Evaluation of the performance of catalytic oxidation of VOCs by a mixed oxide at pilot scale

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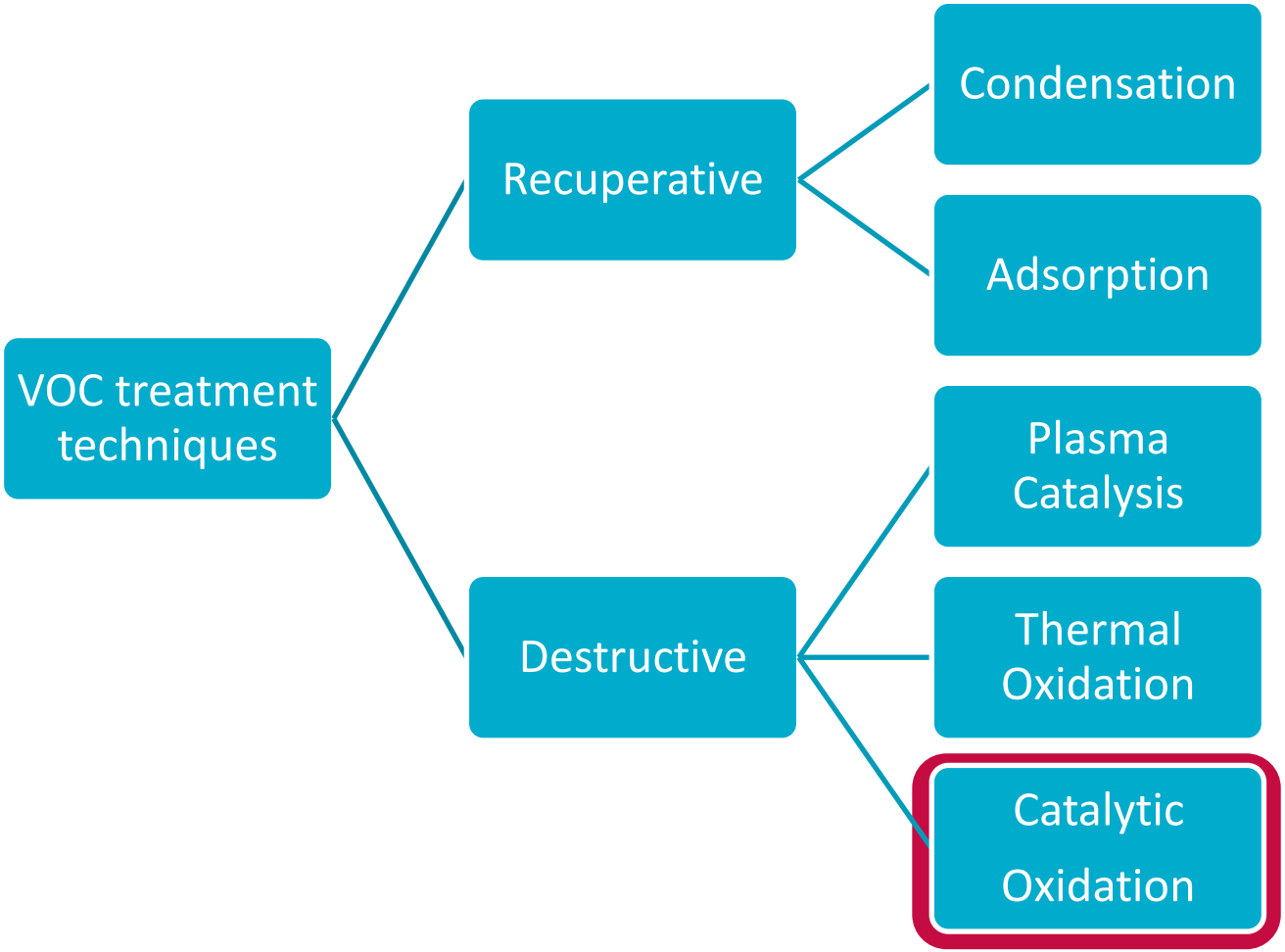
VOC treatment techniques



Catalysts and VOC

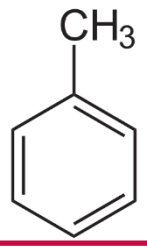
Mixed Oxide:

$Co_6Al_{1,2}Ce_{0,8}O_9$

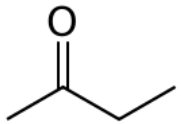
Commercial Benchmark:

$Pd\_\gamma Al_2O_3$

Toluene

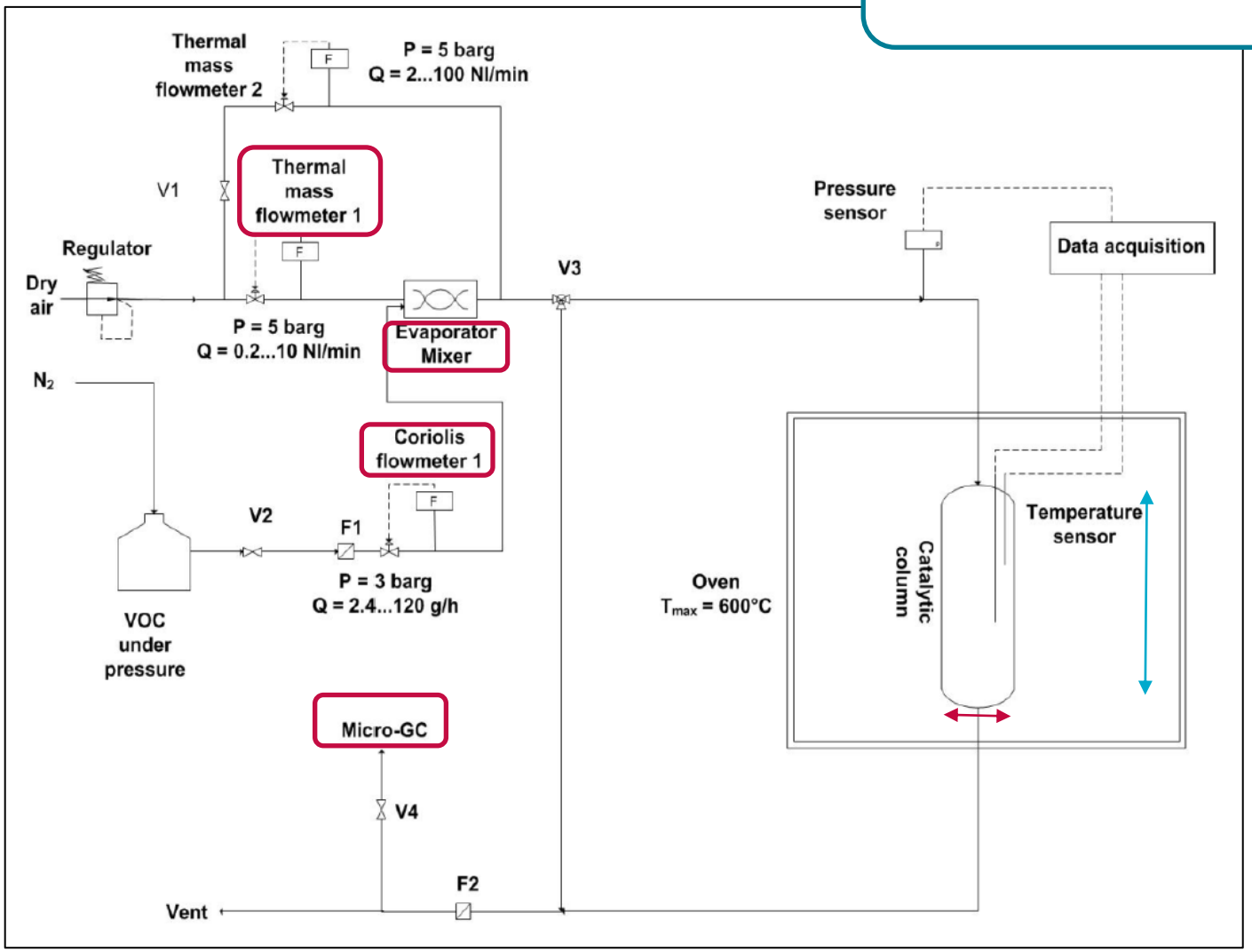


Methyl-ethyl-ketone(MEK)



Catalytic Oxidation Pilot Unit

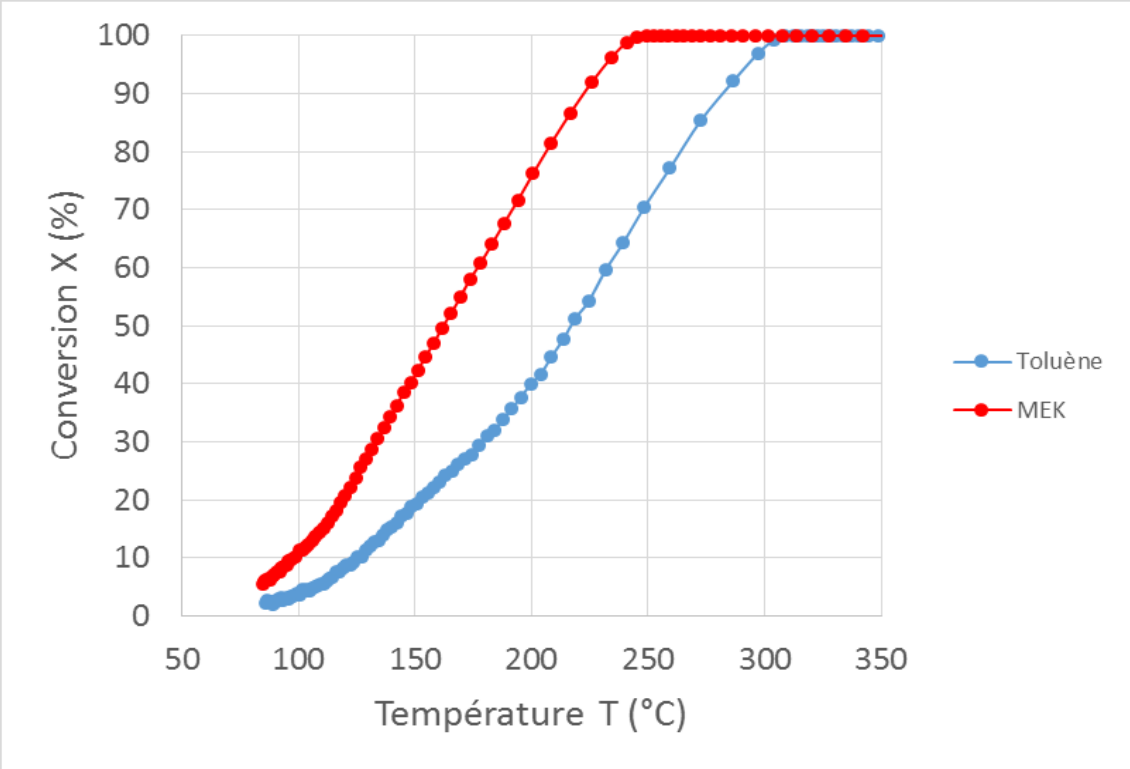
Flowrate: 22-66 NL/min
VOC conc: 500-1500ppmv



Reactor
D_i =5cm
L =50cm

Light-off Curves for $Co_6Al_{1,2}Ce_{0,8}O_9$

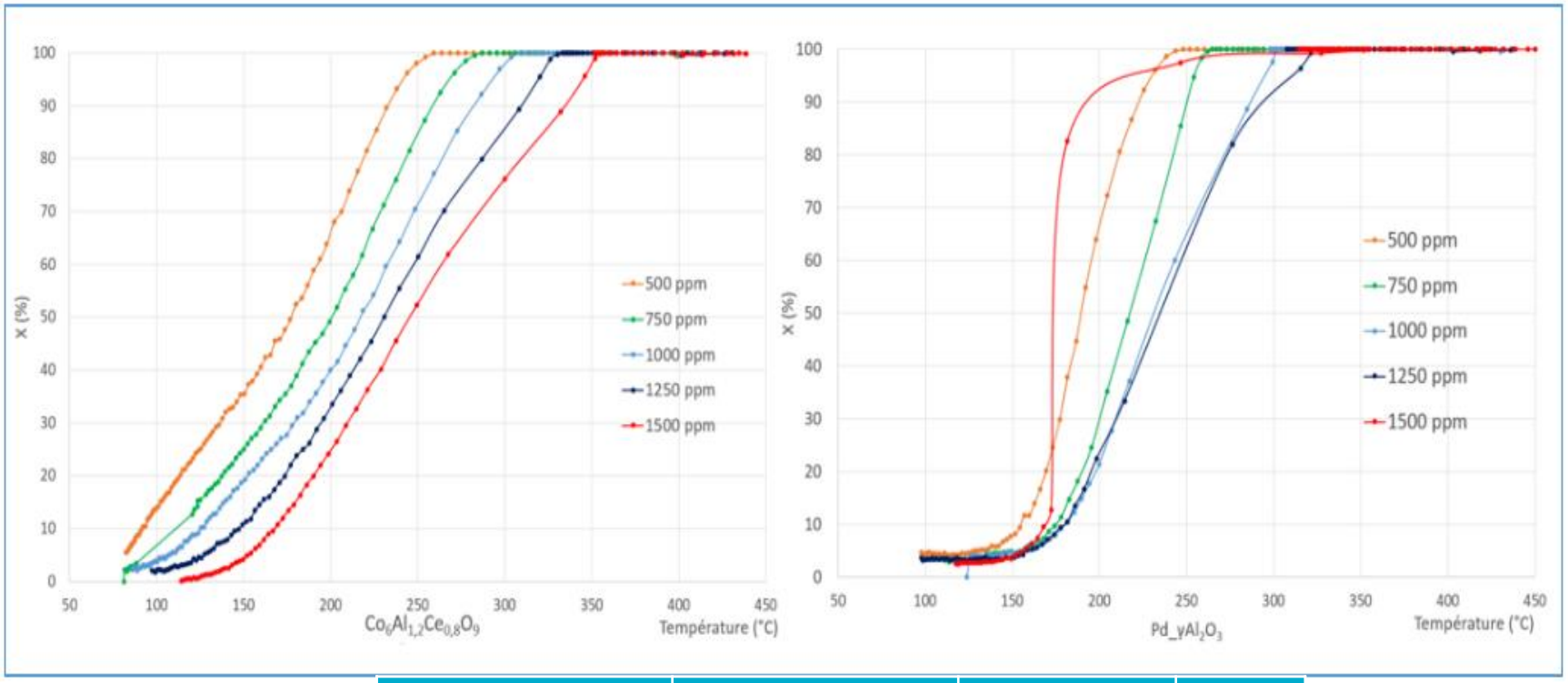
44NL/min



	MEK 1000ppm	Toluene 1000ppm	ΔT
T_{10}(°C)	98	125	27
T_{50}(°C)	161	218	57
T_{90}(°C)	224	284	60

Influence of initial concentration

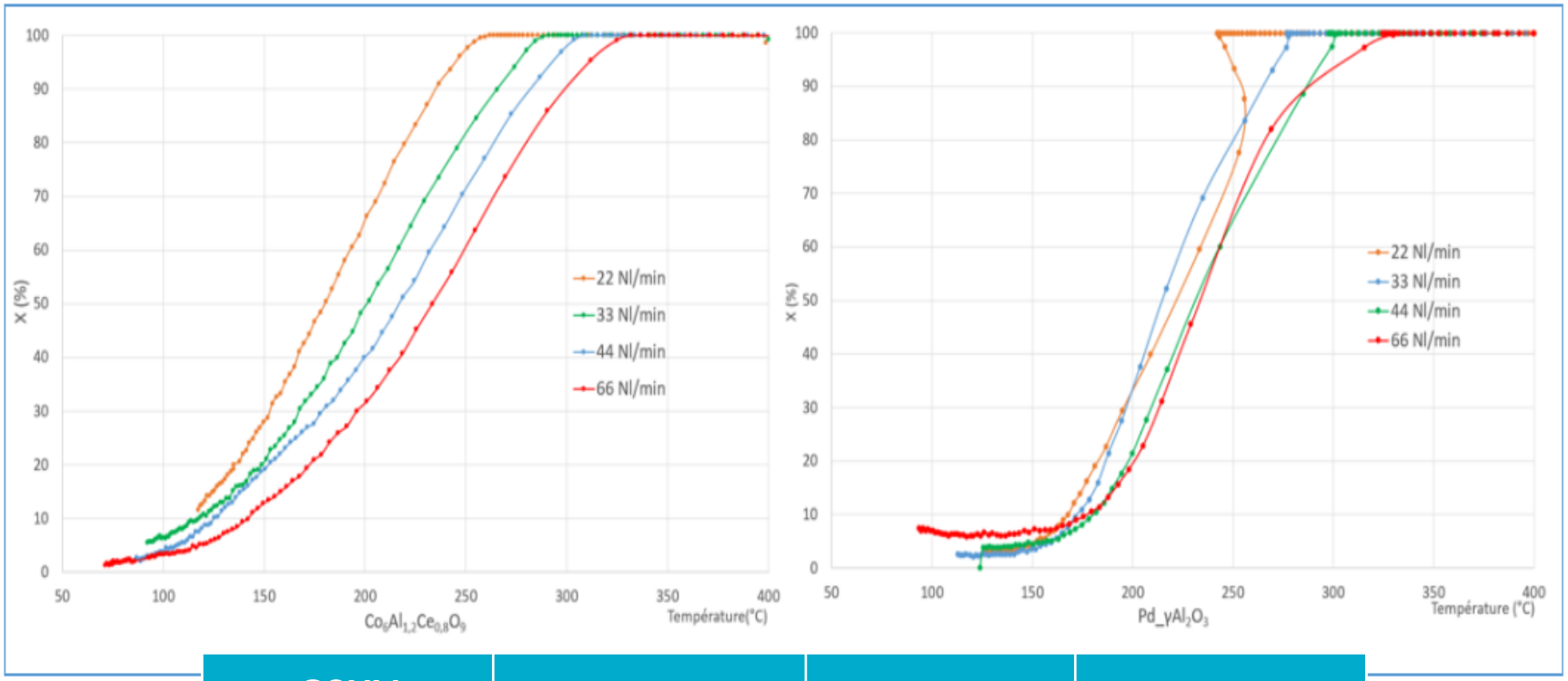
Toluene 44NL/min



Initial concentration (ppm)	T_{50}(°C) $Co_6Al_{1,2}Ce_{0,8}O_9$	T_{50}(°C) $Pd\_\gamma Al_2O_3$	ΔT
500	177	190	13
750	200	217	17
1000	216	231	15
1250	230	235	5
1500	245	/	/

GSHV influence

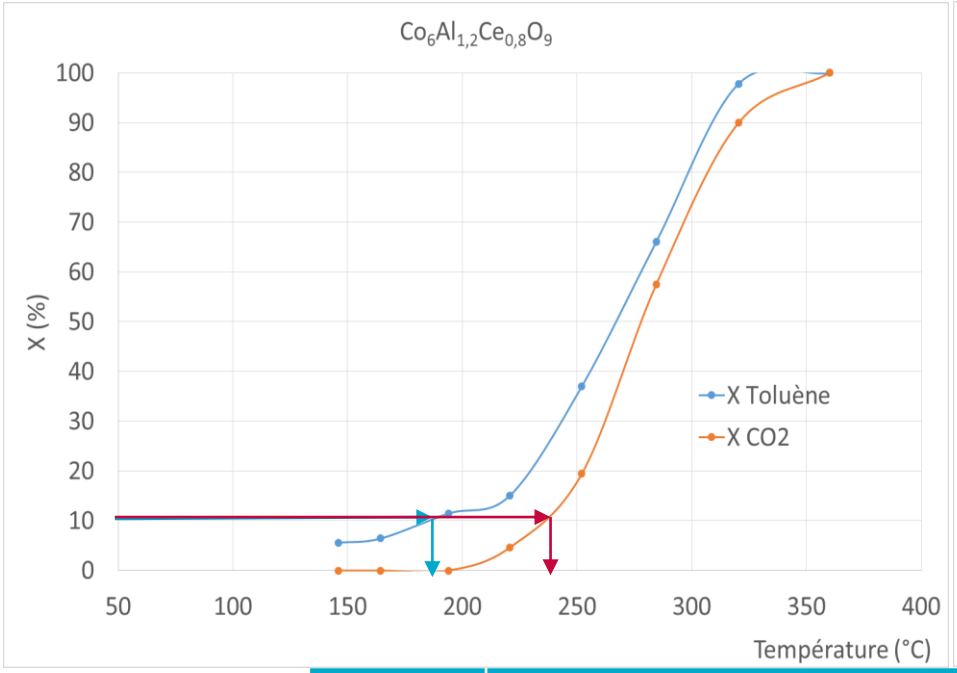
Toluene 1000ppm

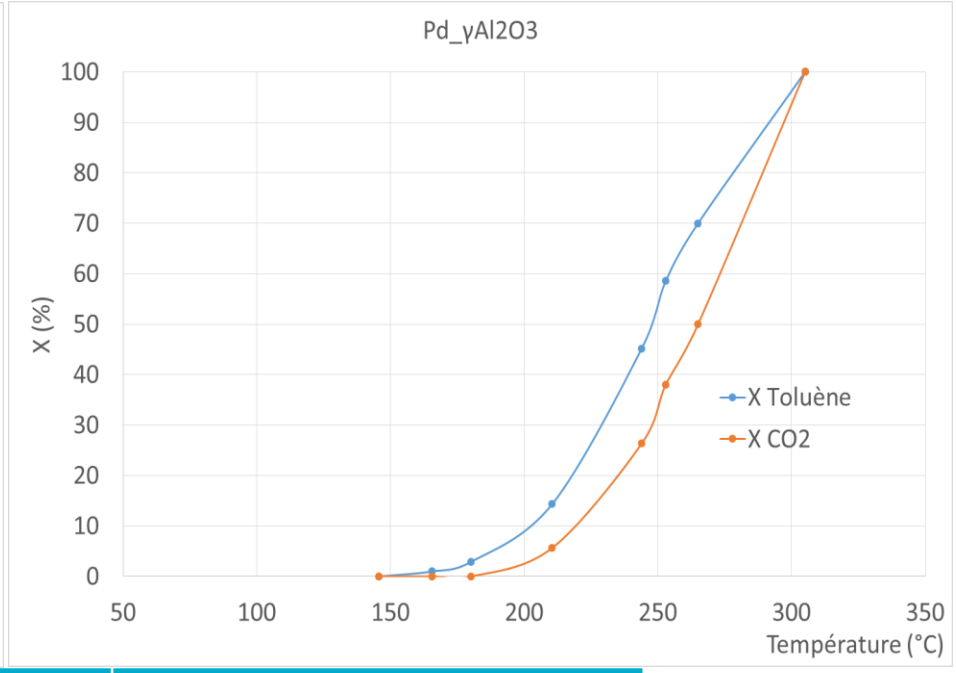


GSHV 3000(h^{-1})	$Co_6Al_{1,2}Ce_{0,8}O_9$	$Pd\_\gamma Al_2O_3$	ΔT
T_{10}(°C)	118	168	50
T_{50}(°C)	201	222	21
T_{90}(°C)	266	252	-14

Catalyst Selectivity

Toluene oxidation (1000 ppm, 44NL/min)

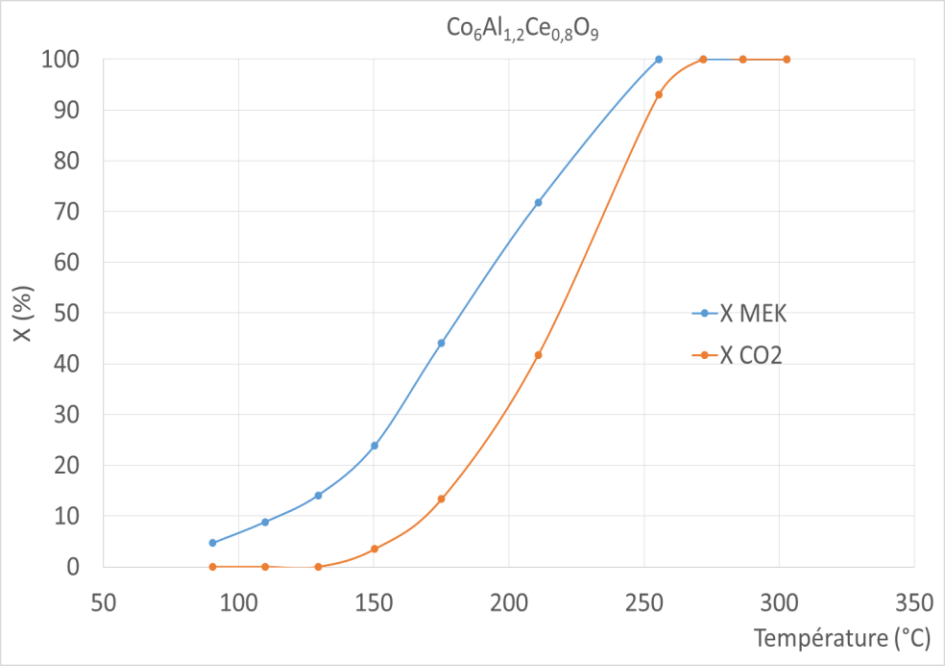


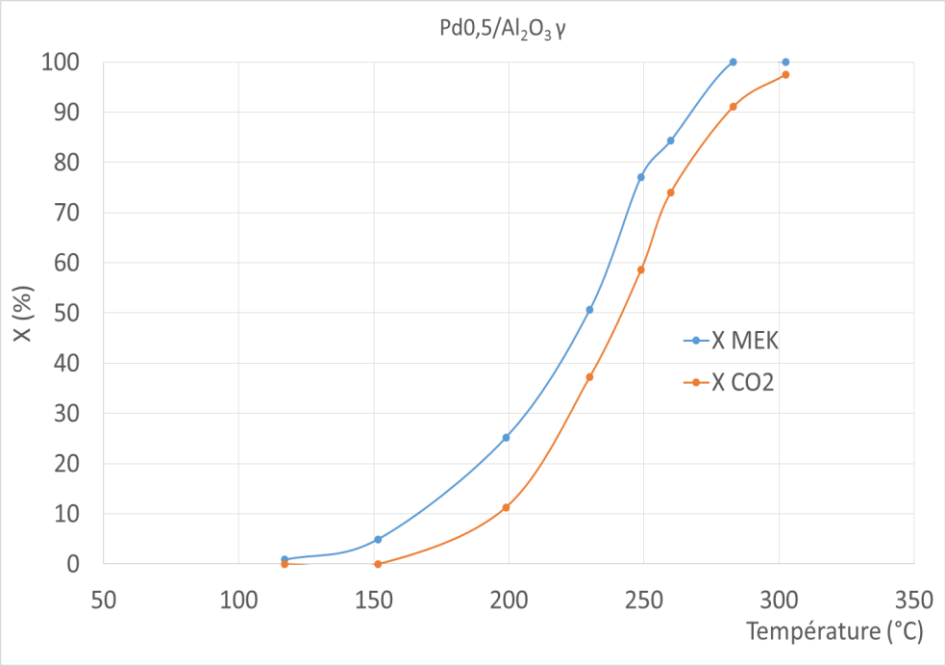


	$Co_6Al_{1,2}Ce_{0,8}O_9$			$Pd\_\gamma Al_2O_3$		
	Toluene	CO_2	ΔT	Toluene	CO_2	ΔT
T_{10}(°C)	196	215	19	206	235	29
T_{50}(°C)	244	264	20	266	277	11
T_{90}(°C)	292	297	5	308	320	12

Catalyst Selectivity

MEK oxidation (1000 ppm, 44NL/min)

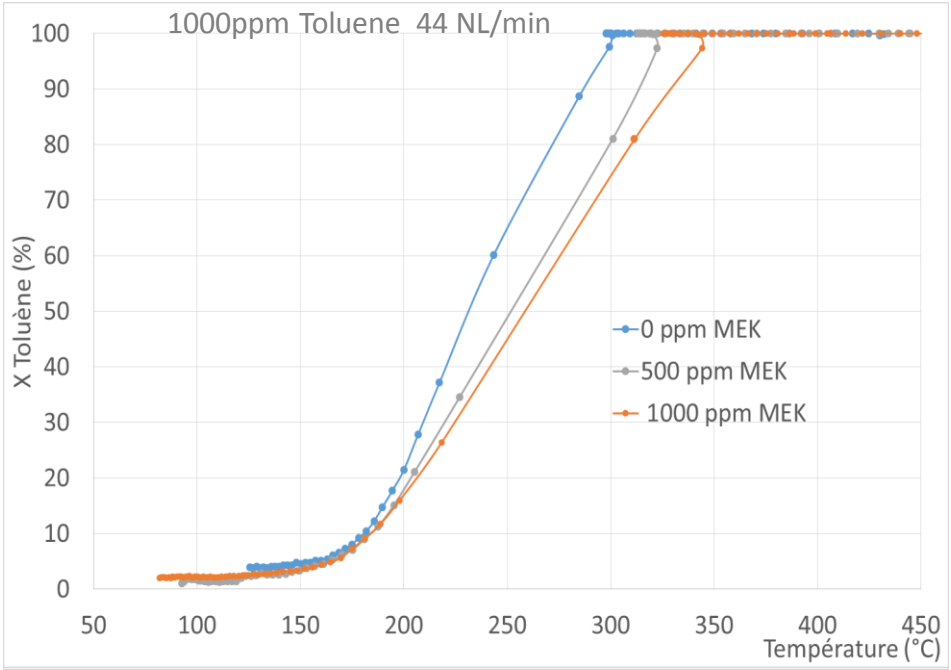


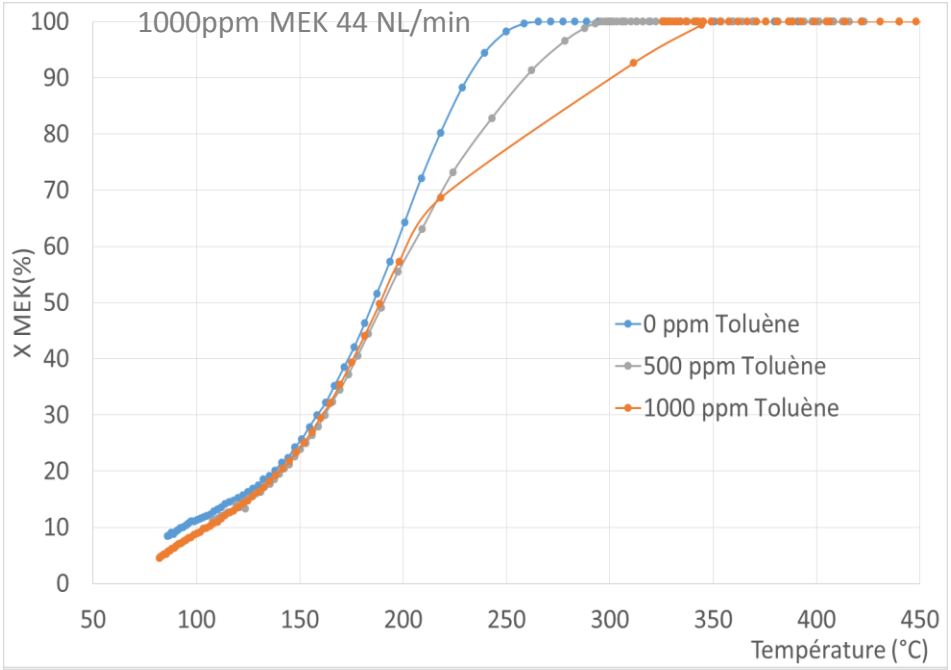


	$Co_6Al_{1,2}Ce_{0,8}O_9$			$Pd\_\gamma Al_2O_3$		
	MEK	CO_2	ΔT	MEK	CO_2	ΔT
T_{10}(°C)	114	170	55	166	196	30
T_{50}(°C)	184	217	33	226	243	17
T_{90}(°C)	238	253	15	265	281	16

Mixture influence

$Pd\_\gamma Al_2O_3$





Results and Future directions

Results for $Co_6Al_{1,2}Ce_{0,8}O_9$:

- ✓ Lower oxidation temperature
- ✓ Better selectivity for toluene
- ✓ Lower Cost

Future directions:

- ➢ Modeling and Scale up.

References

[1] X. Scutenaire, “Faculté Polytechnique Evaluation des performances d'oxydation catalytique de COV par un oxyde mixte de nouvelle génération,” 2015.

[2] E. Genty, “Synthèse par méthodes conventionnelles ou non d'oxydes mixtes par voie hydrotalcite : Application pour l ’ oxydation des COV et du CO .,” 2014.

[3] J. Brunet et al., “Identification of by-products issued from the catalytic oxidation of toluene by chemical and biological methods,” Comptes Rendus Chim., vol. 18, no. 10, pp. 1084–1093, 2015.

[4] J. Brunet et al., “Co-Al-Ce Mixed Oxide Materials Prepared by Hydrotalcite Way for VOCs Total Oxidation in Micro- and Semi-Pilot Scale,” Mater. Today Proc., vol. 3, no. 2, pp. 188–193, 2016.

[5] J. Brunet, “Traitement des BTEX industriels par oxydation catalytique,” 2015.