Polycyclic aromatic hydrocarbons (PAHs)

PAHs are investigated as they are mutagenic compounds and they are known to be amongst the most harmful compounds in determining adverse health effects associated to atmospheric particle pollution in urban areas (Hannigan M., 1998). PAHs are constantly monitored for the background urban atmosphere of Milan (Italy), that is BaA, CHR, BbF, BkF, BeP, BaP, BghiP, dBaA and IcdP. Such compounds are found in the atmosphere quite exclusively in the particulate phase (particle/gas distribution =96-100%), where they are completely distributed in the fine fraction ([PAHs]PM2.5 >95%[PAHs]PM10). A strong seasonal trend is observed for relative PAHs content in atmospheric particles, with maximum values during December-January (0.45±0.18 ngΣ9-PAHs/mgPM) and minimum quite constant values between April-August (0.3±0.02 ngΣ9-PAHs/mgPM). This indicates a different “quality” of particulate matter, with important implications for its toxicological properties (particles more than ten times richer in PAHs during winter months) (Perrone, M.G., 2004).

The traffic source is estimated to be one of the main PAHs source for urban areas (Harrison R.M., 1996). A campaign was done by analyzing PAHs concentrations in PM10 samples from two different sites of Milan: a background urban site (near the city center, but not directly influenced by point sources: more than 100 m from roads) and a kerbside site, primarily influenced by traffic source (= 10 m away from a busy road). The traffic site shows [PAHs] about 5-6 times higher (FIG 1), and the relative PAHs content in atmospheric particles (ngΣ9-PAHs/mgPM) is over 2-3 times more than the background urban site. The relative PAH profile is different for the two sites, and for the kerbside urban site is the same as that for traffic source (road traffic tunnel), with higher concentrations for lighter PAHs like PY, while for the background urban site BghiP is the most abundant one (FIG 2).

Alkanes

Linear alkanes (C14-C32) have been analysed in PM10 samples as they give information about the different relative contribution of anthropogenic and natural (biogenic) sources. Molecular diagnostic ratios, as CPI (*carbon preference index: = [alkanes Cn(odd)]/[alkanes Cn(even)]) and waxCn% (% biogenic source) are used for the reconciliation of compounds sources. Biogenic contribution leads to a predominance of n-C25-n-C33 congeners with odd-even predominance: the biogenic source can be quantitatively estimated by calculating *waxCn (Simonett B.R.T., 1991).

For the vehicular source (road traffic tunnel) a CPI=1 is calculated, which indicates pure anthropogenic urban source. In the background urban area of Milan, biogenic source is estimated to contribute to about 38% during summer (CPI = 2.9±0.7), while during winter 12% (CPI = 1.3±0.1%) (TAB 1).

PAHs and alkanes in the first 90 m of the urban atmosphere of Milan

Atmospheric vertical mixing in the first 90 m height of the urban atmosphere of Milan was studied by parallel sampling of PM10 at the ground (4m height) and at altitude (86 m height). PM10 was been analyzed for both PAHs and alkanes (Perrone, M.G., 2004).

By comparing concentrations and trends and at altitude, PAHs (FIG 4) and alkanes (FIG 5) show a good correlation, during night as well as day time. It indicates a good mixing in the first 90 m of the urban atmosphere for both PAHs and alkanes, which are both associated to the fine fraction of PM10. Such good correlation is not always seen also for PM10, in particular during some night events when, because of a higher atmospheric stability, the coarse fraction tends to sediment at the ground (FIG 6).

For PAHs, higher concentrations are usually measured at altitude than at altitude, with a % of reduction of about 20% (mean value), indicating a general major contribution of local sources at the ground (e.g. traffic source). Dislike PAHs, alkanes don’t show this clear trend of reduction with altitude.

REFERENCES


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NOTE: PAHs nomenclature = Pyr(yrene), BaA (benzo[a]anthracene), CHR (chrysene), BaB (benzo[b]pyrene), BbF (benzo[bf]fluoranthene), BkF (benzo[k]fluoranthene), BghiP (benzo[ghi]perylene), BaP (benzo[a]pyrene), IcdP (indeno[1,2,3-cd]pyrene), BghiP (benzo[ghi]perylene).