Tomorrow's Flexible Pavement Binder

Gayle King

SEPPP – New Orleans

May 13th, 2009

Mission Statement:

- **Create a sustainable flexible pavement binder which:**
  - 1) is derived from renewable resources and enables the paving industry to become carbon negative (net removal of CO_2 from the atmosphere).
  - 2) yields safe and economical high-performance pavements under all traffic and climatic conditions.
  - 3) can be constructed, maintained, and recycled with minimal disruptions to traffic.
  - 4) enables all existing environmental health and safety standards to be met and exceeded.

Guiding Principles

- **Needed raw materials will be produced for paving needs, rather than being sourced from a by-product of other fuels technologies (e.g. lignin, pyrolysis pitch).**
  - a) Preference for biomass sources which do not use the land and fresh water resources needed for food production.
- **2) Pavement life-cycle costs will be competitive in a market of gradually rising petroleum crude prices.**

Nanotechnology

- **The understanding and control of matter**
  - Between 1 and 100 nanometers
  - where unique phenomena enable novel applications*
- **Nanotechnology is diverse**
  - Device physics
  - Approaches based upon molecular self-assembly
  - Materials with nanoscale dimensions
  - Nano-farming

* www.nano.gov

What Can Nanotech Do for AC?

1. **Disperse and suspend fine powders or metal ions as asphalt additives**

2. **Deliver novel precursors for tomorrows bio-engineered sustainable paving materials – "nano-farming"**

Do others share our dream?

- **Algal Biomass Organization**
  - promotes the development of viable commercial markets for renewable and sustainable commodities derived from algae.
- **Bio-jet from algae: DOD, Boeing**
- **Bio-diesel from algae: Ames labs**
- **Why not algae-asphalt?**

Paving Binders Through Molecular Engineering

Algae-phalt

- **Algae: A Raw material source for tomorrows bio-asphalt:**
  - Grows in salt water
  - Voracious appetite for CO_2
  - Loves hot, desert climates with constant sun
  - Preferred nutrients: sewage sludge
  - Algae strains produce different oil molecules
  - Produces 100 times more oil per acre than typical grains

Current Technology Limitations

- Use common algae species
  - No specificity for the chemistry of product oils
- Recovery of algal oil is expensive
  - Drying and extraction required
  - Host algae killed by the recovery process
- Conversion processes to usable products are inefficient & expensive

Why Nanotech for Algal Biomass?

"Nano-farming" solution (DOE Ames)

- Grow the right algae
  - **Genetic engineering for higher quality oils with better yield**
- Recover oil from living algae
  - **Sponge-like mesoporous nanoparticles extract oil from living algae**
- Convert algal oil to product
  - **Processing catalysts**

NCAT search: $$$ & team for Applied Research

- **Create the right algal oil**
  - Genetic engineering
- **Recover oil efficiently**
  - Nano-farming
- **Convert algal oil to paving binder**
  - Basic chemistry
  - Processing technology to scale
- **Adapt paving technology**

Questions?

If Americans could put a man on the moon in a decade, we have the ingenuity to solve the energy crisis. Obama