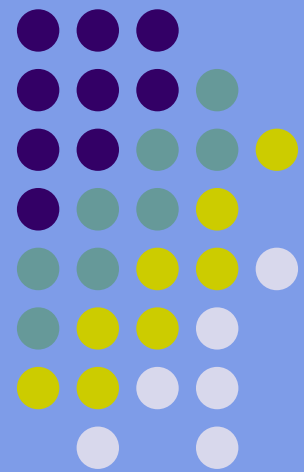
LEATHER WASTE - FLUIDIZED BED COMBUSTION CHARACTERIZATION IN LABORATORY AND DEMONSTRATION SCALE

A.T. Tuñón,C. Pawlik, F. Winter
(Institute of Chemical Engineering, TU Wien)

A. Bahillo, A. Cabanillas
(Department of fossil fuels, CIEMAT, Madrid)



Aim of this work

- Heat and Power Production from Leather Waste
- Characterization of Leather Waste for Fluidized Bed Combustion in Lab-Scale Unit

Leather waste analysis

PROXIMATE ANALYSIS (% wt d. b.)	
Moisture	13.3 %
Volatile matter	76.55
Ash	5.25
Carbon fixed	18.20

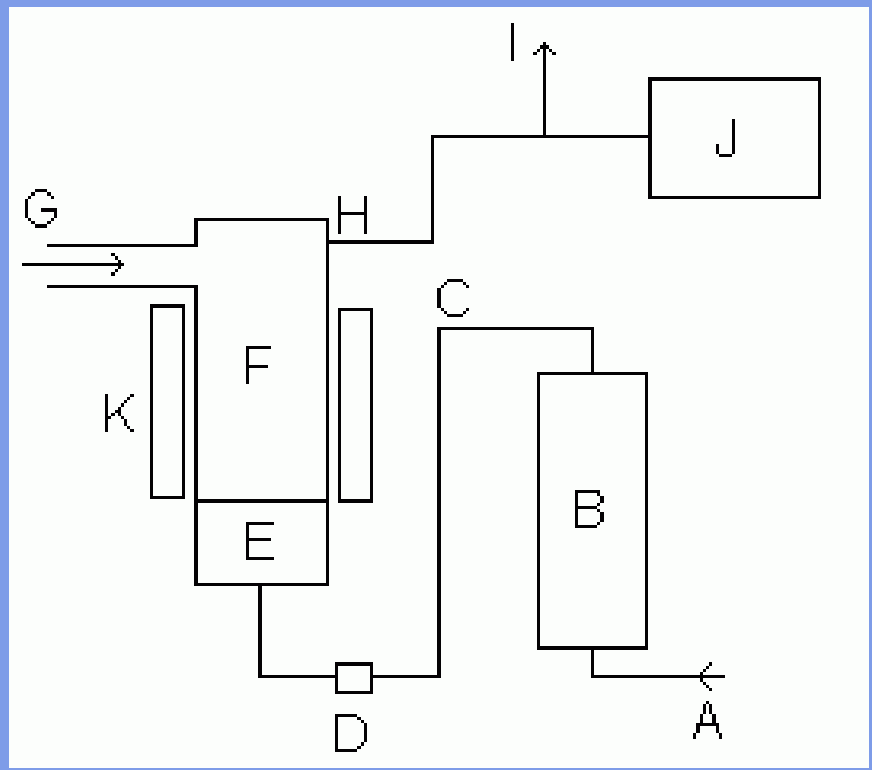
ULTIMATE ANALYSIS (% wt d. b.)	
Carbon	54.9
Hydrogen	5.1
Sulfur	1.4
Oxygen	19.2
Nitrogen	14.1
Chlorine	0.8
Chromium	2.3
Other	2.2

OTHER DATA	
HHV (MJ/Kg)	19.6
LHV (MJ/Kg)	18.3
Bulk density (Kg/Nm^3)	200

* These data were obtained in CIEMAT, Department of Fossil Fuels

Experimental setup of Formation Rate Unit

A	Feed gas
B	Heated column with packing
C-D	Heated line
E	Fluidized bubbling bed
F	Fluidized bed reactor
G	Fuel addition
H	Flue gases
I	Exhaust
J	Data acquisition in FTIR
K	Heating shells



Lab- scale stationary fluidized bed reactor - formation rate unit

- Inner diameter of the combustion tube = 35 mm
- Height of the reactor = 240 mm.
- Thermocouples applied at two positions
- Two surrounding heating shells

- Bed material: quartz sand with a diameter of 315 - 400 mm
- Fluidized bed height: about 3 cm (50 g. of sand)

Set of experiments

- ***Fuel heterogeneity effect***

- ***Temperature and oxygen concentration effect***

Bed temp	%O2	Nº exps
800 ºC	6 %	4
800 ºC	10 %	4
800 ºC	21 %	3
850 ºC	**6 %**	**8**
850 ºC	10 %	3
850 ºC	21 %	3
900 ºC	6 %	4
900 ºC	10 %	3
900 ºC	21 %	3

Fuel quantity: 0.50 g for each experiment

H2O content feedgas: 5 %

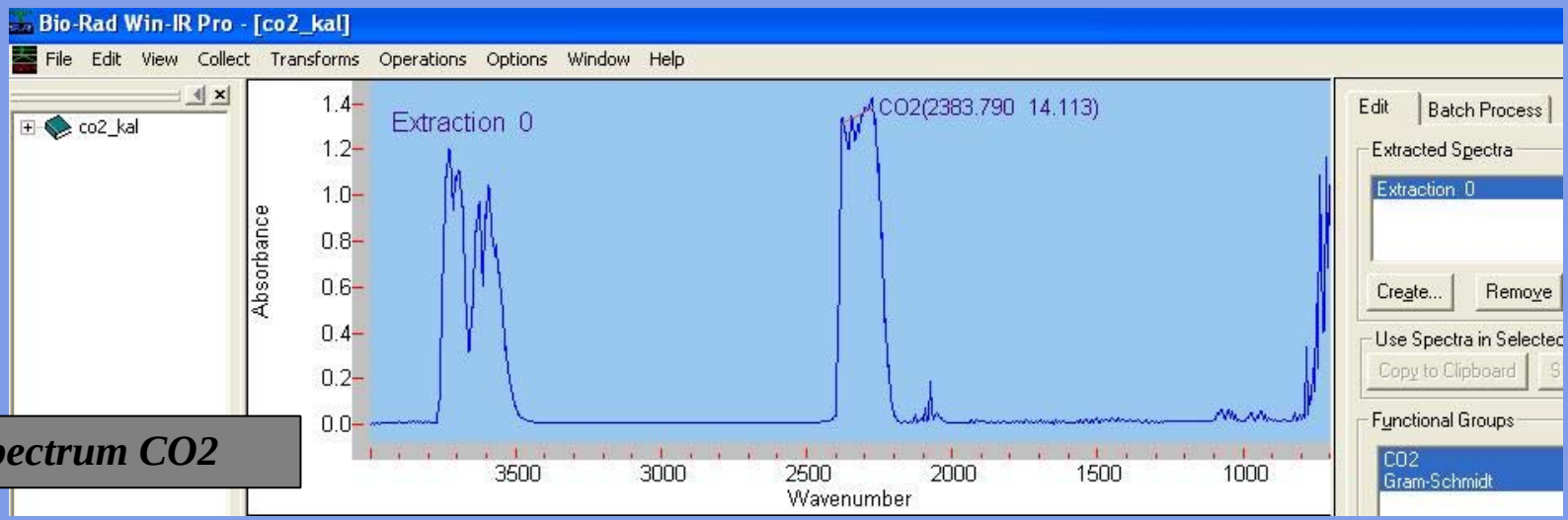
Superficial velocity of inlet gases: 0.5 m/s

Residence time in bed: 100 ms.

Peak sets of FTIR

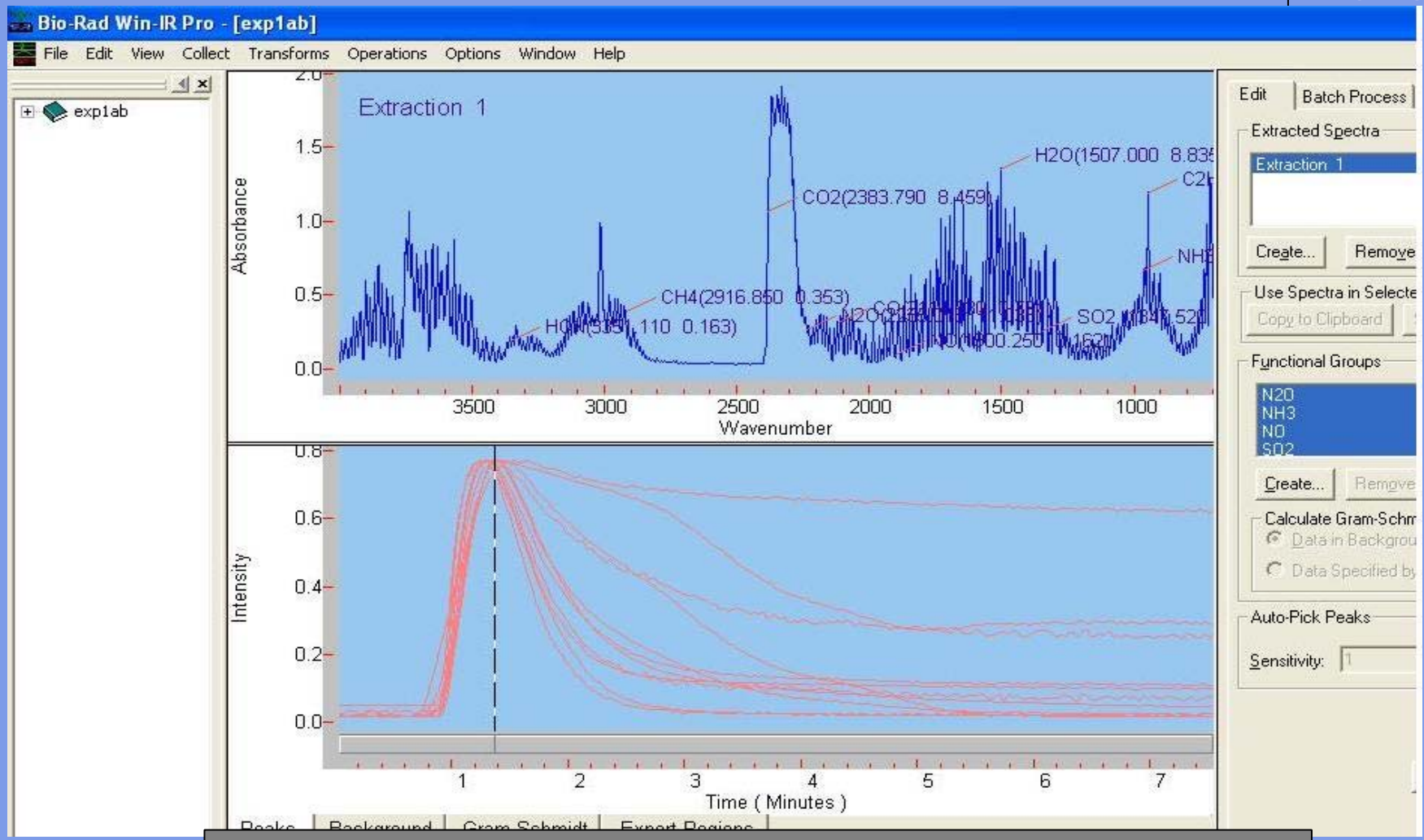
Species	CO2	CO	CH4	C2H4	HCN	NH3	NO	N2O	H2O	SO2
Method	Area	Area	Height	Area	Height	Area	Area	Area	Area	Area
Region										
Left Edge [cm-1]	2396.21	2116.42	2916.42	950.04	3351.11	968.96	1901.24	2262.64	1513.61	1348.03
Center [cm-1]	2383.79	2114.93	2916.42	949.45	3351.11	966.45	1900.25	2235.01	1507.03	1347.52
Right Edge [cm-1]	2380.61	2112.81	2916.42	947.93	3351.11	959.84	1898.39	2223.41	1502.95	1346.74
Calibration range	0-35 %	0-20 %	0-1%	0-2000 ppm	0-2000 ppm	0-5000 ppm	0-1000 ppm	0-500 ppm	0 - 5 %	0-900 ppm

Baseline: Left Edge [cm-1] 2503.02 ; Right Edge [cm-1] 2411.27



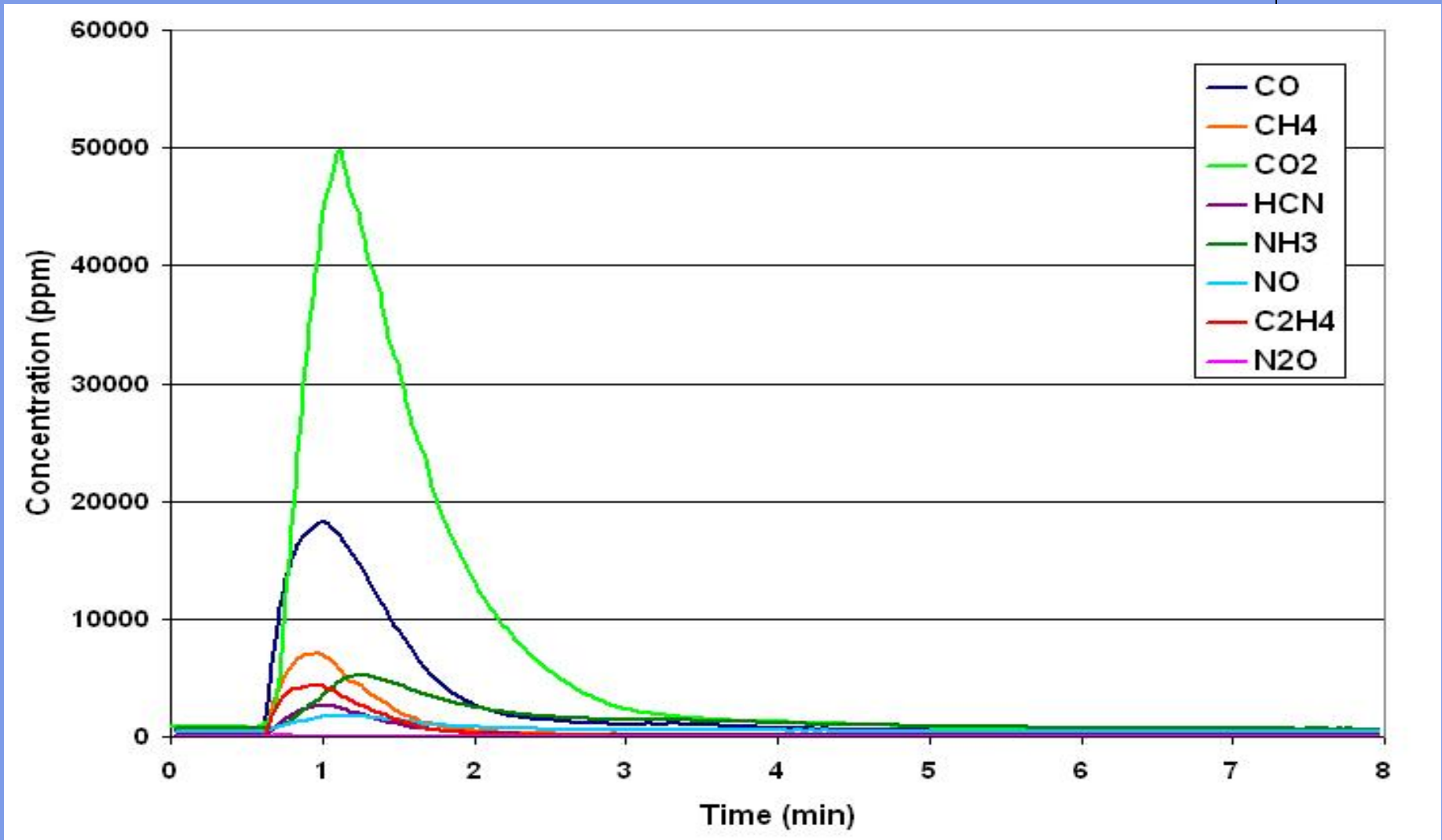
Calibration spectrum CO2

Example of an FTIR spectrum



Spectrum obtained form leather combustion at 800ºC and 6 % O2

Quantitative analysis of standard conditions (850ºC,6%O_2)



Some mechanism reactions

Effect of water

$HCN + H_2O \rightarrow NH_3 + CO$

Sintesis of NO

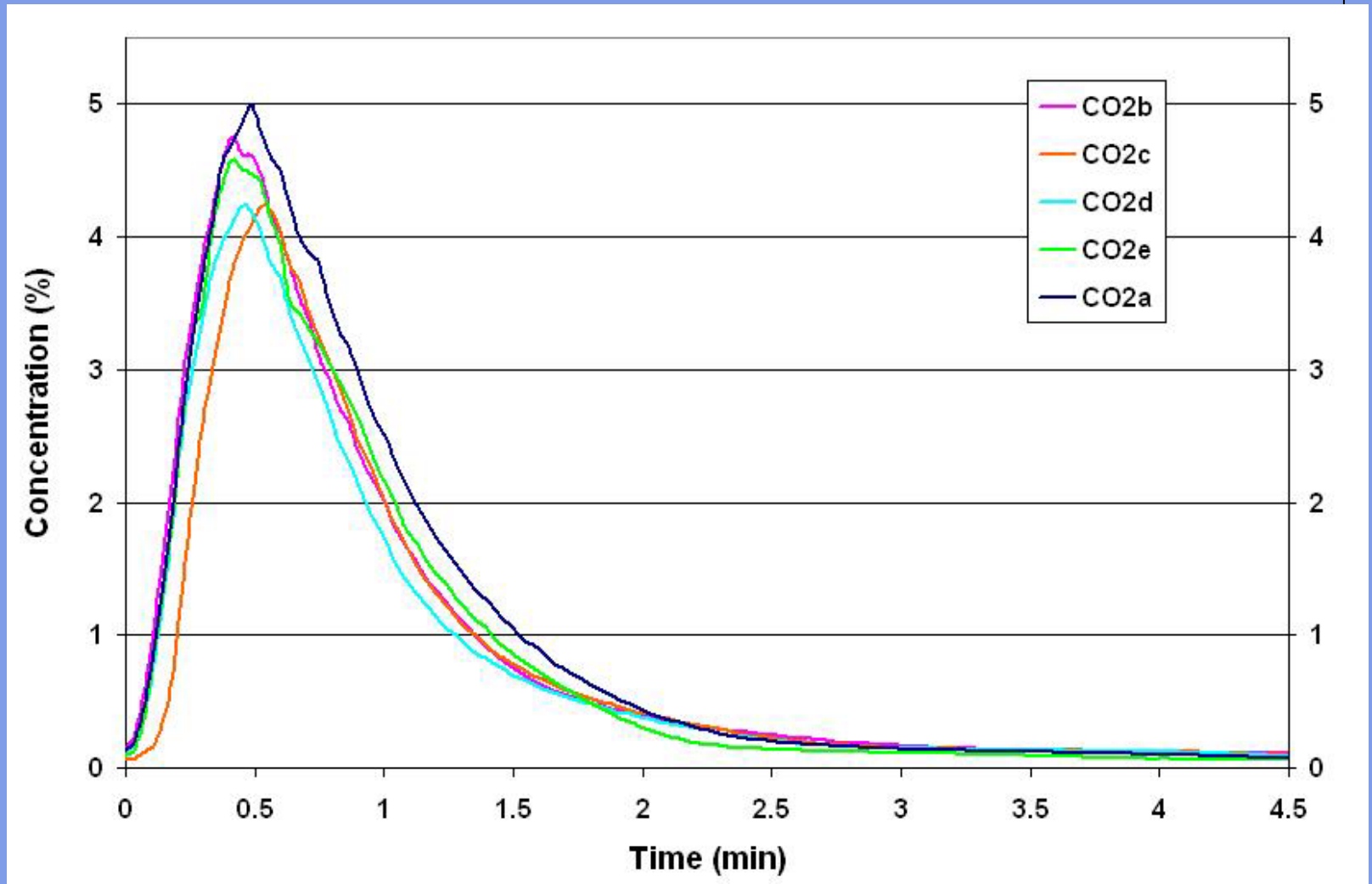
$HCN + O \rightarrow NCO$

$NCO + O \rightarrow NO + CO$

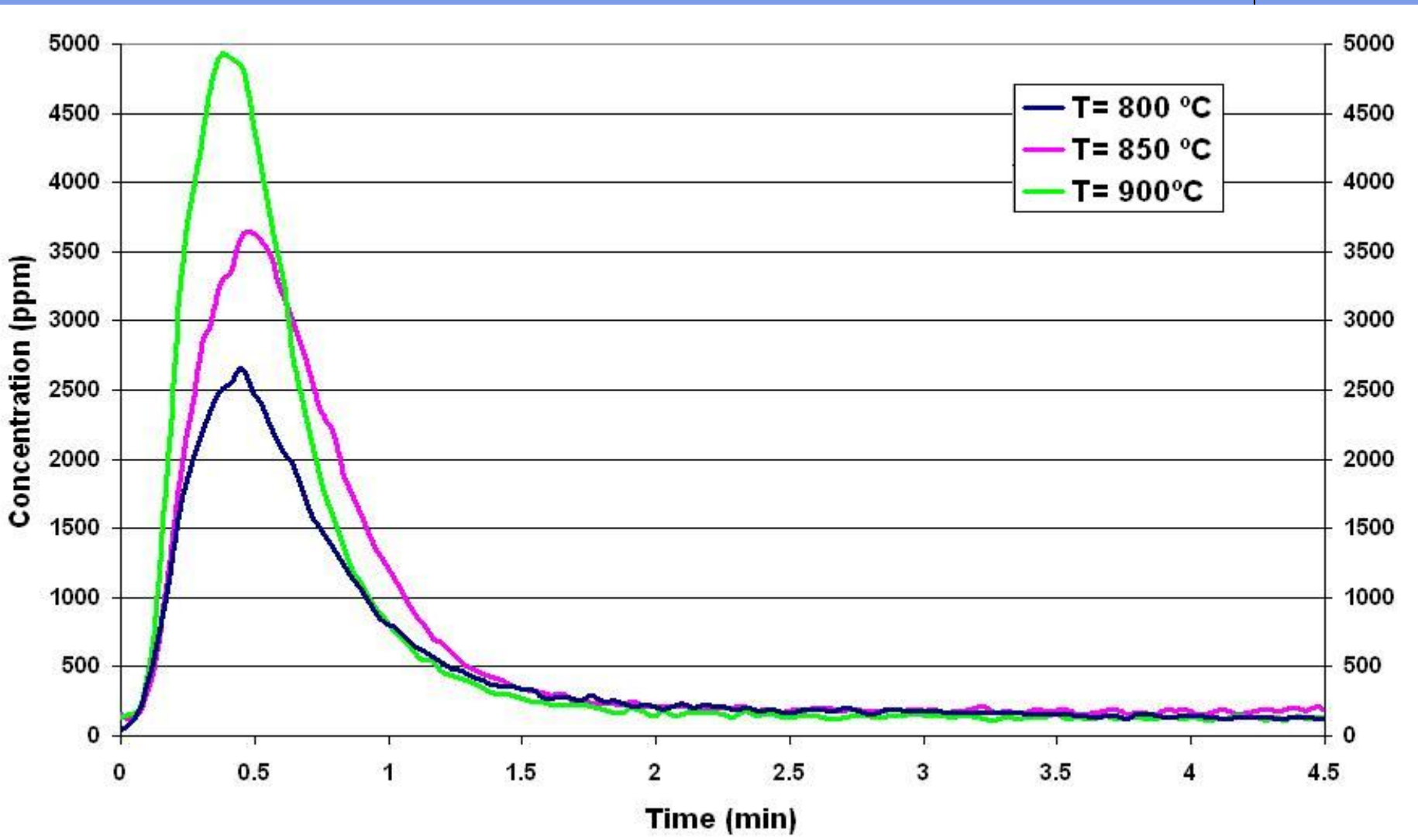
Sintesis of N2O

$NO + NCO \rightarrow N_2O + CO$

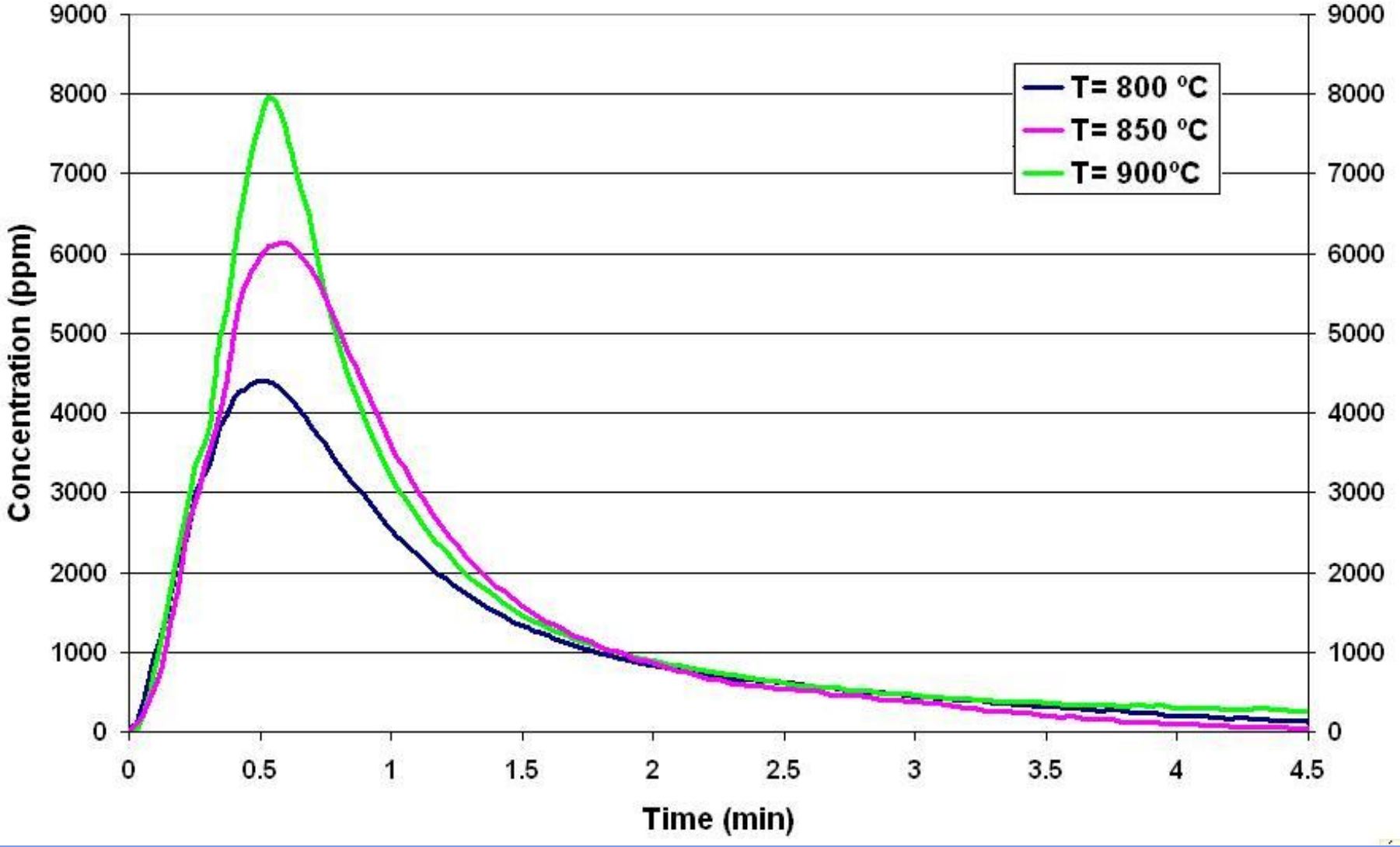
Effect of heterogeneity of fuel



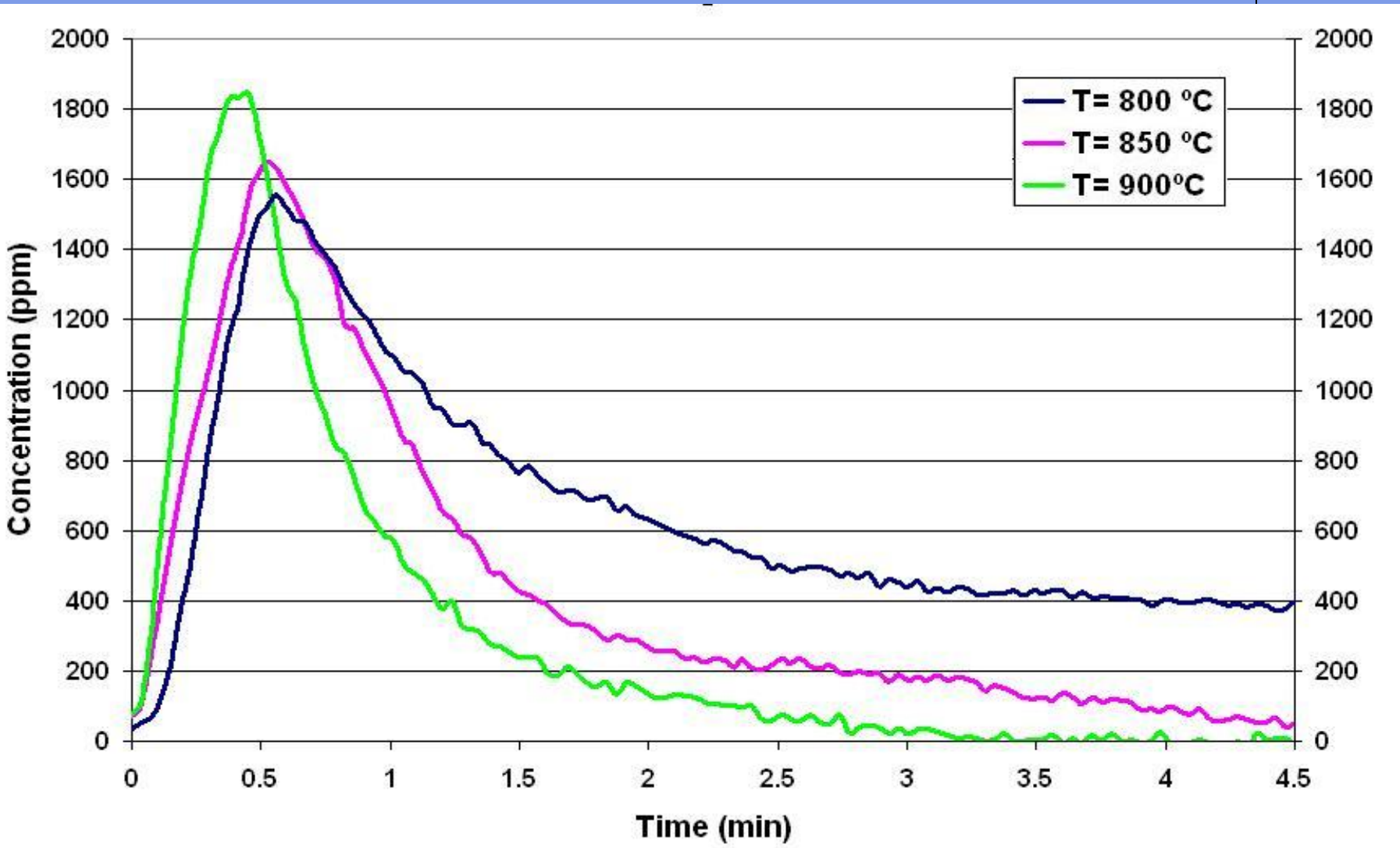
Effect of temperature in HCN



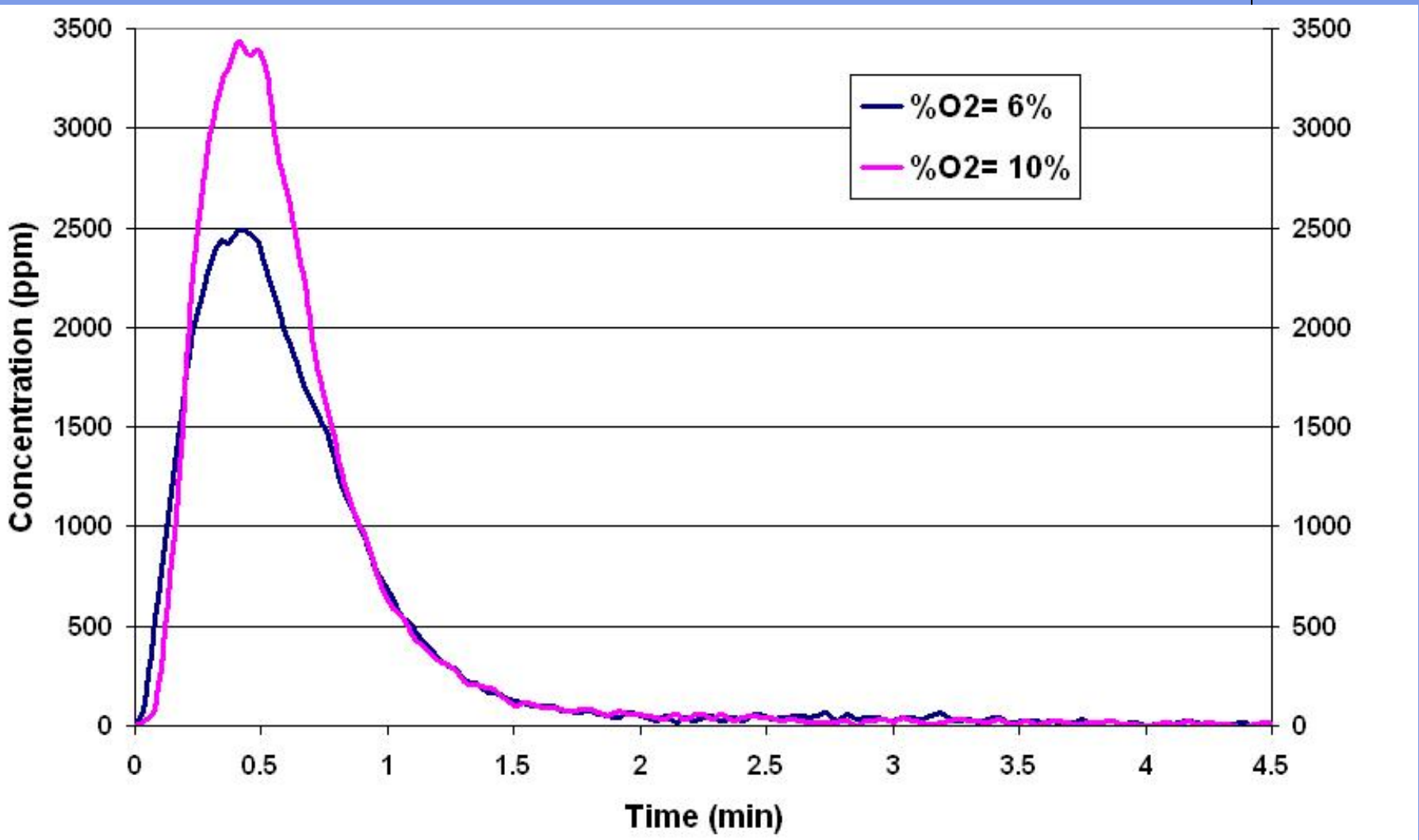
Effect of temperature in NH_3



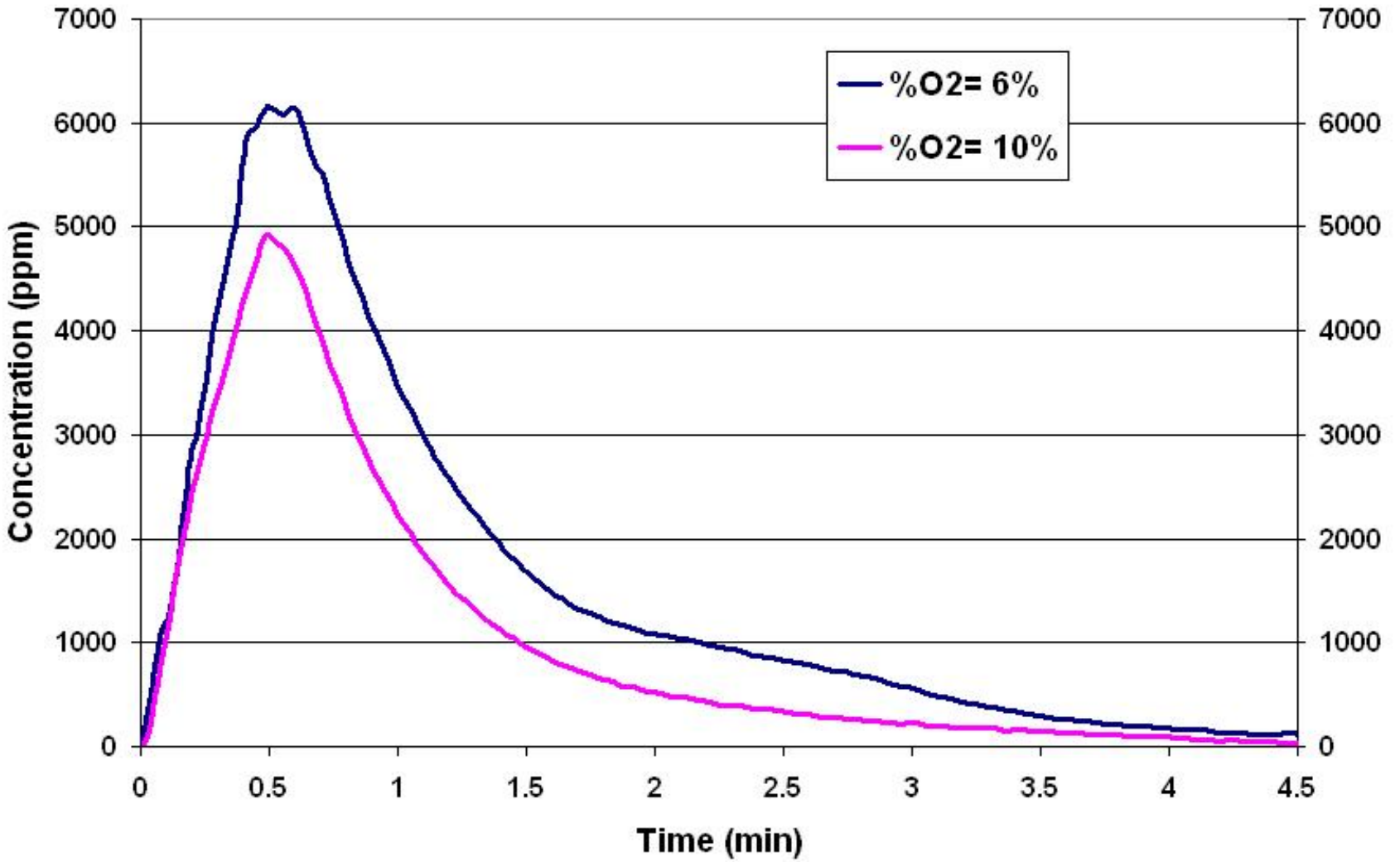
Effect of temperature in NO



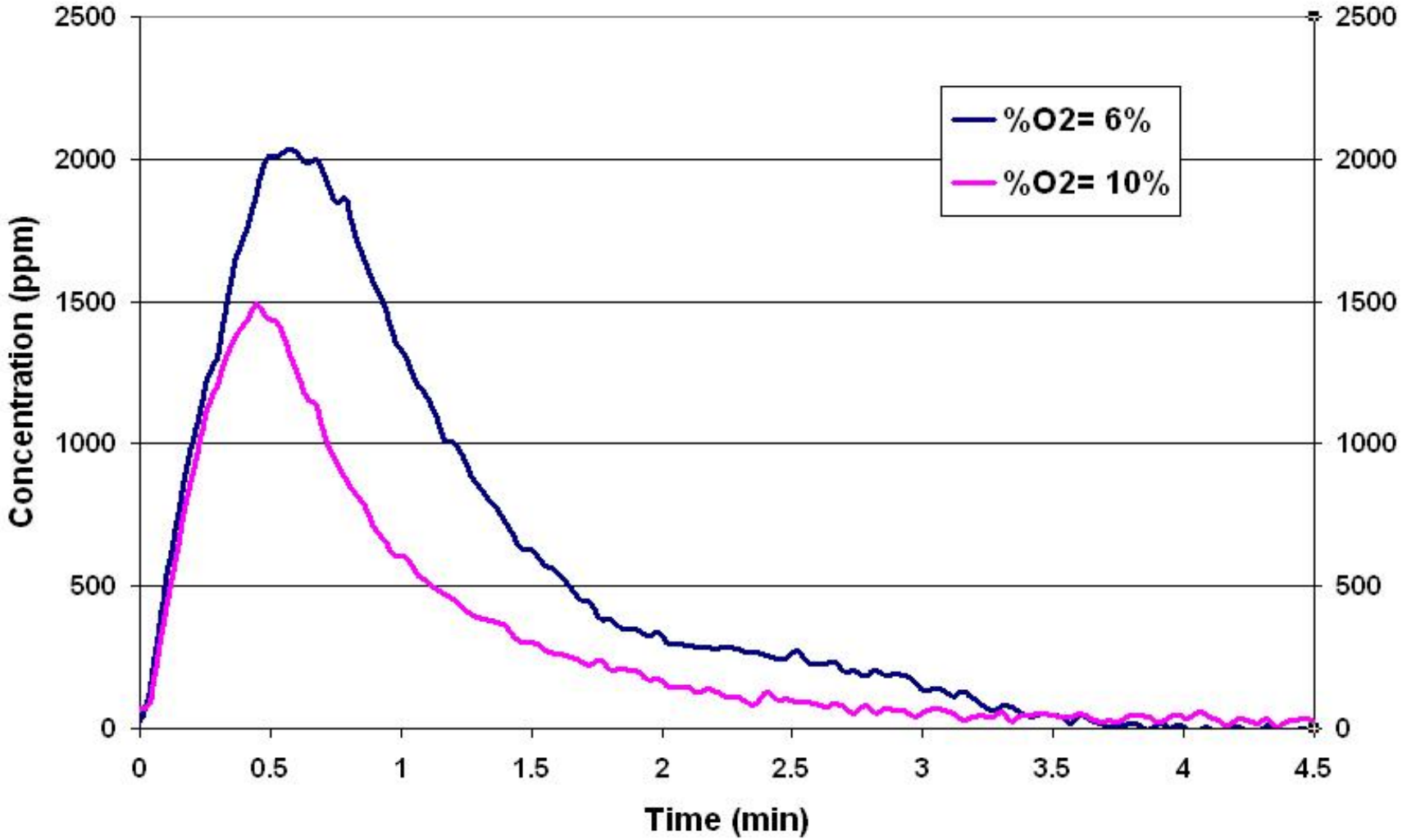
Effect of % O_2 in HCN



Effect of % O_2 in NH_3



Effect of % O_2 in NO



Some mechanism reactions

Scavenging effect

$SO_2 + H \rightarrow HSO_2$

$HSO_2 + OH \rightarrow H_2O + SO_2$

$HSO_2 + H \rightarrow H_2 + SO_2$

Possible reduction of SO2

$2NH_3 + SO_2 + 2\,OH \rightarrow (NH_4)_2SO_4$

SNCR

NH3 + NO → H2O + N2

Conclusions

- *NH3 and HCN turn to be relevant species in the samples due to the existence of water in the feed gas*

- *Because of the heterogeneity of the fuel results show variations at similar conditions.*

  Therefore only peaks with equal areas were used for comparison.

- *Increase of the maximum concentration during char-combustion of NH3, HCN and NO with increasing temperature.*

- *Higher HCN- concentration with higher Oxygen concentration in feed gas. NH3 and NO increase with lower O2.*

Acknowledgments

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