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Notes on Evaporative Emissions

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Background

Rationale

Necessity to have ethanol (EtOH) in the reference fuel, if it is present in the market fuels.

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Europe: E5 (5% EtOH) and E10 reference fuels for passenger car type approval.
E10 is marketable.

Impact on evaporative emissions of ethanol/gasoline blends

1. Increased vapor pressure
2. Increased permeation rates through plastic materials
3. Reduced working capacity of the canister

JRC contribution

Report #1 (2007):
"Effects of gasoline vapour pressure and ethanol content on evaporative emissions from modern cars"

Report #2 (2012):
"Review of the European Test Procedure for Evaporative Emissions: Main Issues and Proposed Solutions"

Report #1

Report #1 (2007):
"Effects of gasoline vapour pressure and ethanol content on evaporative emissions from modern cars"

Experiments
7 Euro 3-4 gasoline passenger cars
10 gasoline blends with 5-10% EtOH
EU Evaporative Emissions test procedure

Notes
Main objective: Investigating the impact of ethanol on total evaporative emissions
Not addressed: Test temperature profile, presence of ethers in the fuel, fuel permeation and the effects of ethanol and water on carbon canister.
No JRC specific testing on the effect of ethanol on the canister ageing.

Results

✓ DVPE is a key parameter for evaporative emissions.
Increase in DVPE → higher evaporative emissions.

✓ Disproportional increase of emissions when DVPE > 70 kPa
(reference value = 60 kPa, 75 kPa reached e.g. by winter fuel + EtOH). System management problems.

Solution

No splash blending. EtOH blended with a lower initial vapour pressure of the base fuel (fuel Directive 2009/30/EC).
EtOH/gasoline blends have to comply with the same DVPE spec as non-ethanol blends.

But

- Derogations are possible (Spain).
- Commingling effect: Splash blending occurs in the vehicle tanks when different market fuels/blends coexist in a given area → no vapour pressure compensation.

Results

The programme was not designed to separately address the three effects of ethanol on evaporative emissions.

Nevertheless useful information obtained:

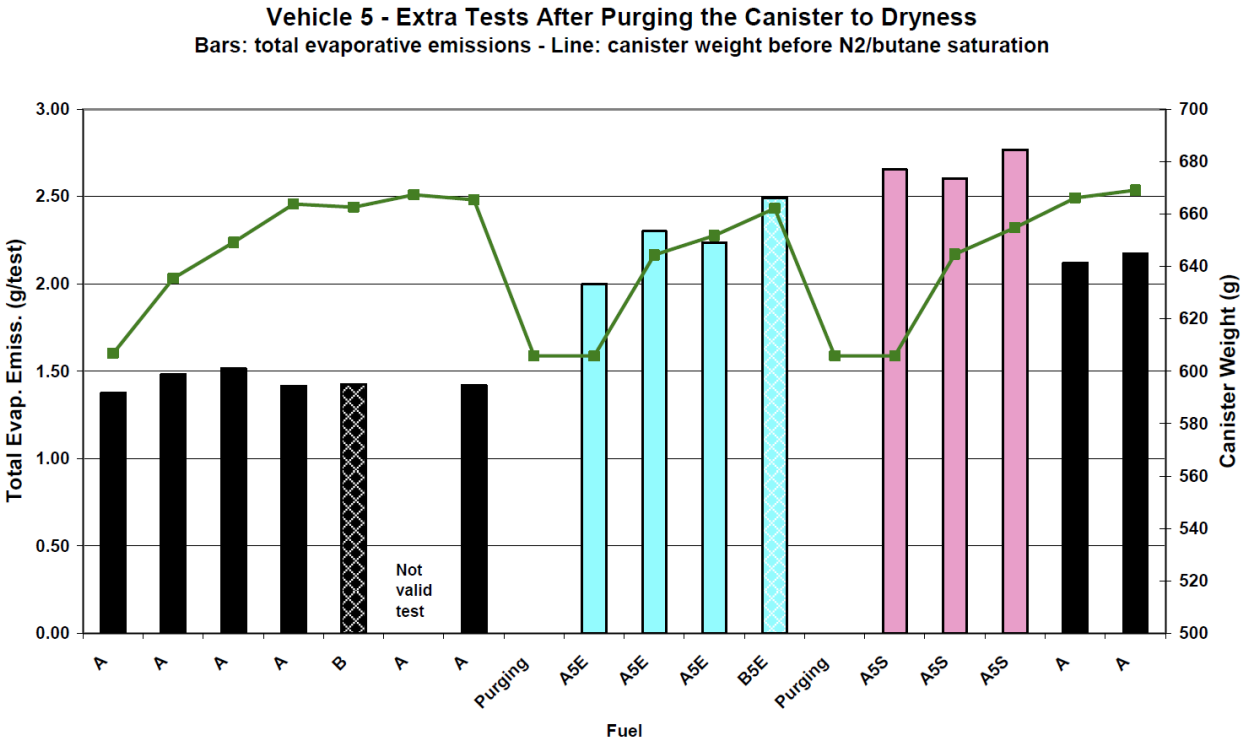
- ✓ Increased carbon canister weight: accumulation of vapours, insufficient canister purging. EtOH more difficult to remove – polarity/affinity.

  → Steeper increase of canister weight with ethanol

  → Need of additional conditioning before testing

Results

Repeated tests with the same car/fuel



- Only short term effect of ethanol addressed (≈3 days/test)
- Purging to dryness vs Prescribed purging (=33km)

DVPE Match blended, 5% EtOH

Splash blended, 5% EtOH

Collected Results

Johansson (2009, SAE) + Swedish Transport Administration (2011):

- Approx 30% of vehicles with ethanol blends fails the evap. test → effect of ethanol?
- Ethanol content of the Swedish fuel has a negative effect on the capacity of charcoal canister and materials of the tank.

California Environmental Policy Council (1999, CARB)

"Air Quality Impacts of the Use of Ethanol in California Reformulated Gasoline".

- Reduced working capacity of canister due to ethanol – carbon affinity

CRC Project No. E-65 (2004, CARB)

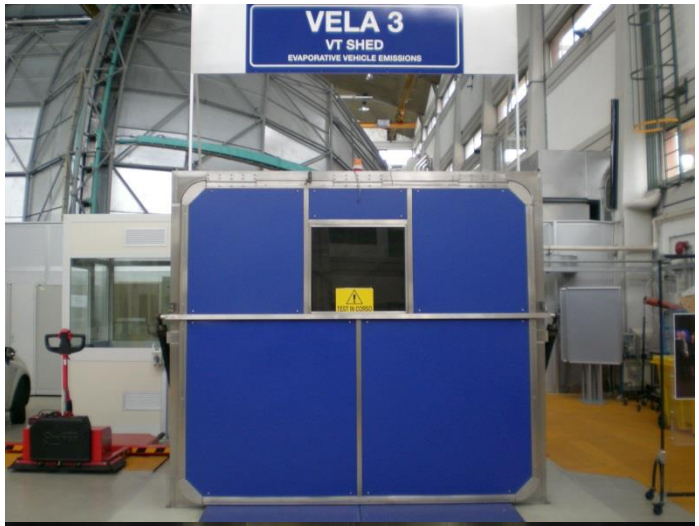
"Fuel Permeation from Automotive Systems"

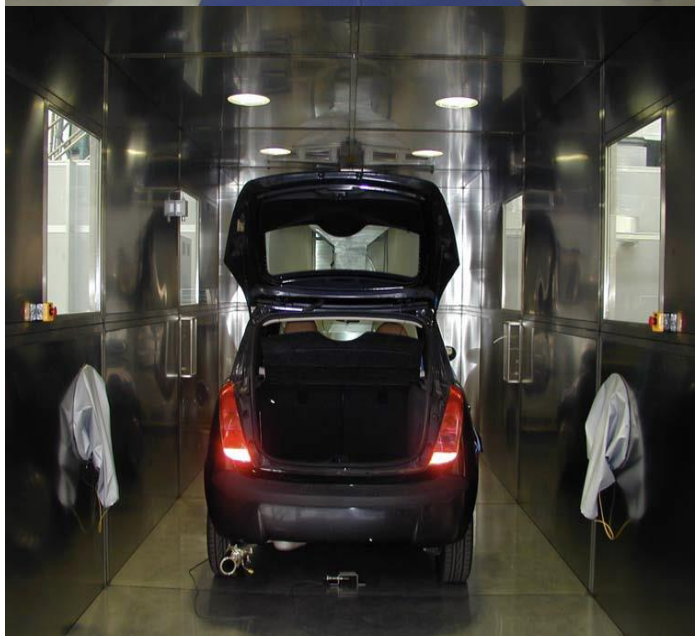
- EtOH increases permeation rates (45% increase for 5% blend).
- Several weeks for stability.

Fuel tank producers presentation (available in Circabc)

20 weeks for stability

→ Considering short tests on long-term effects





European Commission

THANKS FOR YOUR ATTENTION

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