THE USE OF ORGANIC HUMECTANTS AS NON-CORROSIVE DUST CONTROL AGENTS

Sean W. Morefield
Construction Engineering Research Laboratory
Charles A. Weiss, Jr., Ph.D.
Philip G. Malone, Ph.D.
Geotechnical and Structures Laboratory

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Development of Aldonic Acid Derivatives Designed for Dust Control

- **Problem: Dust from roads and runways cause corrosion and wear on vehicles and aircraft that must be used in dusty environments.**
- **Approach: Use environmentally-friendly, non-toxic, non-corroding, water-based hydrogel to contain particulate agents**
- **Method: Prepare and evaluate organic moisture-collecting compounds based on aldonic acid (sugar-derived) hydrogel that are effective, safe and durable**

Dust is both a corrosion and a safety problem.

Aldonic Hydrogels - Optimum Dust Control Agents

- **Hydrogels are strongly hygroscopic and maintain a moist surface that can hold fugitive dust**

- **As the moisture level decreases the hydrogel develops a solid surface that can rehydrate and hold any fine particulates touching the surface**

- **Hydrogels do not support the rapid growth of mold or bacteria**

- **Hydrogels will not leach down into the lower soil layers**

Lab sample of Vicksburg Loess treated with lactobionic acid after months in the laboratory

Hydrogels - Non-Toxic and Environmentally-Friendly

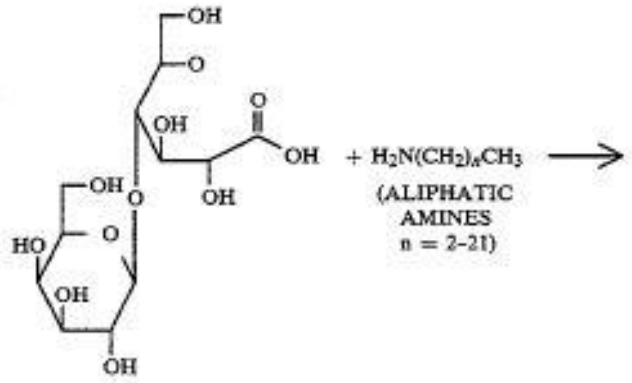
Rye grass on the left is growing in soil treated with a 25% lactobionic acid solition. The application produced a 10-day delay in wilting when no water was applied to the test plants.

- **Lactobionic acid, an easily synthesized hydrogel, is used as a food additive and is a suspension agent used in pharmaceutical preparations were a suspension agent is needed**
- **Tests with rye grass indicate the hydrogel in soil does not inhibit plant growth**
- **Root clusters concentrate in the soil treated with hydrogel because the gel concentrates moisture in the treated layer at the top of the soil column**
- **Gel enhances the growth of root hairs and reduces the tendency of the plant to wilt when water is not applied**

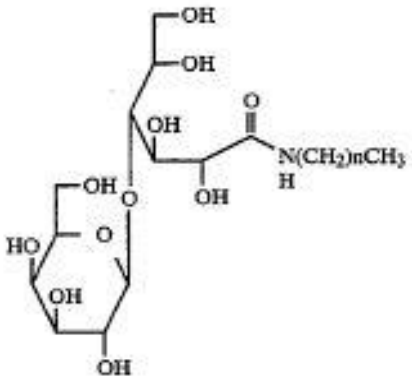
Adaptation of Aldonic Acids

- **Aldonic acids, lactobionic acid and maltobionic acid can be chemically modified to form surfactants that bond more firmly to soil**

- **Mixtures of hydrogel and surfactants moieties may be best for capturing and holding dust particles**



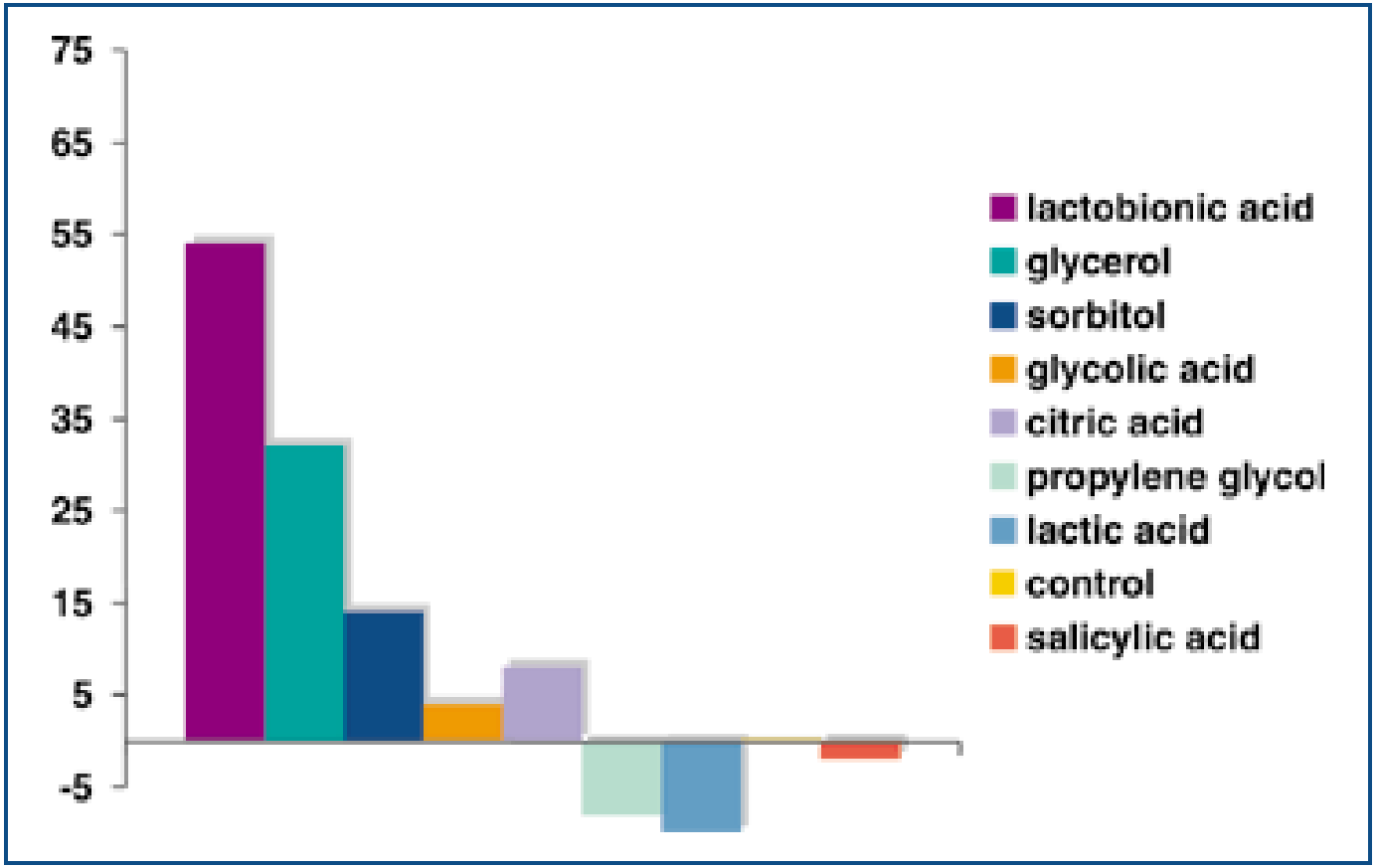
LACTOBIONIC ACID



N-ALKYL LACTOBIONAMIDES

Comparison of Water Retention for Organic Humectants

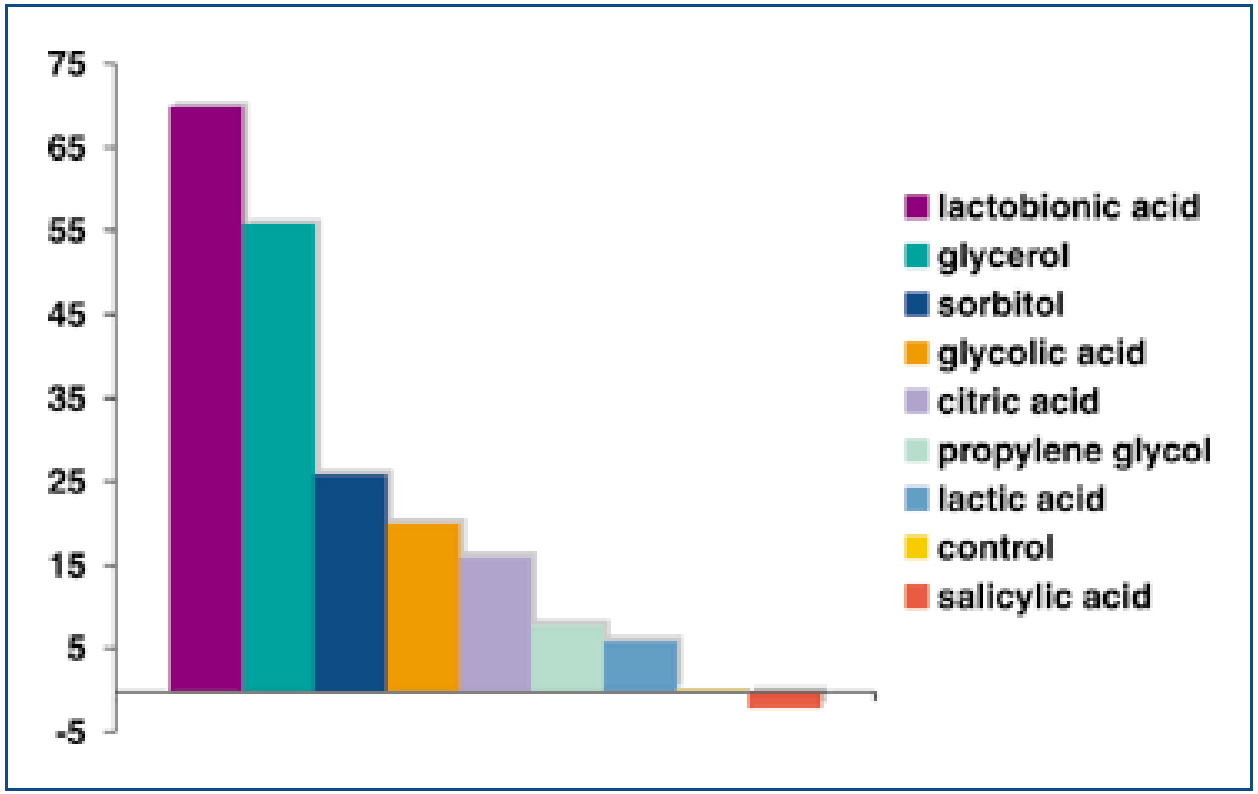
Weight (g) of water retained per mole



Test compounds were prepared as 1M aqueous solutions in petri dishes to a total volume of 25 ml. Solutions were oven dried at 100 F until one went to zero moisture. From Green, B.A. et al. 2002

Rate of Water Absorption for Organic Humectants

Weight (g) of water absorbed per mole of substance



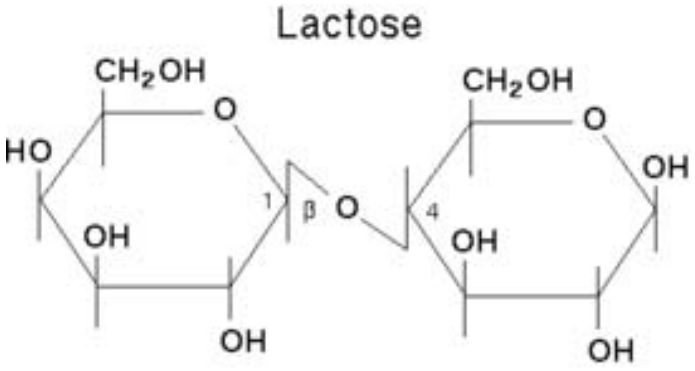
Oven dried samples were exposed to 100% humidity chamber for four hours. Green, B. A. et. al. 2002

Lactobionic Acid Hydrogel

- Natural gel matrix containing water forms on evaporation at room temperature
- Structural resembles a glycoaminoglycan (sulfated polysaccharides seen in connective tissue)
- Gel matrix film contains approximately 14% water
- Does not irritate or harm exposed skin. Non-irritating equivalent to saline solution control

Availability of Aldobionic Acid Dust Control Agents

- **The base material, lactose, is a common byproduct of manufacture of cheese**
- **An estimated 500,000 tons of lactose are produced every year and there is little market for this compound due to its indigestability**
- **Conversion of lactose to lactobionic acid can be done inexpensively using chemical oxidation or by bacterial or fungal fermentation**
- **Continuous, high-yield production makes lactobionic acid a useful humectant for safe dust control**



Lactose makes up around 2-8% of milk (by weight). Its systematic name is β-D-galactopyranosyl-(1↔4)β-D-glucopyranose.

Summary

- Lactobionic acid the the most hygroscopic organic compound that is currently available.
- Natural gel matrix containing water forms on evaporation at room temperature
- Non-toxic used in food, cosmetics and pharmaceuticals
- Gel matrix film contains approximately 14% water
- Does not irritate or harm exposed skin.
- Can prevent air entrainment of dust without harming plants.


Questions?