PAH content of diesel fuels

How EU refineries would be affected by a reduction of the current limit

Using the EU-refinery model introduced in the previous article, CONCAWE has evaluated the potential consequences of a reduction of the diesel fuel polycyclic aromatic hydrocarbons (PAH) specification on the European refining industry from the point of view of costs and CO_2 emissions, both from the refineries and from a global point of view i.e. including the impact of changes in fuels carbon/hydrogen ratio on in-use emissions. A full report has recently been published (report 7/05) and is available on the CONCAWE website.

The PAH content of diesel blending components depends on many factors, notably the operating conditions of desulphurisation plants, the severity of operation of cracking units and, to a lesser extent, the crude origin. As a result there are considerable variations between regions and refineries. Indeed, in their present configurations, the vast majority of refineries do not have a direct way to control the PAH level of diesel fuel. The value obtained is a result of the effect of the desulphurisation processes which go some way towards converting poly- into mono-aromatics. The extent of this is a complex function of feed properties, catalyst performance and operating conditions. As refineries gradually reduce the sulphur content of diesel fuel, the average PAH content is also reduced. Even at the 10 ppm sulphur level a wide range will remain, reflecting individual refinery circumstances. We have therefore approached the modelling of PAH on the basis of current and forecast levels, indicated by a survey of some 30 refineries, and after consultations with catalyst technology suppliers.

Reducing PAH in European diesel fuel is technically feasible but would entail at least either major revamps of existing desulphurisation facilities (for the more modest reduction figures) or, more generally, installation of dedicated de-aromatisation plants.

The current diesel fuel PAH specification is 11% m/m max. The move to the 10 ppm sulphur specification will result in a reduction of the average measured PAH level to about 4% m/m, with maximum values up to 8% m/m. As a result of the variability, any specification below 8% m/m would entail costs and additional CO_2 emissions for the industry.

The further the specification falls below this level, the more refineries would need to install additional process units, essentially in the form of dedicated de-aromatisation and hydrogen production facilities. Investment would be required, gradually increasing to nearly 9 G€ at 1% m/m with total annualised costs of 2.2 G€/annum representing 12.4 €/t of diesel fuel.

A reduction of the diesel fuel PAH specification below 8% m/m would cause refineries to emit additional CO_2, up to 15.9 Mt/a for a 1% m/m limit, corresponding to an increase of more than 10% of the total refinery emissions in the reference case. Even after accounting for end-use emission reduction due to the lower CO_2 emission factor of the de-aromatised diesel fuel, a net effect of up to 9.2 Mt/a can be expected.

Table 1 summarises the evolution of costs and CO_2 emissions as a function of the PAH specification level.

Table 1 Costs and CO_2 emissions as a function of the PAH specification level

Diesel fuel PAH specification (% m/m)			8.0	6.0	4.5	3.5	2.0	1.0
Capital investment		(M€)	14	1278	2627	4748	7538	8762
Annualised costs *		(M€/a)	3	312	634	1203	1893	2249
Extra CO_2 emissions:	from refineries	(Mt/a)	0.0	1.5	4.2	8.4	13.4	15.9
	net	(Mt/a)	0.0	0.8	2.4	4.8	7.6	9.2

* *Assuming an annual capital charge of 15%*