# DENATURED FUEL ETHANOL

# MANUFACTURE, PROPERTIES AND SPECIFICATIONS

**PRESENTED AT THE CALIFORNIA PHASE 3 REFORMULATED GASOLINE REGULATIONS WORKSHOP**

**MAY 4, 2000**

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## U. S. FUEL ETHANOL PRODUCTION

12 Corn Wet Milling Plants

31 Corn Dry Milling Plants

9 Other Sources (Wheat, cheese whey,

potato, beverage and wood waste)

Wet Mills - 63 % of Production

Dry Mills - 35 % of Production

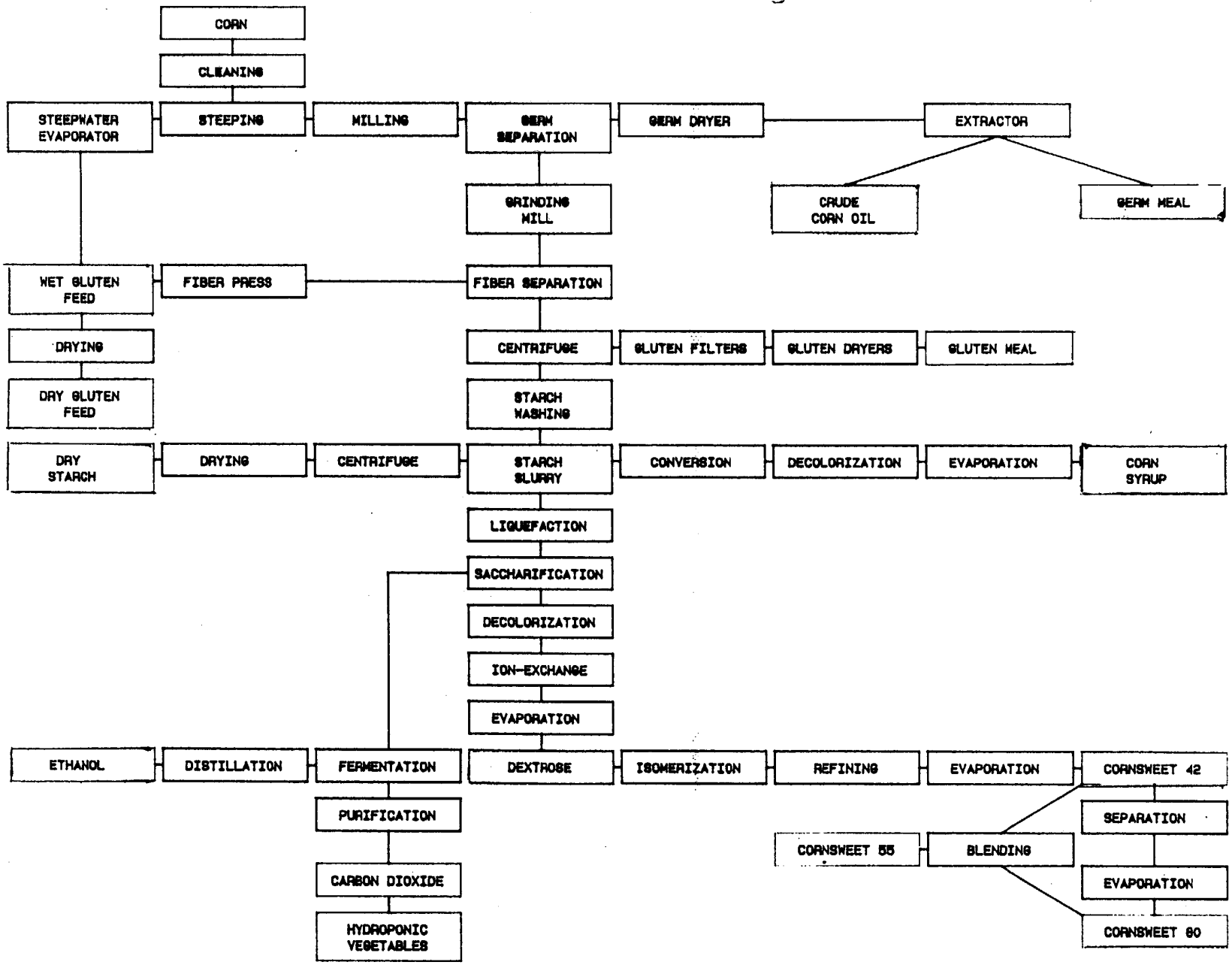
Other - 2 % of Production

## SULFUR IN FUEL ETHANOL

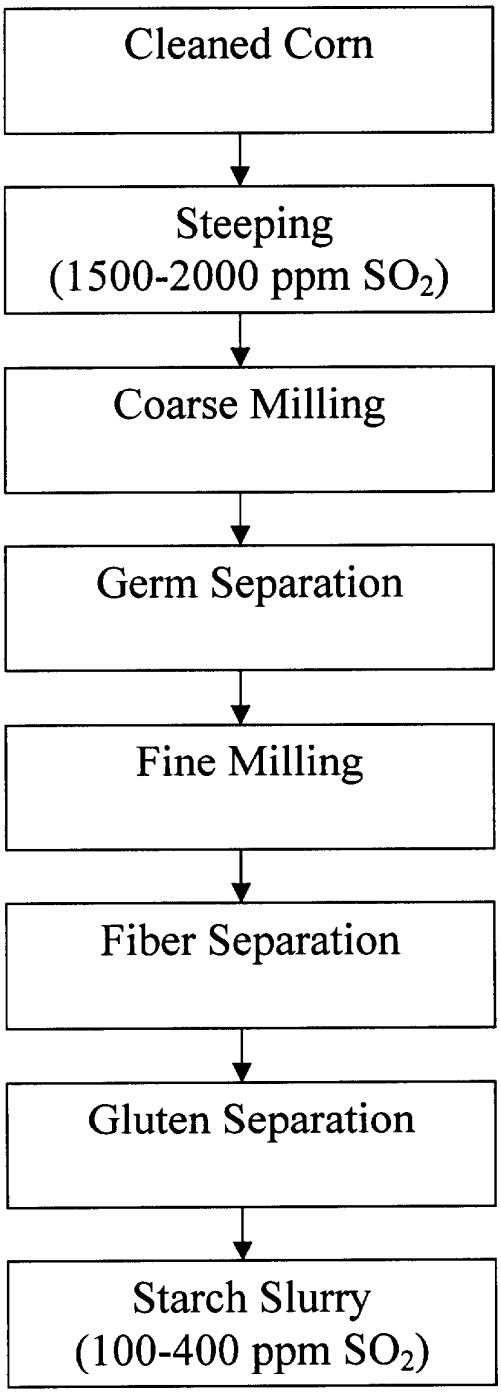
## SOURCES OF SULFUR

1. Ethanol Production Process
2. Denaturant

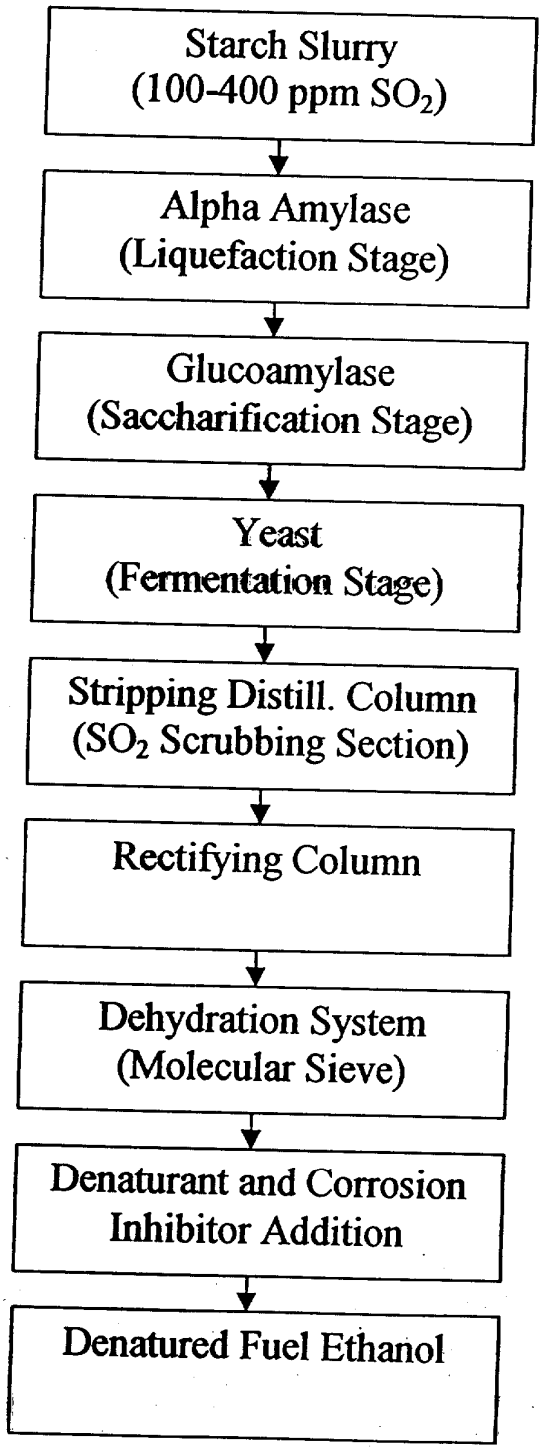
# Corn Wet Milling Process



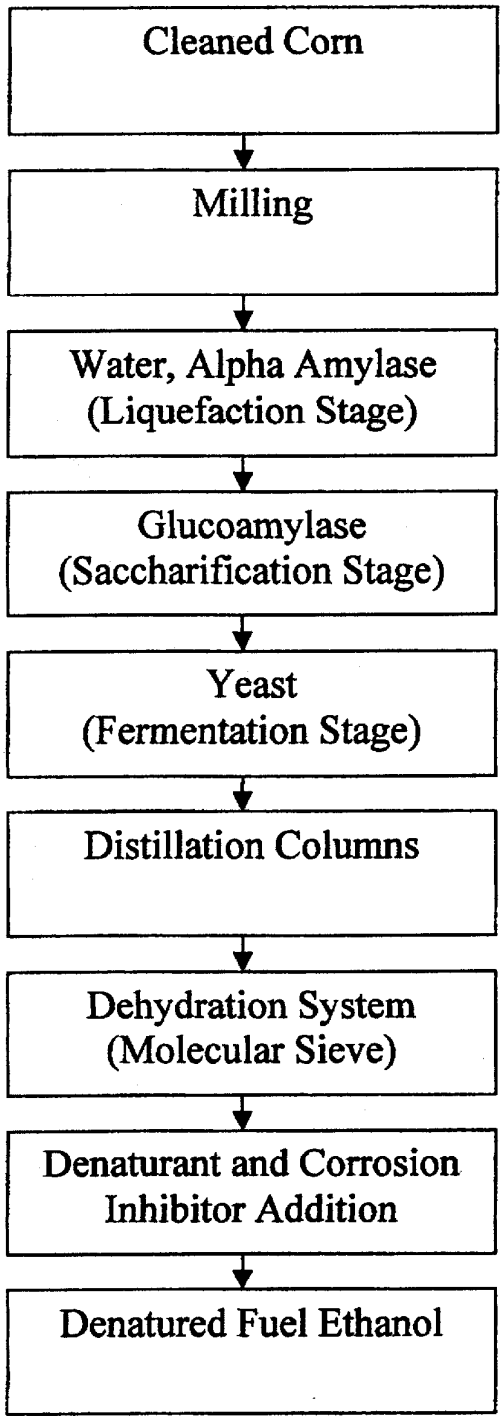
**Corn Wet Milling Process**



## Corn Wet Milling Ethanol Process



## Corn Dry Milling Ethanol Process



# DENATURED FUEL ETHANOL
# TYPICAL COMPOSITION

| | |
|---|---|
| Ethanol, volume % | 94.5 |
| Other Fermentation Alcohols, volume % | 0.3 |
| Denaturant, volume % | 4.6 |
| Water, volume % | 0.6 |
| Acidity (as acetic acid) mass % | 0.004 |
| Solvent Washed Gum, mg/100mL | 2 |
| pHe | 7.0 |
| Chloride Content, mg/L, max. | 2 |
| Copper Content, mg/kg, max. | Not Detectable |
| Appearance | Clear and Bright |
| Corrosion Inhibitor | 20 to 30 lbs/1000 bbl |

# CORROSION INHIBITOR IN DENATURED ETHANOL

The Renewable Fuels Association (RFA) recommends that all fuel ethanol producers add a corrosion inhibitor to all of their fuel ethanol production.

OBJECT: To provide corrosion protection from points of distribution and storage to final ethanol/gasoline use.

USAGE: The corrosion inhibitors approved by the RFA provide fuel ethanol a B+ or better rust rating when tested by NACE TM-01-72 method.

SUMMARY: Field surveys show that the industry is producing ethanol with virtually 100% having NACE rust ratings of A. No samples are below B+ rating.

# DENATURED FUEL ETHANOL

## TYPICAL PROPERTIES

| | |
|---|---|
| Gravity, API | 47.5 |
| Specific Gravity, 60°F | 0.7905 |
| Pounds/Gal., 60°F | 6.58 |
| Vapor Pressure, 100°F, psi | 4.0 |
| Blending Vapor Pressure, 5.7 to 10% in gasoline, psi | 18 |
| Oxygen Content, wt. % | 33 |
| Color | Colorless |
| Appearance | Clear, Free of Suspended Matter |

## FUEL ETHANOL DENATURANTS

Denaturant Definition Specific to D4806 - natural gasoline, gasoline components, unleaded gasoline or toxic or noxious materials added to fuel ethanol to make it unsuitable for beverage use but not unsuitable for automotive use.

## PROPERTIES OF NATURAL GASOLINE HISTORICALLY AVAILABLE FOR DENATURING OF ETHANOL

| | |
|---|---|
| Color, Saybolt | +25 to +30 |
| API Gravity | 80 - 85 |
| RVP @ 100°F, psi | 13 - 14 |
| Sulfur, ppm | 60 - 160 |
| Research octane number | 76 |
| Motor octane number | 74 |
| Distillation °F, Typical | |
| 1 BP | - 92 |
| 10% | - 105 |
| 20% | - 110 |
| 50% | - 125 |
| 90% | - 185 |
| FBP | - 265 |
| Benzene, volume % | 0.3 - 0.5 |
| Olefins, volume % | 0.1 - 0.8 |
| Aromatics, volume % | 1.0 - 2.6 |

# FUEL ETHANOL PRODUCERS' RESPONSE TO CaRFG3 PROPOSED SPECIFICATION

1. The ARB & industry need to review test methods associated with the proposed aromatic, benzene and olefin limits.

2. The ethanol industry is anxious to work with CARB and ASTM to verify an appropriate test method for sulfur in fuel ethanol.

3. It is inappropriate for the ethanol industry to commit to a sulfur specification today. Data from the supplier survey is scattered, the test methods are not known, denaturant sulfur levels are not known and several of the producers have not responded to the survey.

4.We cannot comment today on a sulfur specification until the second RFA survey is completed. We can respond at the next CARB workshop.