

## WHDC DEVELOPMENT - REFERENCE FUEL PROGRAMME

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Heavy-Duty Certification Procedure  
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### Objectives of the programme

- To investigate the effect of different reference fuels on the emissions of Euro V / US2007 engines measured over the WHTC cycle.
- To investigate the effect of different soak times between the cold WHTC and the hot WHTC on the emissions
- The programme is being carried out in collaboration with the engine manufacturers

## TEST Engines

- EURO V Engine
  - 6 Cylinders intercooler Turbo Diesel Engine 10.5 l 300 kW
  - Common Rail Injection System
  - Euro V emission control device SCR with Urea injection
  
- US 2007 Engine
  - 6 Cylinders intercooler Turbo Diesel Engine 14.9 L. 373 kW
  - HPI Electronic injection System
  - EPA 2007, CARB 2007 Emission Certification

## TEST FUELS

		Fuel A	Fuel B	Fuel C
		RF-06-03	RF-06-03+5% FAME	US 86.113-07
Density @ 15 C	kg/m3	833.6	833.6	845.4
Cetane Number		52.9	53.1	46.9
Distillation	IBP °C	204	207	197.5
	10% v/v °C	233.7		217.7
	50% v/v °C	275.3	278.1	272.3
	90% v/v °C	322.3		311.6
	95% v/v °C	348.4	349	322.0
	FBP °C	357.7	356.7	333.6
Viscosity @ 40 C	mm2/s	2.93	2.93	2.55
Aromatics	Total %wt	23.4	22.8	36.3
	Mono %wt	19	18.8	31.2
	Poly %wt	4.4	4	5.1
Sulphur	mg/kg	1.6	1.7	7
Net heating value	MJ/kg	43.199	42.942	42.886
FAME	%vol		5.1	
Oxygen	%wt		0.7	

## Test fuels: main differences

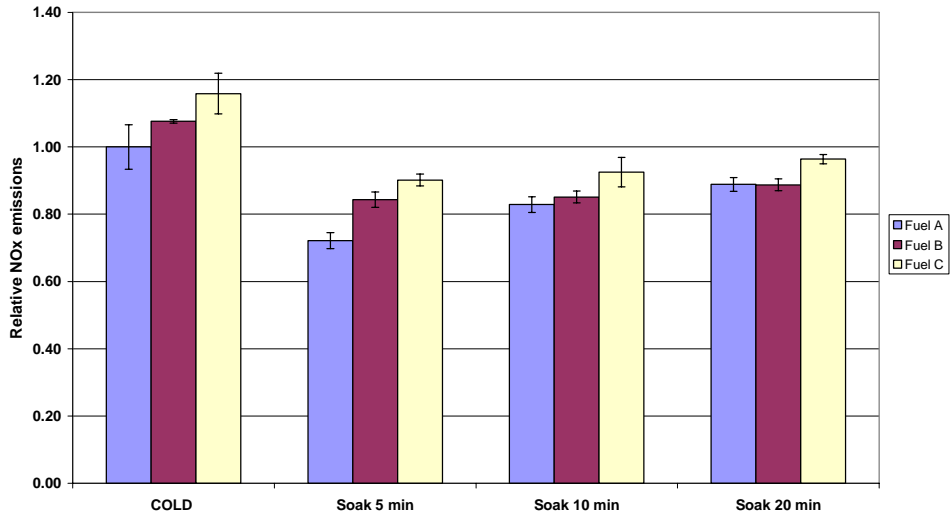
- Fuel A (European Ref.) vs Fuel B (European Ref. + 5% FAME)
  - Very similar properties
  - 0.7 % oxygen content in Fuel B
  - Reduced heating value (- 0.6 %)
- Fuel C (US Ref.) vs Fuel A (European Ref.)
  - Higher density (+1.4%)
  - Lower average boiling point (lower T95%)
  - Higher total aromatic content (36% vs 23%)
  - Lower heating value but higher density -> higher volumetric heating value (+0.68%)

## Results\* Euro V Engine

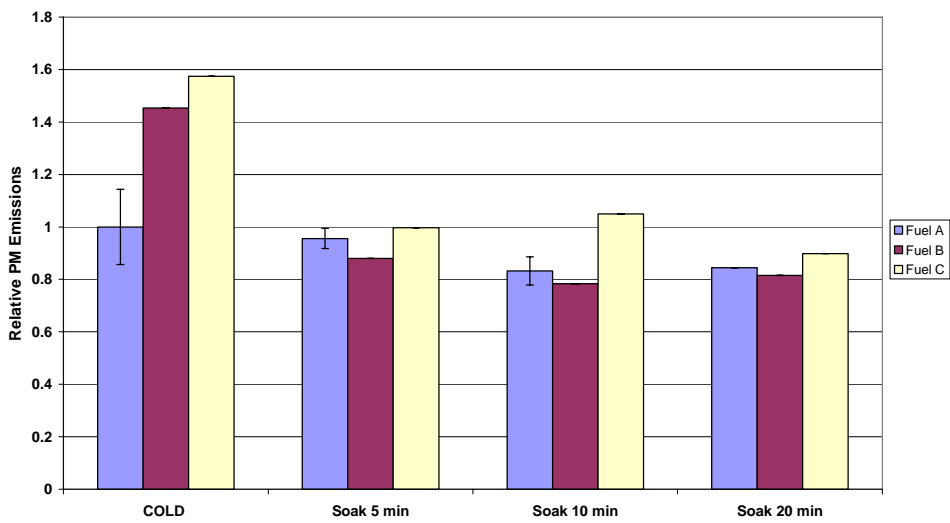
**\*The results are presented in relative terms since they need to be validated and deeply analyzed**

**Cold WHTC emissions with EU Reference Fuel = 1**

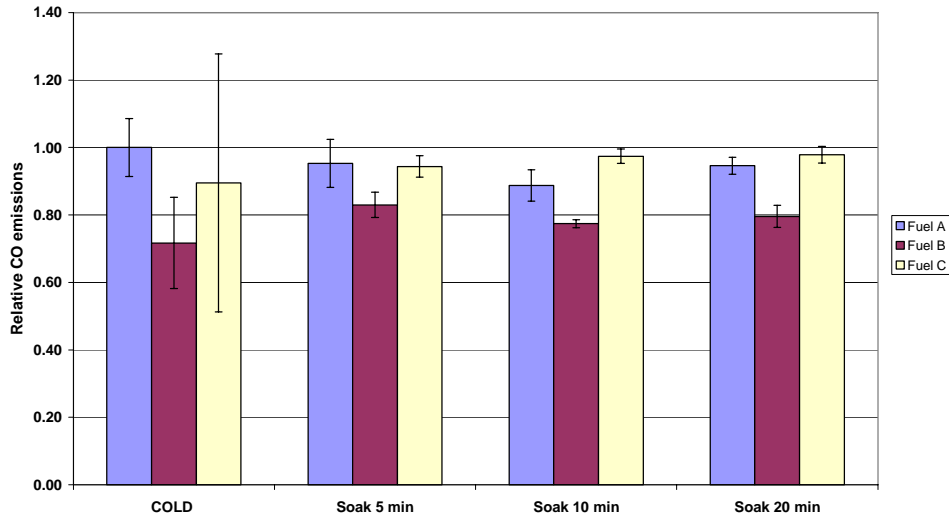
WHTC Cycle - Effect of different soak times and fuels



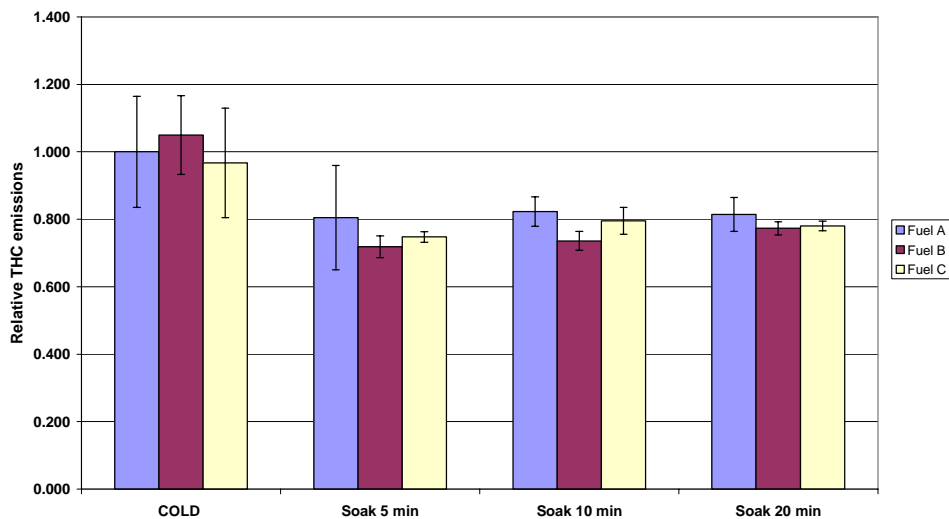
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**Thank you!**



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