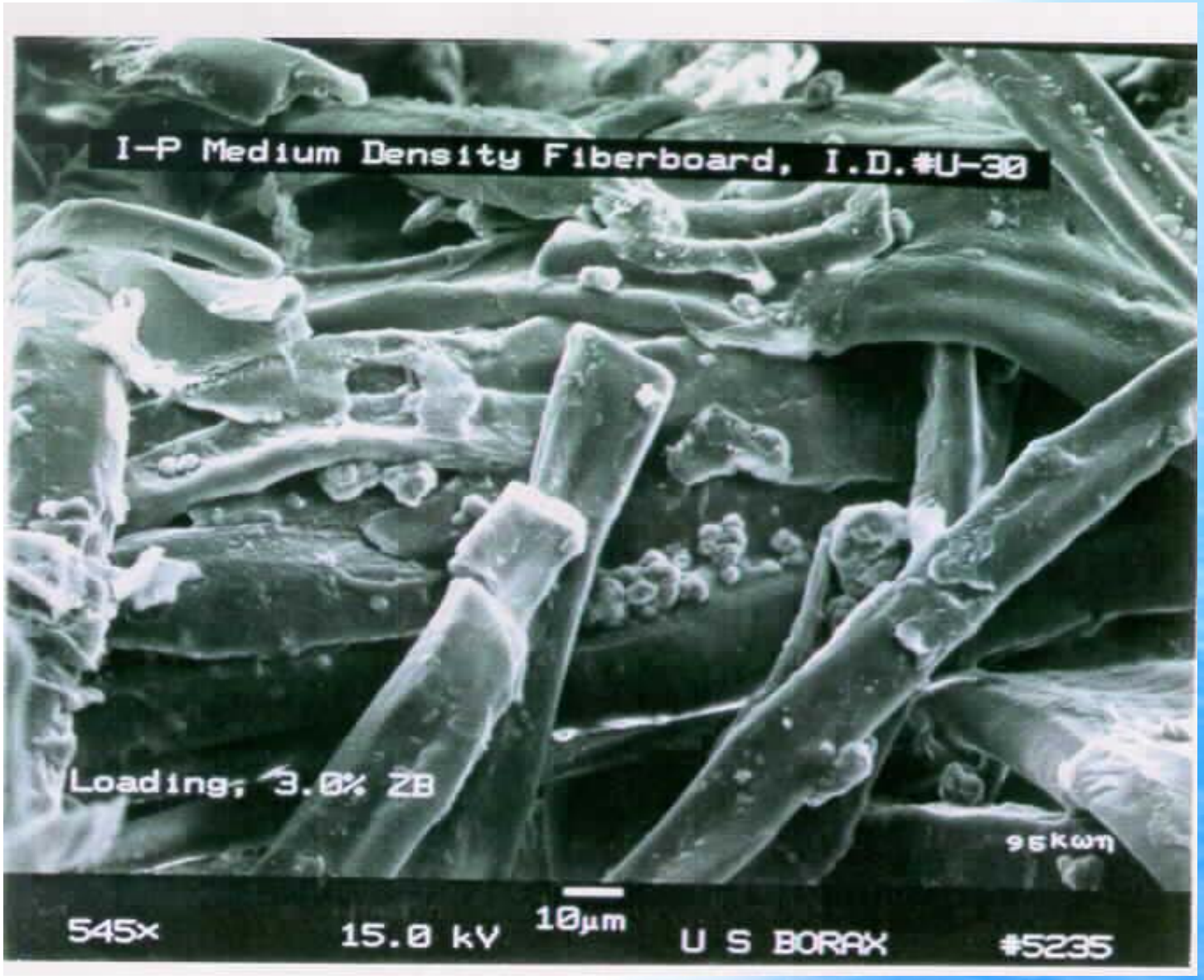
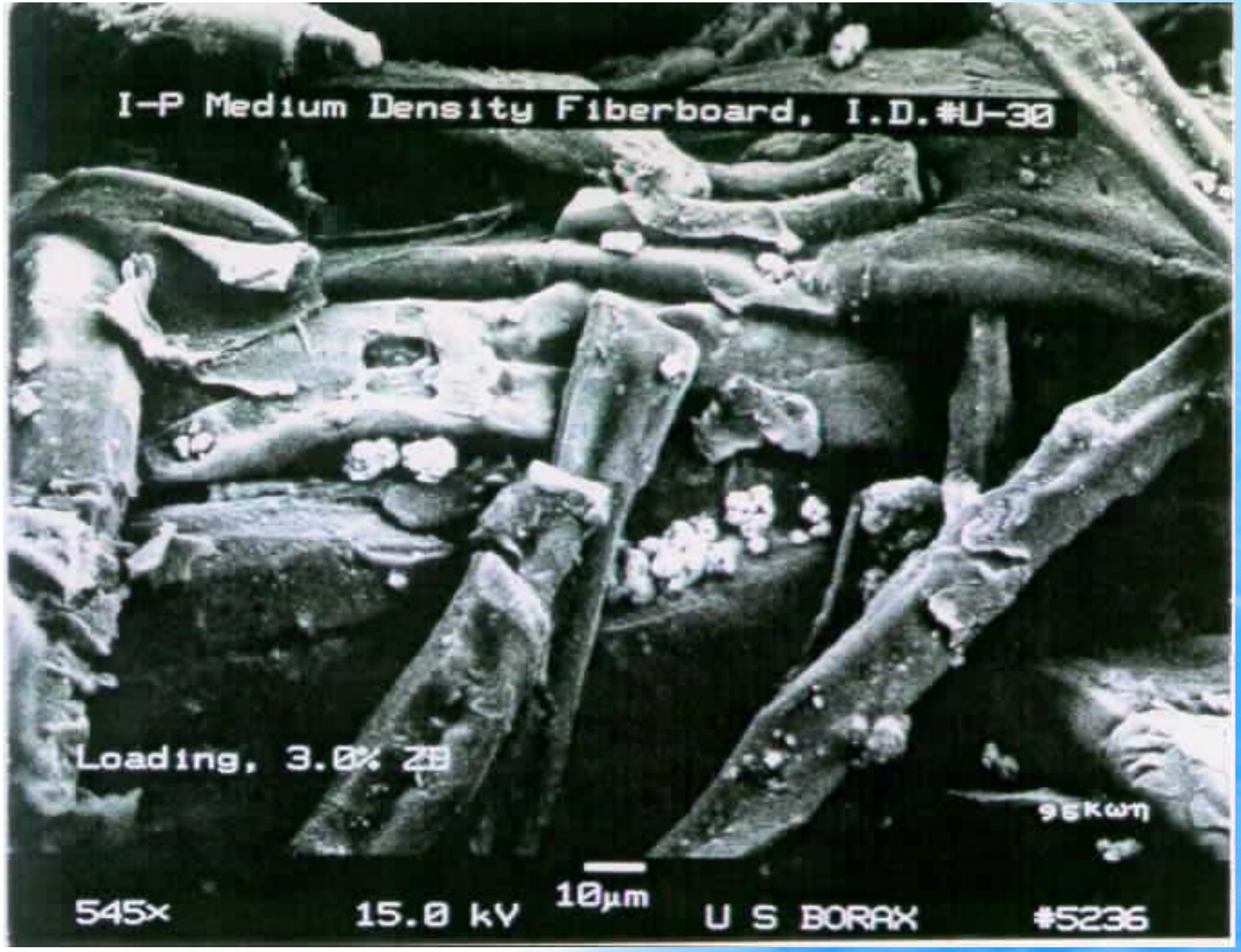


MDF treated with ZB



MDF treated with ZB



Quality Control Issues

- Systematic QC sampling
- Chemical assays conducted in-plant and monitored by independent inspection agency
- Asoma preferred over wet chemistry methods
- Accurate mass balance determination of preservative usage

Conclusions

- Preservative treatment of engineered wood products (EWP) is becoming more prevalent as their end-uses continue to expand
- Treatment of EWP offers options not available with solid wood
- Preservative treatment must not significantly alter physical/strength properties of the EWP
- Adequate macro- and micro-distribution of the preservative is critical for performance
- Quality control methods need to be implemented

Acknowledgements

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- *QUESTIONS?*