Formaldehyde and Composites

Workshop Introduction

Erwin Schutfort
PSI - Professional Service Industries Inc.
Pittsburgh Testing Laboratories Division
2710 West 5th Avenue
Eugene, Oregon 97402
Erwin.Schutfort@psiusa.com

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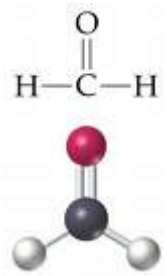
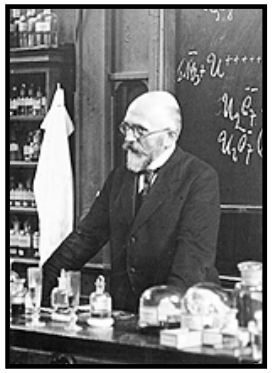
Formaldehyde



- aldehyde, carbonyl-group
- colourless gas
- water soluble (highly)
- a strong reducing agent
- oxidizes in air - sensitive to exposure to light
- average atmospheric abundance: 5 ppb
- boiling point (pure) -19.2°C
- melting point (pure) -117°C

30.03 g·mol−1



A. W. Hofmann,1868

AKA: HCHO, formalin, formol, methyl aldehyde, methylene oxide

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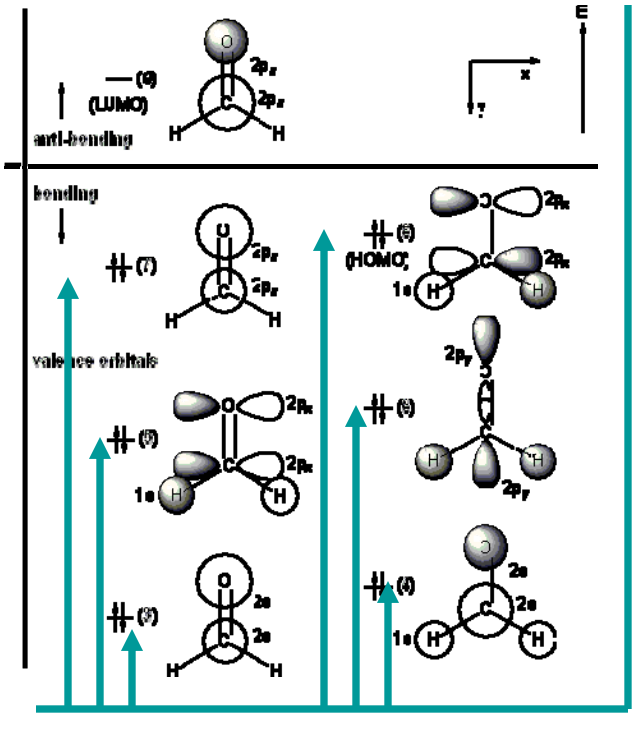
Formaldehyde Chemistry

- Highly reactive in acidic and alkaline enviroment
- Relative inexpensive (gas price sensitive)
- Derived from methanol
- Widely used in industrial processes



low activation energy (few eV's) = high reactivity





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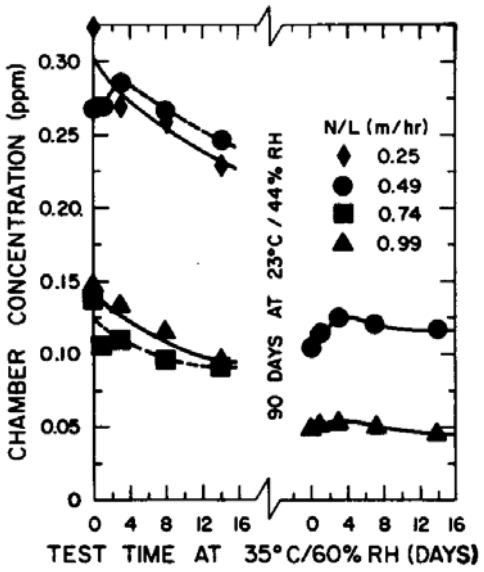
Environmental Fate

- Formaldehyde emissions decrease rapidly in the early stage after panel production.
- In air: half-life of 8 – 12 hours (photochemical degradation, methanol)
- In water: half-life of 10 – 30 days (biological and chemical reaction)



Formaldehyde Sinks

Myers, G., Formaldehyde emission from particleboard
FOREST PRODUCTS JOURNAL Vol. 33. No. 5, 1983

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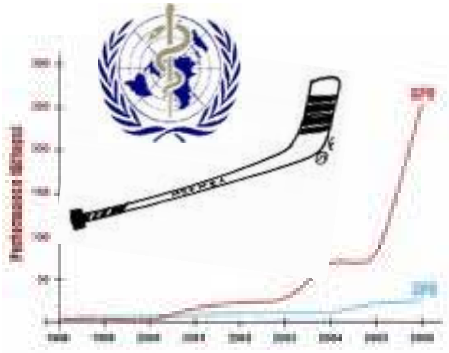
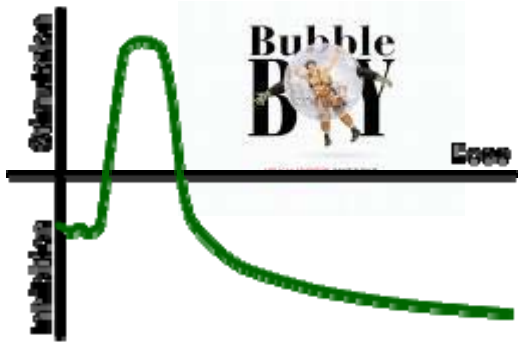
Health Effects

- irritants to the skin (> 1 wt. % in aqueous solutions), eyes and mucous membranes (> 0.1-0.5 ppm in air)
- IARC reclassified formaldehyde as a known human carcinogen (June 2004)
- Hockey stick controversy and Hormesis hypothesis





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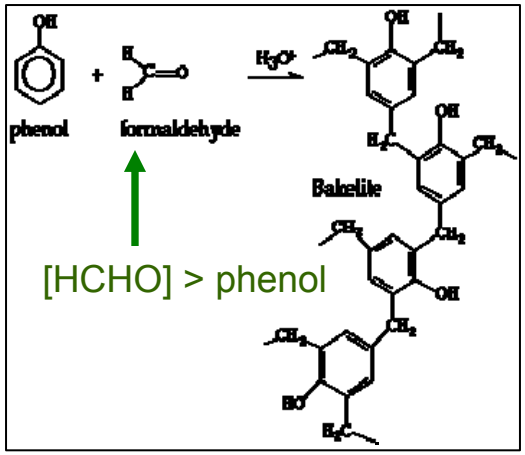
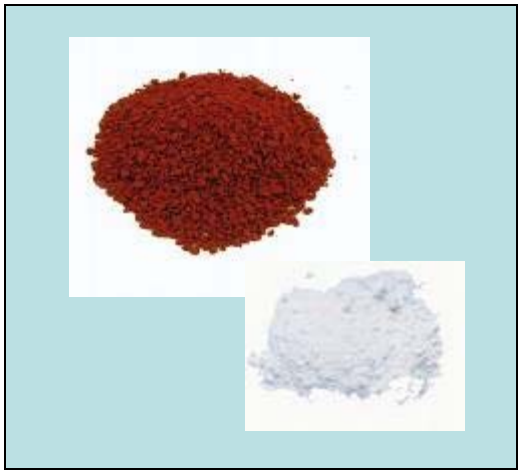
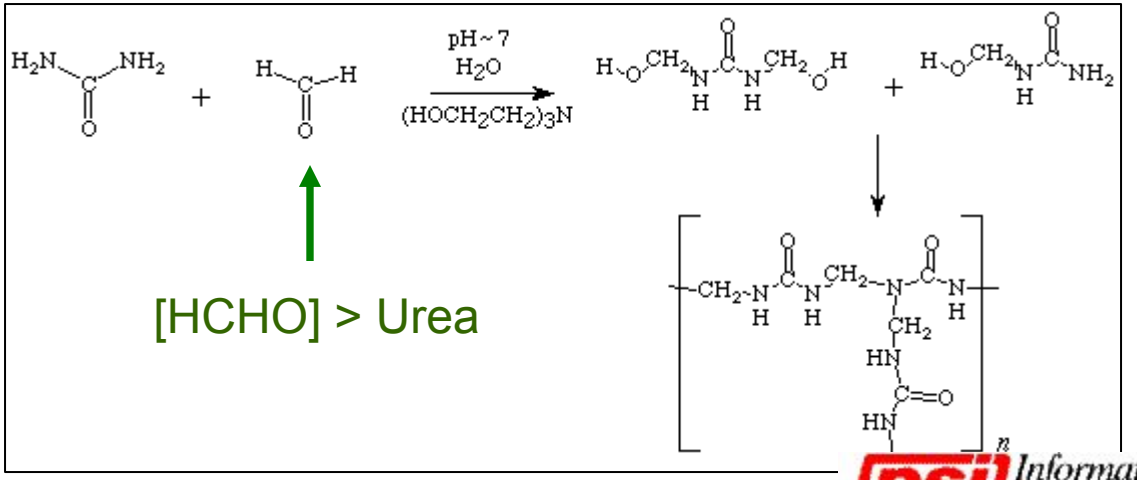
Thermosetting Resins



- Phenol Formaldehyde
- Urea Formaldehyde
- Resorcinol PF (cold setting)
- Melamine UF

Excess ‘free’ formaldehyde is required to assure reasonable completion of condensation reaction.





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History of Engineered Wood

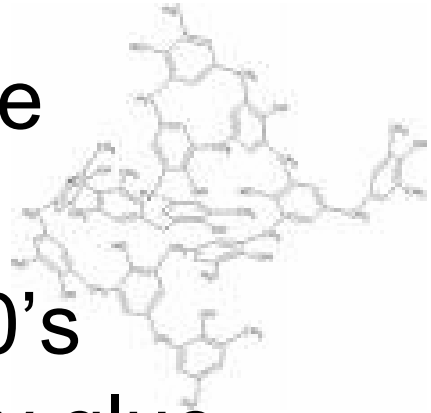
- Plywood invented in Portland, Oregon (1905)
- Initial motivation to produce door Skins

The initial Adhesive was blood (albumin) from slaughter houses.

Source: http://www.apawood.org/plywoodcentennial/history.htm

Water-Resistant Adhesives

- Phenol - Formaldehyde thermosetting resin
- Breakthrough in the 40's leads to exterior quality glue



Leo Baekeland

Fiber Utilization

- Smaller tree diameter – industrial wood
- Recycling of sawdust waste
- Whole tree utilization concept

Source: APAwood.org

HUD 1984 **E1 1985** **IARC 2004** **CARB 2007**

Plywood 1900's **PB 60's** **MDF 70's** **OSB 80's**

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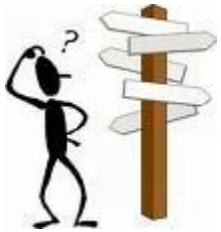
The Sinful 60's and 70's

- Particleboard allowed new furniture designs
- Nationwide need for affordable mobile and manufactured housing increased
- Urea Formaldehyde Foam Insulation UFFI
- Formaldehyde was not recognized as a potential health hazard

Green Building Products

- Paradigm shift towards green building products

- Japanese ‘sick house’ syndrome – European requirements
- California §01350 compliant products
- Inflation of marketing trade marks
- Consumer confusion is high



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Discussion

- Formaldehyde Chemistry
- Evolution of Engineered Wood Products
- Resin and adhesive manufacture
- Environmental and Health Effects

Comments or Questions?

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Thank you!

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