Vienna University of Technology
Institute of Chemical Engineering

Research Group:
Fluidized Bed Systems and
Refinery Technology

Direct use of biomass in FCC -plants

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Content

Catalytical Cracking of Bio Oils

- Based on Biomass: Natural Oils (Rape Seed Oil, Sunflower Oil, Soya Oil, Palm Oil),Fatty Acids, Used Frying Oils, Animal Fat
- Results from Testruns with an FCC- pilot plant
- Addition of Bio Oils to Vacuum Gas Oil

  up to 100 m%:

  - ➲ Continuous Cracking of Bio Oils possible?
  - ➲ Effects on Products?
  - ➲ Effects on the FCC Pilot Plant?

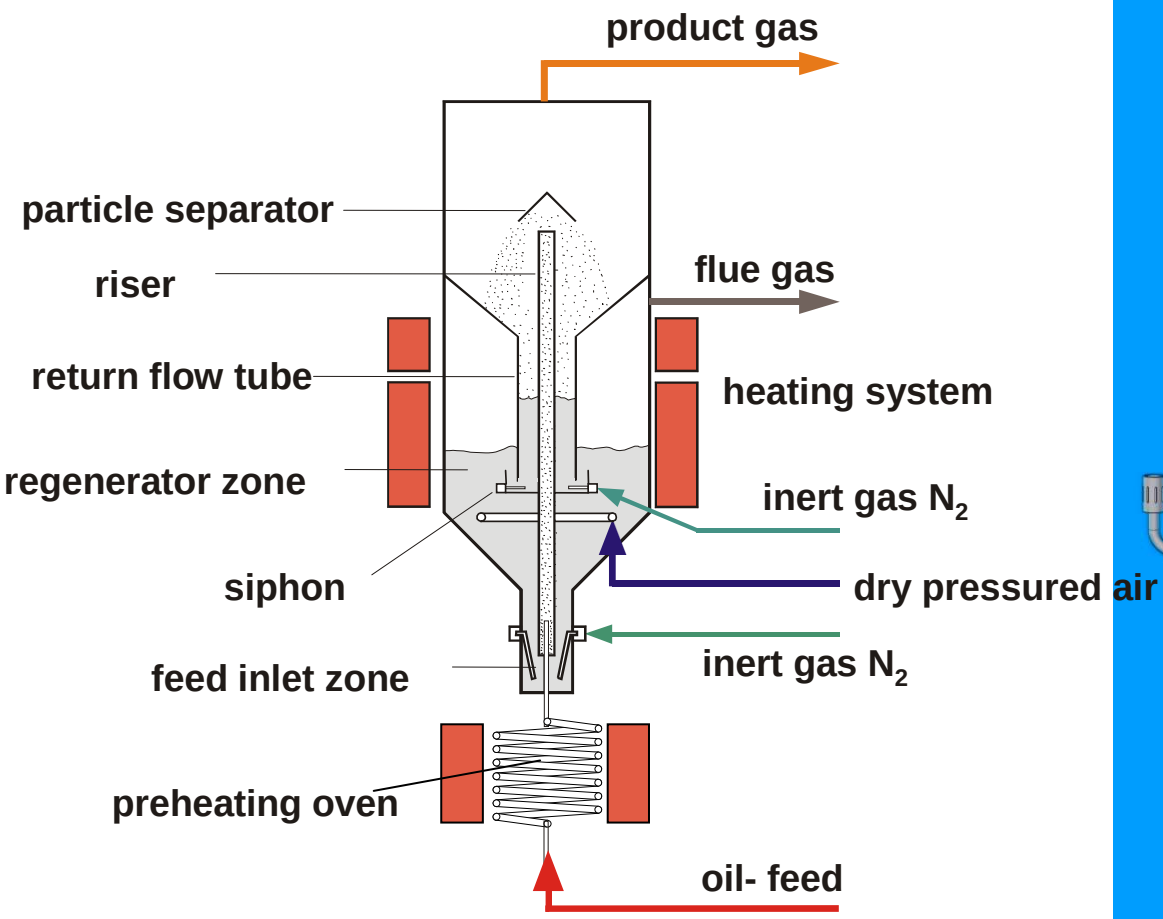
Content

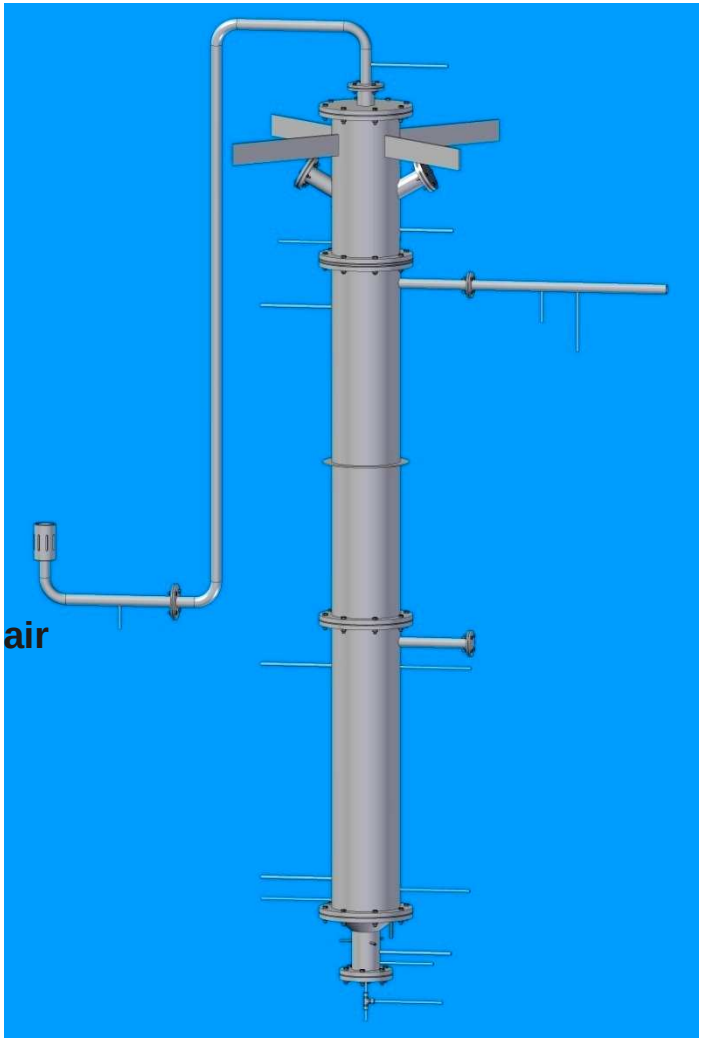
Catalytic Cracking of Bio Oils to Fuels and Monomers for Polymer Industry

- Possibilities of an oil refinery:
  - Hydrogenation to split the ester bond
  - FCC to crack the big molecules of fatty oils

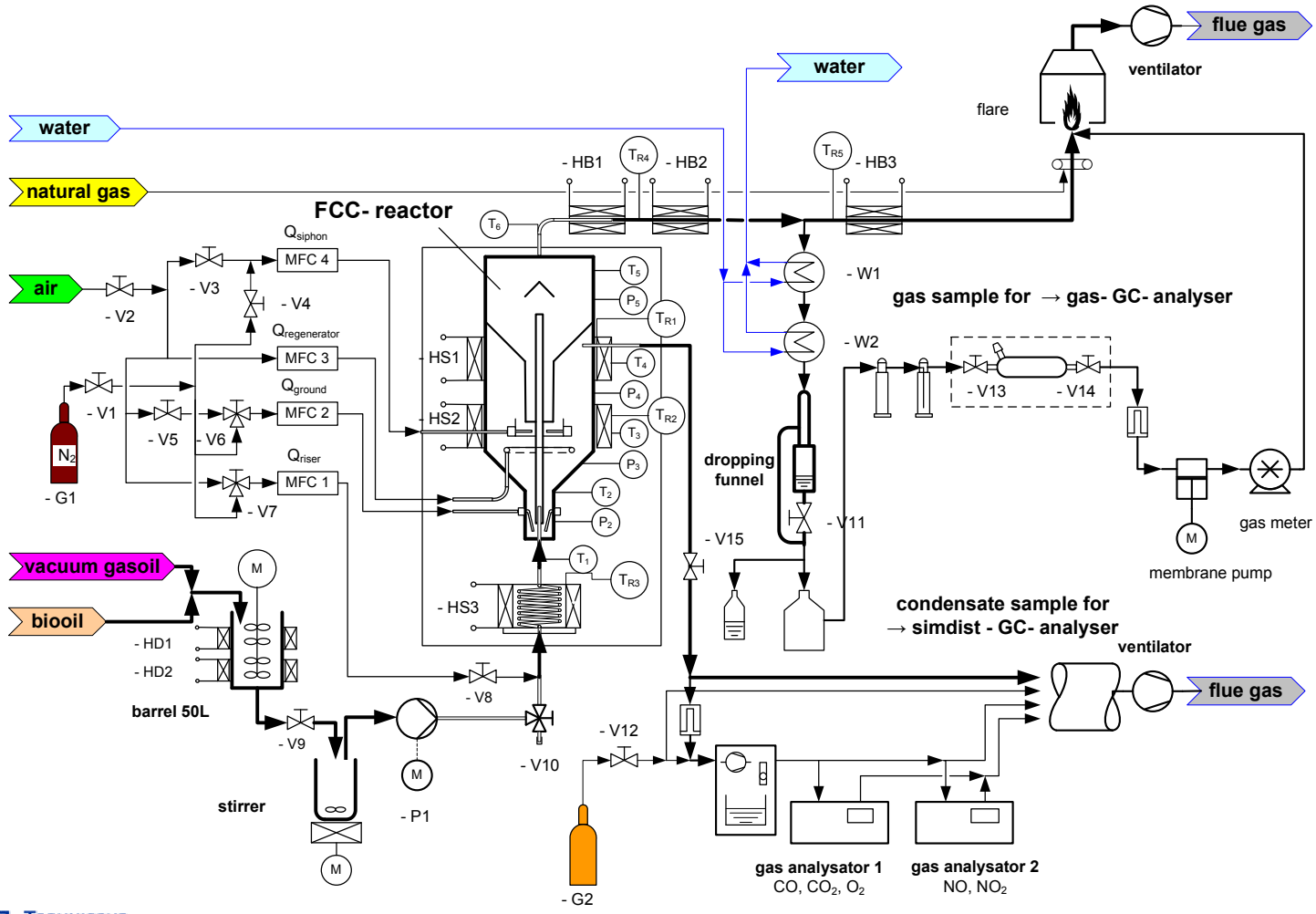
- After the treatment in the refinery the products appear to be similar to crude oil products
  - No difference in material compatibility
  - No biodegradability
  - Additives work as usual

The Fluidized Bed System





Experimental Setup



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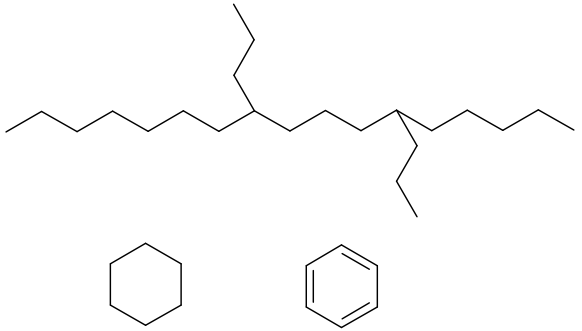
Chemical Composition of applied Oils

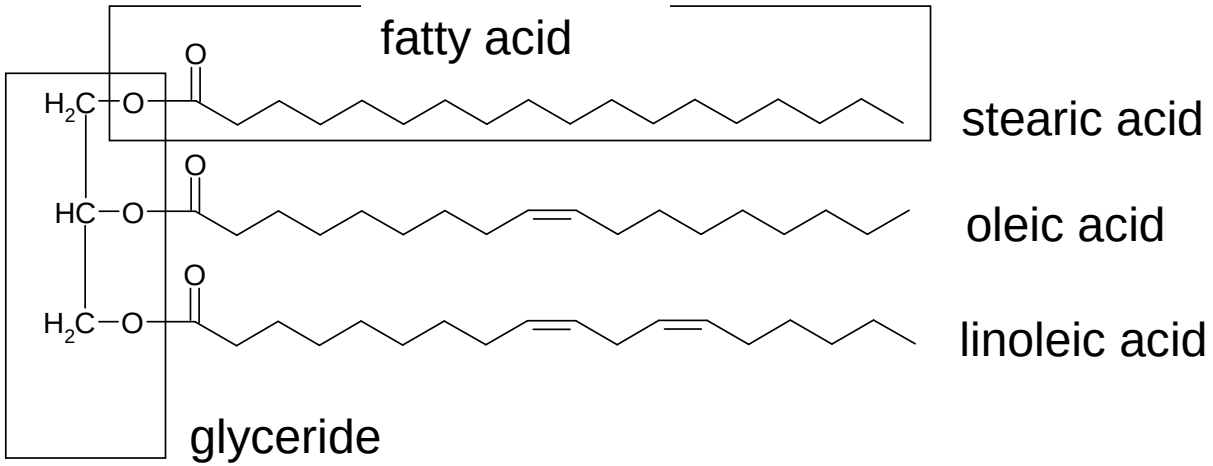
- Hydr. Vacuumgas Oil:
  (Crude Oil- Product)

Density (20°C)	0.895 g/cm³
Viscosity (100°C)	6.476 mm²/s
Aromatic Carbons	23.3 w%
Paraffinic and Naphtenic Carbons	>70 w%
Boiling Range	281°C-588°C



- Bio Oil:

Chain lenght of fatty acids	C12 – C22
Boiling Point	< 300°C



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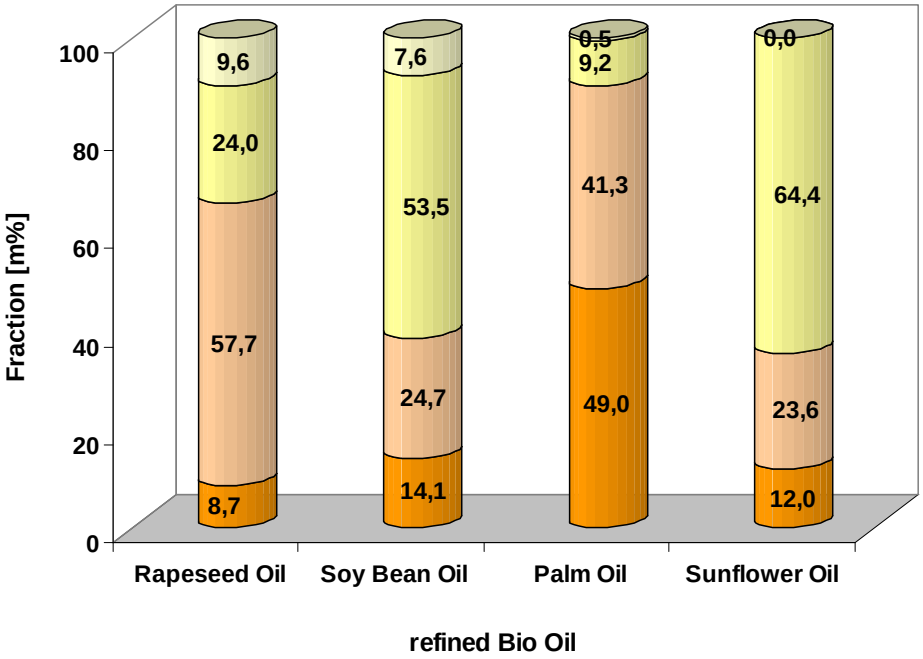
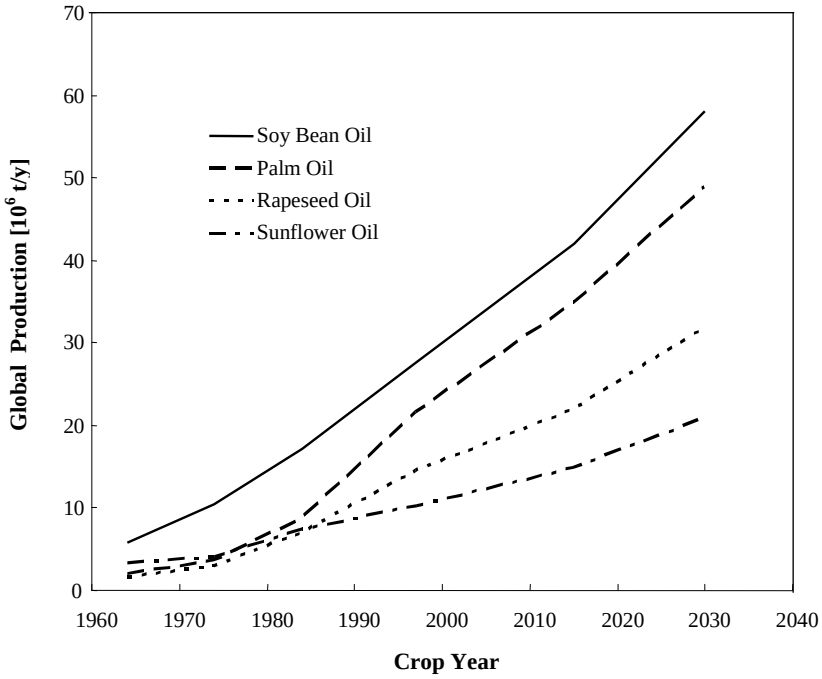
Bio Oil Composition (C12 – C22)





*Source: VFI

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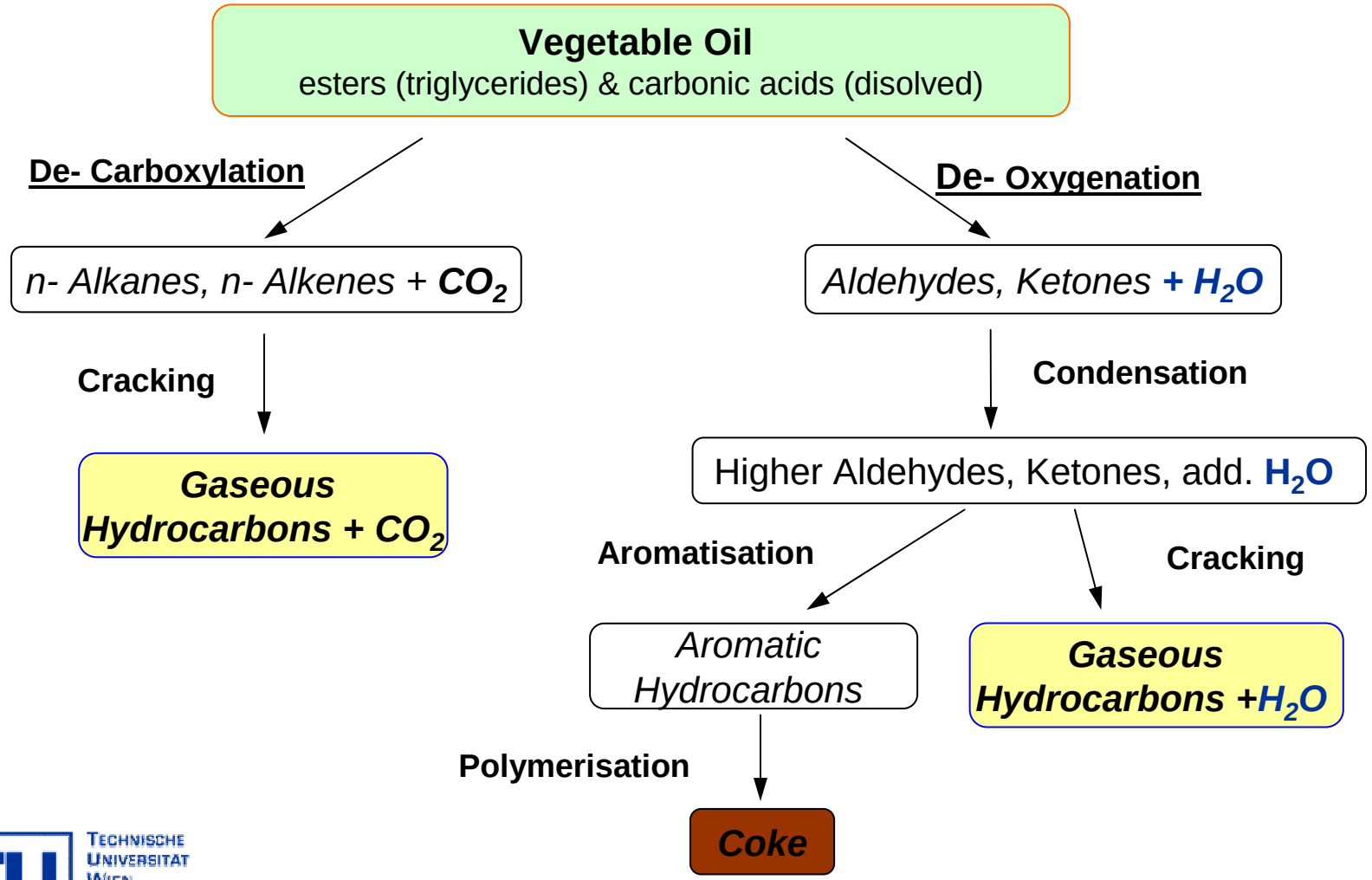
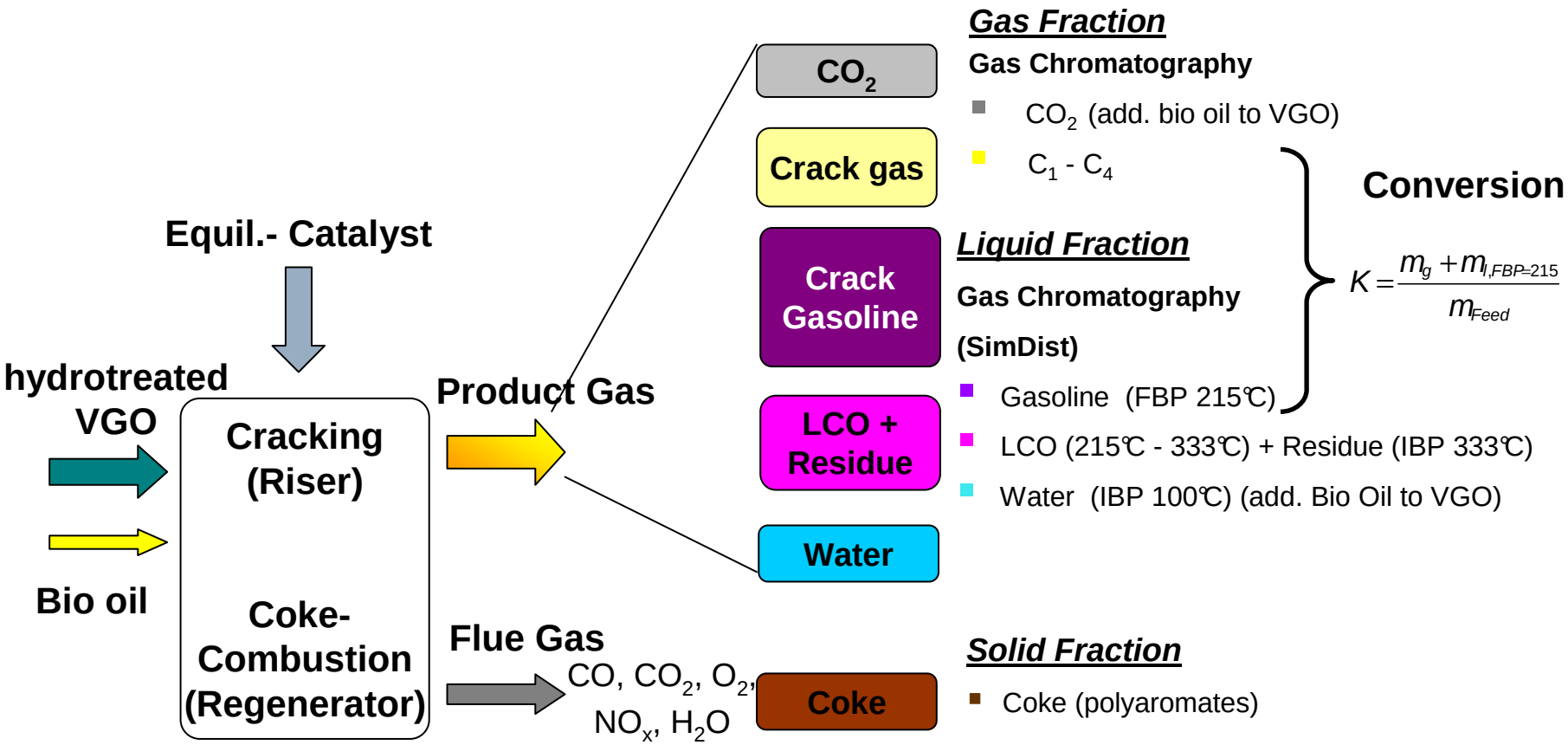
Suggested Reaction Pathes

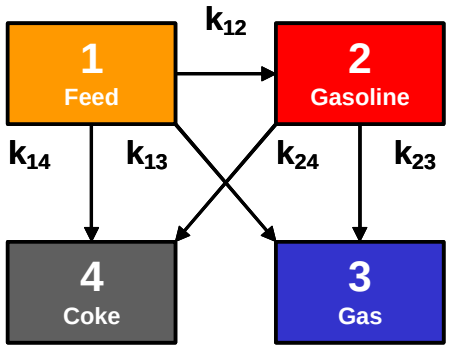


Cracking- Products (Lumps)

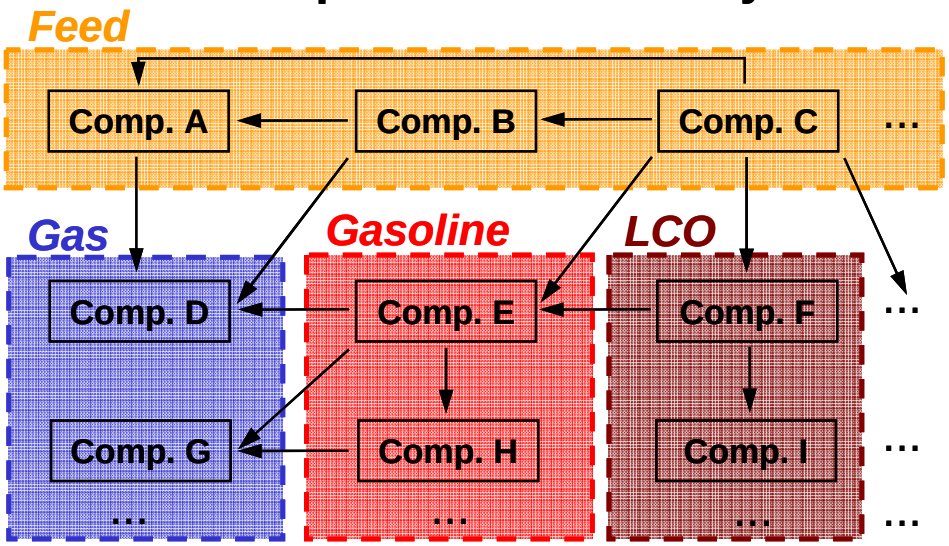


Cracking- Products (Lumps)

4-Lump Reaction System

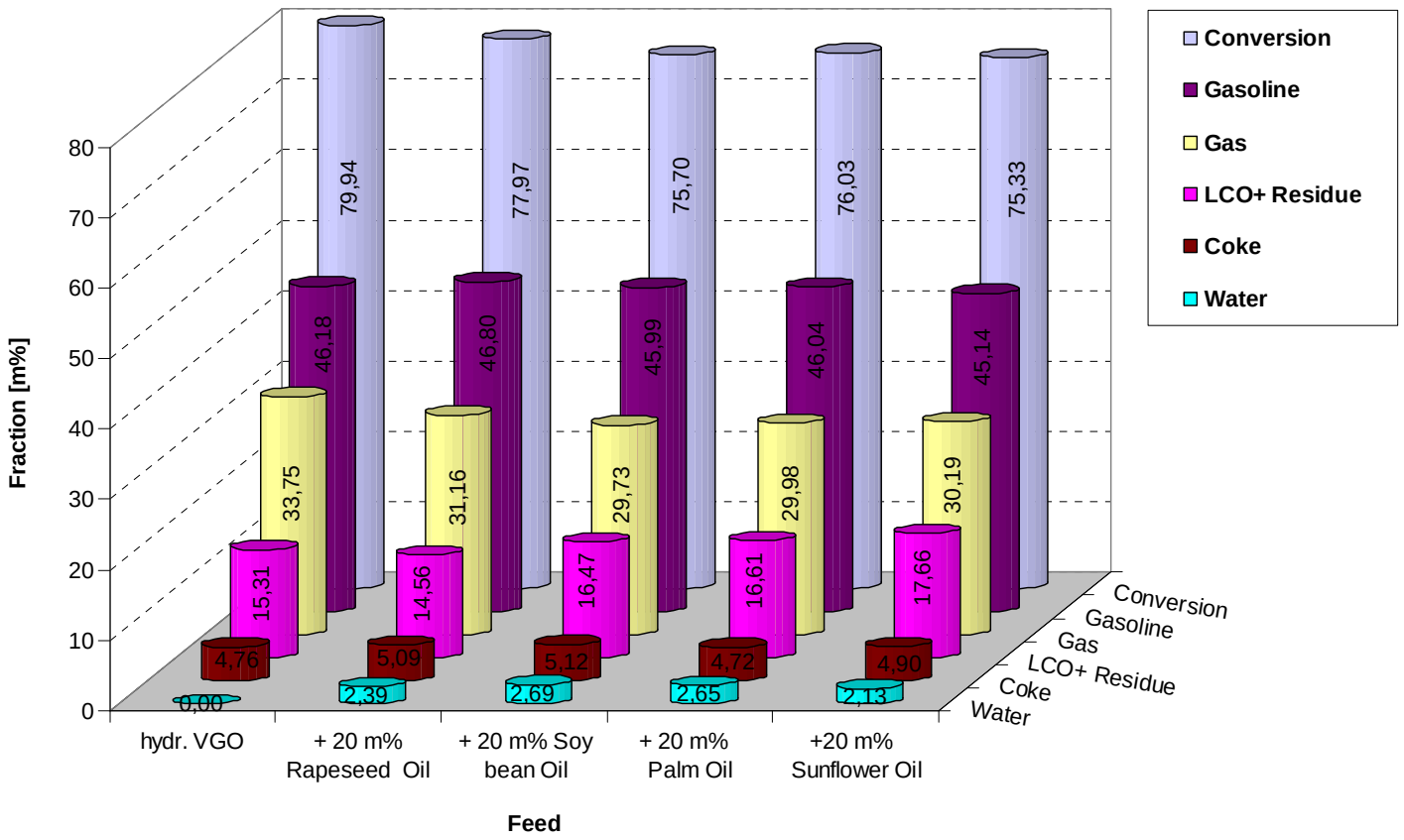


Multi Component Reaction System

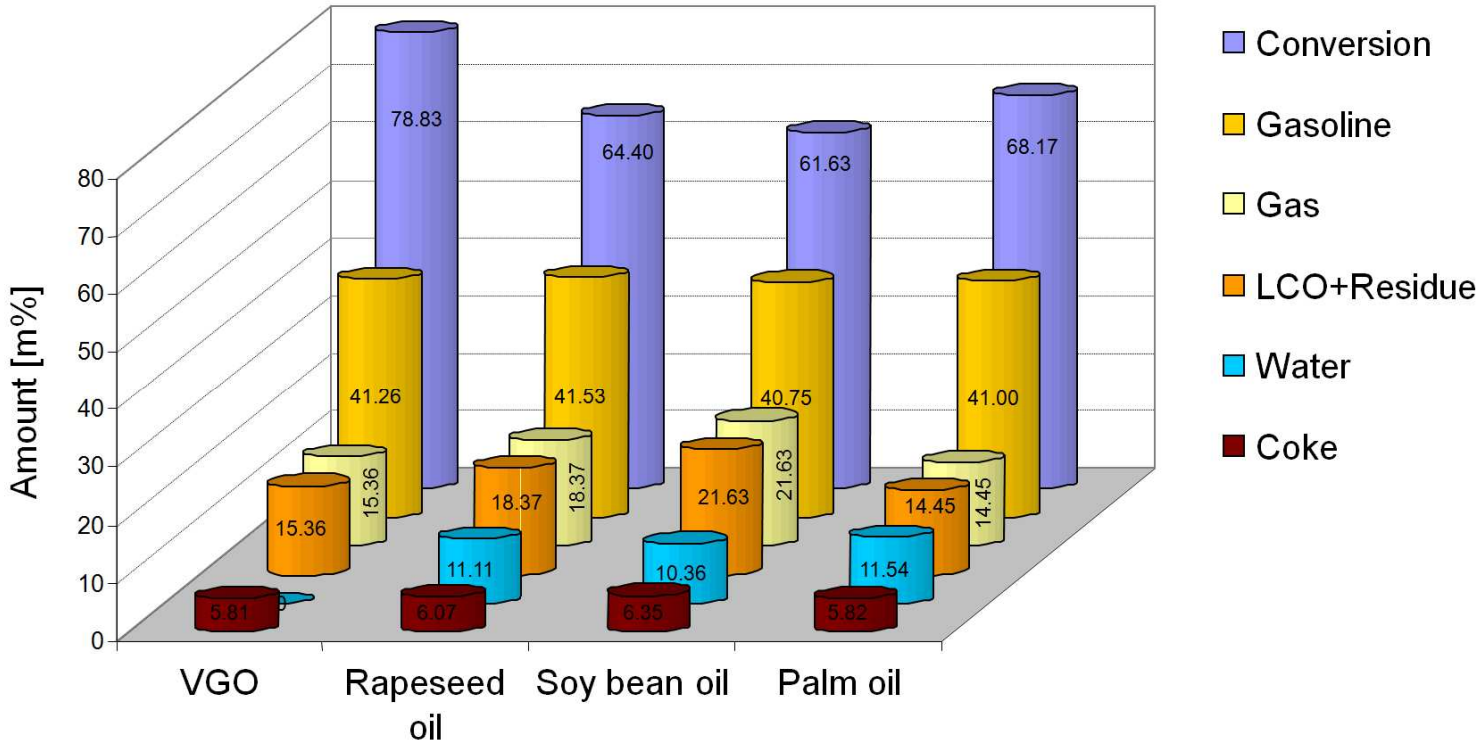


$$\frac{dy_1}{dt} = -k_{12,n} \cdot \Phi_n \cdot y_1^2 - k_{13,n} \cdot \Phi_n \cdot y_1^2 - k_{14,n} \cdot \Phi_n \cdot y_1^2$$

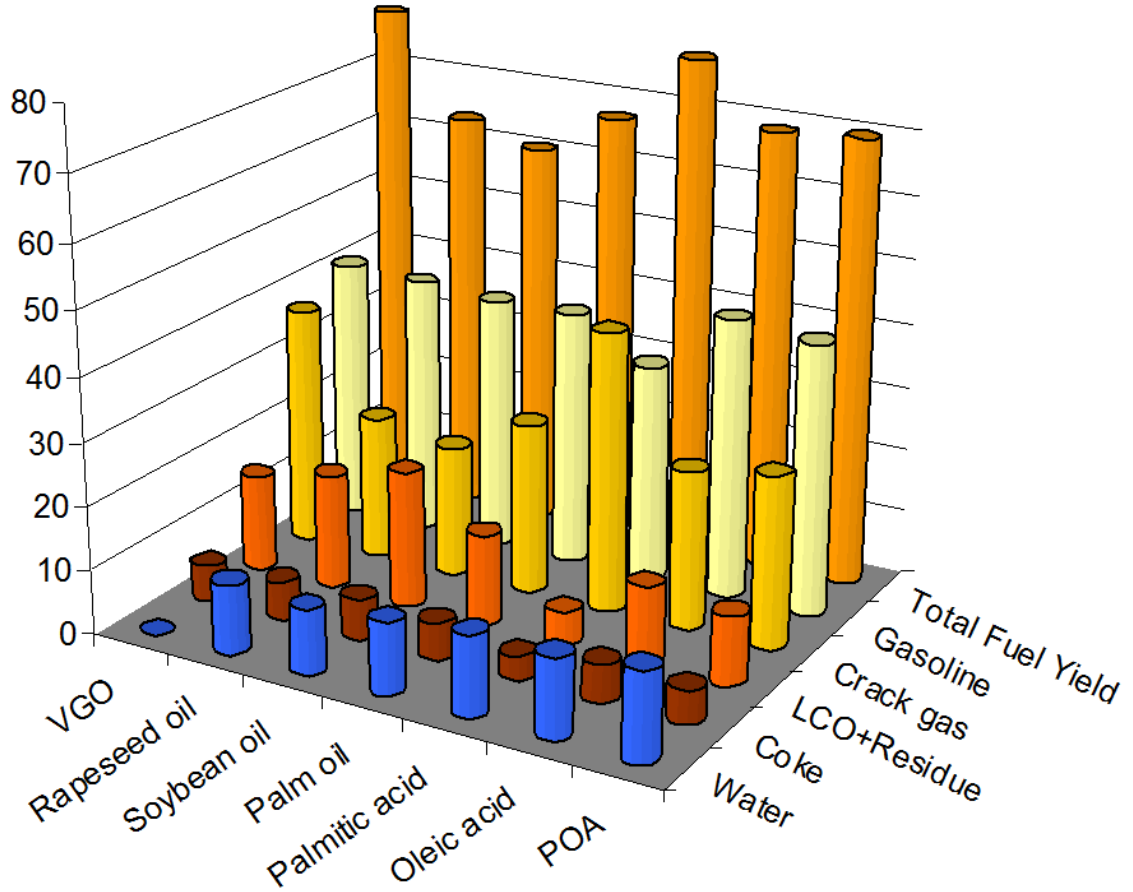
Product Composition



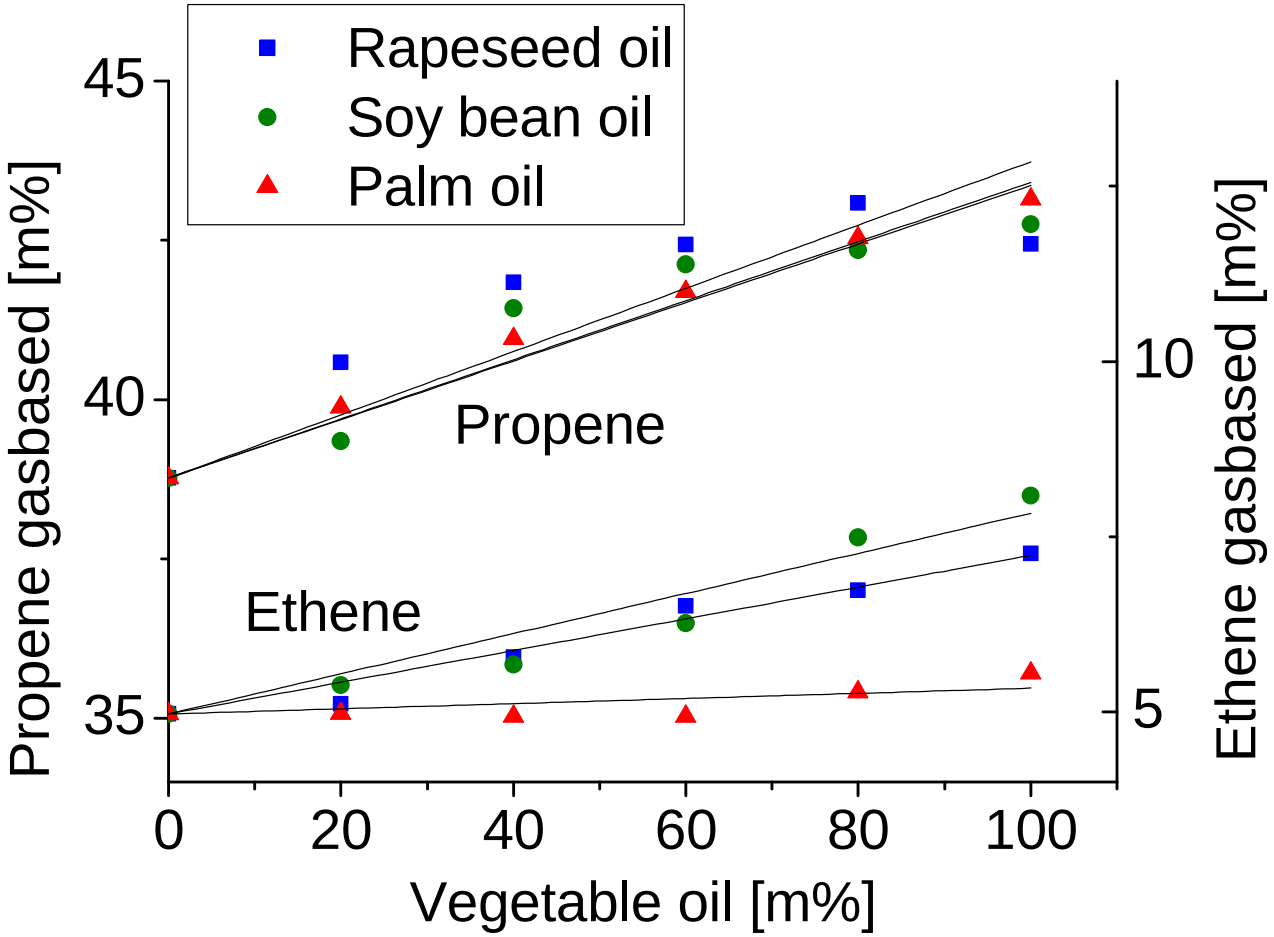
Product Composition



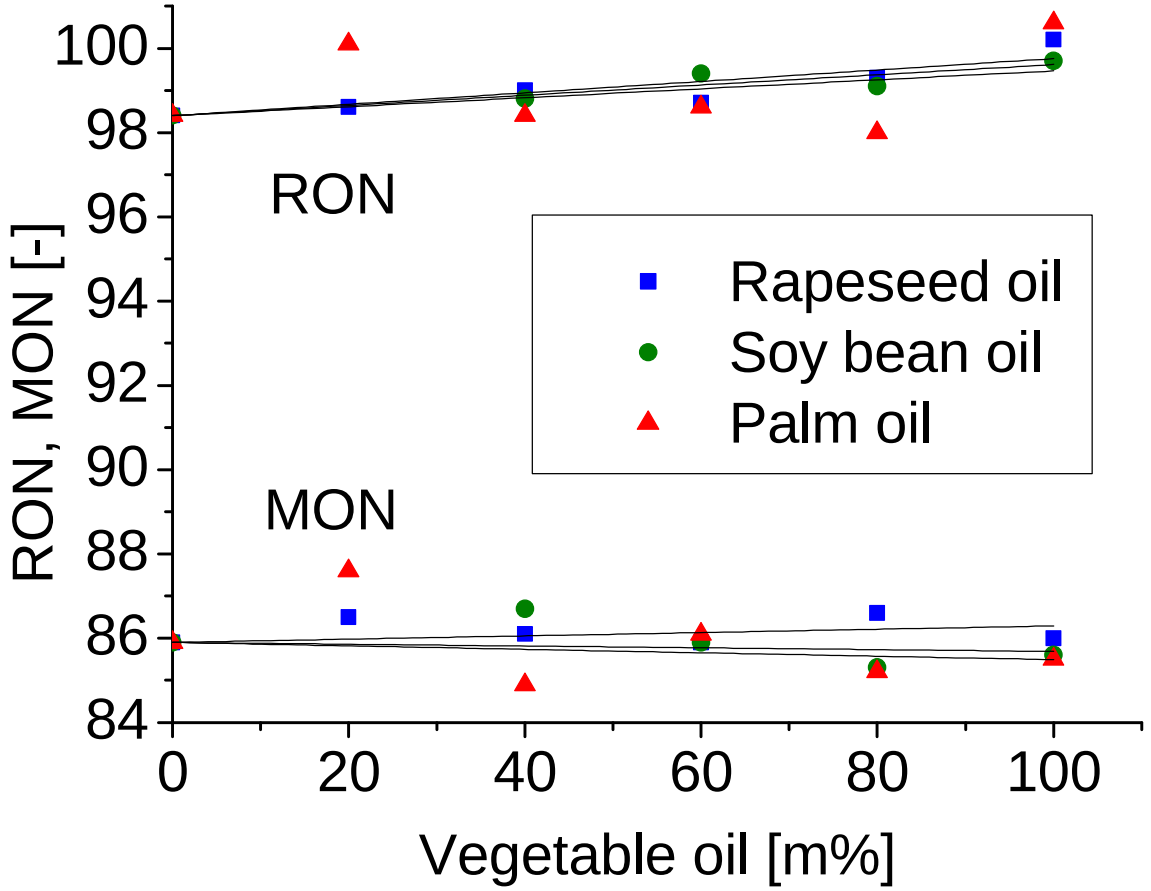
Product Composition



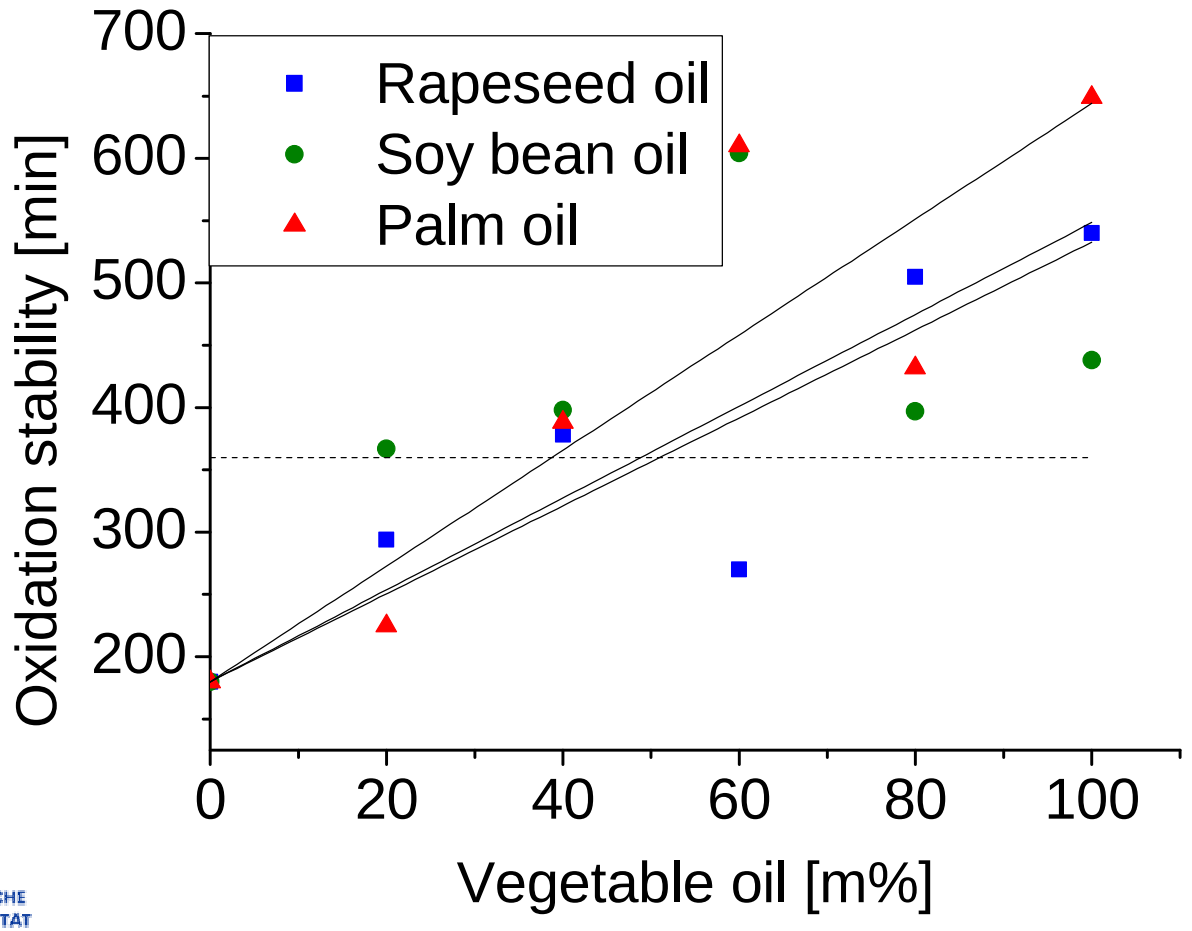
Product Composition



Product Quality



Product Quality



Conclusions

- The addition of bio oils has no significant influence on the routine operation of the FCC-plant
- It does result in a slightly modified product spectrum
- It has to be pointed out that the slight decrease in conversion was mainly caused by the oxygen content of the feed
- The production of up to 12 percent mass water from the oxygen in the bio oils does not constitute a problem in downstream processing of the products, since industrial FCC-units utilize steam for fluidization of the riser and the stripper
- The obtained liquid product contained a high octane (RON 99) gasoline fraction, which is comparable to high quality gasoline pools from traditional refineries
- The obtained light hydrocarbons contained a high percentage of propylene and ethylene - so the FCC process further offers a possibility to produce bio polymers without supporting the greenhouse effect.

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