

# Water Use in Bioethanol Production

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**Illinois Water Conference 2008**

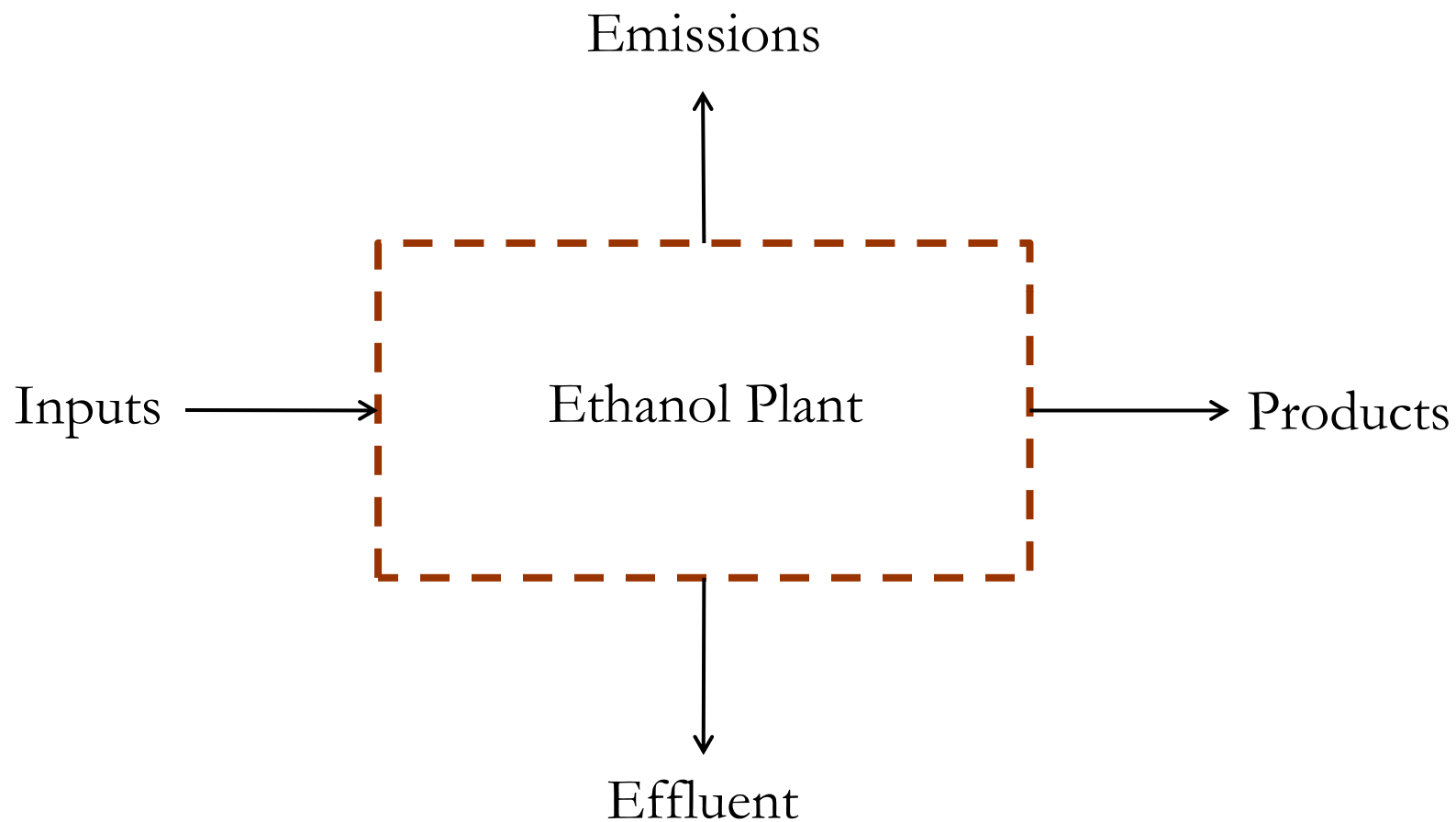
**Champaign, IL**

**October 8-9, 2008**

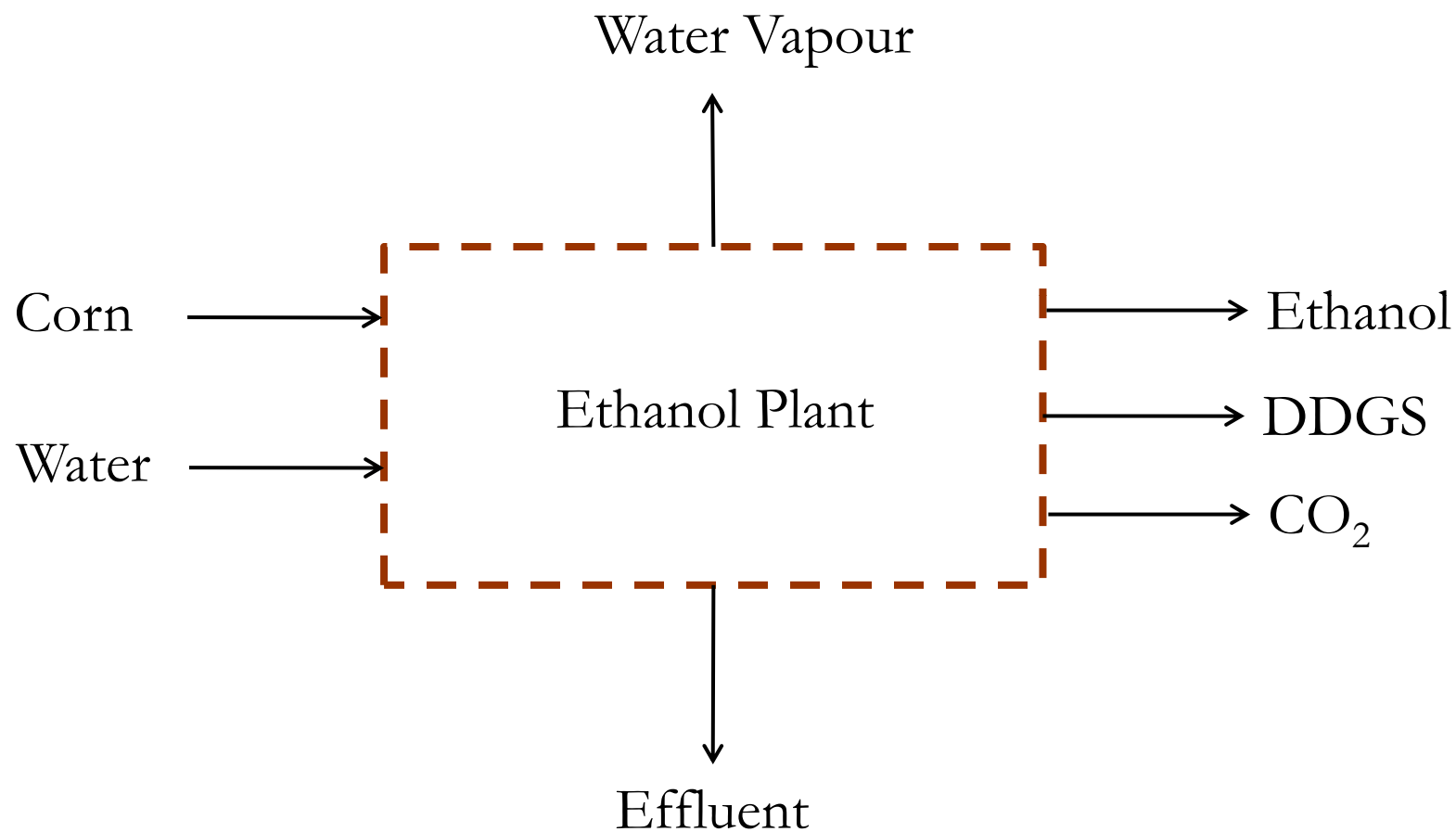
# Types of Water

- Process Water
  - CO<sub>2</sub> Scrubber
  - Yeast tanks
- Non-Process Water
  - Cooling Tower
  - Boiler (RO water)

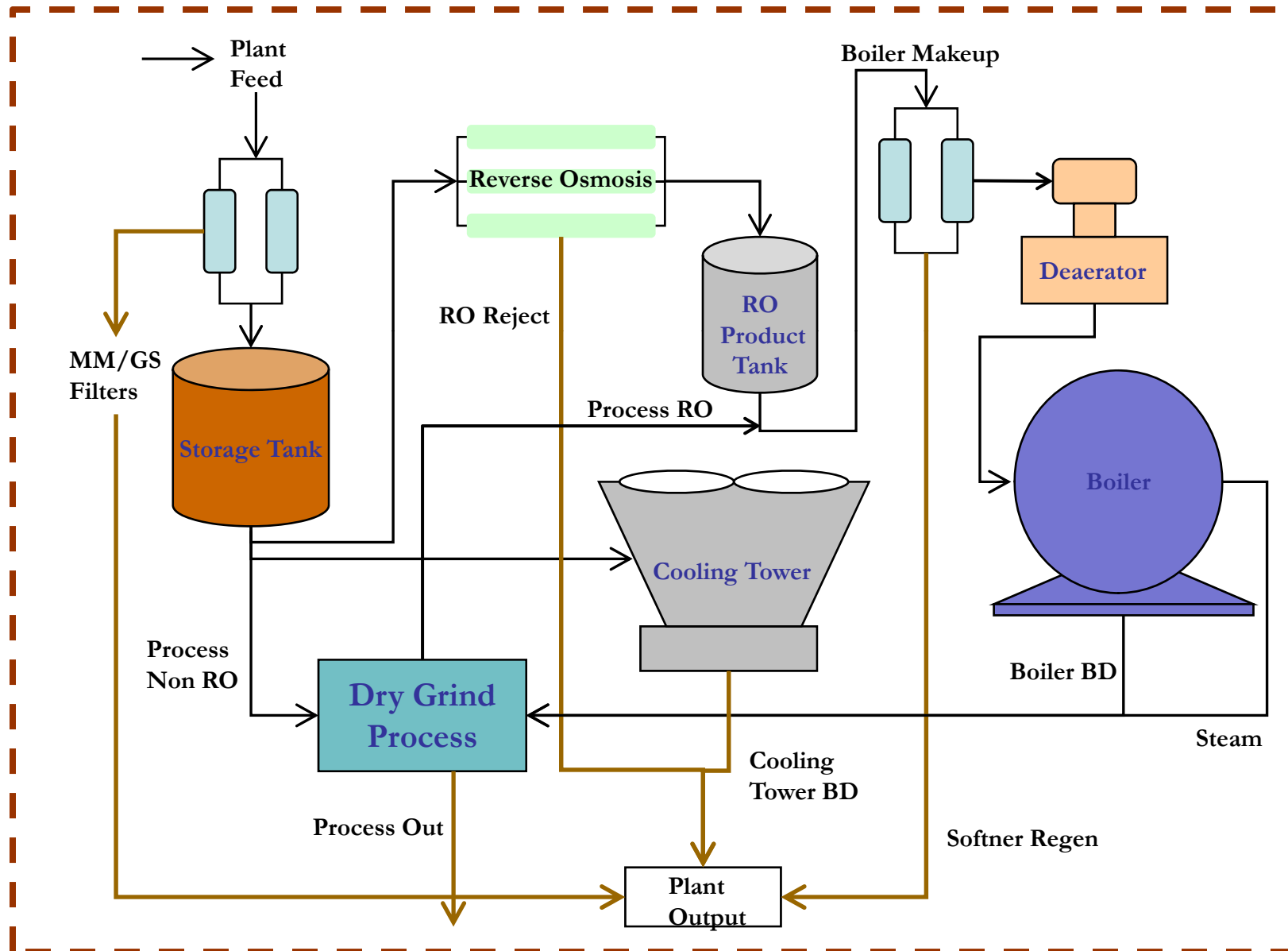
# Input and Output: Water Balance



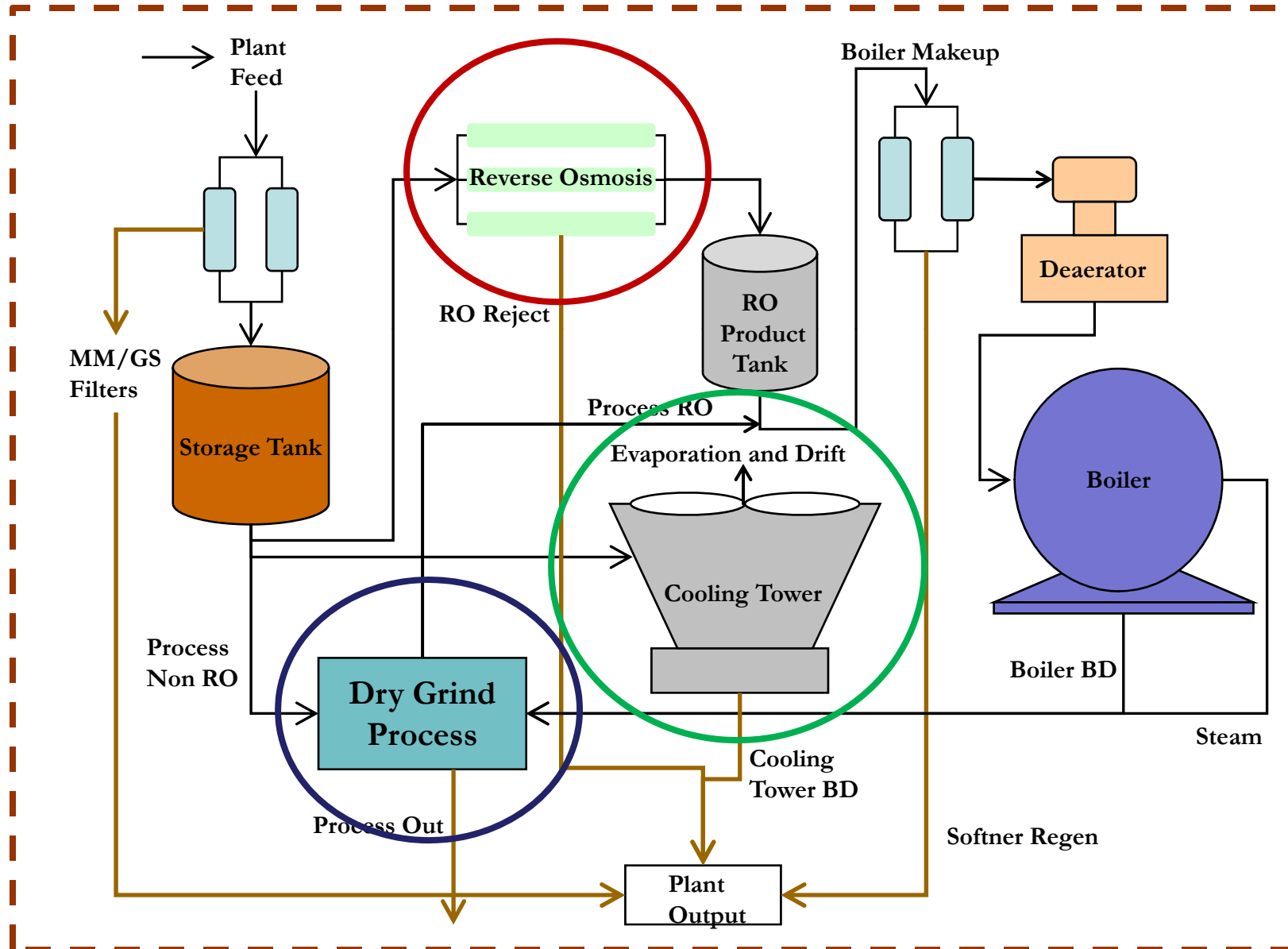
# Input and Output: Water Balance



# Water Routing in Dry Grind Ethanol Plant

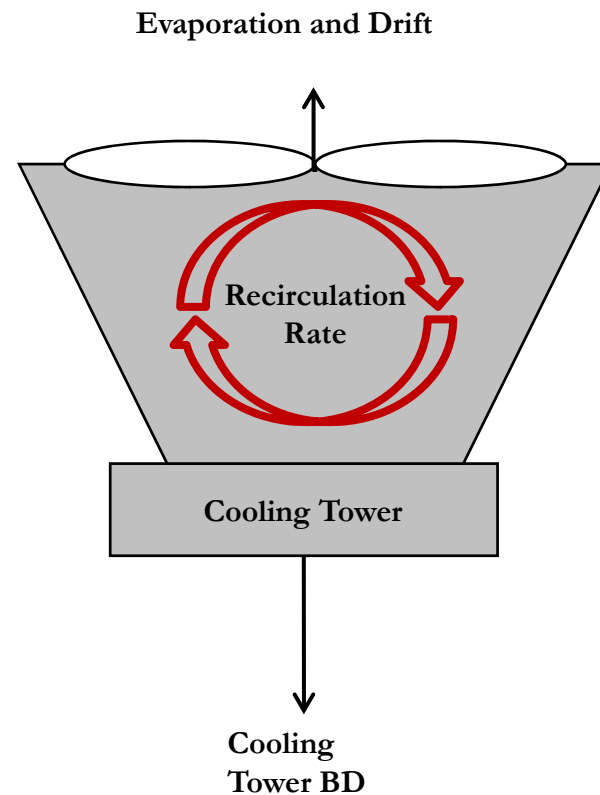


# Water Routing in Dry Grind Ethanol Plant



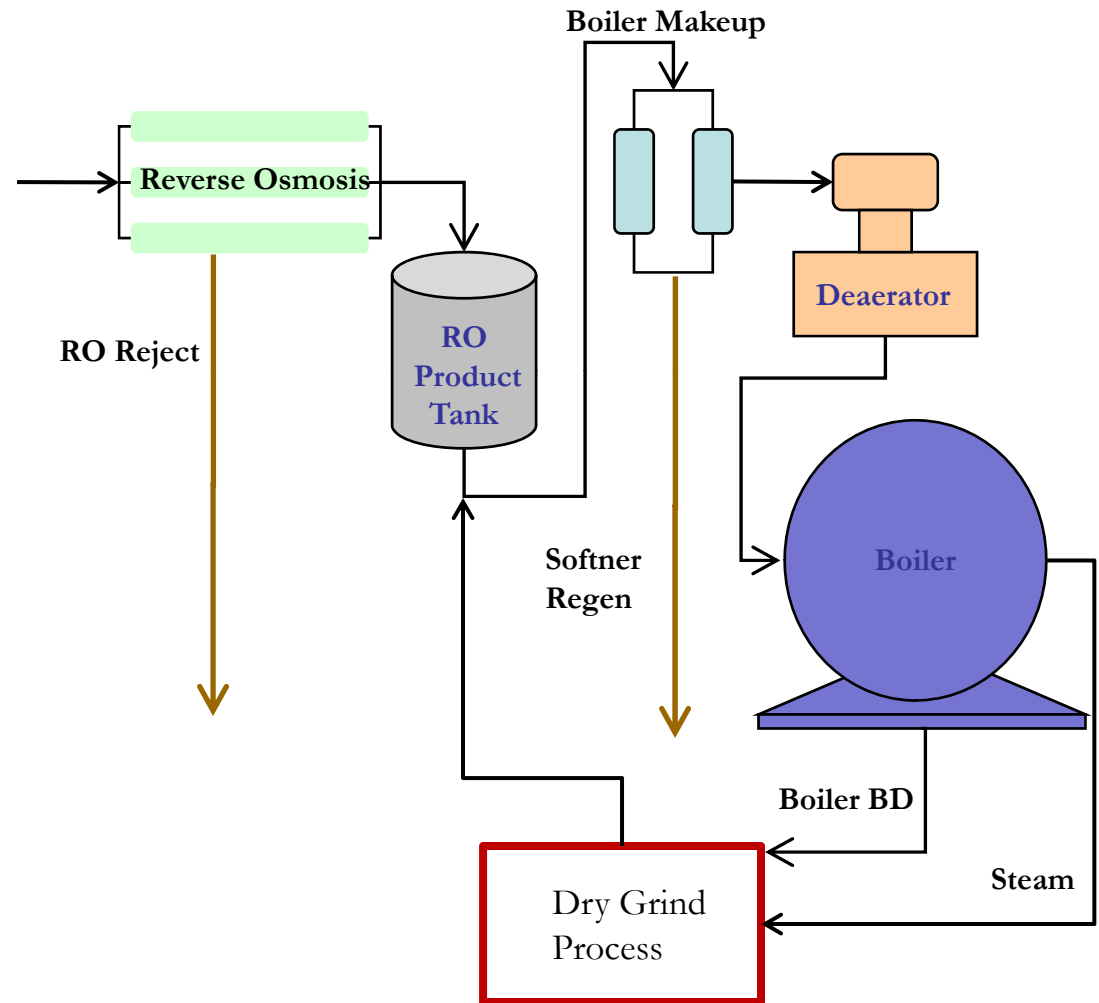
# Cooling Tower

- Circulation rate is set by process design
- Evaporation and drift is determined by heat load, circulation rate and design of tower
- Blowdown is calculated by cycles of concentration (permit requirements)
- Makeup is sum of evaporation and drift and blowdown.



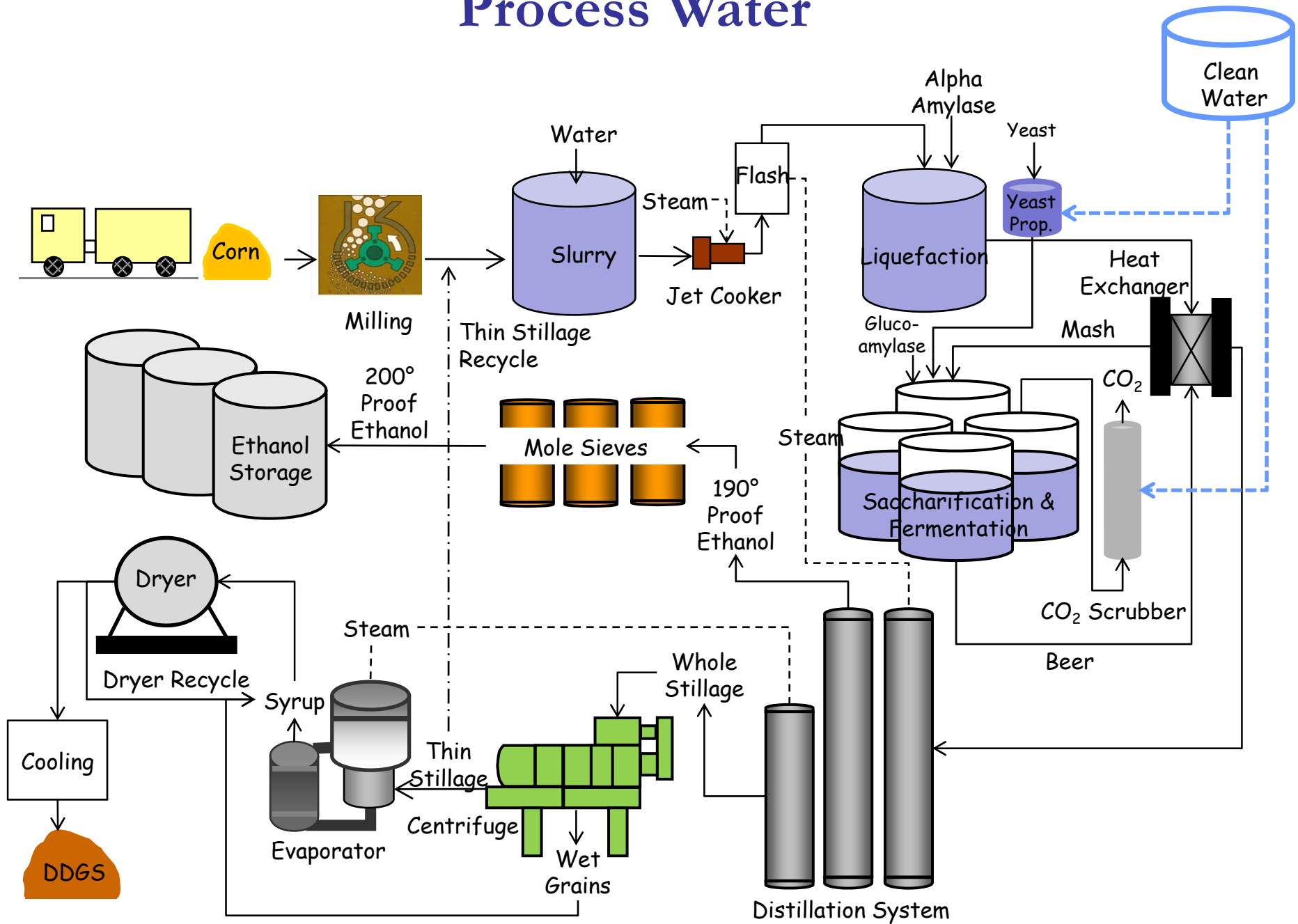
# RO/Boiler

- Steam load and condensate return is determined by process design
- Boiler blowdown is determined by the water chemistry
- RO reject is determined by RO design

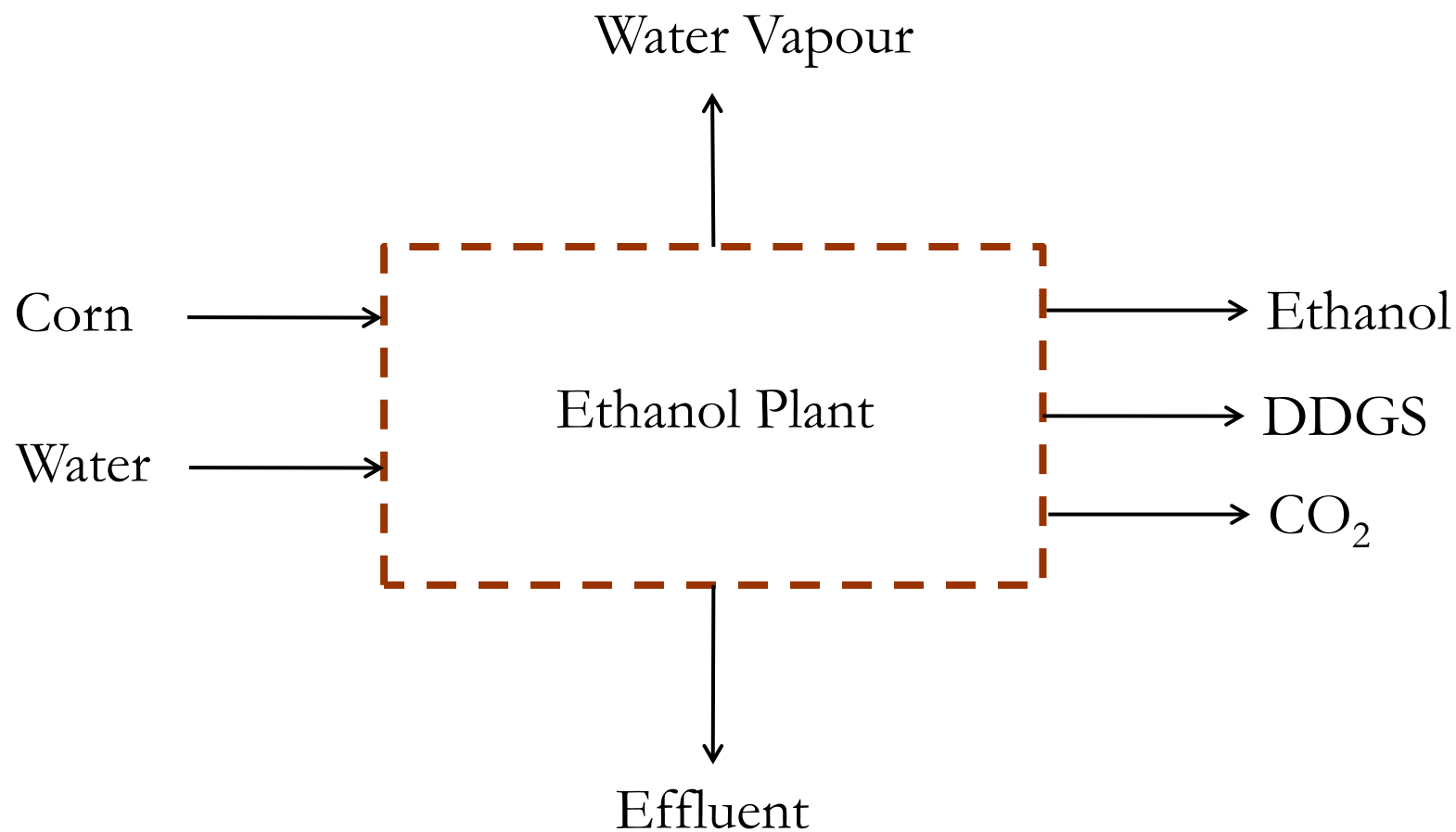




# Process Water



# Input and Output: Water Balance

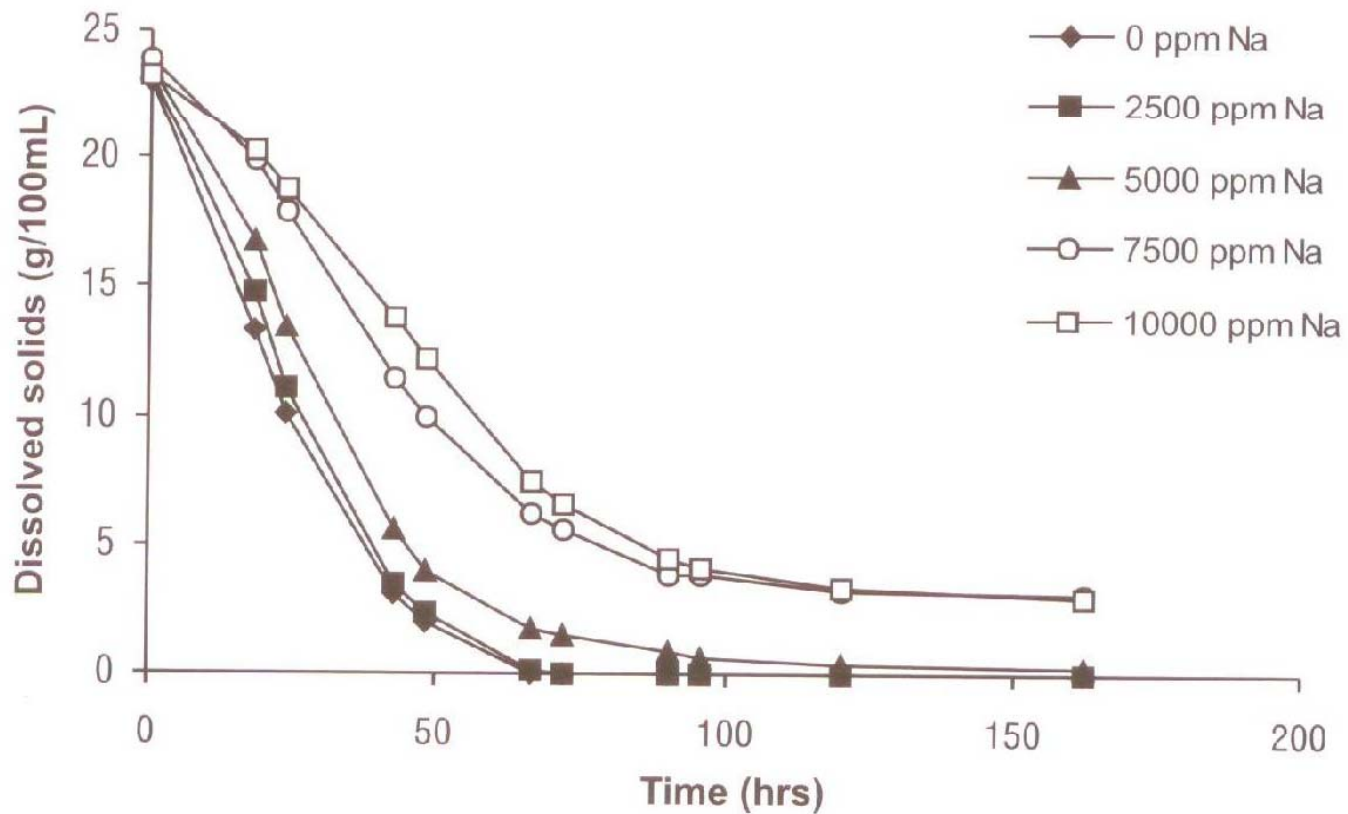


## Water Use in Other Industries

- Water used to produce
  - 1 can of fruit = 9.3 gallons
  - 1 lb of sugar = 14 gallons
  - 1 lb of synthetic rubber = 55 gallons
  - 1 gallon of paint = 13 gallons
  - 1 lb of cotton = 101 gallons
  - 1 Sunday newspaper = 150 gallons
  - 1 gallon of gasoline = 2 to 2.5 gallons

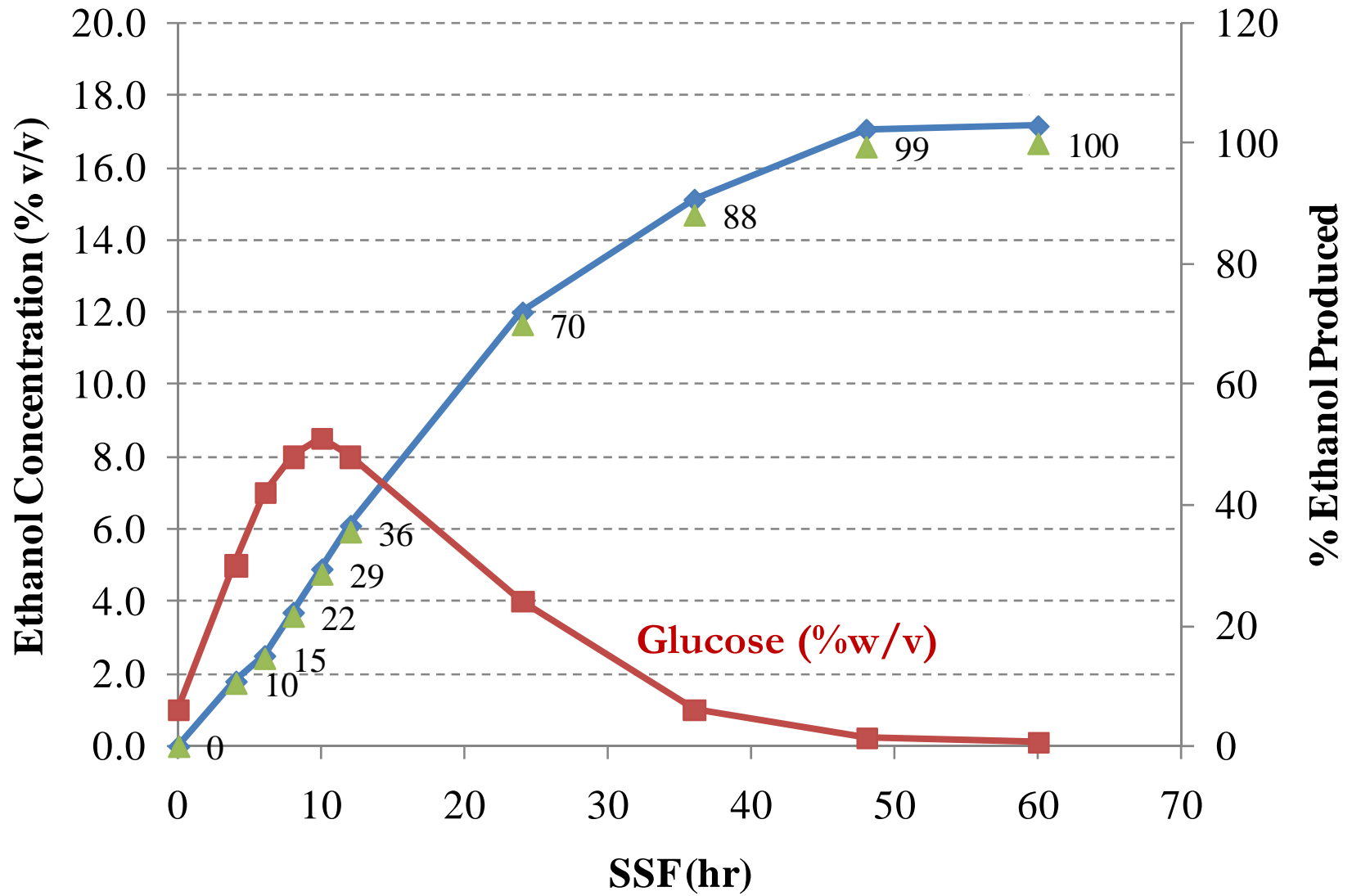
Source: USGC/USEPA

# Sodium and its Effect on Fermentation

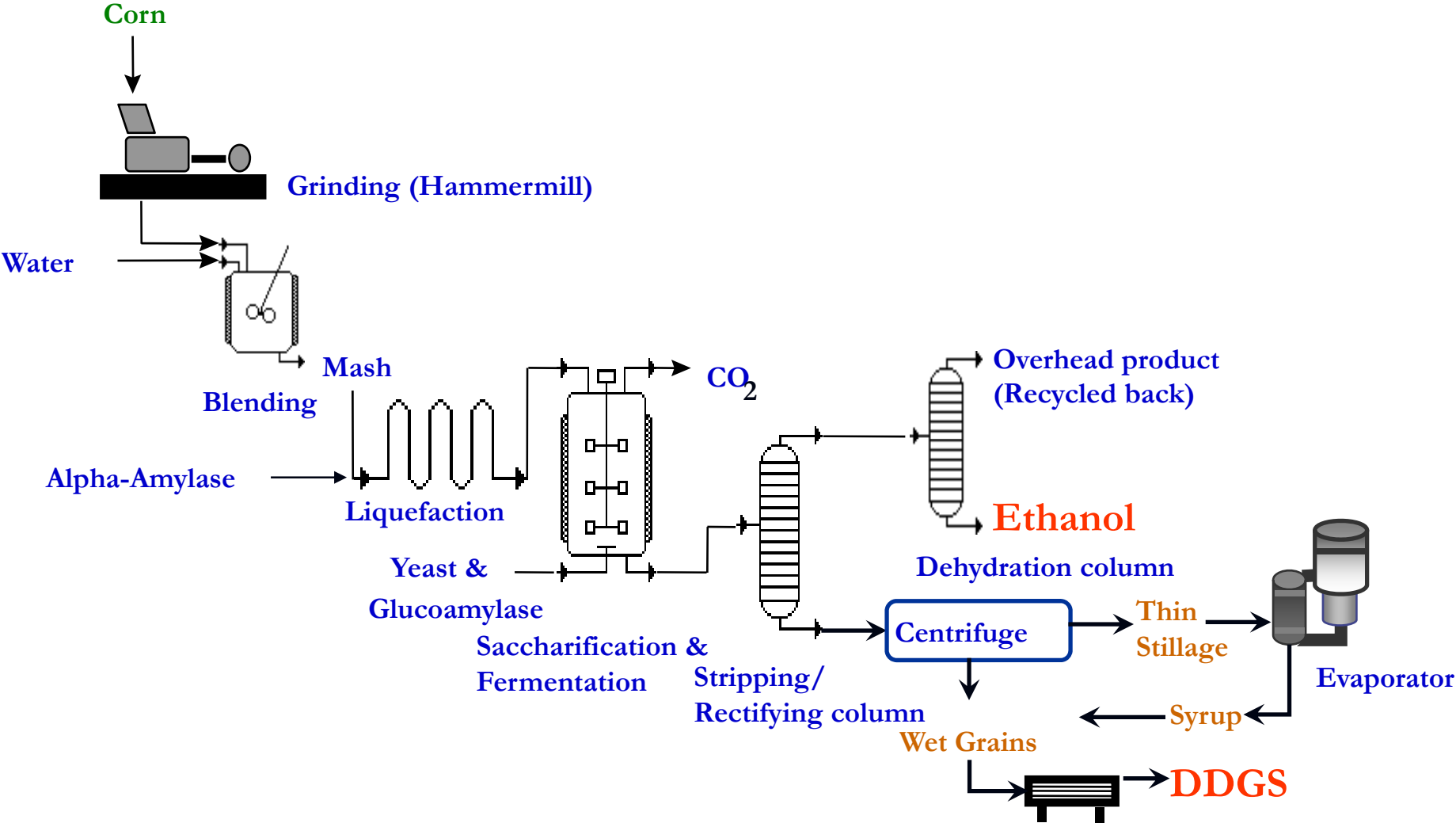


Source: Alcohol Textbook,  
Ingledeew, 2003

# Fermentation Profile



# Conventional Dry Grind Process



# Conclusions

- Conventional dry grind ethanol production requires
  - 4 gallons water/gallon of ethanol
  - 60-70% of this water is for cooling towers
- Water use in dry grind ethanol plants is small compared to other industrial processes
- New technologies can further reduce water requirement in dry grind ethanol process