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STELLA-JONES INC.

- **PRESERVATIVE COMPARISONS & TREATMENT METHODS**

- **Wood is pressure treated to render it unusable as a food source and therefore extend its service life. Replacement of wood that has decayed accounts for 10% of total harvesting and approximately $1.5 billion US.**

PRESERVATIVES

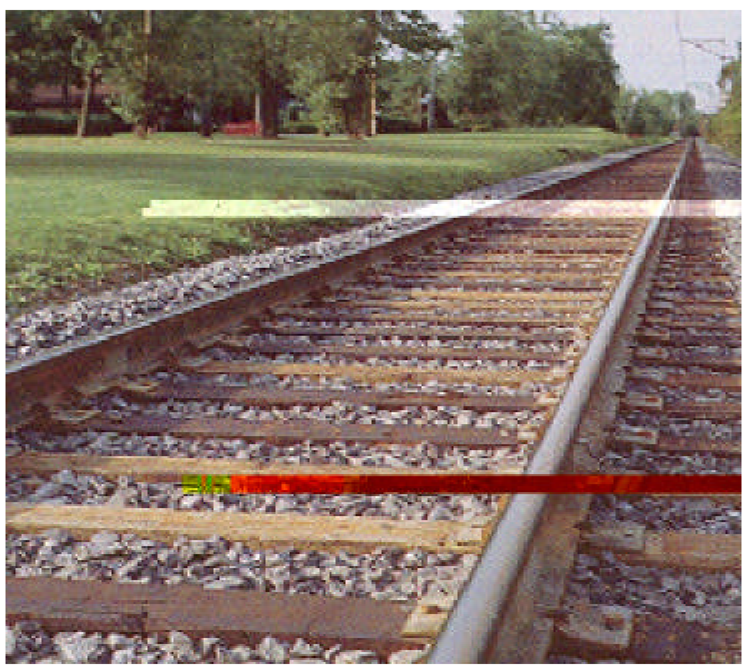
Preservatives are either water or oil borne.

- **The two most common waterborne preservatives are CCA and ACZA; active ingredients include copper, chromium, arsenic and zinc.**

- **Oil borne include pentachlorophenol and creosote.**

CREOSOTE

- **Most successful preservative developed during the 19th century.**
- **Product of the distillation of coal.**
- **Main usage is as a wood preservative, but it is common in dandruff shampoo as a fungicide.**
- **The presence of more than 300 organic chemicals is what makes creosote such an effective wood preservative.**



Creosote

- **Positives include efficacy, positive effect on mechanical properties and ability to be metabolized by soil microbes.**
- **Negatives include aromatic nature, being a skin irritant with prolonged contact, bleeding if moisture gradient occurs, and inability to be painted.**

PENTACHLOROPHENOL

- **Pentachlorophenol also known as just penta has been in service since the 1950's.**
- **In treating solutions, penta consists of 4-9% penta solids dissolved in light petroleum oil.**
- **The largest use for penta today is as a wood preservative, but other uses include:**
  - **Preservative in soy sauce**
  - **Insecticide for termite control**
  - **Molluscide for the control of snails**
  - **Herbicide for cotton growers**
  - **Slimicide for the paper industry**

Penta

- **Positives include metabolism of aromatic ring, decreased conductivity, non-corrosive to hardware, low water solubility and no reduction in mechanical properties (MOE and MOR). Penta is also biodegradable over time.**

- **Negatives include aromatic nature and bleeding if moisture gradient occurs.**

CCA

- **CCA is a solution comprised of three metals:**
  - **Chromium (as chromium trioxide)**
  - **Copper (as cupric oxide)**
  - **Arsenic (as arsenic pentoxide)**
- **CCA was developed in 1933 and has been used for utility poles since the 1980's.**
- **CCA is most commonly found as the preservative for consumer lumber.**

ACZA

- **Ammonical Copper Zinc Arsenate is a refinement of Ammonical Copper Arsenate where 50% of the arsenic has been substituted by zinc. This improves coloration and limits impacts in aquatic environments.**
- **It is used almost exclusively on refractory species such as Douglas Fir and is effective provided the phase change of ammonia from liquid to gas is controlled.**
- **ACZA is used exclusively in the wood preserving industry.**

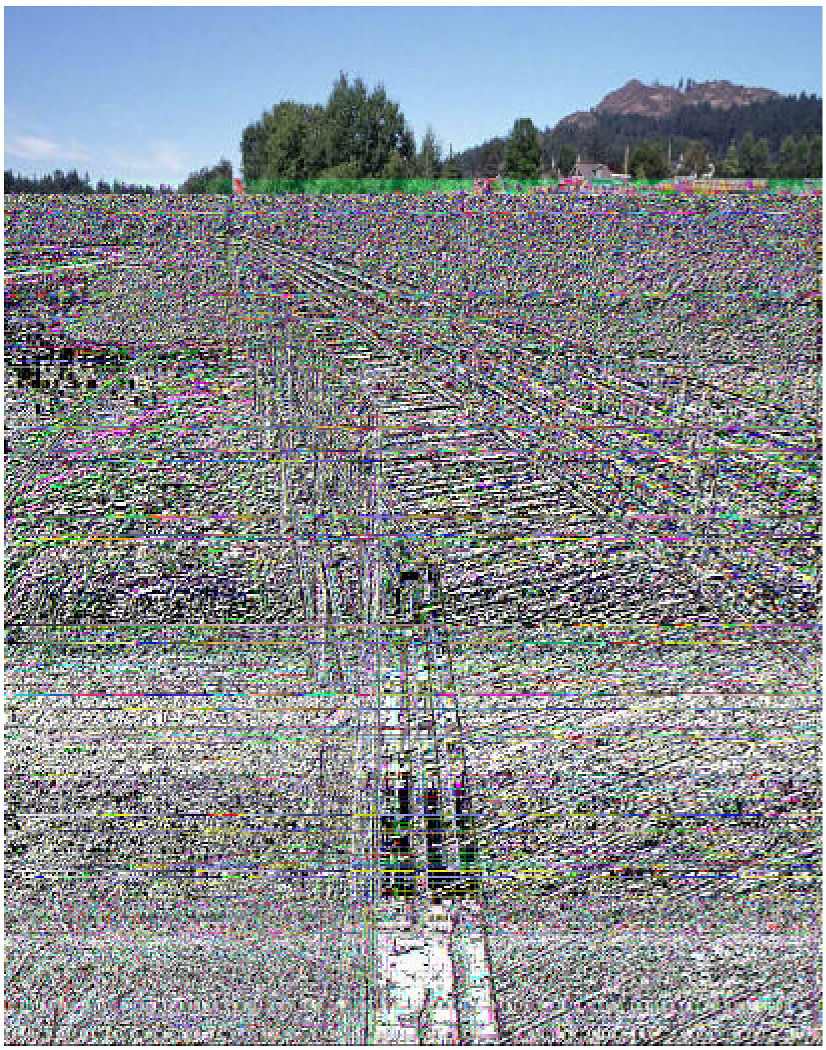
Preservative Comparisons

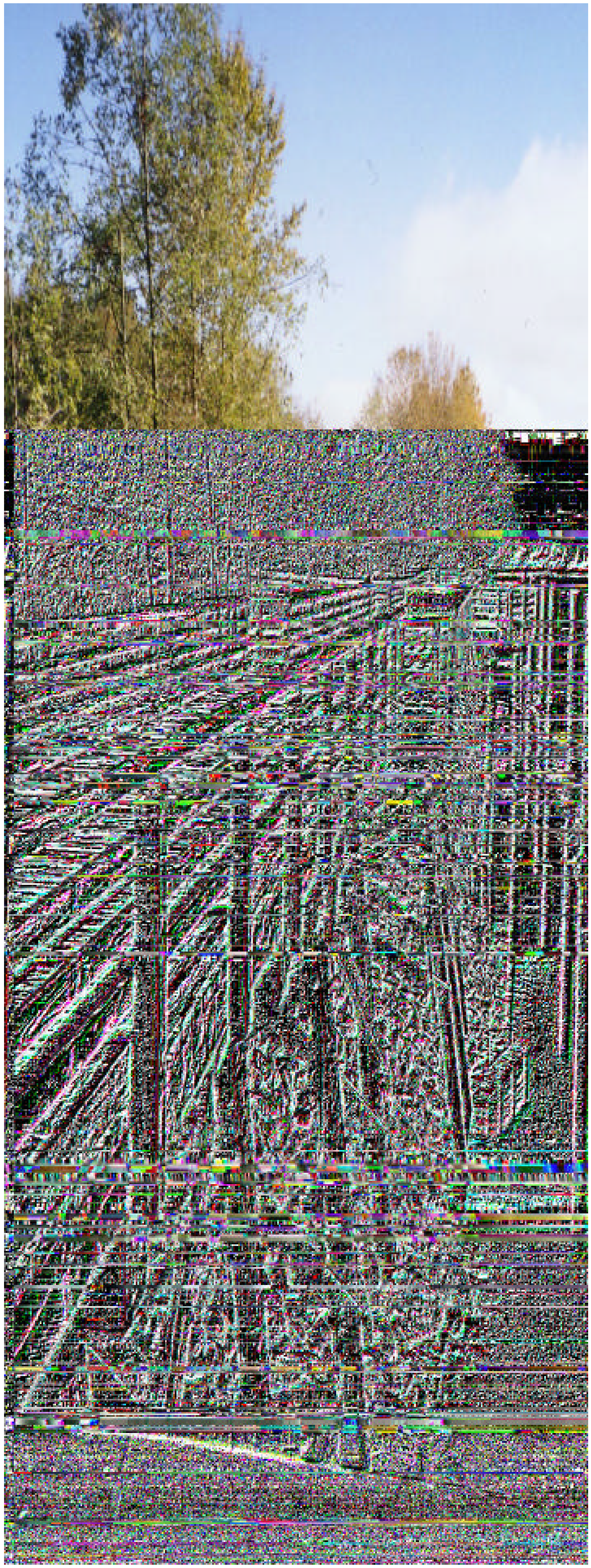
CCA

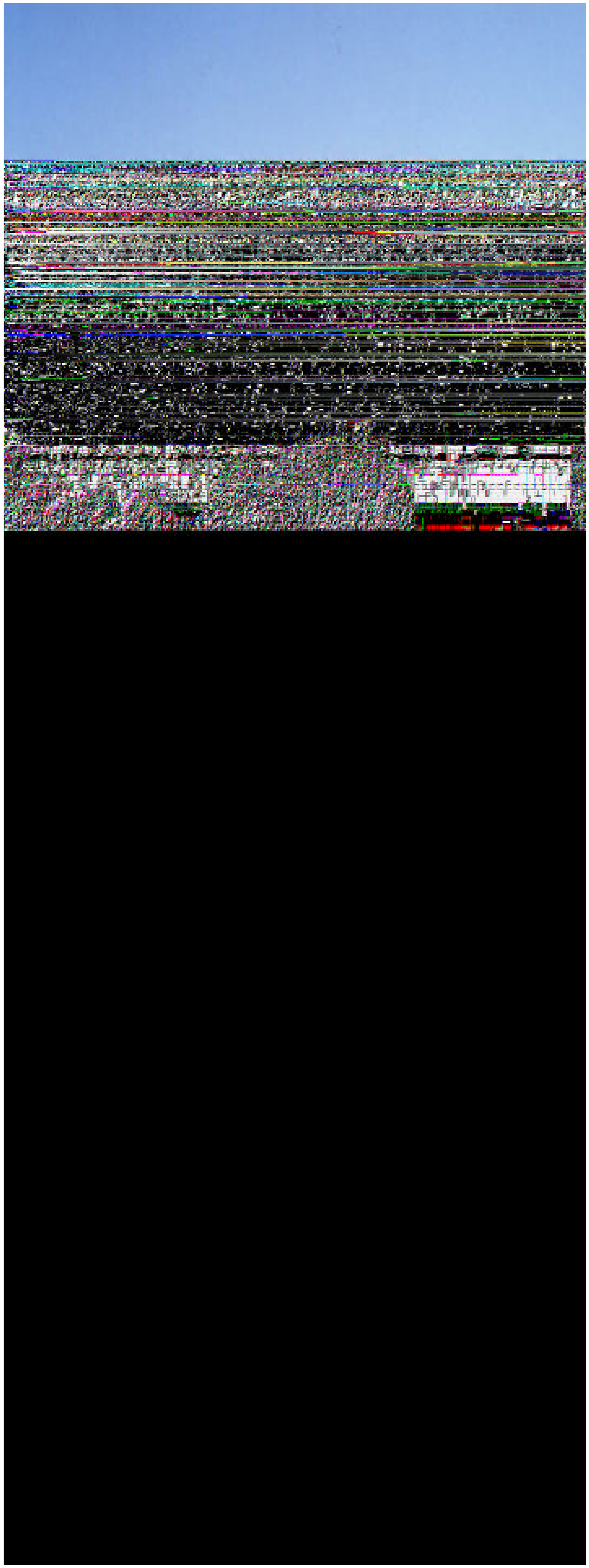
- **Positive points include low levels of leaching when properly fixated, ability to be painted, non-aromatic and aesthetically more pleasing.**
- **Negatives include increased conductivity, inability to chemically transform, and inability to treat refractory species such as Douglas Fir.**

ACZA

- **Positives include non-aromatic nature, ability to treat refractory species and aesthetics.**
- **Negatives include blooming resulting from the uncontrolled phase change of ammonia and inability to be biologically metabolized.**







Next Generation

- **The next generation of preservatives includes ACQ, Copper Citrate and thermally cross linked CCA additives. Copper and metal emulsions will remain the focus of the preservative manufacturers. Success will depend on the ability to chemically bind with the wood.**
- **The ideal preservative is application specific and <u>biologically</u> engineered to the specific environment and end use.**
- **New preservatives must be evaluated as a function of treatability, efficacy, effect on mechanical properties, conductivity, recycling potential and ability to target only decay organisms.**

TREATING

- **The goal of treating cycles is to produce a quality, clean product that meets applicable penetration and retention requirements at the lowest possible cost.**
- **Treaters can achieve this goal by controlling variables such as wood condition, preservative, and treating cycle procedures.**

The Wood Preserving Process

Consists of three basic steps:

1. Pre-treatment conditioning
2. Preservative treatment
3. Post-treatment conditioning

Pre-treatment Conditioning

- **Removes excess moisture content from the wood. Moisture is a physical barrier to preservative.**
- **Makes the wood more permeable to the preservative by the removal of wood nutrients which block pits during drying.**
- **Minimizes leaching (bleeding) after treatment. Reduces the moisture gradient behind the preservative.**
- **Minimizes wood checking after treatment.**
- **Often not required for well seasoned wood.**

Pre-treatment Conditioning Methods

Pre-cylinder

- **Air Seasoning**
- **Kiln Drying – too rapid can cause high moisture gradient and more bleeding**

Cylinder

- **BUV - boiling under vacuum**
- **Steam conditioning**
- **Heating in preservative (bathing)**

***Effectiveness is directly proportional to high surface area to volume relationships*.**

Pressure Treatment

Two basic processes - empty cell and full cell:

- **Empty cell - Rueping process or Lowry process:**
  - **Used for obtaining deep penetration with relatively low net preservative retentions.**
  - **Should always be used for oil borne preservatives if it will provide the desired retention as it reduces bleeding.**
- **Full cell - Bethell process:**
  - **Used for waterborne preservatives and creosote marine treatments (piling).**
  - **Net retention is controlled by regulating the preservative concentration and final vacuum.**

Post-treatment Conditioning

- **Minimizes leaching (bleeding) after treatment**
- **Removes excess preservative from the surface of the wood**


Post-treatment Conditioning Methods

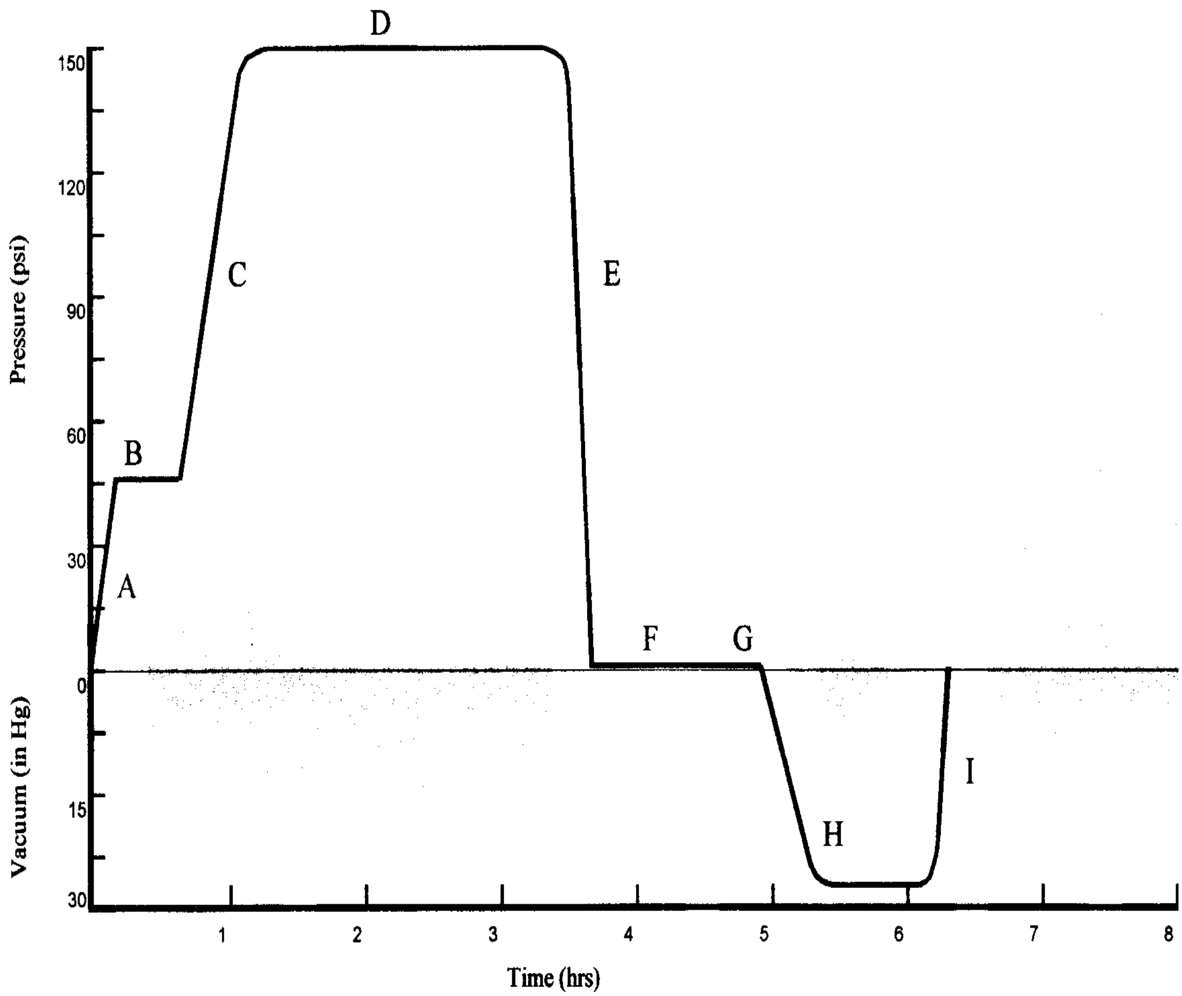
Options include:

- **Expansion bath.**
- **Post-pressure steaming.**
- **Accelerated fixation by steam, hot air, or hot water (waterborne preservatives). Fluid provides the most efficient heat transfer.**

Empty Cell - Rueping Process

- **The cylinder is pressurized with air before it is filled with preservative.**
- **The expansive force of the compressed air is used to expel some of the preservative absorbed during the pressure period.**
- **Proper post treatment conditioning is required to prevent bleeding.**

Rueping (Empty Cell) Cycle



A - Initial Air Pressure
B - Fill Cylinder
C - Pressurize Cylinder
D - Pressure Period
E - Release Pressure

F - Expansion Bath
G - Empty Cylinder
H - Final Vacuum
I - Release Vacuum

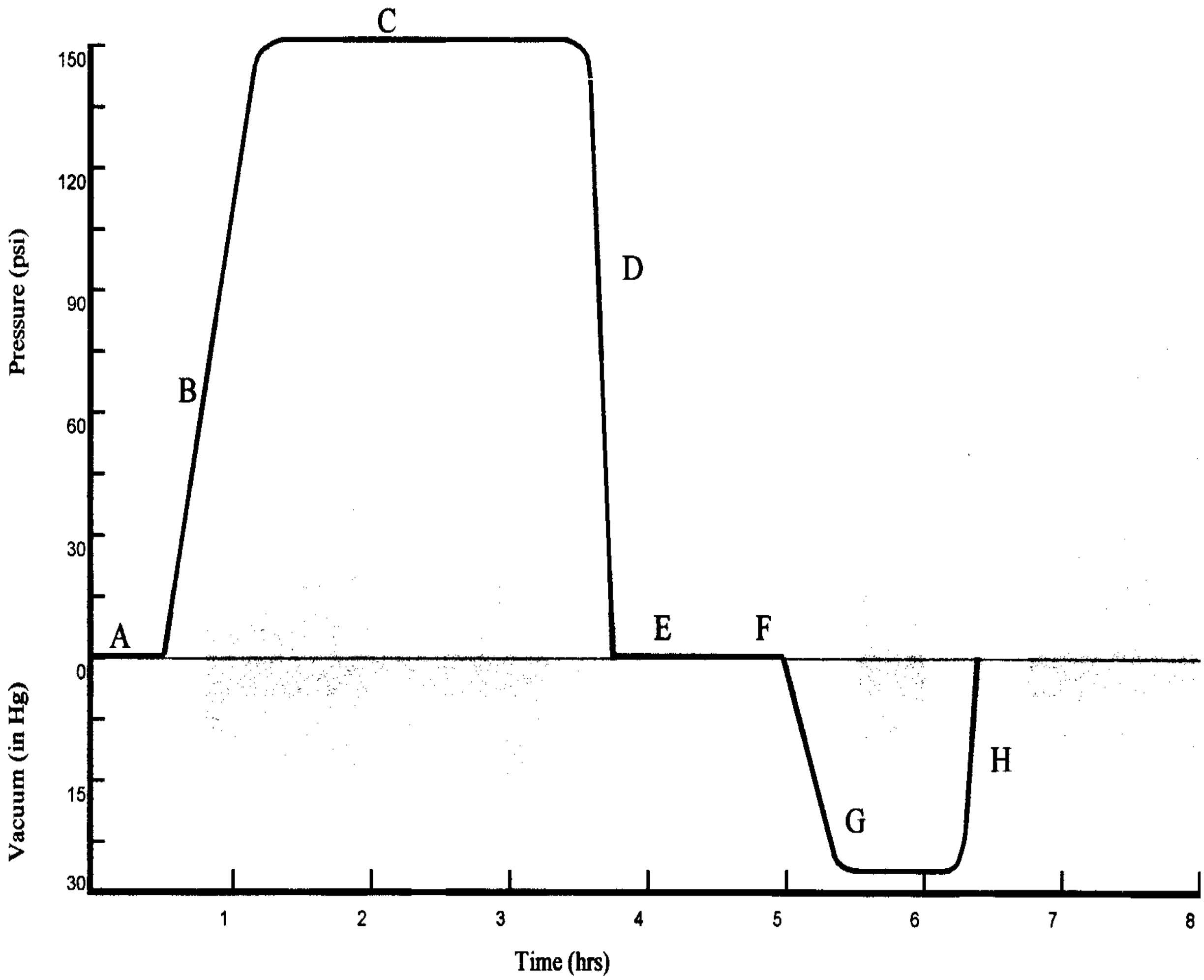
Rueping Retention Control

- **Two variables are available for control - the initial air pressure and the gross retention.**
- **If the cycle used results in penetration failure, increase the gross retention.**
- **If penetration is achieved but assay is not, decrease the initial air pressure.**
- **If assay is too high (over-treatment), increase the initial air pressure, or reduce the gross, or both.**
- **With penta solutions, concentrations must be optimized to minimize the amount of solvent used.**

Empty Cell - Lowry Process

- **Essentially a modified rueping process. Only the cylinder is filled under atmospheric pressure.**
- **The expansive force of the air left in the wood is used to expel some of the preservative absorbed during the pressure period.**
- **Normally used for creosote treatments of difficult to penetrate sawn timbers.**

Lowry (Empty Cell) Cycle



A - Fill Cylinder
B - Pressurize Cylinder
C - Pressure Period
D - Release Pressure
E - Expansion Bath
F - Empty Cylinder
G - Final Vacuum
H - Release Vacuum

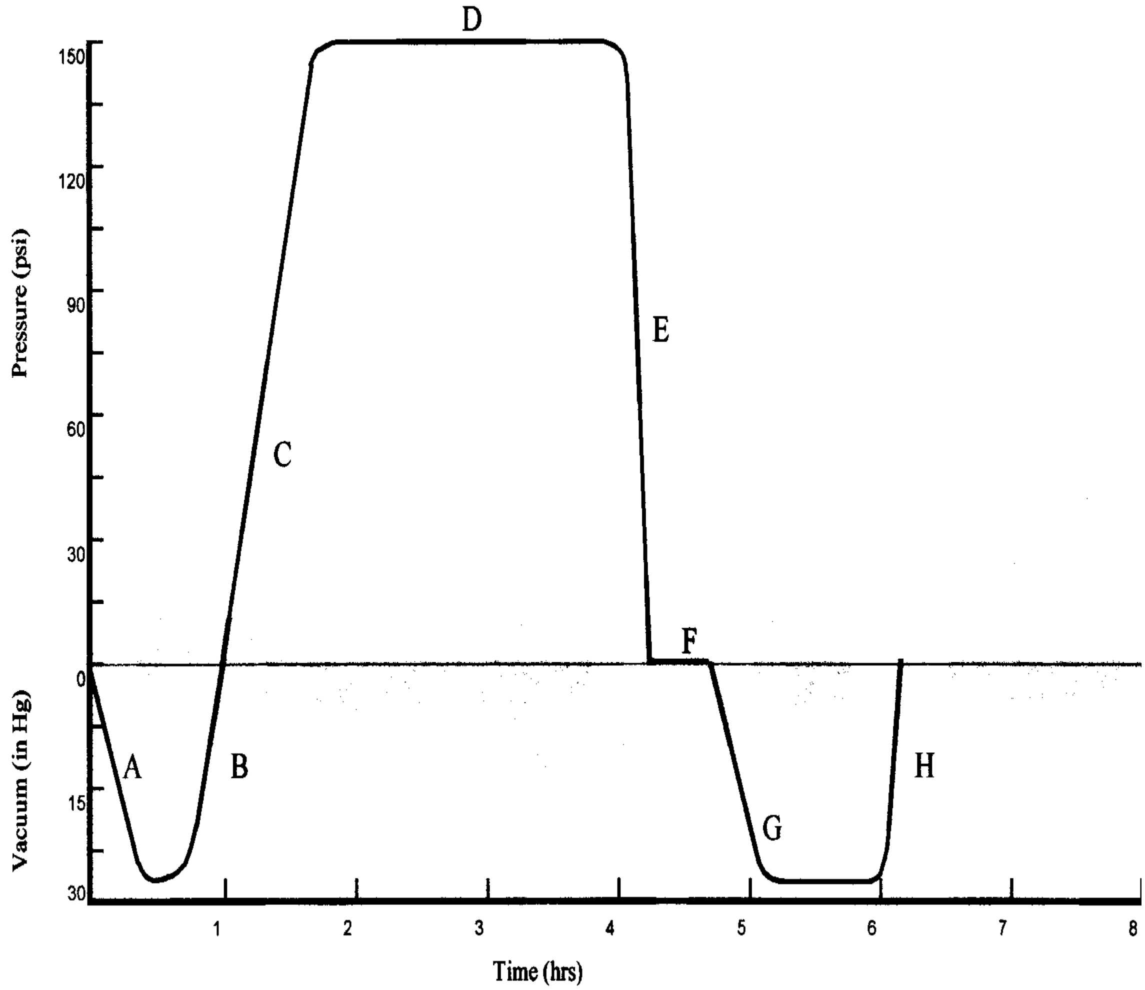
Lowry Retention Control

- **Only one variable is available for control - the gross retention.**
- **If the cycle used results in penetration or net retention failure, increase the gross retention.**
- **If penetration is achieved but net retention is too high (over-treatment), reduce the gross.**
- **If reducing the gross lowers the net but results in penetration failure, use a rueping cycle to get the additional benefit of initial air pressure.**

Full Cell - Bethell Process

- **Air is removed from the cylinder and wood by applying a vacuum before the cylinder is filled with preservative.**
- **Normally used for waterborne preservatives and when high retention with minimum kickback is required.**

Bethell (Full Cell) Cycle



A - Intial Vacuum
B - Fill Cylinder
C - Pressurize Cylinder
D - Pressure Period

E - Release Pressure
F - Empty Cylinder
G - Final Vacuum
H - Release Vacuum

Full Cell Retention Control

- **Two variables are available for control - the preservative concentration and the gross retention.**
- **Penetration control is achieved by gross retention - if penetration failure occurs increase the gross by increasing the duration of the pressure period.**
- **Net retention (assay) control is achieved by varying the preservative concentration.**
  - **For under-treatment (assay failure), increase the treating solution strength.**
  - **For over-treatment (assay too high), reduce the treating solution strength.**

Summary:

- **By careful control of process variables and preservative solutions, treaters can produce products that meet customer requirements while minimizing preservative usage and environmental impacts.**
- **Statistical analysis can assist in the systematic reduction of cycles and preservative consumption.**