ETHANOL PRODUCTION: RESEARCH AND DEVELOPMENT

ETHANOL 2002 INTERNATIONAL CONFERENCE ON POLICY, FINANCING AND MARKET DEVELOPMENT ISSUES

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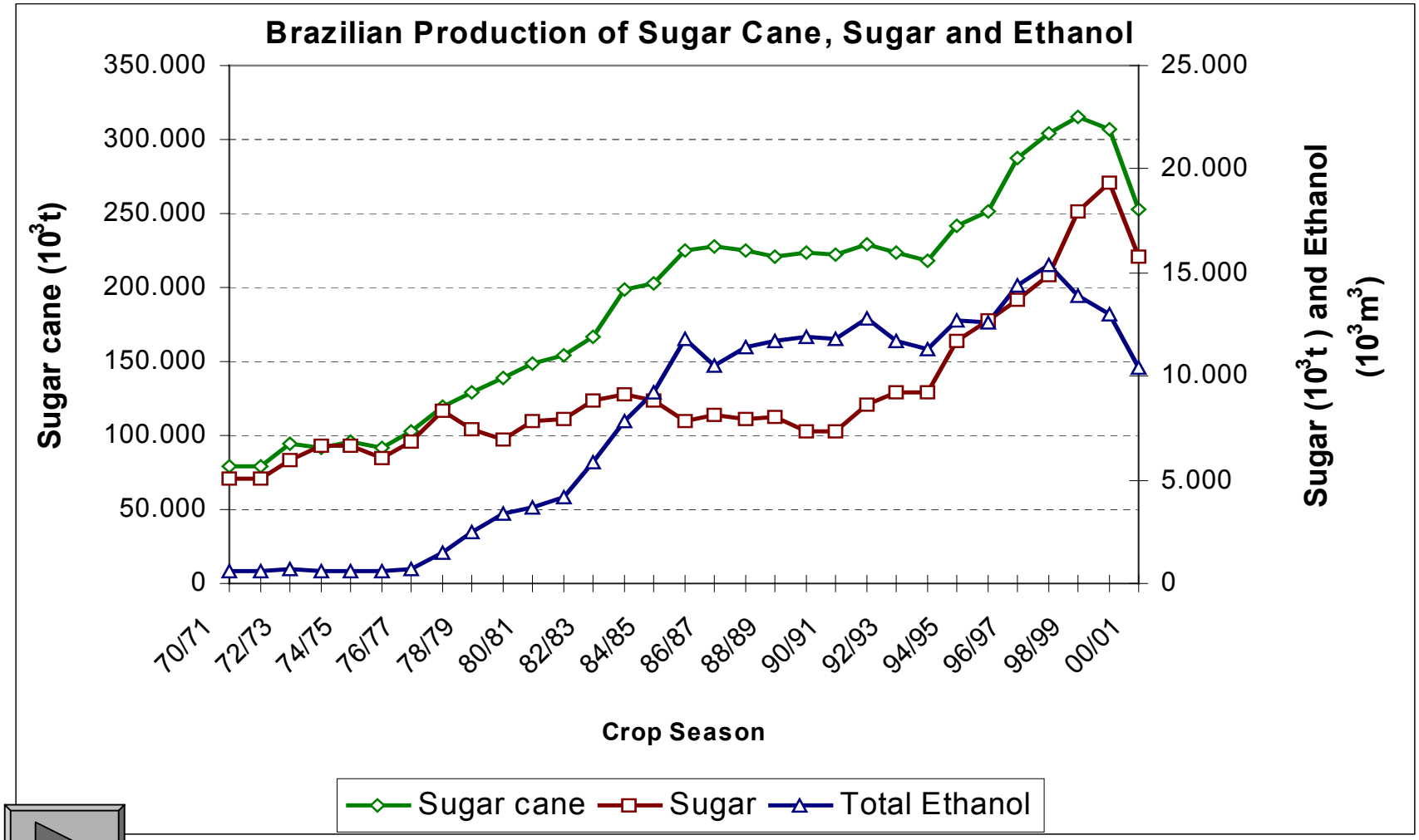
COPERSUCAR UNIÃO

ETHANOL PRODUCTION

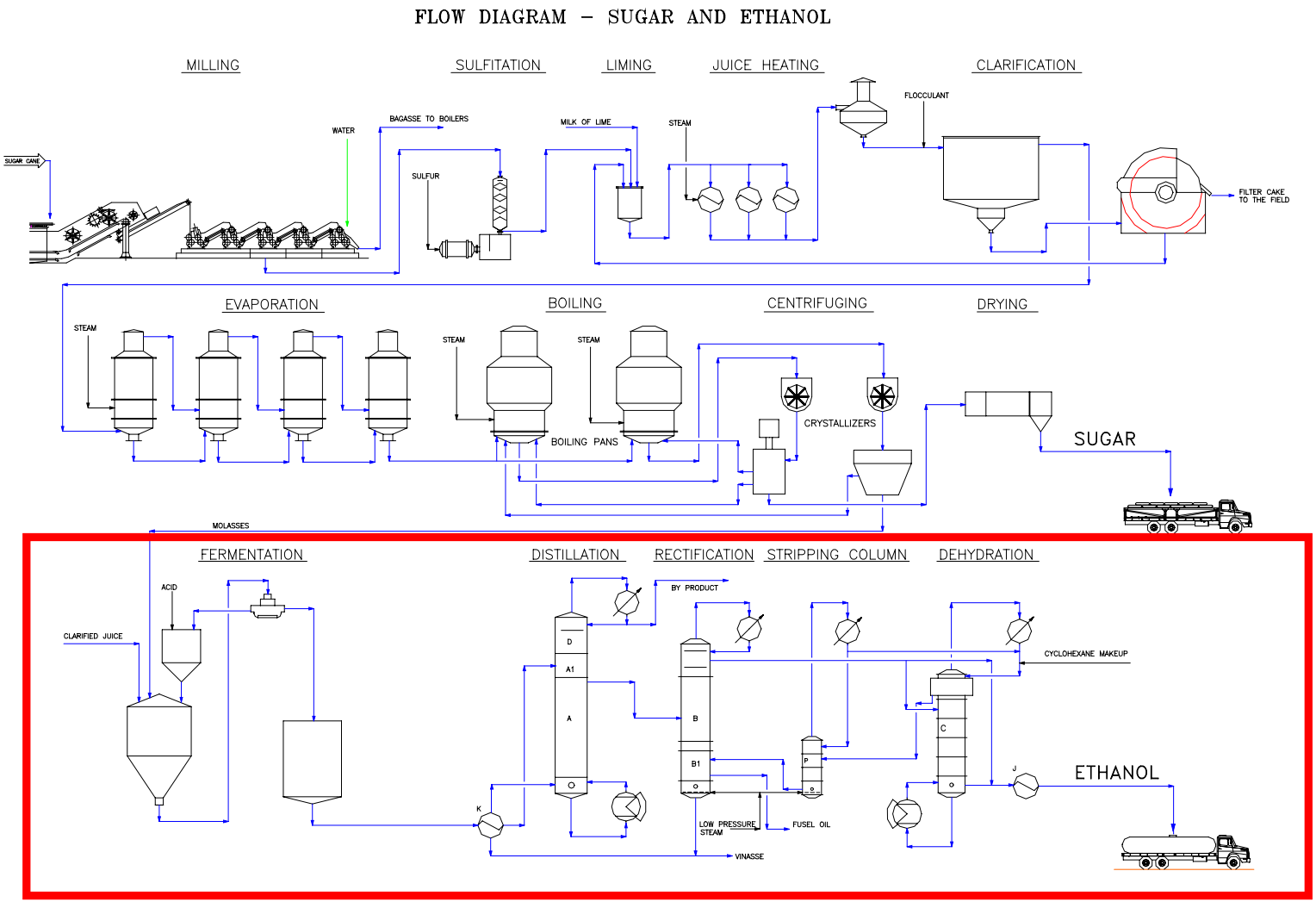
- BRAZIL: **~11,6 x 10^6 m^3 / year in ~ 300 plants**

- COPERSUCAR: ~**2.3 x 10^6 m^3 / year in 35 plants**

BRAZILIAN PRODUCTION



BRAZILIAN PROCESS



BRAZILIAN PROCESS

- **Main Characteristics**
  - ***Simultaneous production*** **of ethanol and sugar**
    - **Higher purity in the must (treated juice + molasses)**
    - **Energetic Complementation**
  - **High efficiency and high yield**
    - **Low Cost**

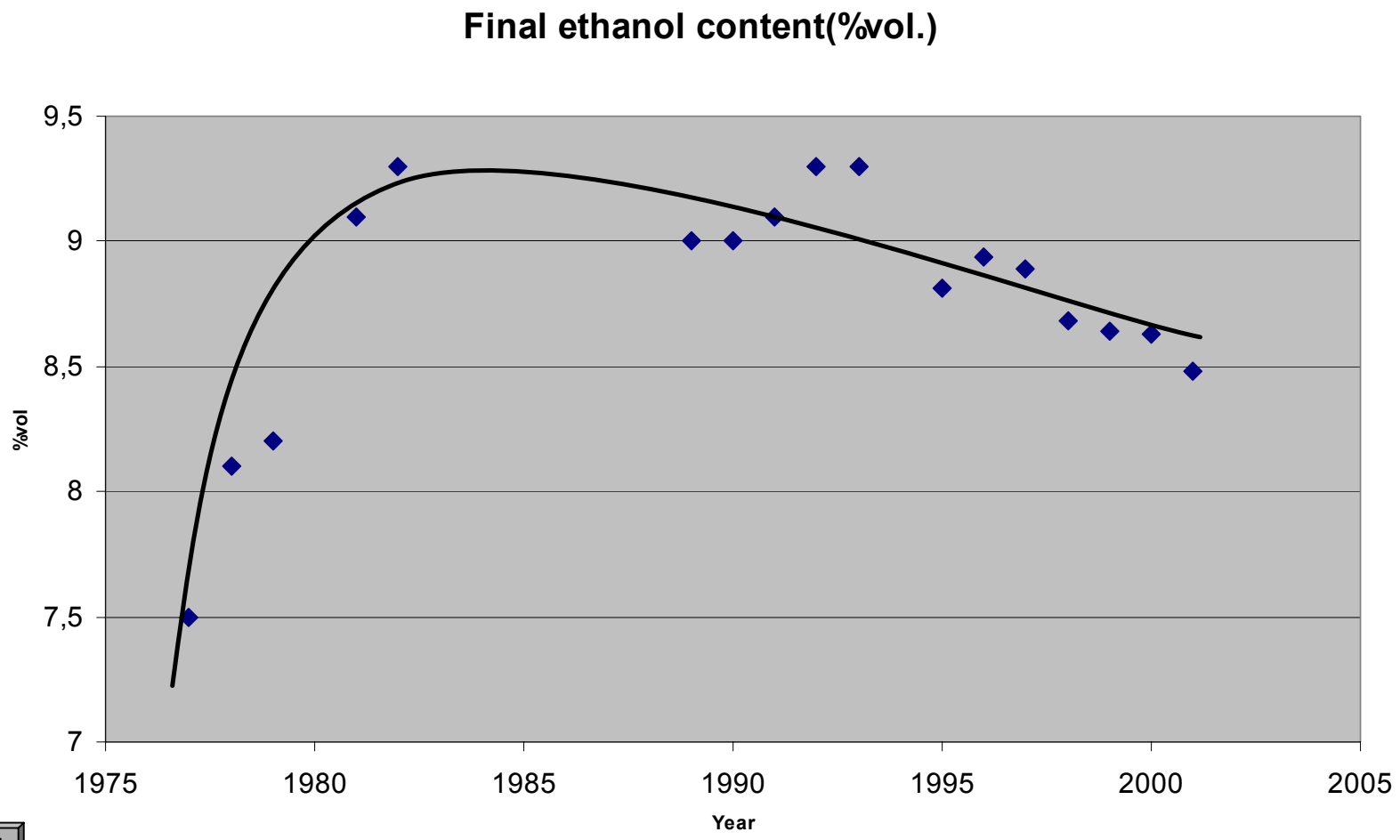
FERMENTATION PROCESS

- **75% (plants)Fed-batch with total cell recycle**
- **25% Continuous multistage with total cell recycle**
  - **Selected yeasts**

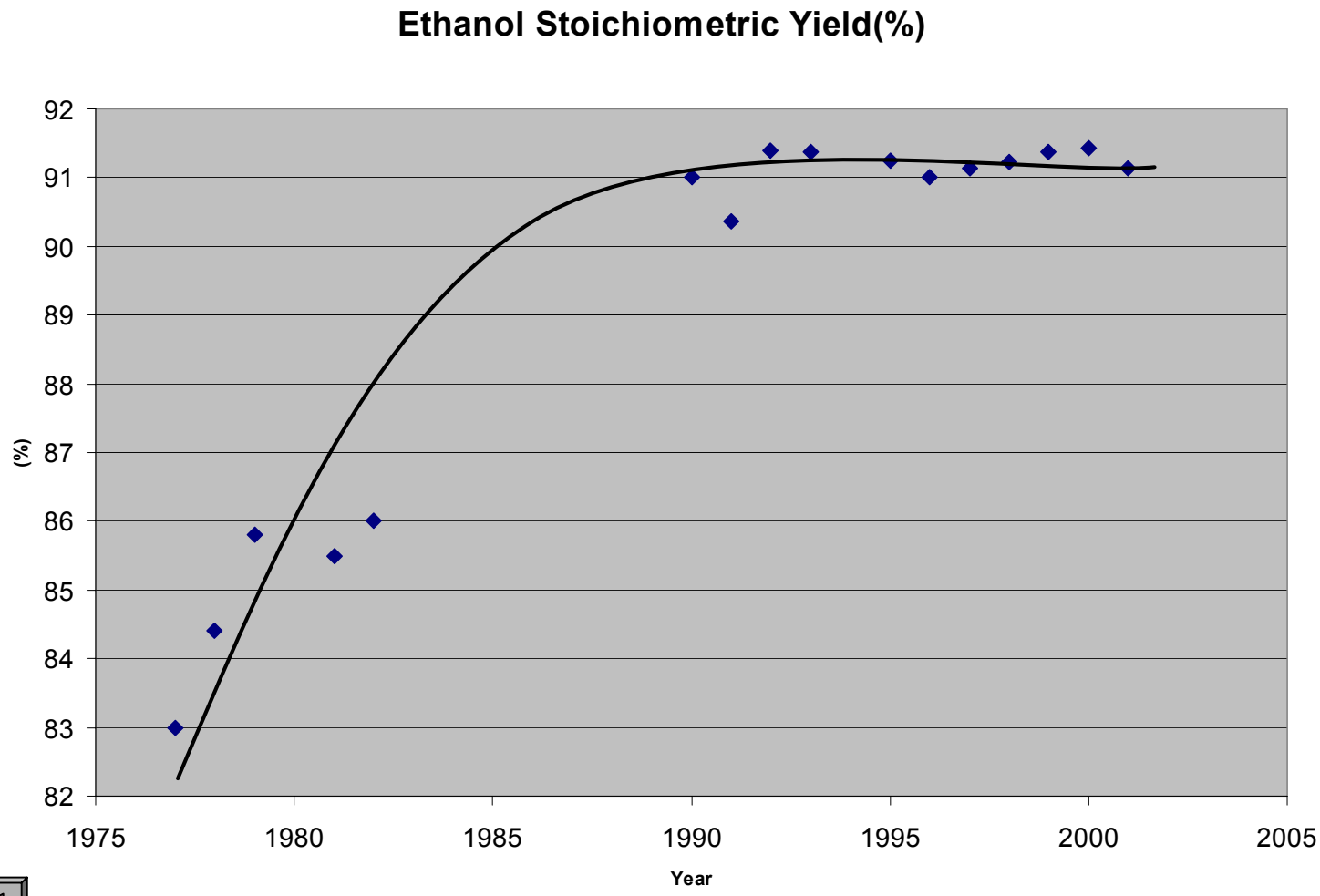
FERMENTATION PROCESS

- **Main parameters:**
  - **Final ethanol content: 9 ºGl (%vol)**
  - **Final yeast concentration: 13% (~10^9 cells/ml)**
  - **Fermentation time: 6-11h**
  - **Average production rate : 450 m^3/day**
  - **Total fermenter capacity: 3000 m^3**
  - **Yield (stoichiometric): 91%**
  - **Temperature: 34-36ºC**

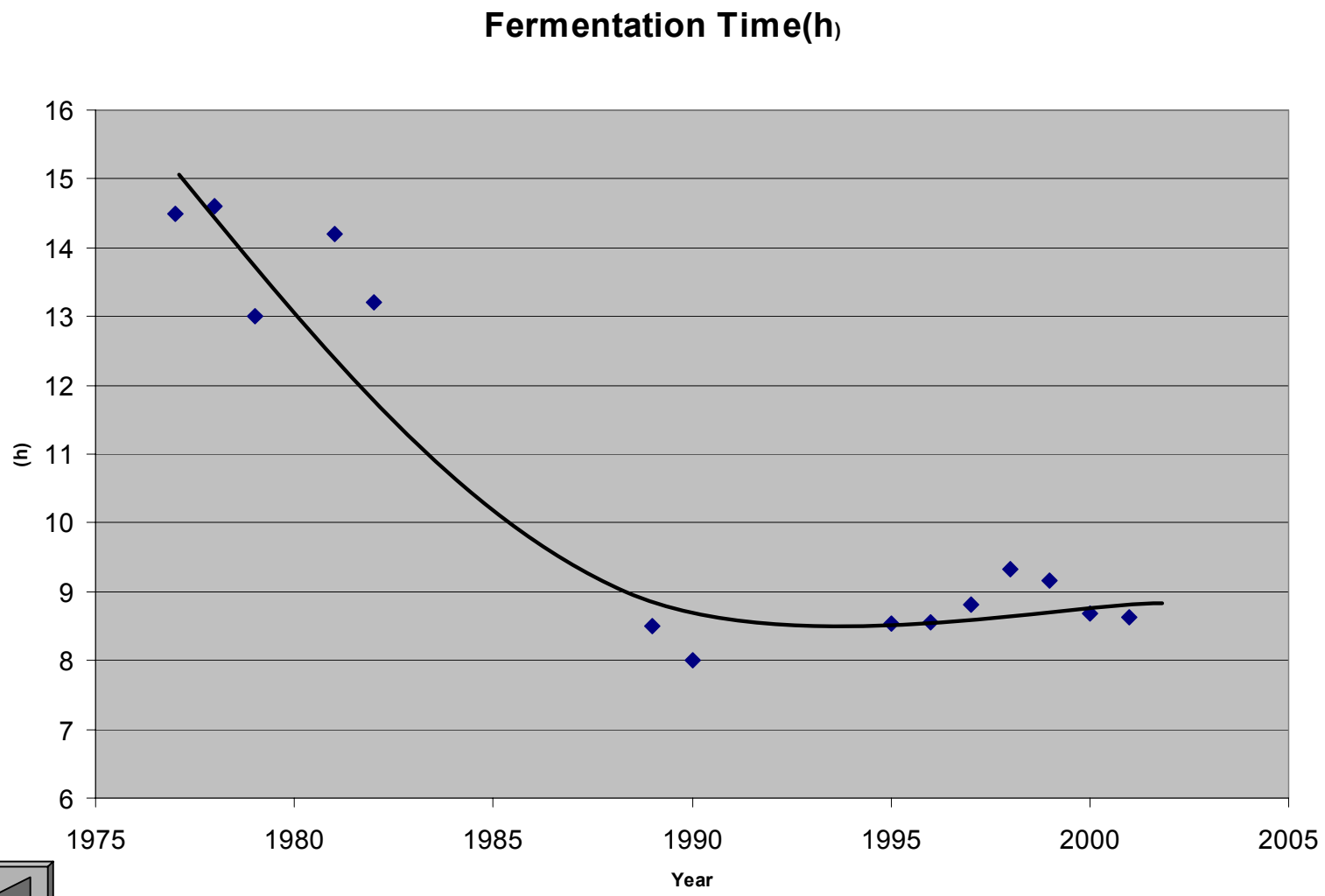
FERMENTATION EVOLUTION



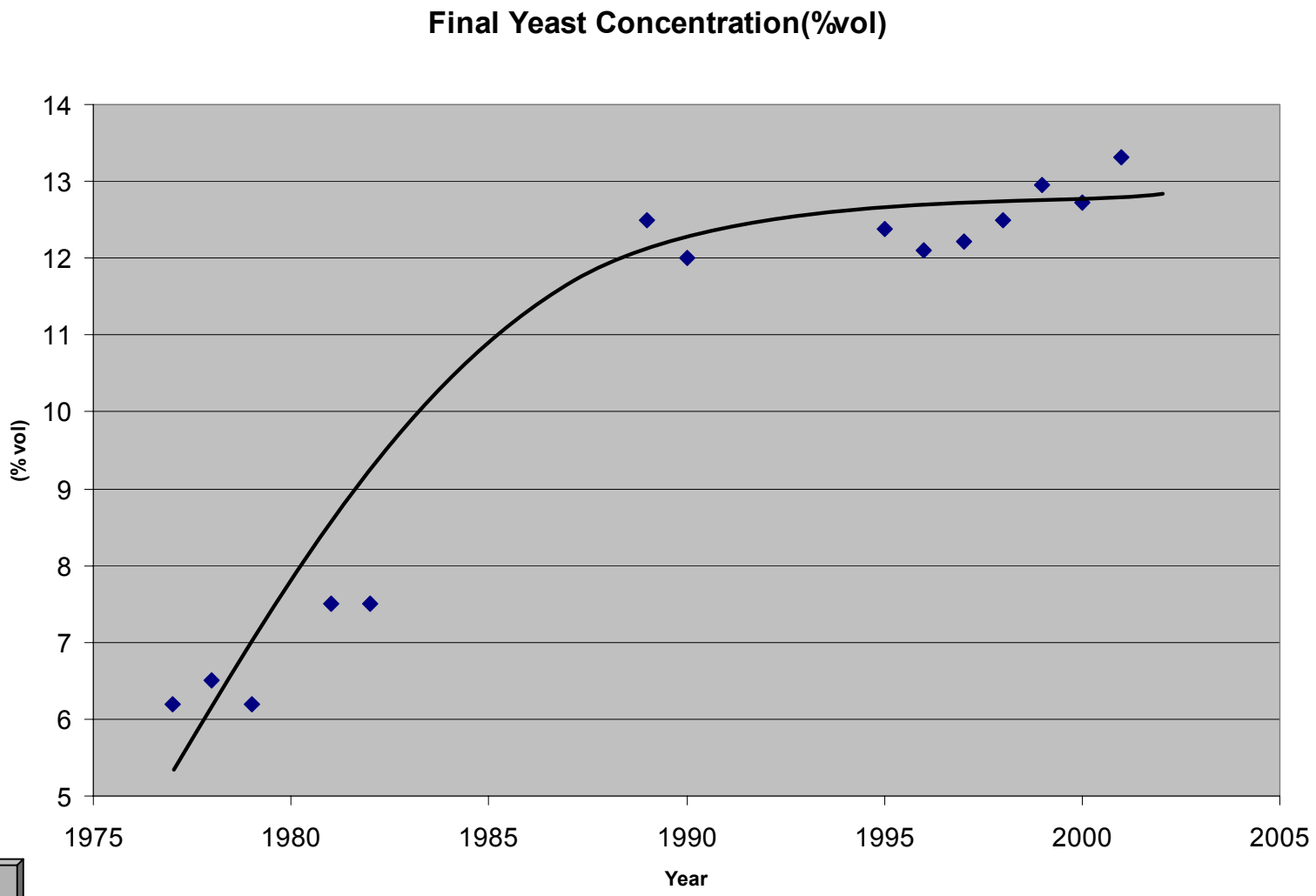
FERMENTATION EVOLUTION



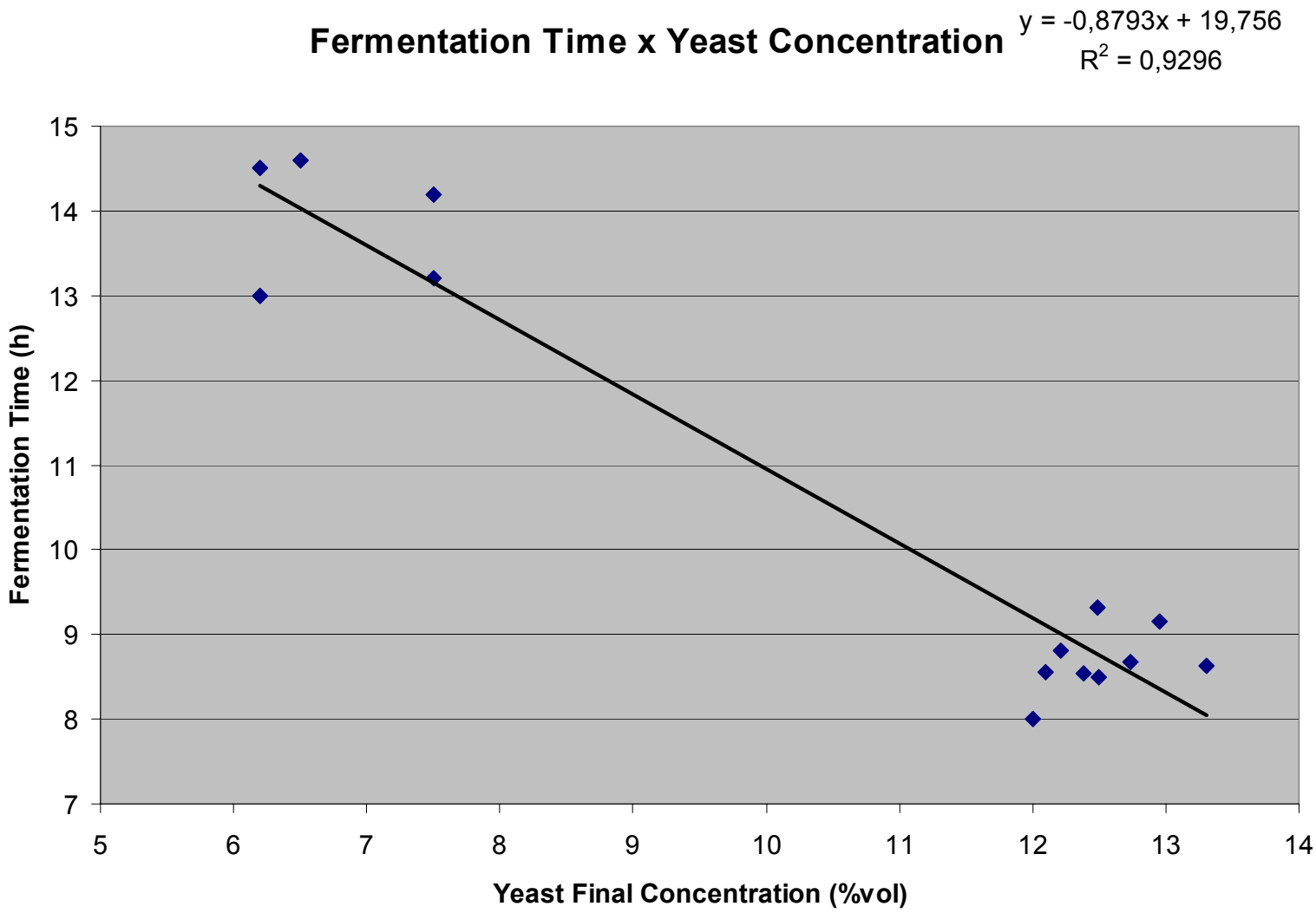
FERMENTATION EVOLUTION



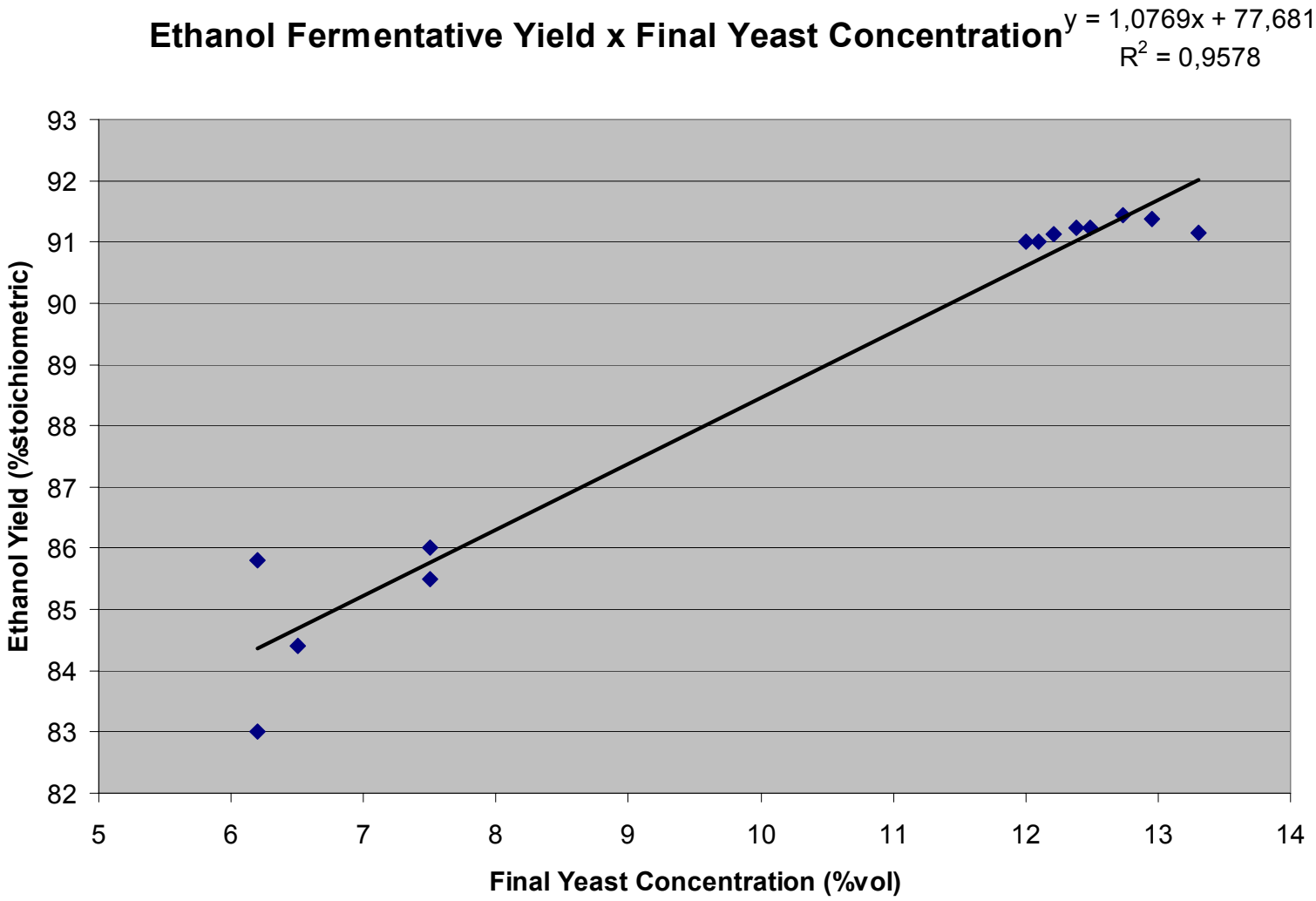
FERMENTATION EVOLUTION



FERMENTATION EVOLUTION



FERMENTATION EVOLUTION



DISTILLATION

- Steam consumption: 3-5 kg / l ethanol
- Yield: >99%
- Residues:
  - Vinasse (12-15 l/l): recycled as ferti-irrigation at the cane fields

- **Water consumption:**
  - 100-120 l / l ethanol (hydrated 96 ºGl)
  - 140-170 l / l (anhydrous 99.2 ºGl)
- **Dehydration: azeotropic (cyclohexane) or extractive (monoethylenglycol) distillation or molecular sieves**

CONCLUSIONS

- **There was a good evolution in the main parameters of the fermentation process**
  - **Fed-batch with cell recycle is an excellent choice:**
    - **robust**
    - **flexible**
    - **easy to turn bigger and better**

CONCLUSIONS

- **Steam and water use is not optimized yet**
  - **excess bagasse of low value**
- **Dehydration is a very simple and efficient process**
  - **molecular sieves best option but with higher investment cost**