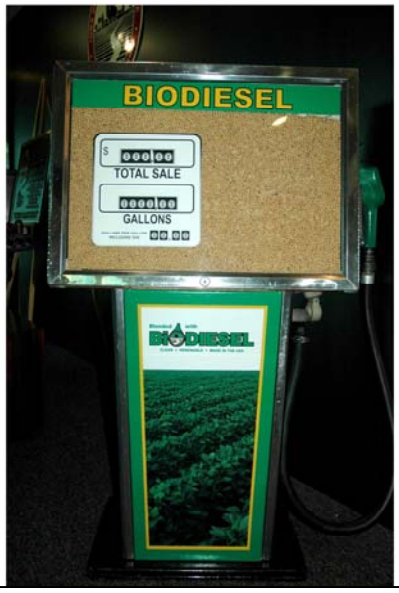
Iowa DNR: Renewable Fuels



The Growth of Renewable Fuels

- **High oil prices, tax breaks, government mandates, goals and subsidies**
  - **Energy independence**
  - **2005 Energy Policy Act doubles the use of ethanol and biodiesel by 2012 (7.5 billion gallons)**
  - **Bush proposal is 35 billion gallons by 2017; cut consumption of gas by 20% in 10 years**
  - **MTBE bans**
  - **CO_2 emissions**

It's amazing what high oil prices, tax breaks and government mandates have done for renewable fuels: more options for these fuels become available.

The Bush administration's production goal is ambitious compared to the EPA of 2005

Just as MTBE replaced lead in gasoline, ethanol is replacing MTBE

Carbon emissions from 800 million vehicles and other sources have received a lot more attention. There are good ideas about greenhouse gas management, mostly from CA, but from what we're told we can't wait for fifty states to adopt legislation.

Behind renewable fuels there are really two major catalysts and problems that must be solved above all else: energy dependence and greenhouse gas emissions. No one fuel is going to do it, but we have taken a small step forward.

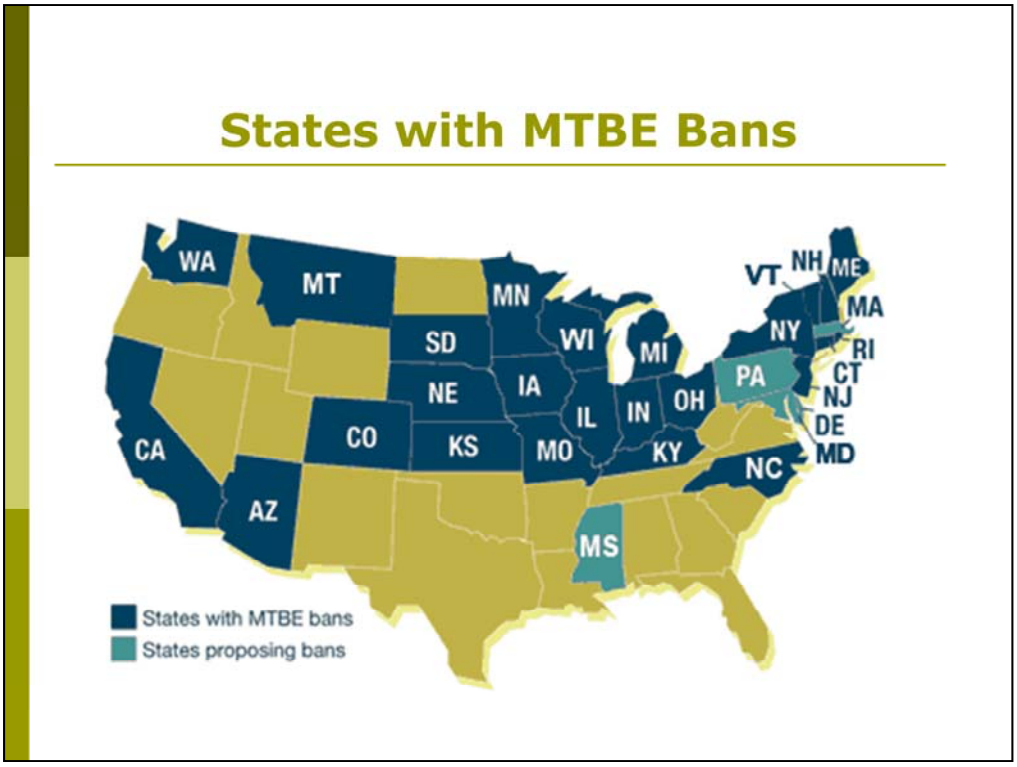
Second Generation Fuels

- Cellulosic Ethanol
  - Field waste (residue from harvesting)
  - Biomass
  - Perennial
- Ethanol's Successor?
  - Biobutanol

We are already seeing the second generation of ethanol, which is cellulosic ethanol or ethanol produced from perennial crops like switch grass and other biomass instead of just the corn. Cellulosic ethanol has a better energy balance.

Biobutanol, may be the successor to ethanol. It too uses energy crops, but doesn't have the storage and transport issues related to ethanol.

A biobutanol plant will be built in the UK at the end of the year. The plant will use sugar beets as feedstock. Biobutanol can be transported by pipeline and does not require new engine design, has higher octane than ethanol and supposedly improves gas mileage.



The last I saw, 25 states across the U.S. have banned or propose banning MTBE as an oxygenate and have substituted ethanol.

Biofuels in Iowa

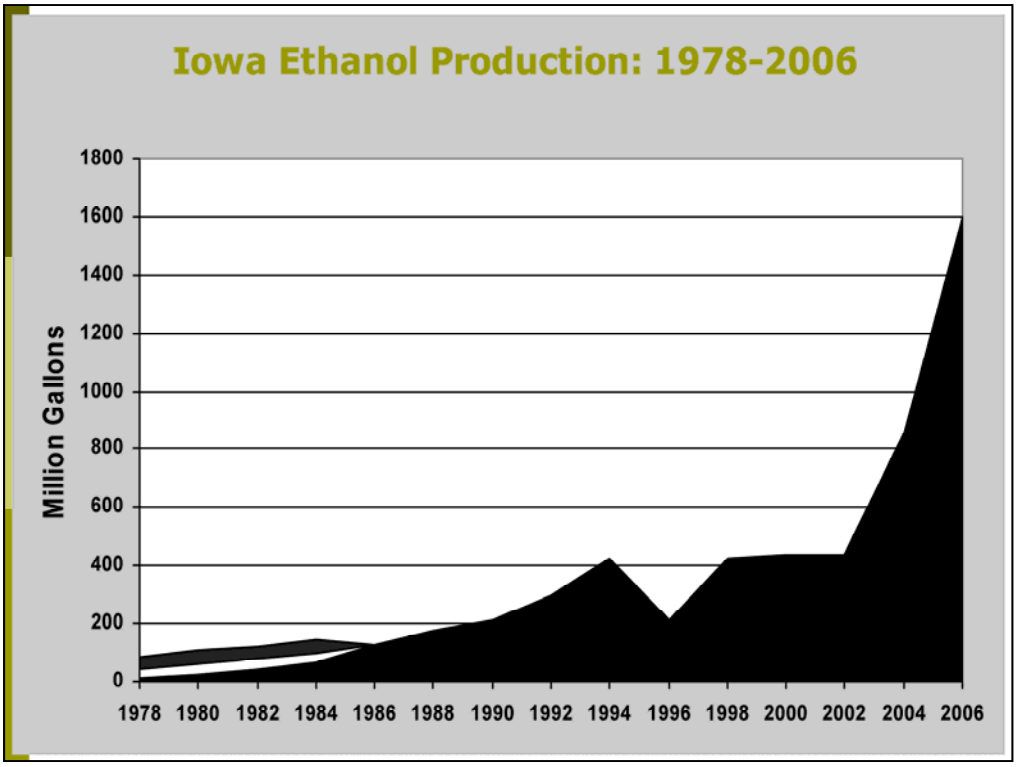
- Ethanol started out as an oxygenate (E10) in 1979
- Value added product
- 75% of gasoline sold in Iowa is blended with E10
- Leader in corn-based ethanol and the natural resource capacity to be a leader in cellulosic ethanol production as well
- New jobs and local investor interest
- Exporter of energy/sustainable economy
- Iowa Power Fund: $100 million investment in renewable fuels by 2008

Iowa has been using a 10% blend since 1979. It's important economically for Iowa not only to grow the crops used in biofuels, but to make it as well.

Ethanol production in Iowa has been compared to what happened during the oil boom in parts of Texas in the early 20th century. Parts of Texas prospered, not just from the oil extracted but from the expertise that Texans developed in all aspects of oil production. For that reason, Iowa wants to be a leader in renewable fuels.

Renewable fuels in Iowa have created new jobs in communities that hadn't seen new jobs in years and are financed by local investors from farmers to bankers.

The Iowa Power Fund wants to triple the availability of E85 and double the production by 2008.



Right now, Iowa has the capacity to produce 1.6 billion gallons per year from ethanol plants already constructed and an estimated capacity in excess of 5 billion gallons per year if you take into consideration the plants currently under construction, expansion or in the planning process.

Iowa produces about 25 percent of the nation's ethanol. Illinois is second followed by Nebraska

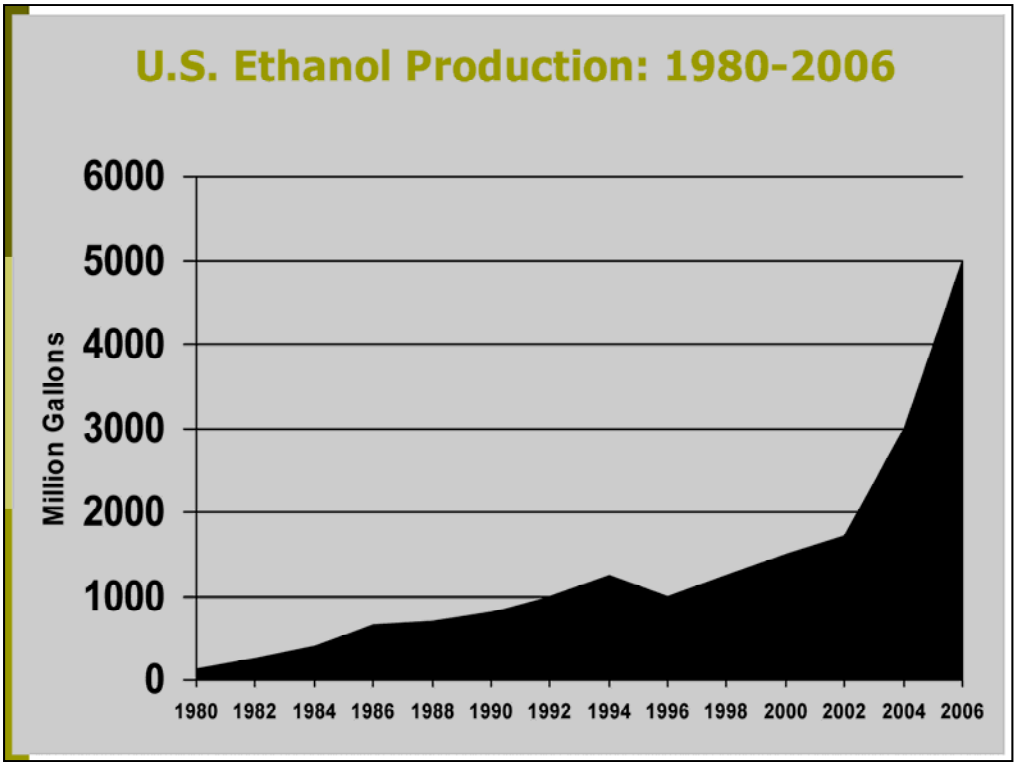
Ethanol Production Concerns

- Demand may exceed supply
  - Increased corn production, i.e., sediment, fertilizer, pesticides
  - Air and water discharges
  - Water use
  - Energy
  - Food supply

Here's the problem. If we continue to use as much energy as we are now, in three to five years we will use 133% of last year's corn crop. We use 40 percent now. That means more land in corn production and more runoff.

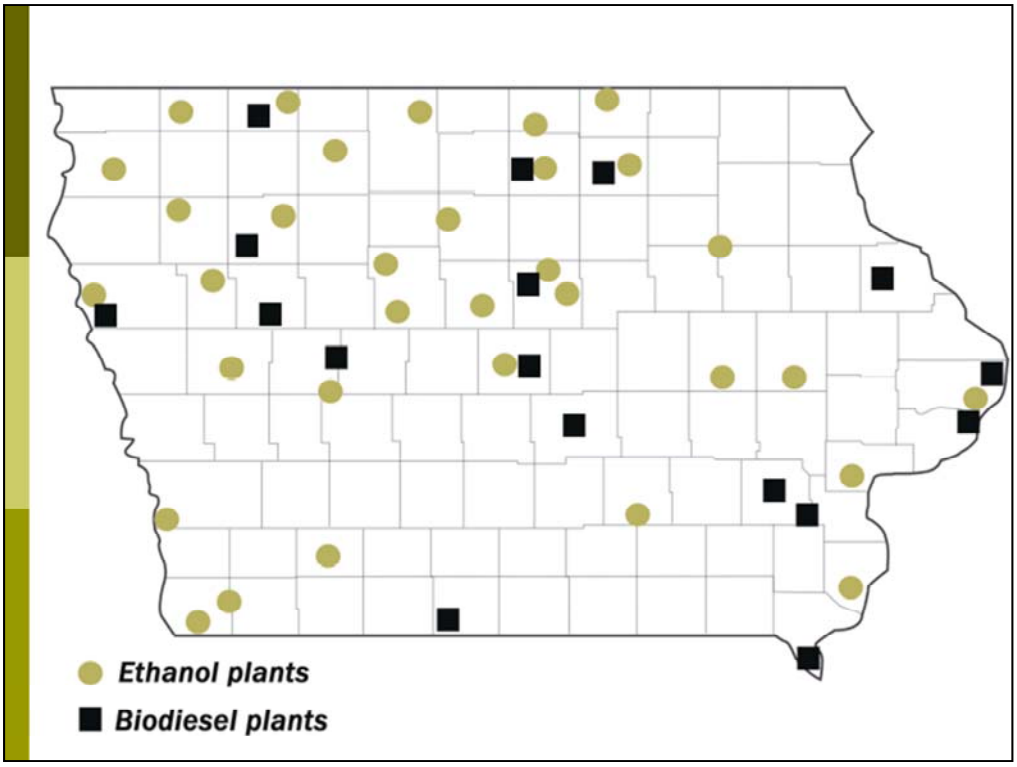
Ethanol plants are heavy users of energy. It takes about 4 gallons of water to make a gallon of ethanol. An ethanol plant that produces 100 million gallons a year uses the same amount of water as a city of 10,000 people.

This is why it's important to explore cellulosic ethanol which is made not from corn kernals, but from fast growing, energy packed grasses and other biomass.



This year the US is expected to produce 6 billion gallons, which is well ahead of the pace set by the 7.5 billion standard of the EPA of 2005, but only 4 percent of the nation's gasoline consumption.

The agriculture sector of the economy would like to offset 25 percent of the nation's gas consumption by 2025 with biofuels.



There are thirty four ethanol plants in Iowa producing 1.6 billion gallons of ethanol and 17 biodiesel plants. Transport is the biggest issue right now.

Existing than processing plants use about 40 percent of Iowa's corn crop.

Biodiesel consumption is has increased dramatically, from a half million gallons in 1999 to 315 million gallons last year. We have 17 biodiesel plants in Iowa.

This is a biodiesel plant where the esterification or chemical process to turn vegetable oils or animal fats into esters or biodiesel. Soy oil is the least expensive of the oils and is commonly used.

B2 and B5 are approved by most engine manufacturers. The long term goal is to get to B20, but the fuels must be consistent in order to do that. Biodiesel has to meet ASTM D-6751 quality specifications.

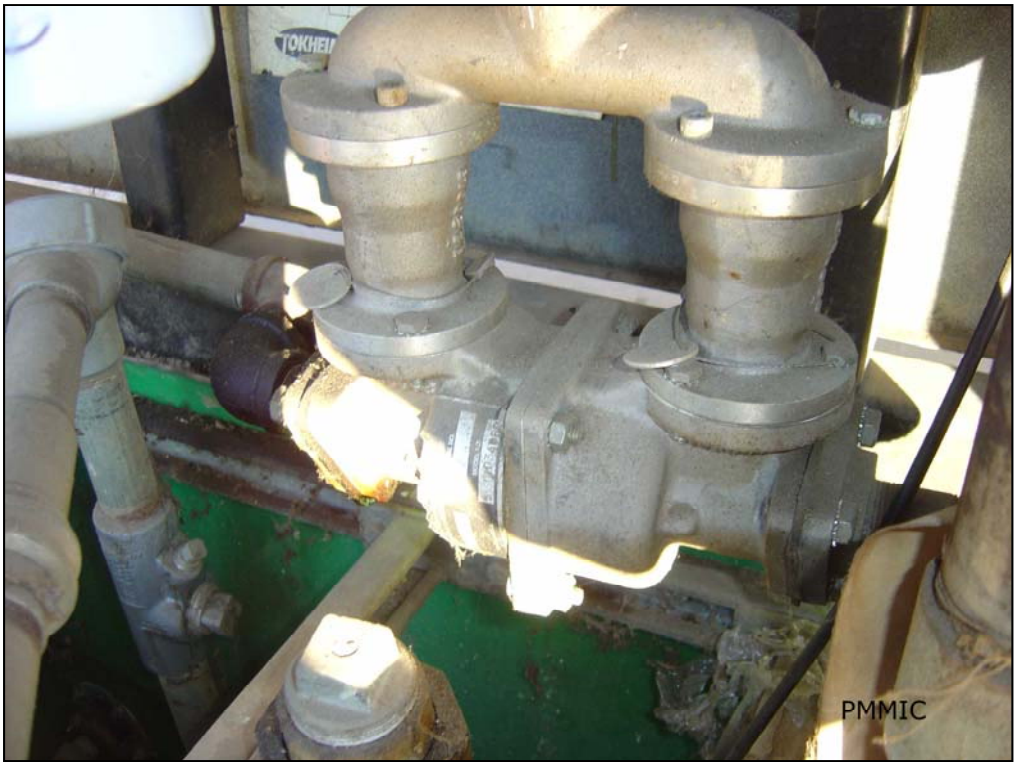
Capacity to make biodiesel is limited more than ethanol and would represent about 5% of on road diesel

U.S Ethanol Biorefinery Locations

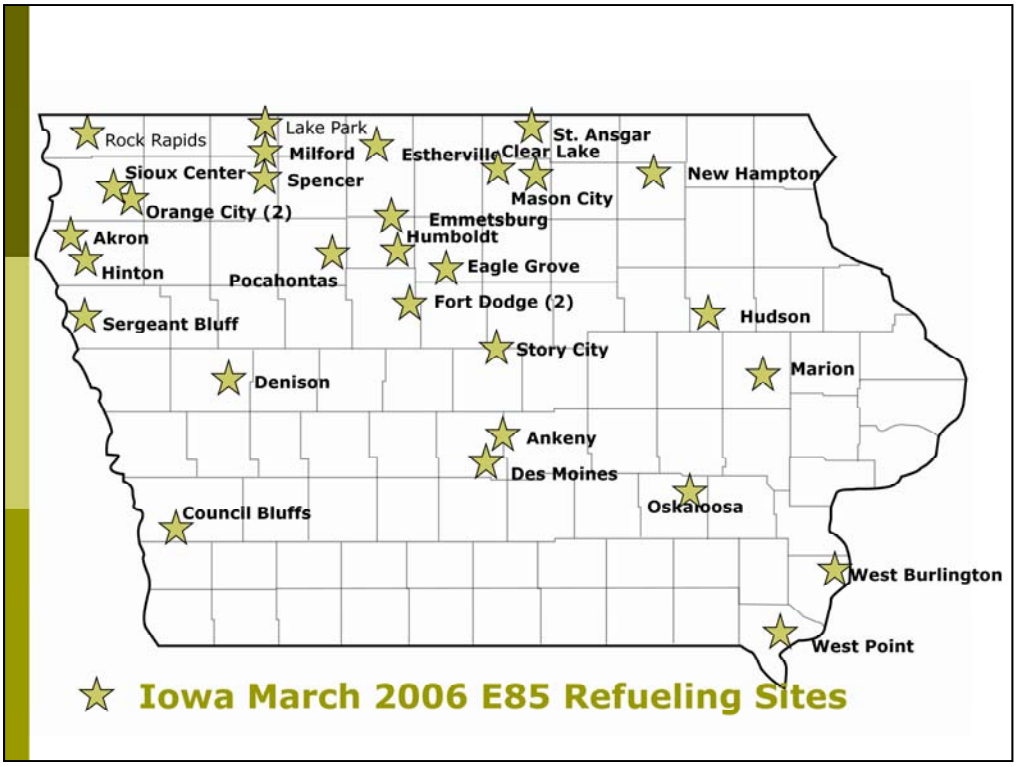
Renewable Fuels Association

Nationwide, there are 117 plants in production with another 76 plants under construction. Over half the country does not have access to ethanol, i.e., no pipelines. As you know, pipelines can't be used for ethanol so they rely mainly on trucks and rail.

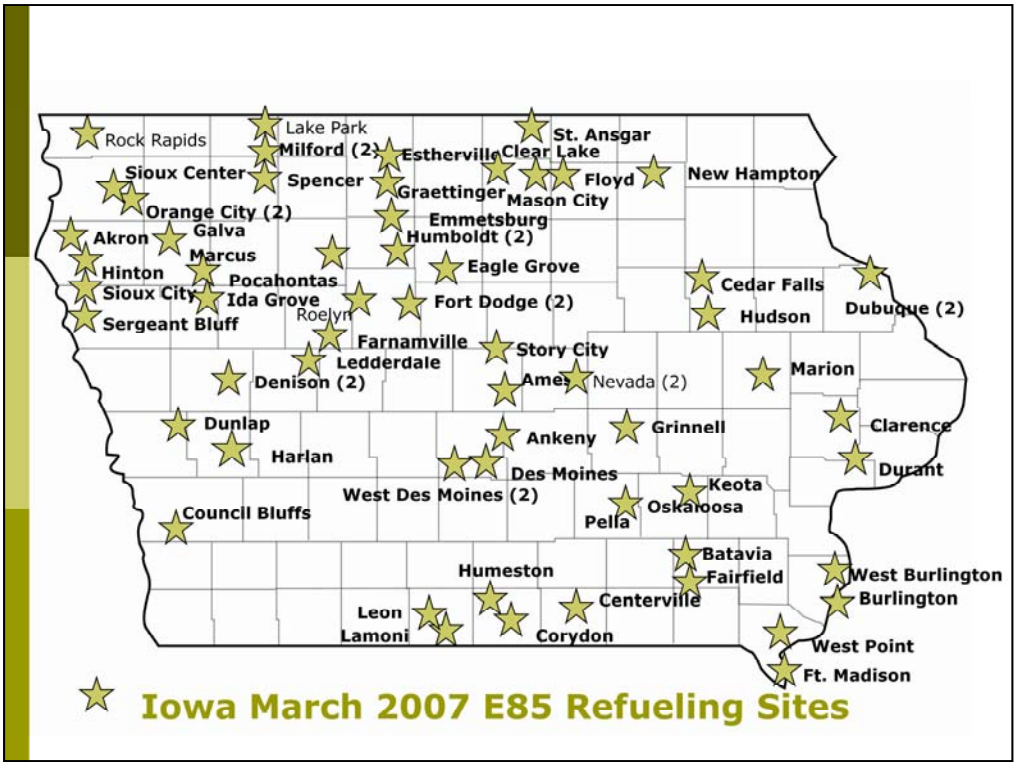
Plants are being built close to power plants where they can take advantage of shipping by rail. Ethanol is splash blended at terminals and then transported by rail or truck.



We’re starting to see more blender pumps like this at dispensers where UST facilities are blending their own ethanol in 10, 15 and 20 percent blends



There were 31 UST retail-marketing facilities selling E-85 in 2006.



We now have 56 sites selling E85. About 6 percent of the vehicles in Iowa are FFVs that can use E85 or 75,000 vehicles.

E85 Issues and Concerns

- Corrosivity
  - Ethanol can scour corrosion cells inside a tank causing a release.

- Conductivity
  - E85 conducts electricity
  - Gasoline is an electrical insulator

The corrosive effects of E85 came to our attention about four years ago when this tank lost over 700 gallons overnight. It was our first known catastrophic failure of an ethanol tank.

It was a 1988 tank that stored E10. The coop decided they wanted to sell E85 so they transferred E85 and lost 700 gallons overnight. The higher concentration of ethanol scoured the corrosion that already existed from E10. The higher the ethanol content, the higher the corrosive effect.

Compatibility

- *Owners and operators must use a system made of or lined with materials that are compatible with the substance stored in the UST system*
- *Industry Codes*
  - *API RP 1626*
- *Fire Code*
  - *NFPA 30*
- Environmental Code
  - State Rules [567-135.4(3)]
  - *40 CFR 280.32 (1988)*

We went back and reviewed all standards and codes for compatibility. They all pretty much say the same thing. All states have the same requirements for compatibility. All storage and dispensing codes make similar statements about compatible equipment.

Compatibility to mean no deterioration of the equipment in the fuel path. No changes to the chemical, mechanical or physical properties of a material.

Compatibility

- Existing UST system components and equipment were optimized for other fuels, namely *gasoline* and *diesel*.

Before we developed our checklist about the only items that were upgraded at E85 sites were hoses and nozzles. E85 requires a modified engine or FFV and a modified UST system. We sent a letter to all owners and operators informing them about storage and dispensing problems and also requiring the completion of a compatibility checklist.

DNR and E85

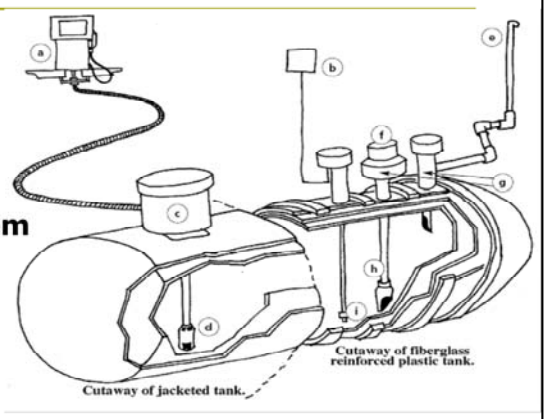
- Assist owners/operators to expand the use of E85 while providing protection to the environment and public
- Guidance
- Checklist
- 2005 Agreement with State Fire Marshal to dispense ethanol blends from existing dispensers that are not independently tested or UL Marked
- Petroleum Marketers Management Insurance Company (PMMIC), Petroleum Marketers and Convenience Stores of Iowa (PMCI), Iowa Renewable Fuels Association (IRFA), Ethanol Industry, Iowa Department of Agriculture

While we were accused of impeding the expansion of E85 we couldn't ignore the warning signs or requirements for compatibility. We tried to stay out of the E85 debate by focusing on how we could improve storage and dispensing requirements.

We worked closely with the state's private insurance company, PMMIC, the state fire marshall, IRFA, petroleum marketers and petroleum equipment installers over a period of six months to develop guidelines

UST System Compatibility

- UST :
  - Tank & Piping
  - Pump System
  - Dispenser & Nozzle
  - Emergency Shutoff
  - Vapor Recovery System
- Environment Controls:
  - Leak Detection
  - Overfill Protection
  - Spill Protection



Existing UST systems were optimized for petroleum. We worked closely with a couple of the larger petroleum equipment company's in Iowa to contact manufacturers about whether their equipment was compatible with E85. PEI's website has compatible equipment on their website.

Accelerated Corrosion

- Same facility
- Same install date
- E85 STP

- Non-E85 STP

Courtesy: PMMIC

Same facility, same equipment, installed at the same time, but different sumps. Top is E85 bottom is regular.

Accelerated Corrosion (E85)

This is an E10 submersible turbine. Notice the flex connector

Accelerated Corrosion E85)

Replace probe cap and have an Iowa licensed petroleum installer assess damage or integrity of the equipment

Accelerated Corrosion (E85)

Replace probe cap

E85 Issues and Concerns

- Phase Separation
  - Ethanol and water are completely miscible
  - Gasoline and water are not miscible
  - Ethanol blends well with gasoline
  - Water/Ethanol will phase separate from the gasoline once enough water is present in the tank

The other issue we became concerned about is Phase separation. Because even small amounts of water in ethanol can lead to direct hydrogen bonding, no amount of water is acceptable in an ethanol tank. It can either cause serious problems for normal spark ignition engines or for the UST equipment. Ethanol picks up water from ambient air and from the distribution system so the content must be carefully monitored.

International Fuel Quality Center, Setting a Quality Standard for Ethanol. pp. 44-45.

Ethanol Spills/releases--Issues

- Vapors denser than air (like gasoline)--settle in low areas
- Burns cleaner than gasoline (flame is visible, but not as bright as gasoline)
- Low flashpoint
- Toxic
- Fire suppression and seal off vapors: Alcohol Resistant Foam
- Control runoff/flow
- Aqueous Film Forming Foams (AFFF), alcohol resistant

The main item I wanted to point out here is that alcohol fires are treated similarly to gasoline and both products act similarly in terms of flammability

At 9:30 on October 26, 2006 a tanker truck was headed toward Jefferson City, MO after being filled at an ethanol plant. Turned over in a soybean field and released 2,700 gallons of ethanol. Due to the volatility of ethanol, the residences, private wells and drainage tiles, the area was evacuated downwind one mile. Did not try to oopen the hatches let it equalize into containment. Static electricity was a concern as well as free phase product. Could not right it because it would belly valves would leak, Several hazmat crews and fire departments were on site. Since the liquid could have flashed easily, the entire area was foamed with a

Cut a 2 inch hole to insert 15/8 diameter stinger tube and pump out to vac truck

Ethanol Spills/releases

Right: pumper trucks prepare to supply water for foaming operation
Left: Vac truck upwind of tanker

Ethanol Spills/releases

Ethanol Spills/releases

Foam crew saturates soil and covers tanker with Aqueous Film Forming Foam or AFFF alcohol resistant foam. Alcohol base fuels require an alcohol resistant retardant.

This operation began midmorning and lasted until 3 A.M. Since the valves and opening to the tanker were damaged, crews had to conduct a stinger operation where you drill into each compartment of the tanker to extract the product.

Ethanol Spills/releases

Left: Vac truck pumping recovered ethanol into tanker dispatched out of Jefferson City, MO. Right: stinger crew moving to each compartment.

Ethanol Spills/releases

9:30 P.M.
Tanker is removed from field.
Fire Departments leave.
Rural Water District crew begins replacement of PVC water line.
MidAmerican Energy resets electrical pole.

3:00 A.M.
The last of 34 truckloads leaves the field.

Where Leaks Can Occur

- Submersible Pumps - aluminum pump and motor housing. O-rings, gaskets, seals can degrade. Fire safety hazard as well as environmental.

Submersible pumps have been a concern for fire safety and environmental reasons as we have seen significant releases from deteriorated gaskets, seals and loose fittings. This is an uncontained sump.

Where Leaks Can Occur

- Dispenser Components:
  - Aluminum and copper tubing
  - Unions
  - Valve poppets and seals
  - Gaskets
  - O-rings
  - Hoses
  - Nozzles (no aluminum)
  - Swivels
  - Shear valve

In 2005 we worked out an agreement with the state Fire Marshal to allow a phase-in on dispensers, which now has been extended until 2009. Equipment must be compatible up to the shear valve.

Owners and operators with no secondary containment must check their dispensers daily to ensure there are no problems.

PMMIC requires secondary containment to dispense E85. I believe Wisconsin also requires secondary containment at dispensers.

Where Leaks Can Occur

- Leak Detection Monitoring Systems that come in contact with fuel:
  - Aluminum electrical conduit
  - Probes for electrical conduit
  - Epoxy

This is a photo of a probe riser for an automatic tank gauging system. This is an older E85 tank system. You can see the metal flaking away. The white oxidation is an aluminum cover plate.

Common Replacements for E85 Compatibility

- Submersible pump
- ATG probe
- Shear Valve
- In-line Leak Detector
- Dispenser Hose and Nozzle
- Drop Tube
- Overfill Device
- New Pipe Sealant Under Dispenser
- Flex Connectors

E85 Checklist

- Complete equipment checklist for tanks/piping/dispensers (iowadnr.gov)
- Replace incompatible equipment
- Inform insurance carrier. Obtain amended certificate
- Check water in tank. No level acceptable
- Tighten all connections at risers. No vapors escape and no water enters.
- Clean tank of water and sediment.
- Label fill ports and paint access covers (API RP 1637). Label dispenser.

Our checklist is on our website at iowadnr.gov. After the owner/operator and Iowa Licensed installer complete the equipment checklist they proceed with the following items.

BioDiesel

- No significant compatibility issues with B20 (BioDiesel Handling and Use Guidelines)
- Physical and chemical properties similar to petrodiesel

Up to B20, biodiesel exhibits the same properties petrodiesel.

Current Funding Assistance

- Iowa Renewable Fuels Infrastructure Fund
  - Cost sharing forgivable loans
  - $13,000,000 for three years
  - Goal: establish renewable fuels and infrastructure and marketability throughout Iowa
  - Eligibility: Sites offering Renewable Fuels after July 1, 2005
- Federal Income Tax Credit
- State Income Tax Credit

Besides state and federal income tax credit, the Iowa Legislature last year created the Iowa Renewable Fuels Infrastructure Fund to improve the renewable fuels infrasturcture and to increase marketability.

Iowa Renewable Fuels Infrastructure Funding

- Forgivable Loans
  - E85 and Biodiesel Retail locations
    - Up to 50% of equipment costs. Not to exceed $30,000
  - Biodiesel Terminals
    - Up to 50% of equipment costs. Not to exceed $50,000.

$13 million dollars will be awarded over three years to E85 and Biodiesel retail locations and at biodiesel terminals.

Tom Collins
Iowa Department of Natural Resources
Underground Storage Tank Section

Tom.Collins@dnr.state.ia.us
www.iowadnr.gov