

French service station study of ambient benzene levels (2005)

New data demonstrate that benzene levels in air around service stations continue to fall

Background

In 2005 a study programme was initiated by a group of French operators of service stations, including oil companies (represented by UFIP), supermarkets and independent retailers, to study levels of benzene in the air around service stations. The principal motivation for conducting this study was an environmental health concern resulting from an earlier French study, published in the scientific literature in 2004, linking residence next to a service station during the period 1990–98 to increased childhood cancer risk. Prolonged high exposures to benzene in industrial work environments are a recognised cause of a particular type of leukaemia in adults, but no such link had previously been acknowledged between the much lower levels of benzene in ambient air and childhood leukaemia. The regulatory and technological developments of recent years have resulted in a general decrease of benzene levels in ambient air. Data on typical benzene levels in air in the 1990s are available for EU countries (collated in CONCAWE report 2/99) and can be compared with measured 2005 levels.

Approach

The study protocol was based on earlier studies by CONCAWE and others, in which levels are measured directly at the perimeter of the station where they are considered as representative of the reasonable worst case exposure of nearby residents. Measurements were also taken at a nearby point assumed not to be influenced by the station (e.g. 'upwind') to represent the local background and starting point for the estimation of the station's contribution. The measurement period was two weeks to allow for meteorological variation. Sampling was done in spring and autumn, thus avoiding extremes of temperature. Comprehensive additional data was recorded for each station, for example nearby traffic flows, to help interpretation of the results.

In 2005, approximately 14 000 service stations were in operation in France. Forty-three stations were included in this study, with operators invited to nominate stations in three categories: along motorways (15); in towns and suburban areas (19); and under apartment blocks (9). This sample was constructed to be indicative of typical potential population exposure, but cannot strictly be seen as a random sample out of the entire 14 000 stations. Therefore, care should be taken when applying the results on an individual level in environmental health studies. Current regulatory requirements in France for Stage II vapour recovery are linked to petrol throughput (> 3000 m³/y). Both Stage I and Stage II stations were included in the study.¹

Results of perimeter measurements were compared with the data collated by CONCAWE (Report 2/99) for the previous decade. Furthermore, data were compared with the French air quality standard, which was set at 10 µg/m³ (annual average) in 2005 and which is reduced by 1 µg/m³ each year to reach 5 µg/m³ in 2010. This is identical to the EU guidelines. In addition, France has adopted a long-term policy objective of 2 µg/m³.

Results

The overall contribution of service stations to local ambient benzene levels was considerably lower in 2005 than in the 1990s. The average perimeter levels were 1.2 µg/m³ for motorway sites, 2.8 µg/m³ for urban sites and 8.2 µg/m³ for stations under apartment blocks. The

¹ **Stage I Vapour Recovery:** system used to reduce hydrocarbon emissions during the refuelling of gasoline storage tanks. Vapours in the tank, which are displaced by the incoming gasoline, are routed through a hose back into the cargo tanker, instead of being vented to the atmosphere.

Stage II Vapour Recovery: system used to reduce hydrocarbon emissions during the refuelling of vehicles at service stations. Special nozzles and hoses at the pump capture the displaced gasoline vapours from the vehicle's fuel tank and route them to the back to the service station's storage tank.

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increases over the local background were on average 0.3, 0.5 and 2.1 $\mu\text{g}/\text{m}^3$, respectively. The station contributions were found to be comparable to what is commonly found at the exit of a road tunnel or a traffic light at a busy junction.

The highest figures were measured at a station inside an underground car park, but this station should probably not have been included in the study, as it has no direct impact on nearby residences. Another measurement inside a car park, but without a service station, confirmed the elevated level that can be found in such an enclosed environment.

Data available from the Paris city authorities showed a decline from 4 to below 2 $\mu\text{g}/\text{m}^3$ over the period 1998–2003 for city background levels, and from 24 to 6 $\mu\text{g}/\text{m}^3$ for monitored sites directly impacted by automotive traffic. These levels are expected to continue to drop in the coming years.

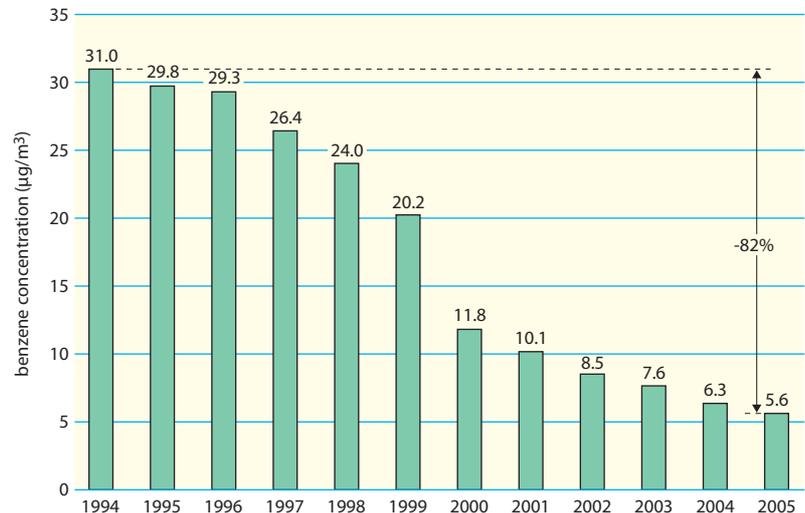
The study also examined the difference between Stage 1 and Stage 2 equipped stations, and in fact found none: the additional vapour recovery through Stage 2 appeared to be offset by the higher sales volume.

Conclusions

The authors concluded that for service stations on motorways and in suburban and urban areas, the increase of the benzene level in air at the boundary of the station compared to the background is less than 1 $\mu\text{g}/\text{m}^3$, considerably lower than a decade ago. Slightly higher numbers were found for stations at the foot of residential buildings, but these were nevertheless lower by a factor of three than in the mid-1990s.

This study updates the existing knowledge base, providing important new data on benzene levels in air around service stations after the introduction of Auto/Oil II policy measures, and documenting the significant decrease of benzene in air which has resulted from these measures.

Figure 1 Evolution of the average annual concentration of benzene at the traffic impacted monitoring station of Place Victor Basch, Paris



Source: AIRPARIF—Bilan de la qualité de l'air en Ile-de-France en 2005
(www.airparif.asso.fr/airparif/pdf/bilan_2005.pdf)

The full study report can be found at:

www.ufip.fr/_fichiers/03_04_2006_%20resume_etude_Bz_limite_prop_stations.pdf

Benzene levels near traffic are dropping in line with those of other primary pollutants emitted by traffic, with a more noticeable drop from 2000 following the introduction of European regulations limiting the benzene content of road fuels.