

STØTTET AF

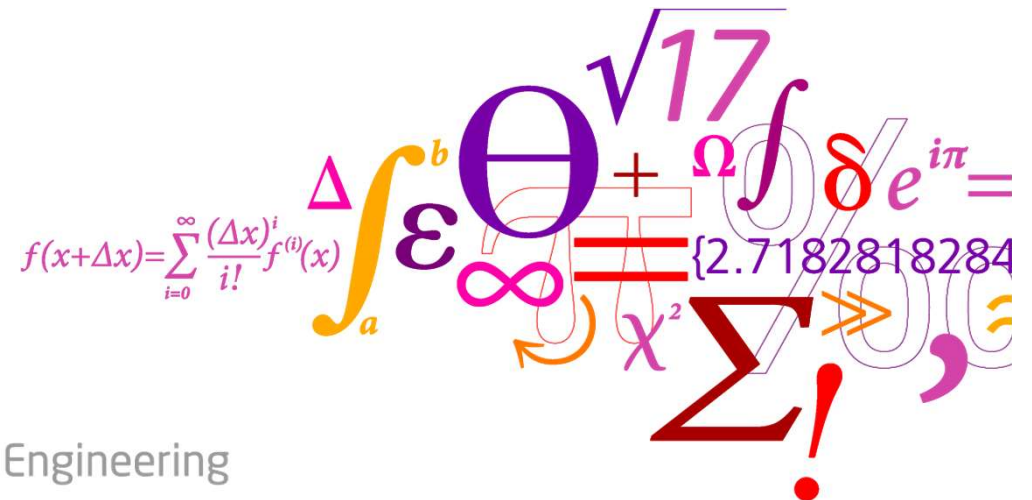


Promilleafgiftsfonden for landbrug

Pyrolyse

by

Ulrik Birk Henriksen



DTU Chemical Engineering
Department of Chemical and Biochemical Engineering

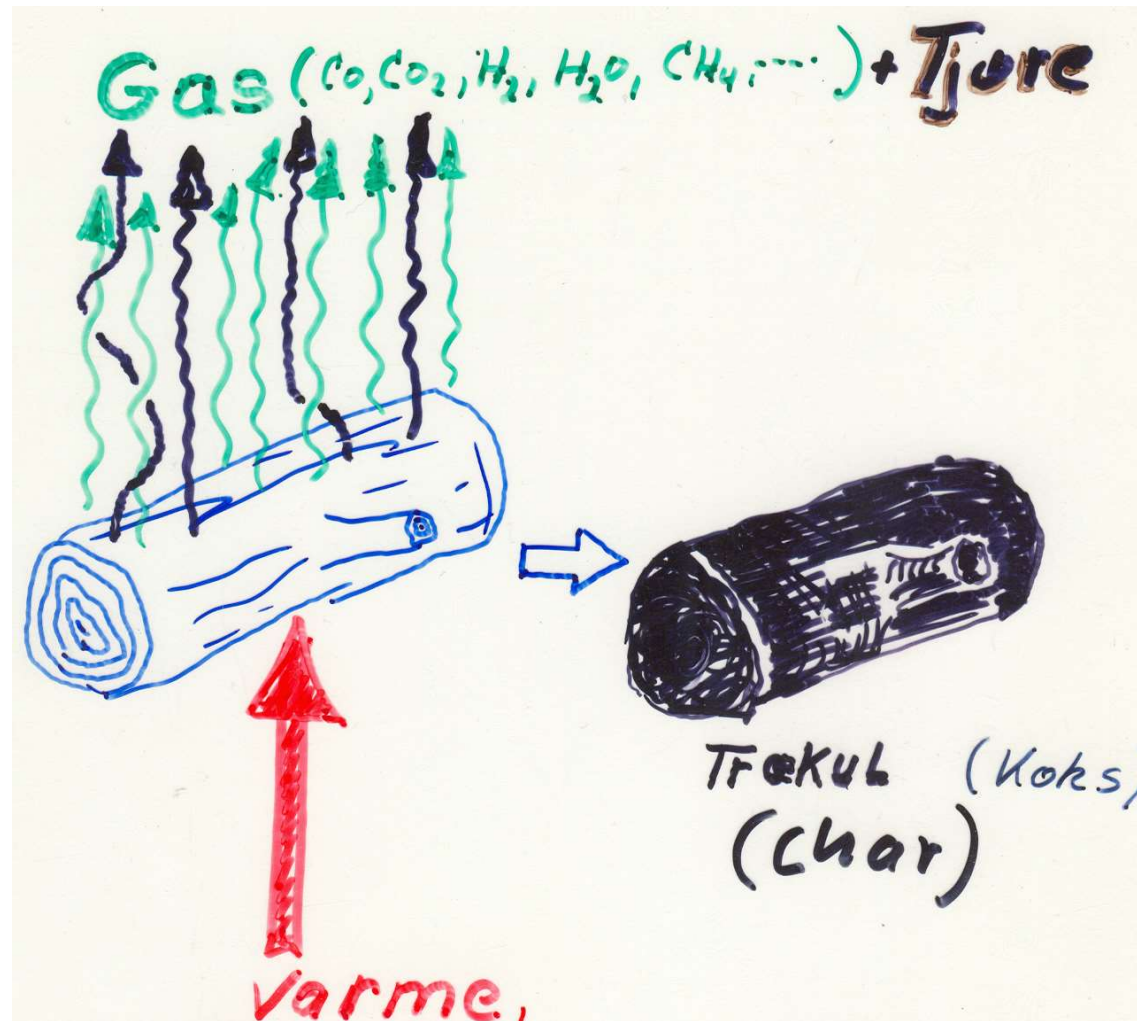


- Bio-ash | Spreading of the ash on a windy day...
- The actual spreading was carried out during the night, when the wind was calm.

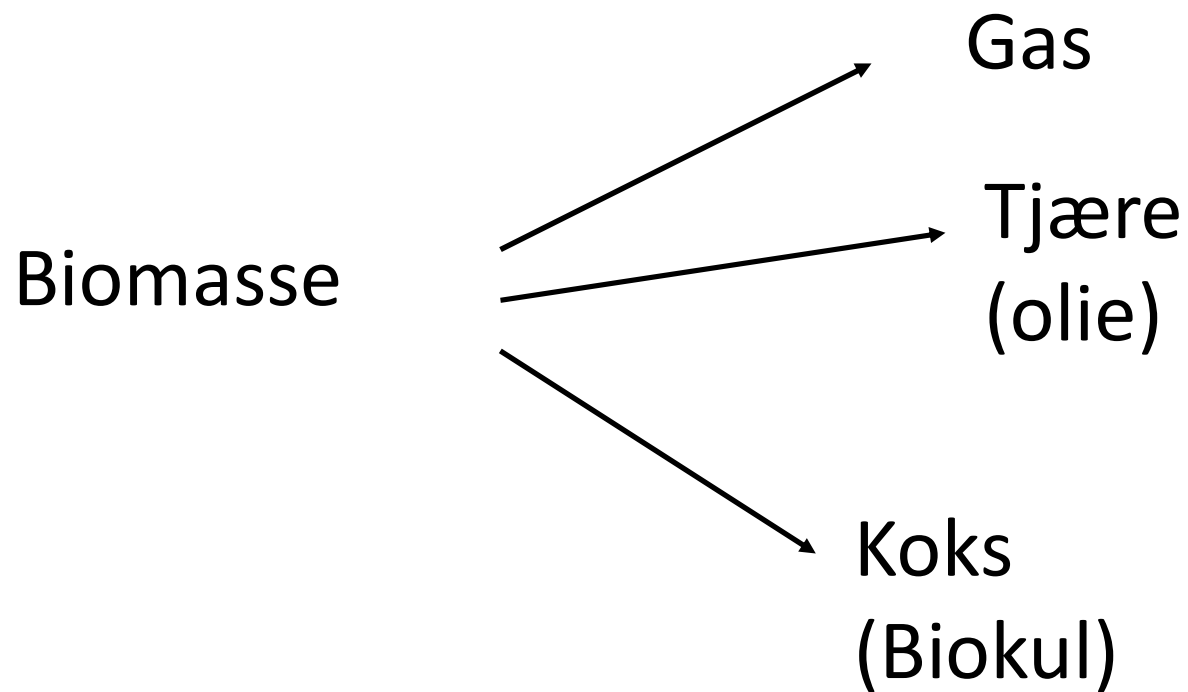
Koks (Biokul) fra halmpiller



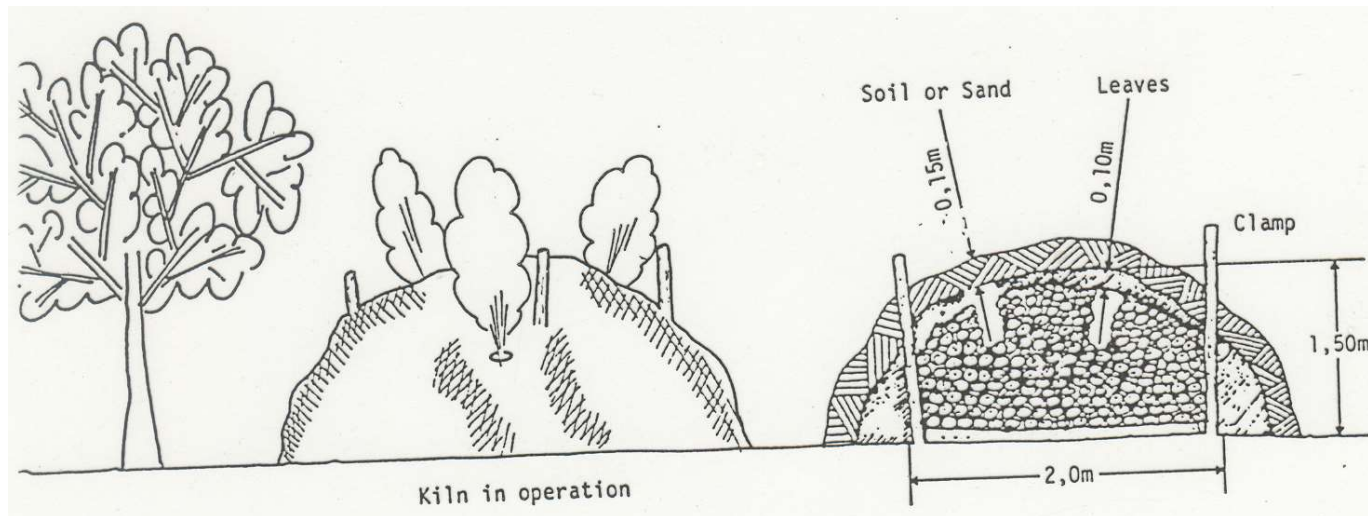
Pyrolyse



Pyrolyse



Pyrolyse

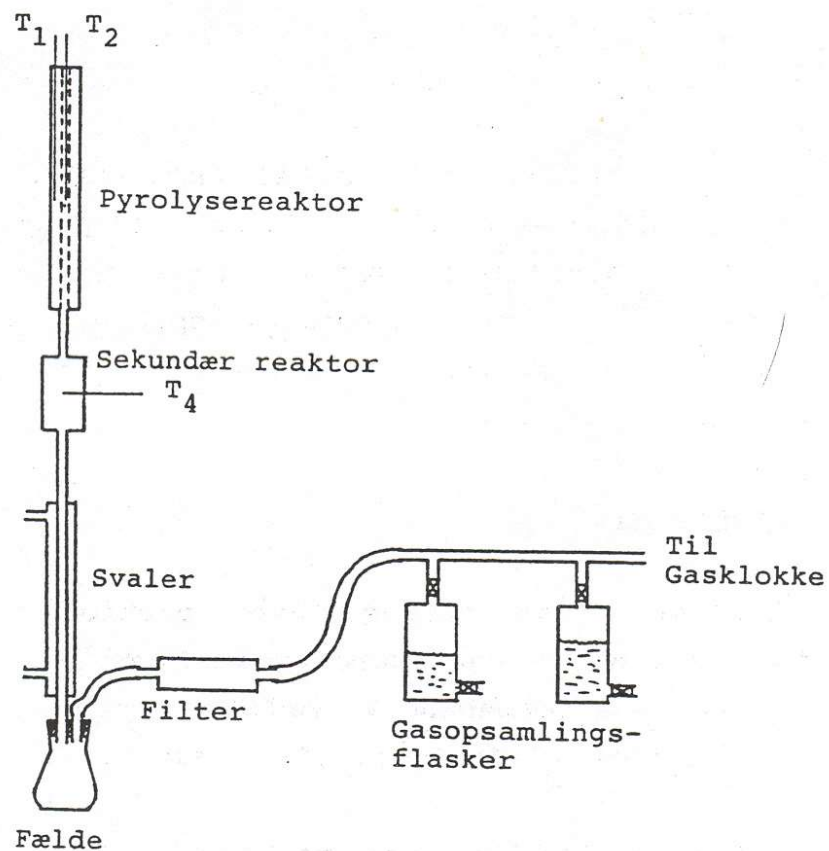


Hurtig pyrolyse (lille koksmængde)

eller

Langsom pyrolyse (Stor koksmængde)

Fordeling af massen i pyrolyseprodukter fra halm



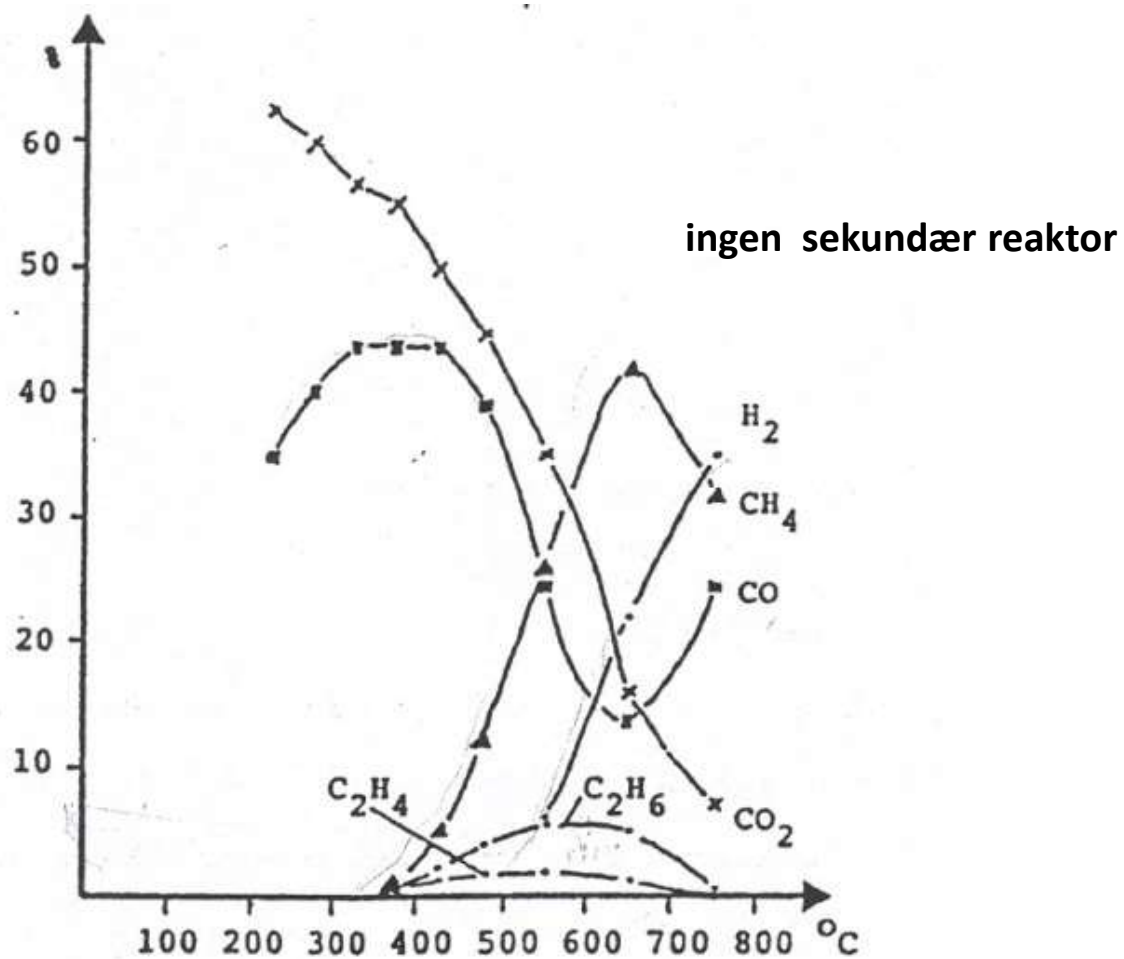
Fordeling af massen i pyrolyseprodukter fra halm

Forsøgsserie	b			
Forsøg nr.	1b	2b	3b	4b
Temp.sek. reaktor °C	-	600	900	900 D
Halm %	100,0	100,0	100,0	100,0
Koks %	30,3	31,3	29,9	29,9
Kondensat %	45,8	39,0	25,8	13,4
Gas %	23,9	29,7	44,3	56,7

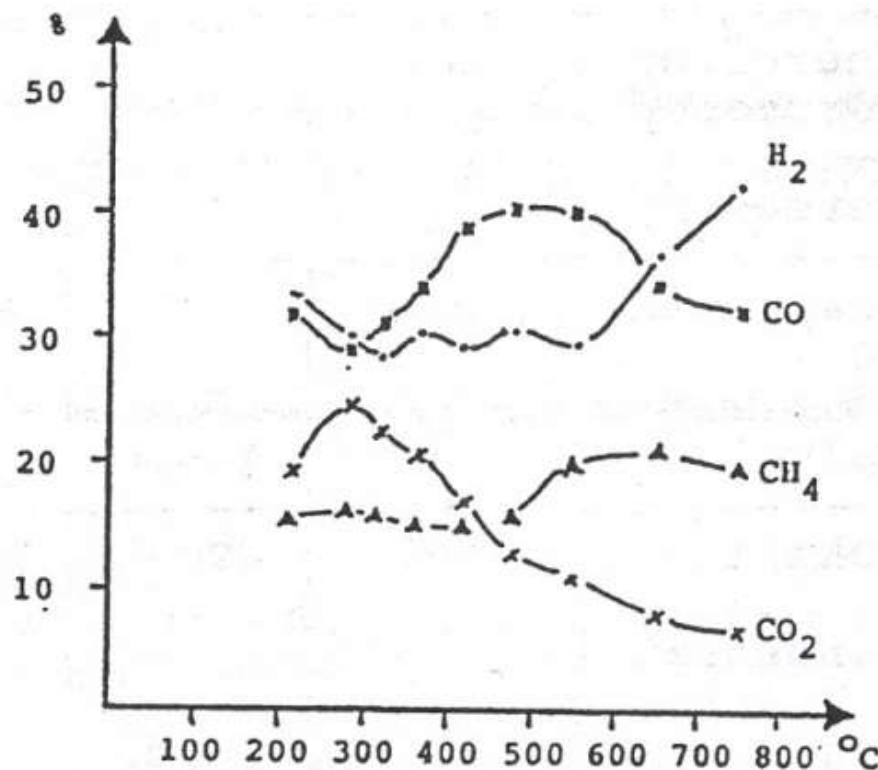
Fordeling af energien i pyrolyseprodukter fra halm

Energifordeling Forsøgsserie c.					
Forsøg nr.	1c	2c	3c	4c	usikkerhed
Temp. sek. reaktor °C	-	600	900	900 D	
Halm %	100,0	100,0	100,0	100,0	± 1
Koks %	43,7	43,7	43,7	43,3	± 0,6
Kondensat %	-	-	-	0,5	
Gas %	16,0	20,7	37,6	54,4	± 0,6-2,3
Sum af produkter %	-	-	-	98,2	± 2,9

Gassammensætningen relateret til pyrolyse temperaturen

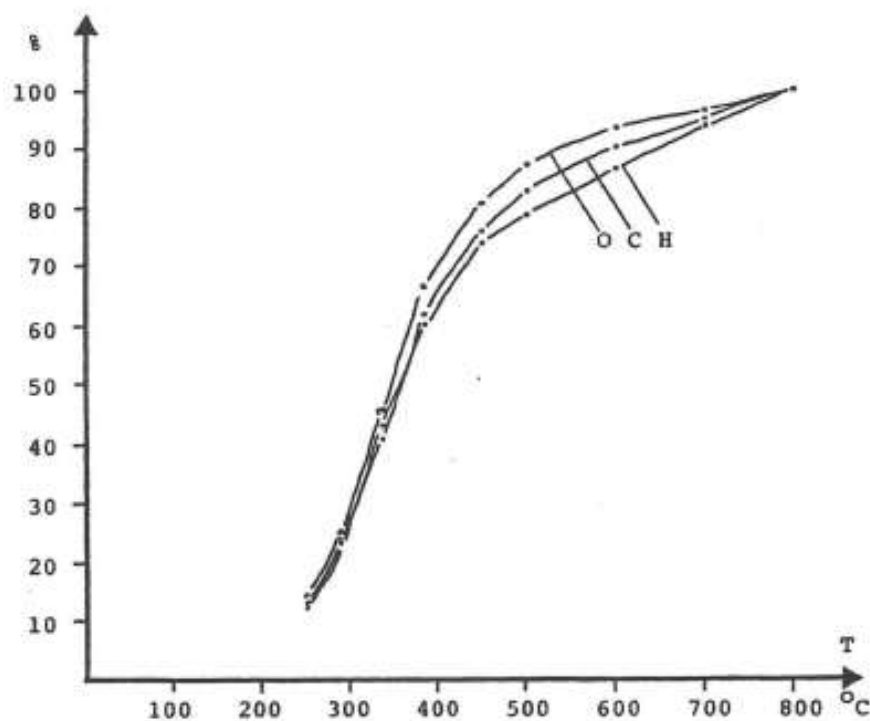


Gassammensætningen relateret til pyrolyse temperaturen



Sekundær reaktor
900 °C og fyldt
med dolomite

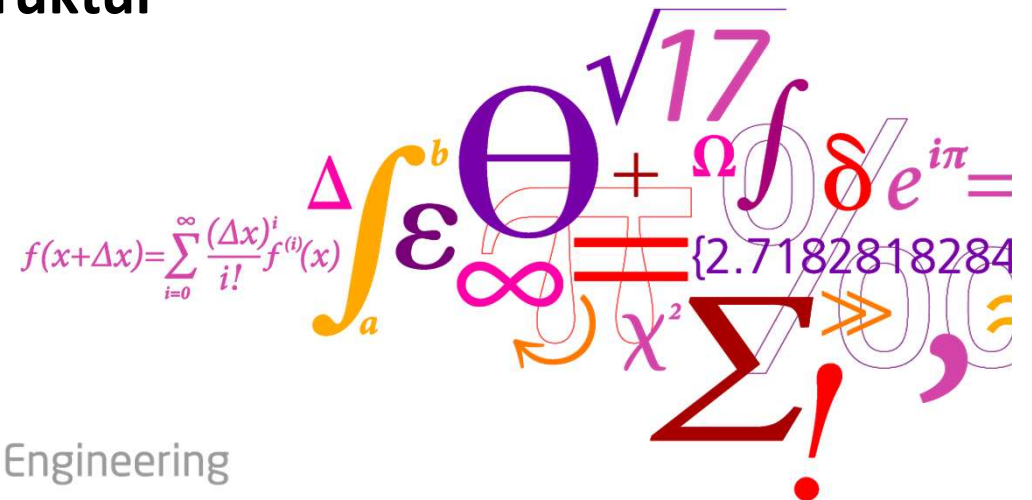
Frigivelse af O, C and H relateret til pyrolysis-temperaturen



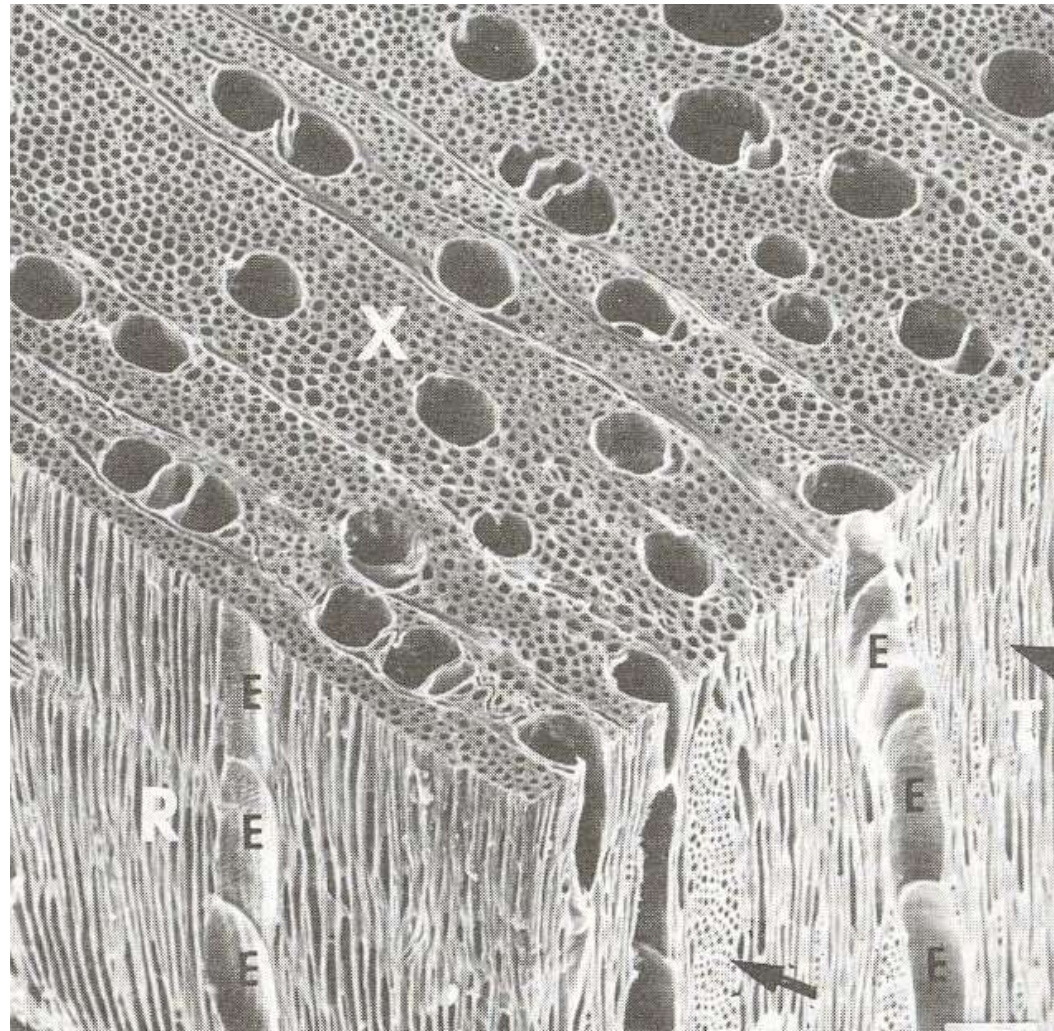
Afgivet grundstof som funktion af pyrolyse-temperaturen. Afgivet stof måles i forhold til stofafgivelsen ved 800°C og angives i pct.

Biomasse og koks

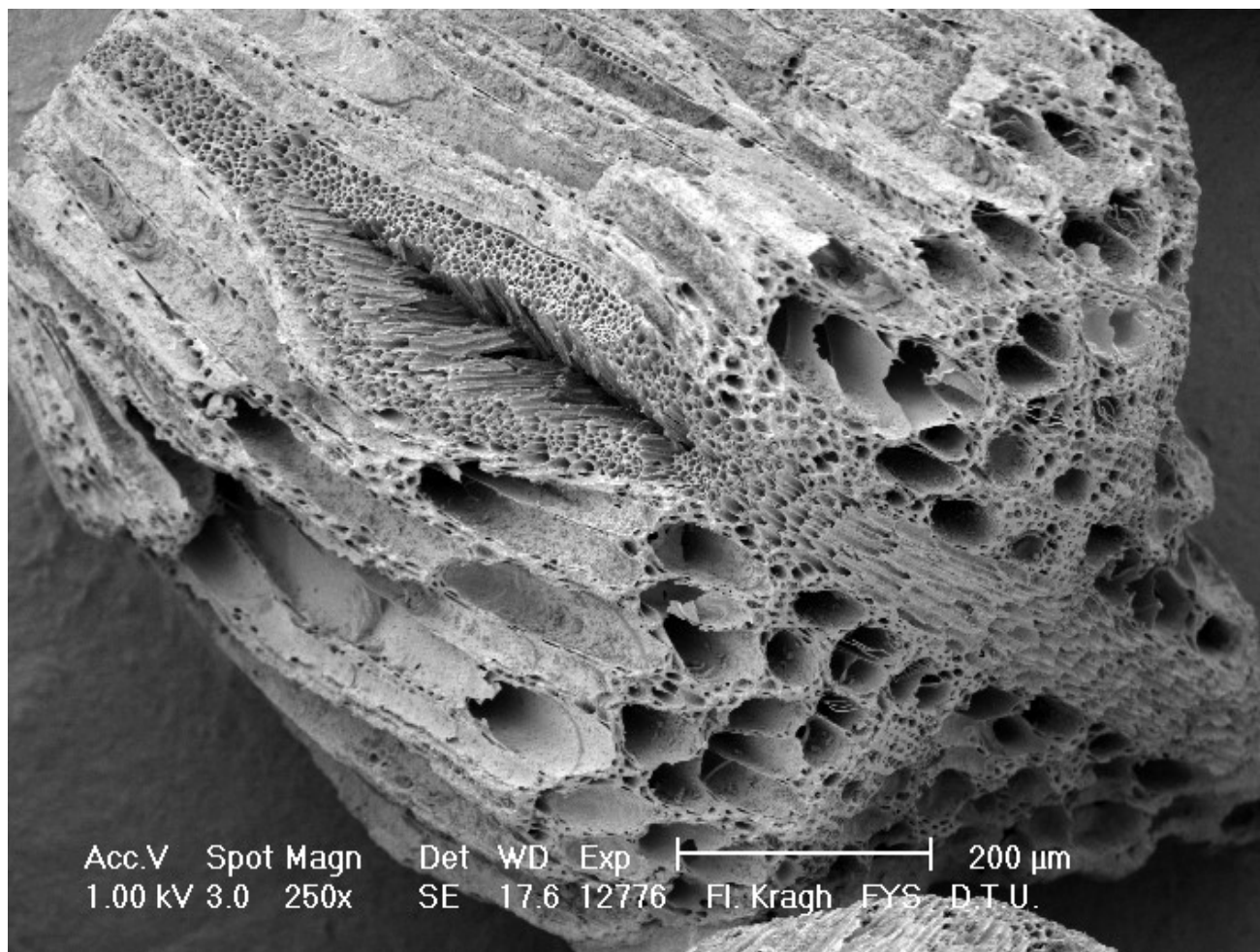
struktur



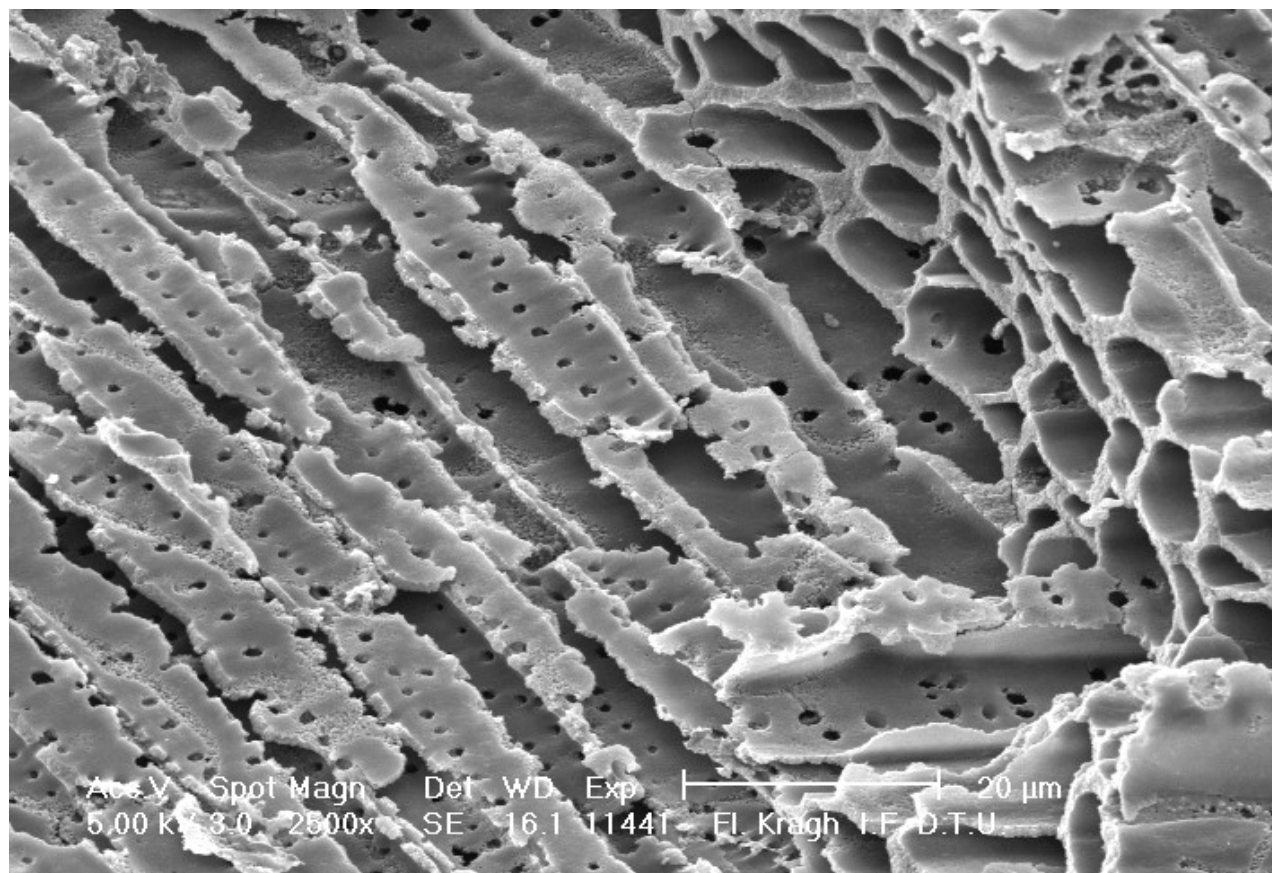
Biomasse (hardwood) struktur

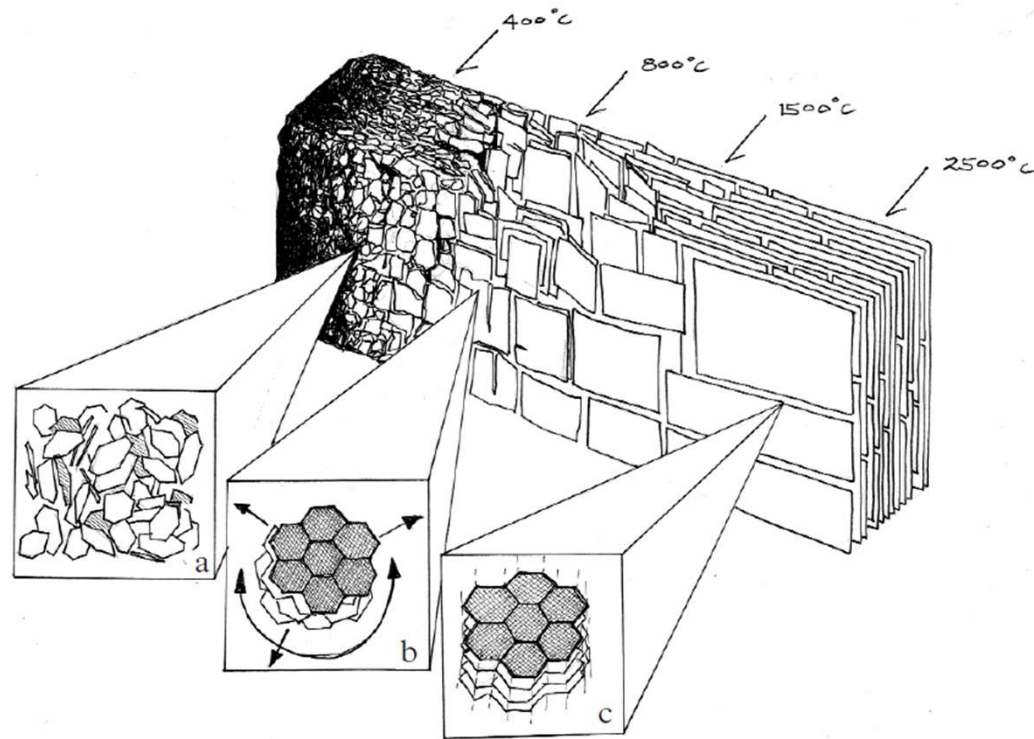


Koks struktur (Bøg)



Koks struktur (Bøg)



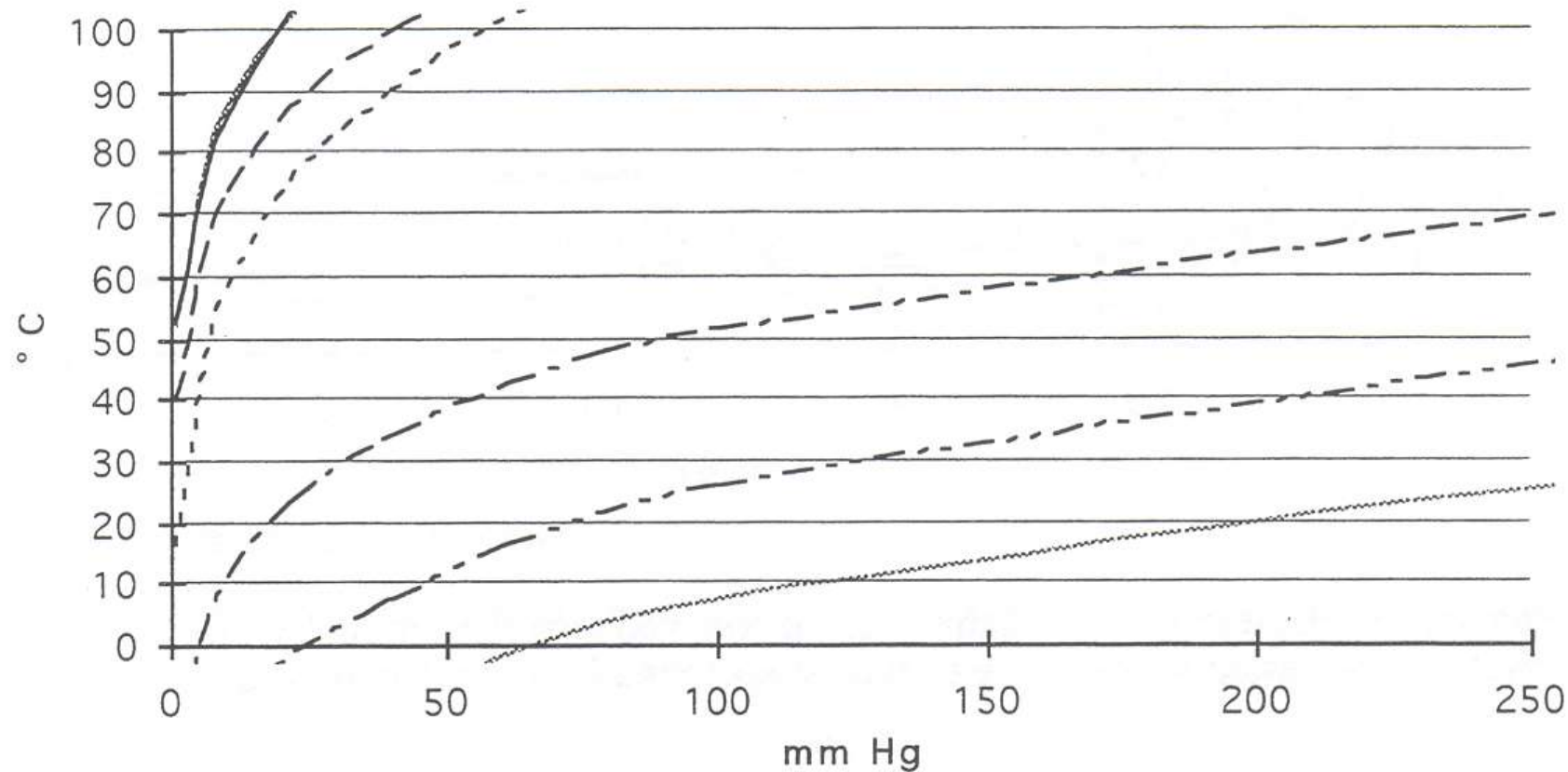


J. Lehmann & S. Joseph, Biochar for Environmental Management, 2015

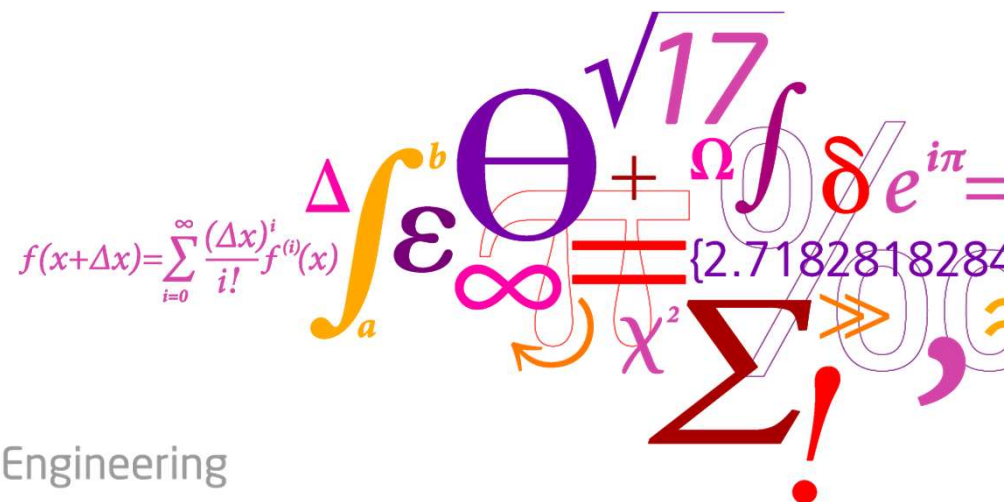
Characterisation of tars

- Primary tars (only oxygenated compounds)
Produced by pyrolysis
- Secondary tars (hydrocarbons and oxygenated compounds)
Produced by light heating of primary tars
- Tertiary tars (hydrocarbons, (PAH))
Produced by heavy heating of secondary tars

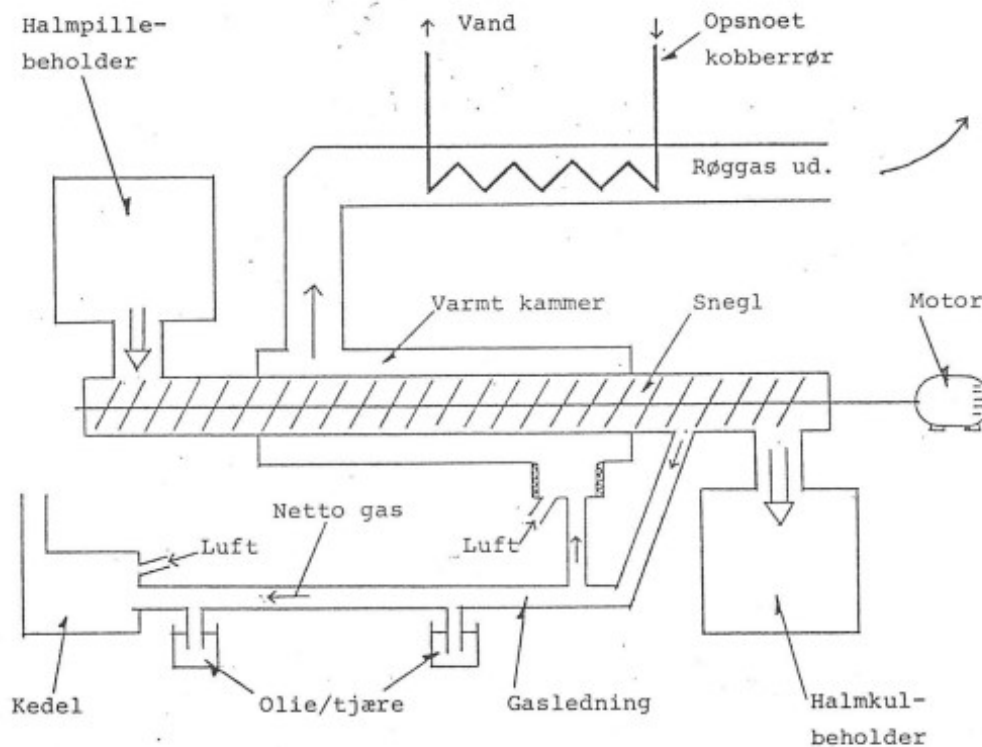
Tjære dugpunkt



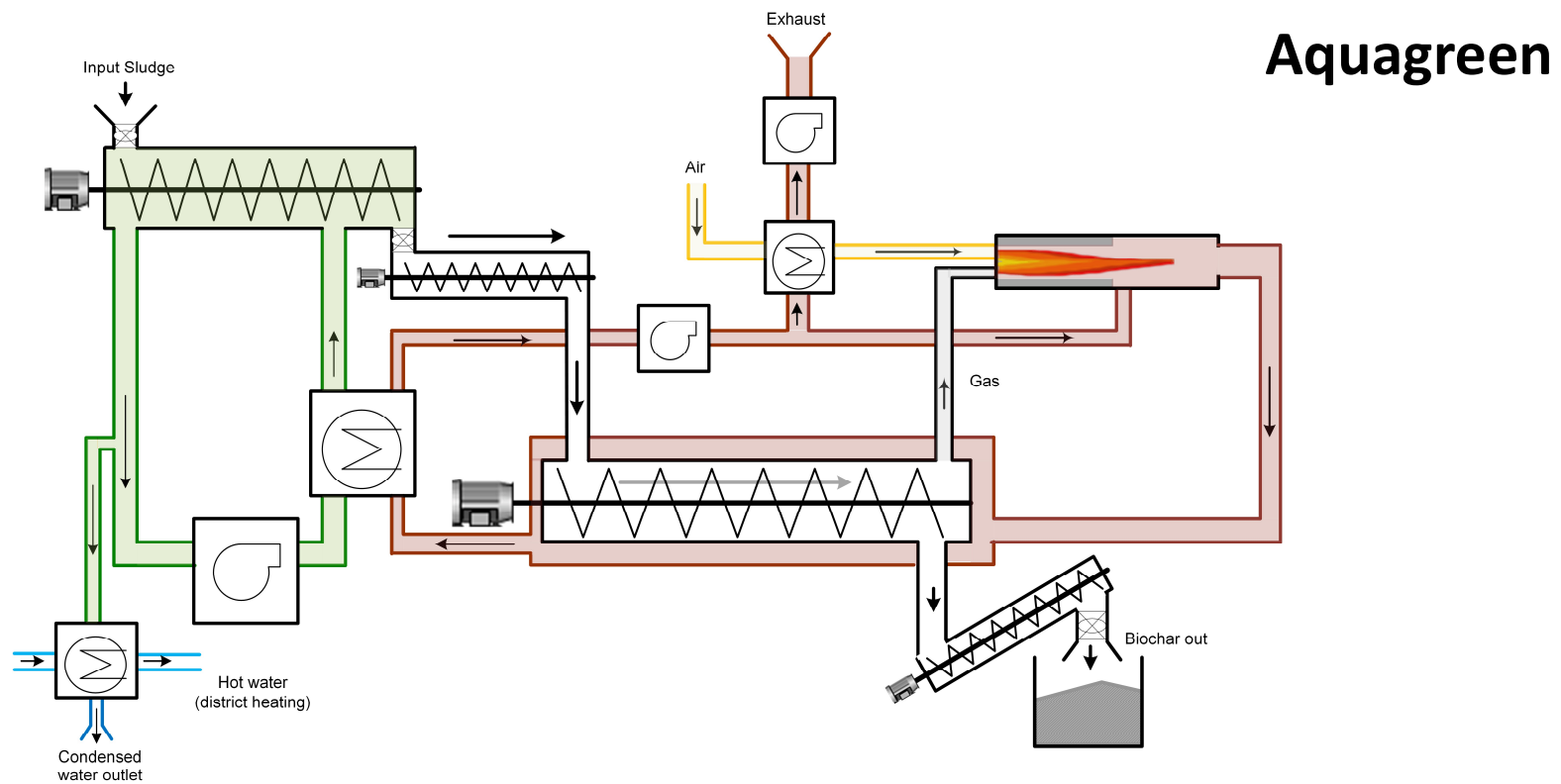
Pyrolyse-anlæg til langsom pyrolyse



Pyrolyseanlæg Vildbjerg, 1986



Damptørning og pyrolyse



Damptørning og pyrolyse

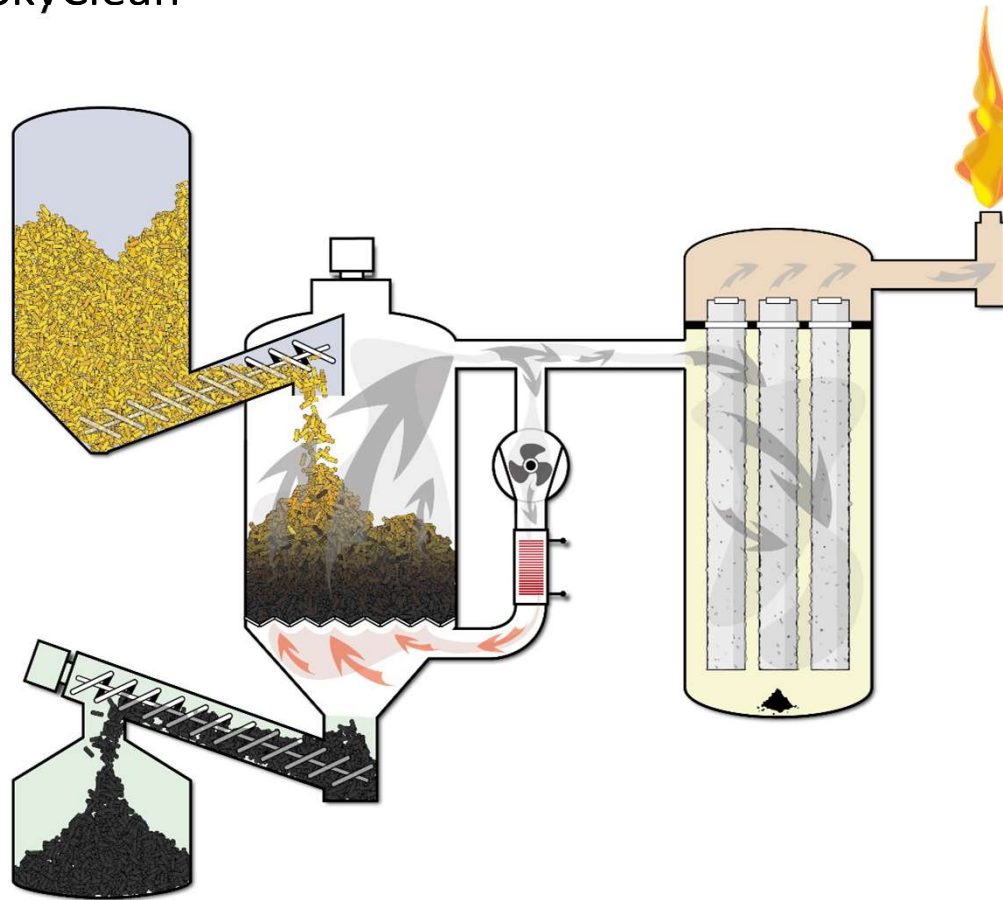
Aquagreen



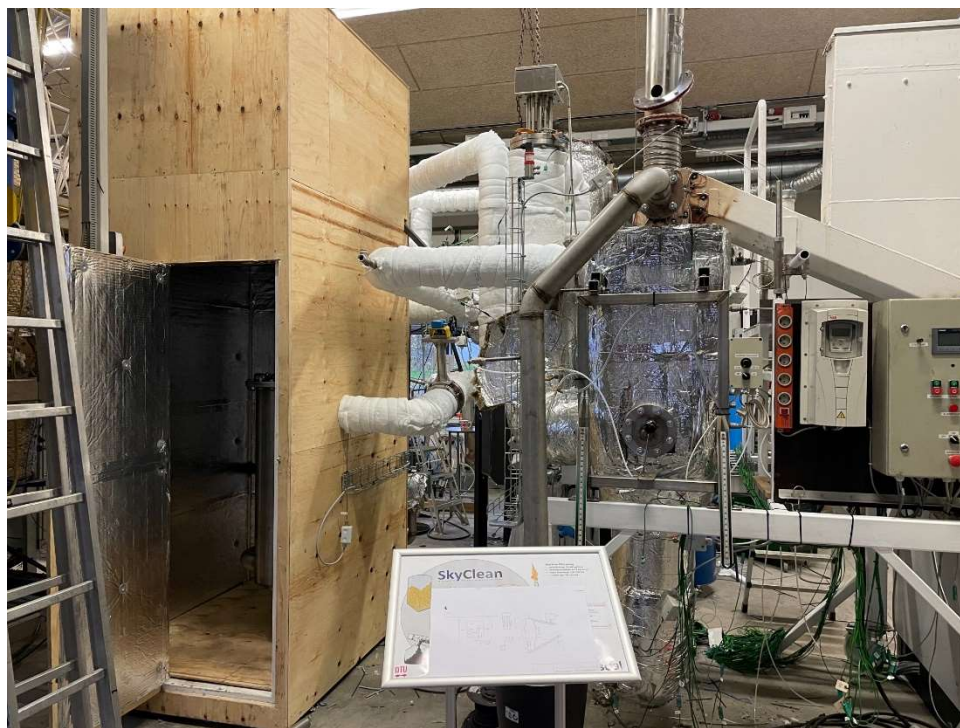
Pyrolysis

SkyClean

Stiesdal



Stiesdal 200 kW



Stiesdal 2 MW



Konklussion

- Pyrolyse er kommet for at blive