

Presentation

The RECCAT® system for incineration of
UHC in the exhaust from engines

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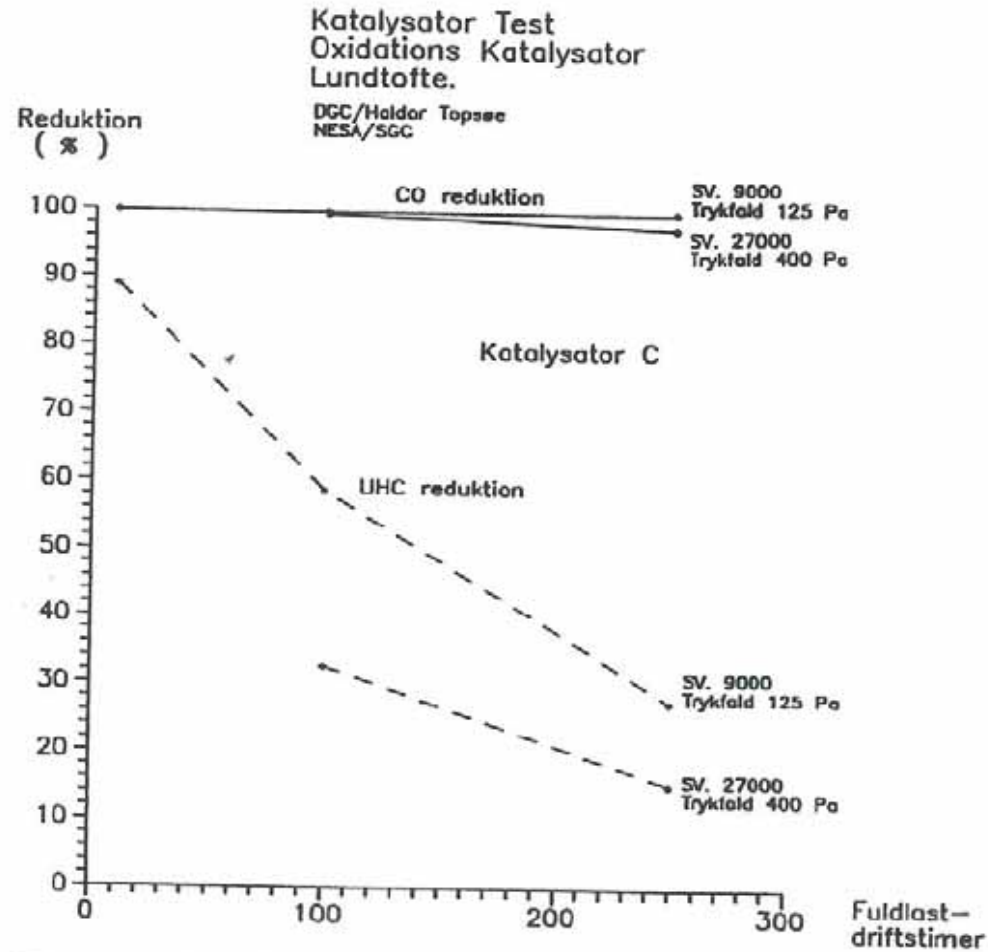
RECCAT - RECuperative CATalyst

RECCAT ApS is a Danish company that has developed a novel catalytic incineration process to be used for combined heat and power (CHP) plants.

Background for RECCAT

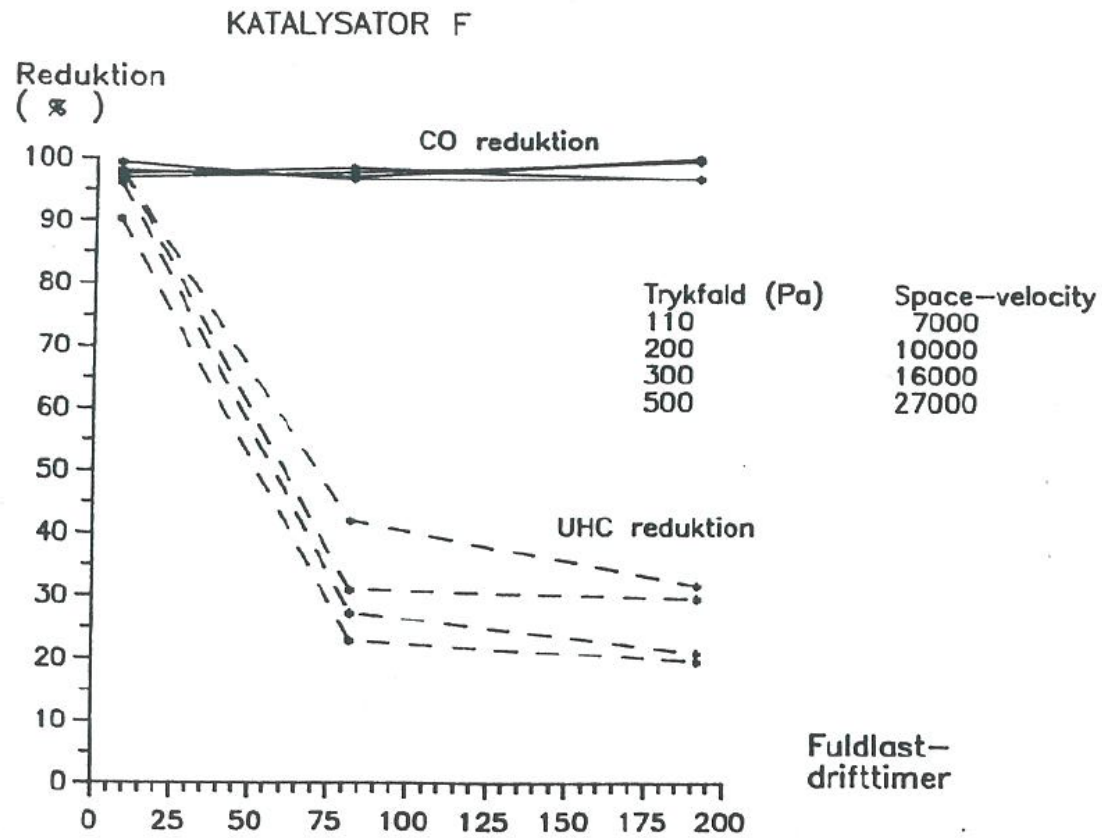
- 3-7% of fuel (UHC) in exhaust from gas engines
- Loss of energy
- Adds seriously to green house gases
- Danish legislation limits for UHC emissions

Earlier tests of catalysts



Figur 5.4 Katalysator C

Earlier tests of catalysts

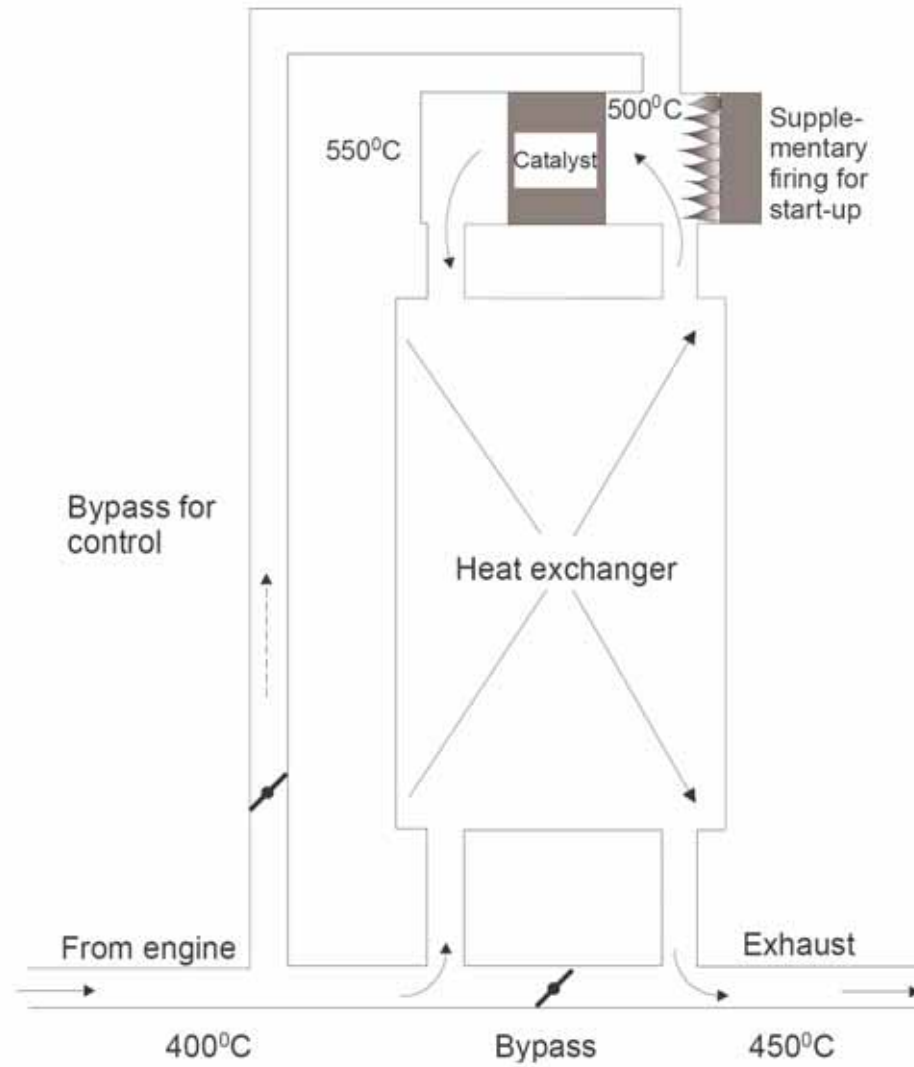


Figur 5.7 Katalysator F

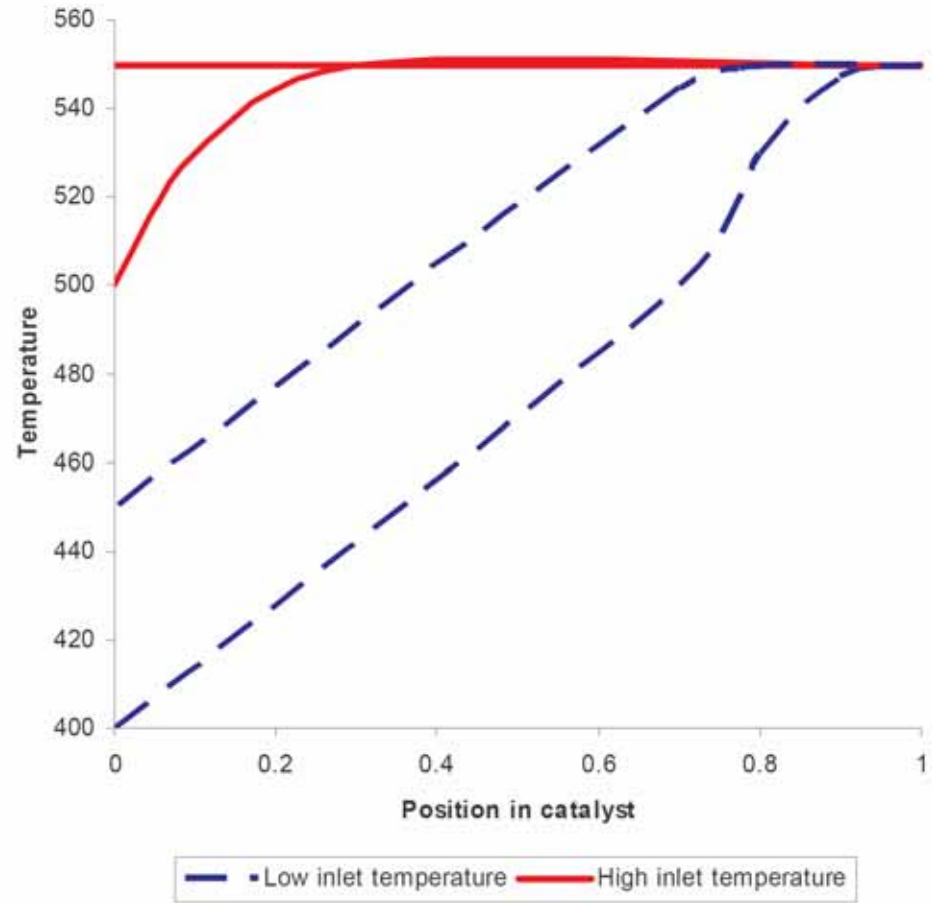
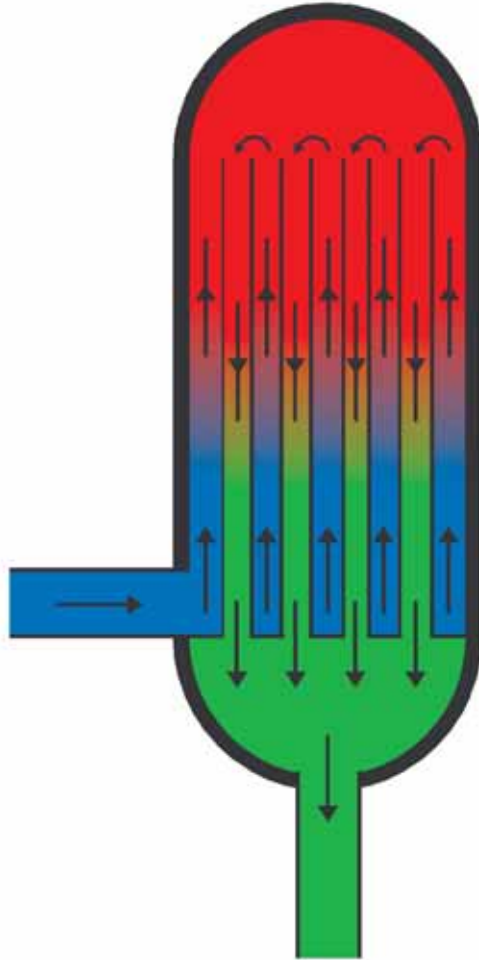
Goals for RECCAT

- Low cost catalyst for UHC, CO and aldehydes
- High durability
- Self-regulating reactor
- Robust to changes in operation conditions

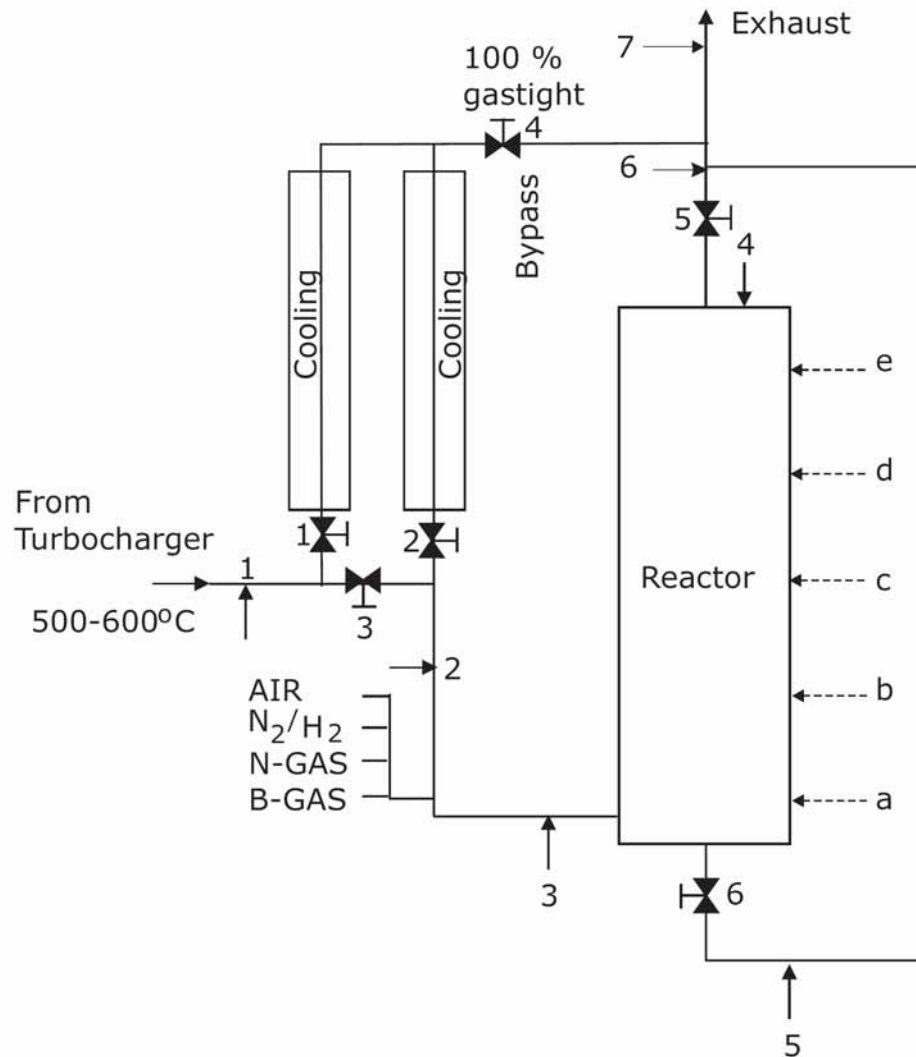
REKUP, the predecessor of RECCAT



The basic RECCAT System



RECCAT



List of signs:

- ← Probe for emission and temperature measurements
- ←····· Temperatur measurements

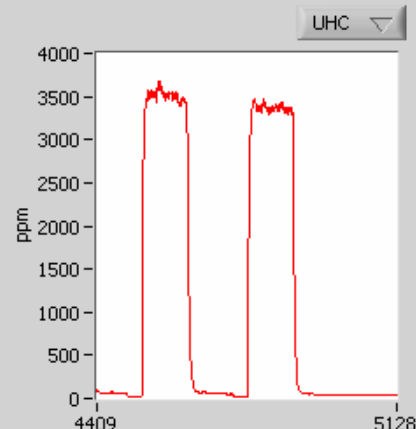
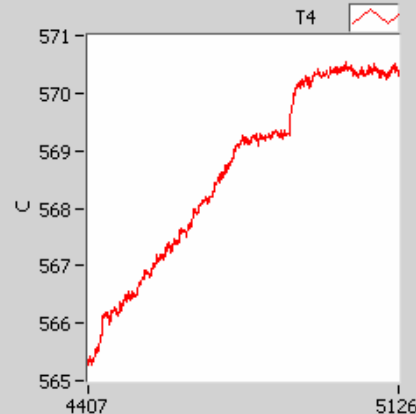
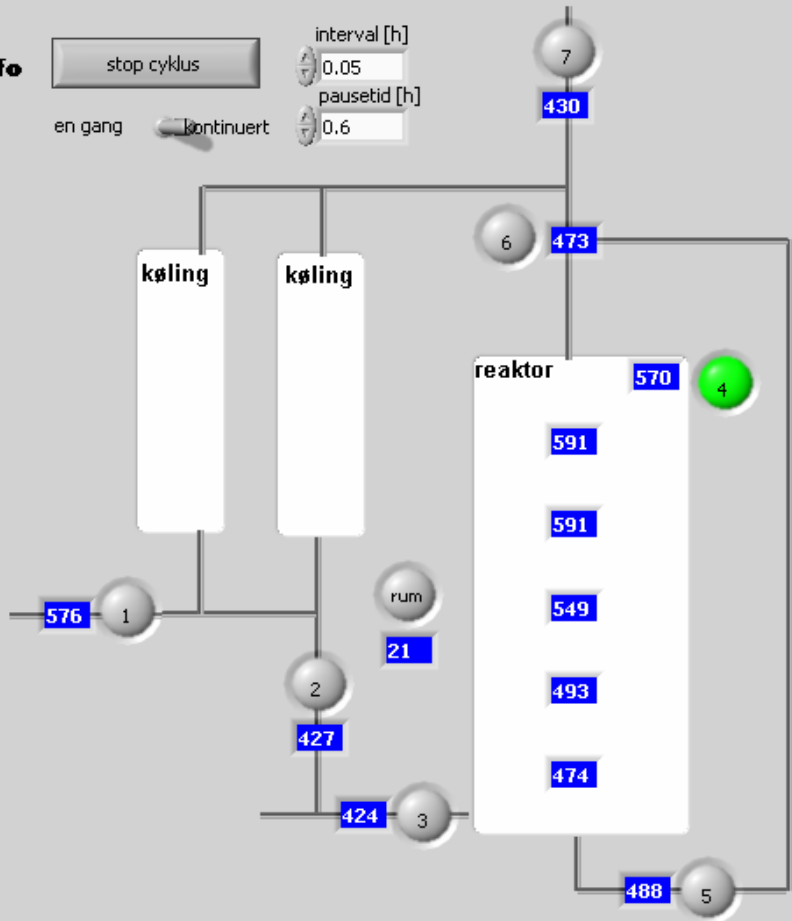


info

stop cyklus

en gang kontinuert

interval [h] 0.05
pausetid [h] 0.6



4 4 målepunkt

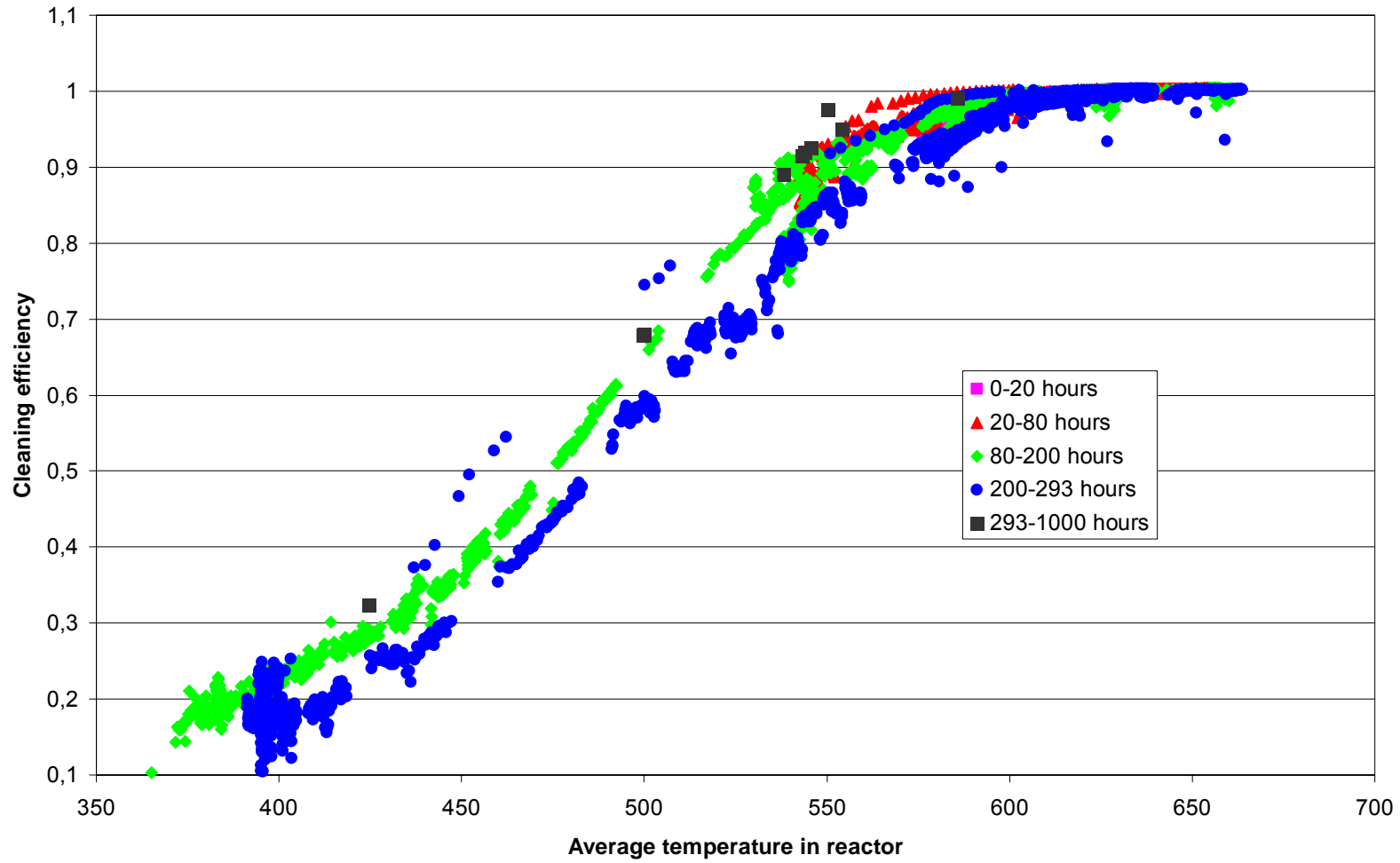
- 0.19 O2 (%)
- 7.01 CO2 (%)
- 4.0 CO (ppm)
- 0.6 NOx/NO (ppm)
- NOx NO
- 38.0 UHC (ppm)
- 10000 UHC range
- 1038.4 P ladeluft (mbar)
- 32.2 T ladeluft (C)
- 22.8 kølevand ind (C)
- 36.6 kølevand ud (C)
- 1.86 kølevand flow (m3/h)
- 29.86 kølevand effekt (kW)
- 1101.60 P gas (mbar)
- 26.51 T gas (C)
- 9.06 gasflow (m3/h)
- 99.74 indfyret effekt (kW)
- 1101.9 p understødnng (mbar)
- 22.80 Δp4-3 (mbar)
- 33.27 Δp5-4 (mbar)
- 29.00 el effekt (kW)
- 1014.6 p rum (mbar)
- 5 Δt måling (s)
- 60 data til fil (s)
- 7.13 tid [h]

C:\reccat\kort-start-09-06-2004.txt

LOG KOPI STOP

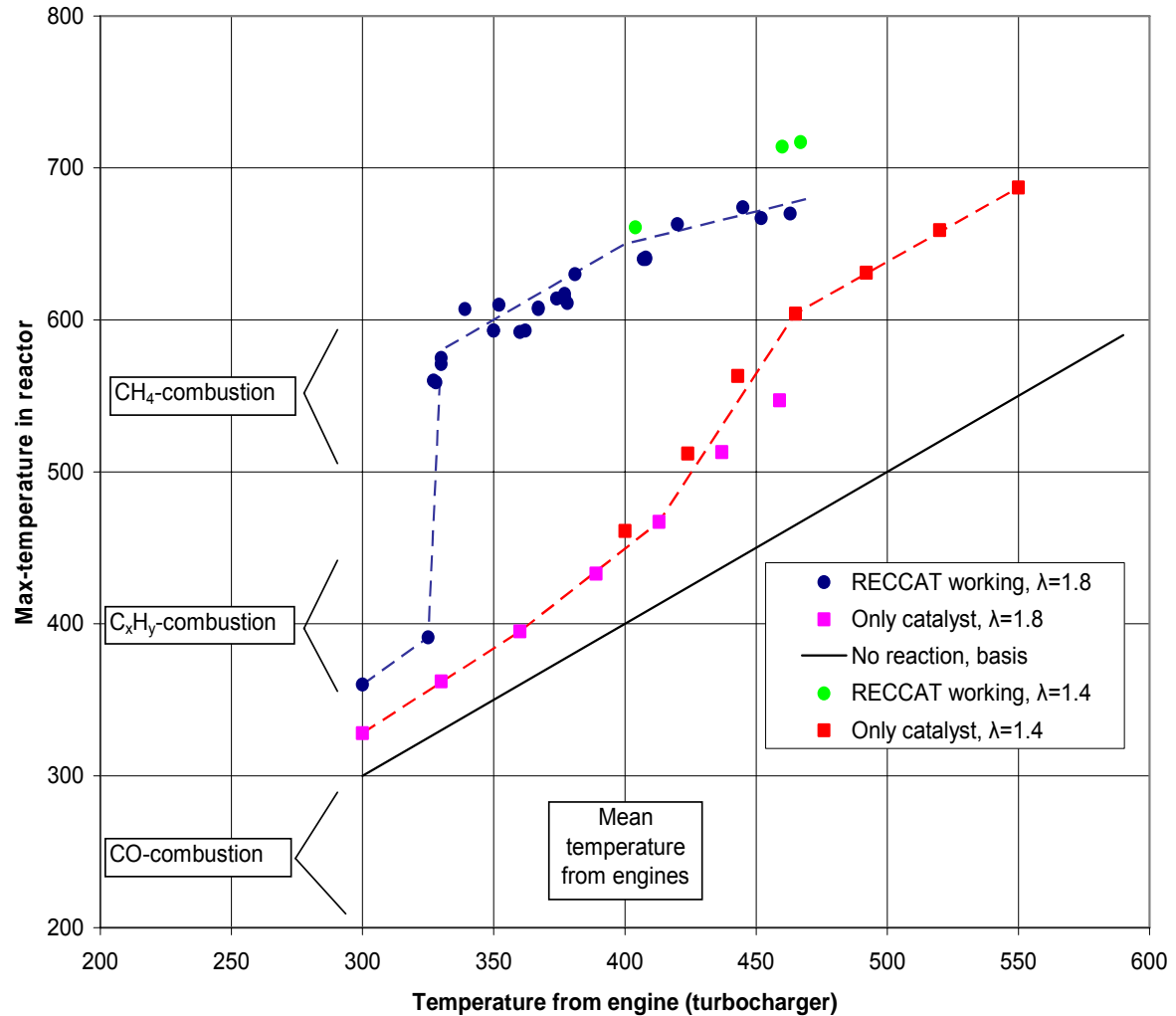


UHC-Cleaning



Self-regulating system

At ordinary engine temperatures (about 400°C), methane (CH₄) can only be removed with RECCAT in operation. The invention results in an almost constant maximum temperature irrespective of inlet temperature and gas composition.



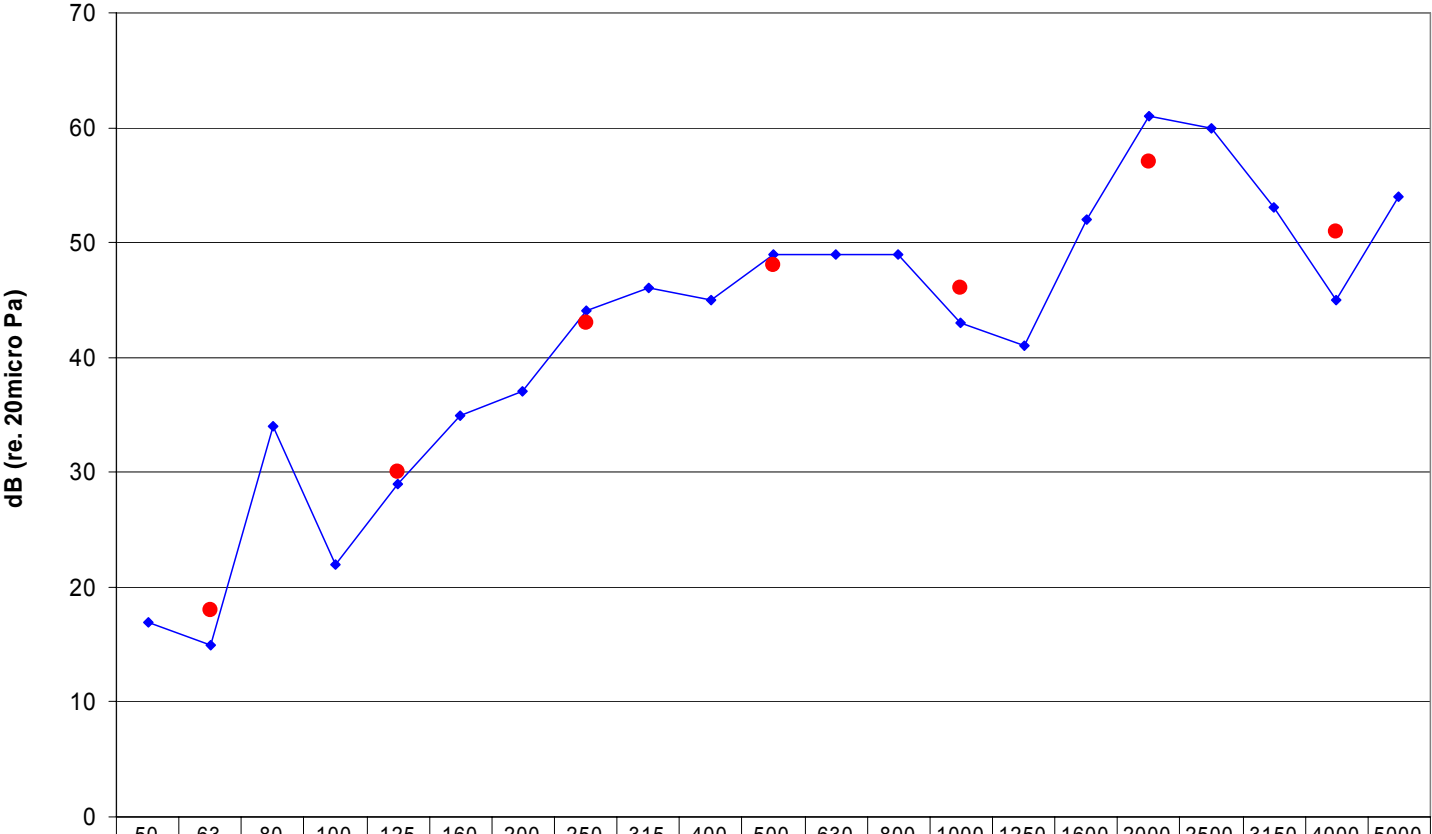
Formaldehyde reduction

Results for RECCAT®	Up-stream catalyst and heat-exchanger			Down-stream catalyst		
	Test 1	Test 2	Average	Test 3	Test 4	Average
Formaldehyde, mg/m ³ n	161	175	168	0.80	0.76	0.78
UHC, ppm			3200			300

Formaldehyde reduced by 99.5%, while reducing UHC 90%.

I. e. about 20 times better formaldehyde-reduction than UHC-reduction.

**RECCAT Catalysator Insertion Loss Measurement
July 2005, ØDS**



	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
—◆— Insertion Loss (1/3 Octave Band)	17	15	34	22	29	35	37	44	46	45	49	49	49	43	41	52	61	60	53	45	54
—●— Insertion Loss (1/1 Octave Band)		18			30			43			48			46			57			51	

Frequency (Hz)



RECCAT advantages

Emission reduction

- Meets legislation limits for CO-emission
- Meets legislation limits for UHC-emission
- Meets legislation limits for aldehydes emissions
- Incinerates emissions at start/stop of engine
- Reduces problems of odour from engine
- Incinerates vapours of lubricating oil in the exhaust
- NO_x may be reduced indirectly

RECCAT advantages

Operation characteristics

- The high heat capacity of the RECCAT system makes it resistant to changes in operating conditions
- After several hours of engine stop the system restarts with high efficiency
- The reactor principle allows for a simple control system without mechanical devices
- The reactor works sound-absorbing as a silencer
- The catalytic reactor contains a stable catalyst without noble metals

RECCAT advantages

Economic

- Contributes positively to the economy of the CHP-plant by selling more heat or buying less natural gas.
- Extending the life time of the engine
- Reduced CO₂-equivalent emissions, CO₂ quotas may be sold
- Secures the CHP-plant against future legislations on emissions

First full scale CHP demo plant (March 2006)

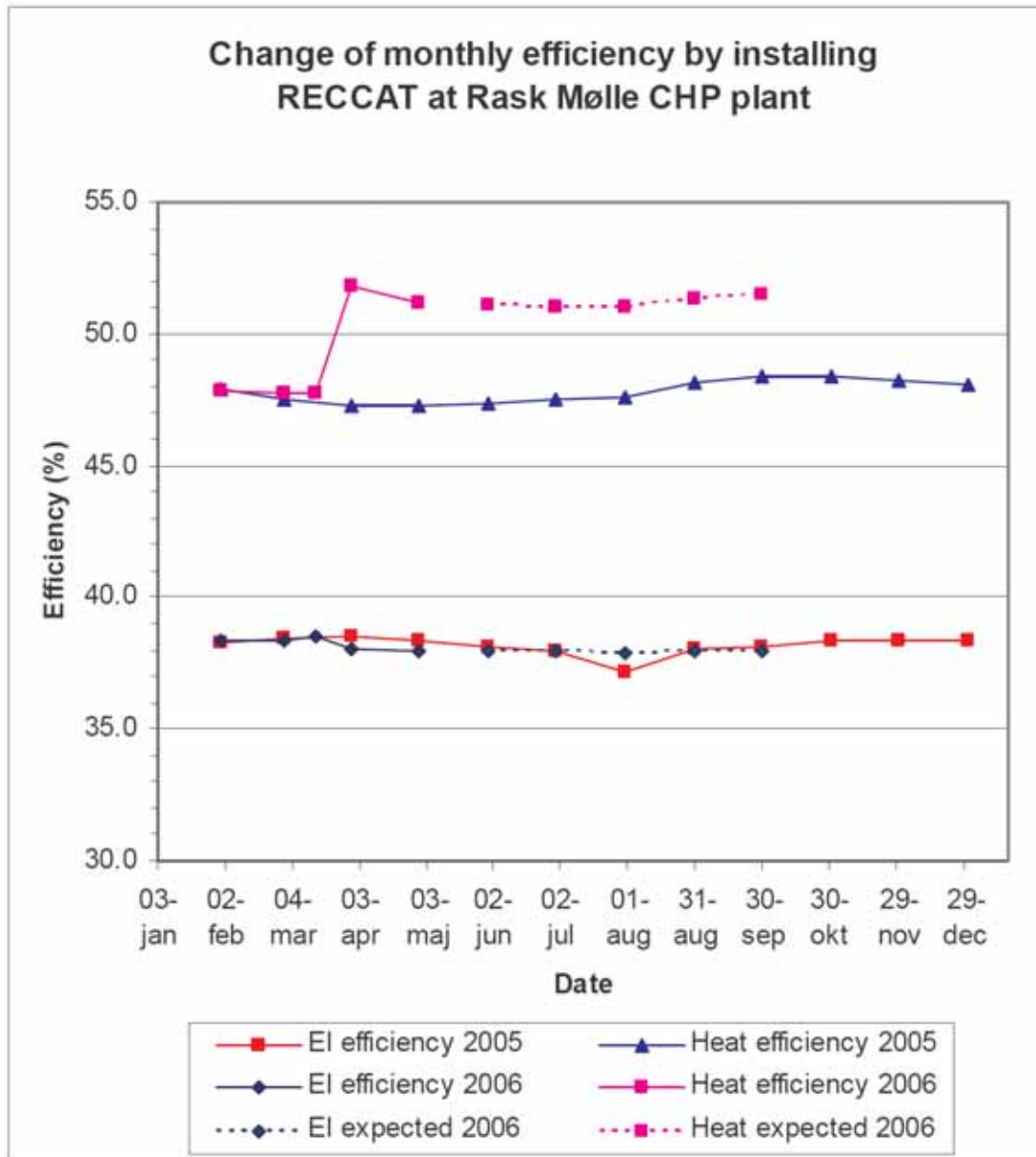




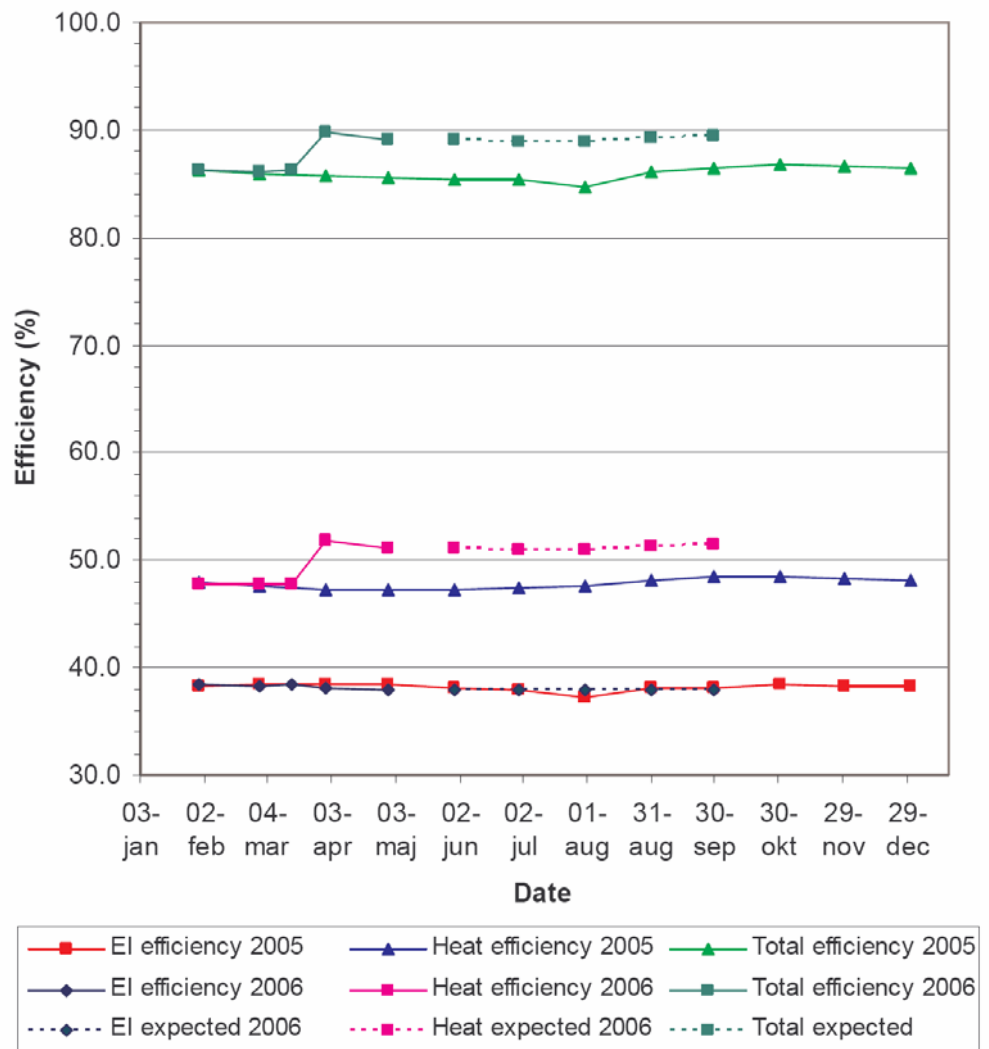


Preliminary results of first full scale CHP demo plant (March 2006)

- CO reduction > 99%
- UHC reduction ~ 70%
- About 5% increase of heat efficiency (47% → 52%)
- Standby top temperature loss: 7 degC/hour



Change of monthly efficiency by installing RECCAT at Rask Mølle CHP plant



Preliminary results of test at an engine supplier (April 2006)

- CO reduction > 98%
- Formaldehyde reduction > 99%
- UHC reduction ~ 90%

RECCAT end users

- Public, private and industrial CHP plants
 - DK: retrofit
 - EU and other countries: new installations
- CNG buses
- Later: Diesel vehicles
 - When the RECCAT technology is further developed

RECCAT customers

- Packagers
- CHP plants
- Engine suppliers
- Bus and truck factories etc.



Conclusions

When installing RECCAT you...

- meet legislations for UHC, CO and formaldehyde
- improve environment, reduce green house gases
- get economical advantages by the extra heat