



## **Monitoring program of Polycyclic Aromatic Hydrocarbons on urban wastewater treatment plants**

## Table of contents

Introduction .....	3
Results of the influent samples.....	3
Concentration .....	3
Treatment efficiency .....	5
Effluent (=load to the surface water).....	6
Concentration .....	6
Load.....	6
Conclusion.....	6
Individual PAH .....	7

## 1. Introduction

116 large UWTUP were sampled for PAH in 2010. All monitored UWWTP had a design capacity larger than 10.000 population equivalent (PE), and represented 4.193.000 PE in total. This means that 82% of all the connected inhabitants in Flanders were part of this monitoring campaign.

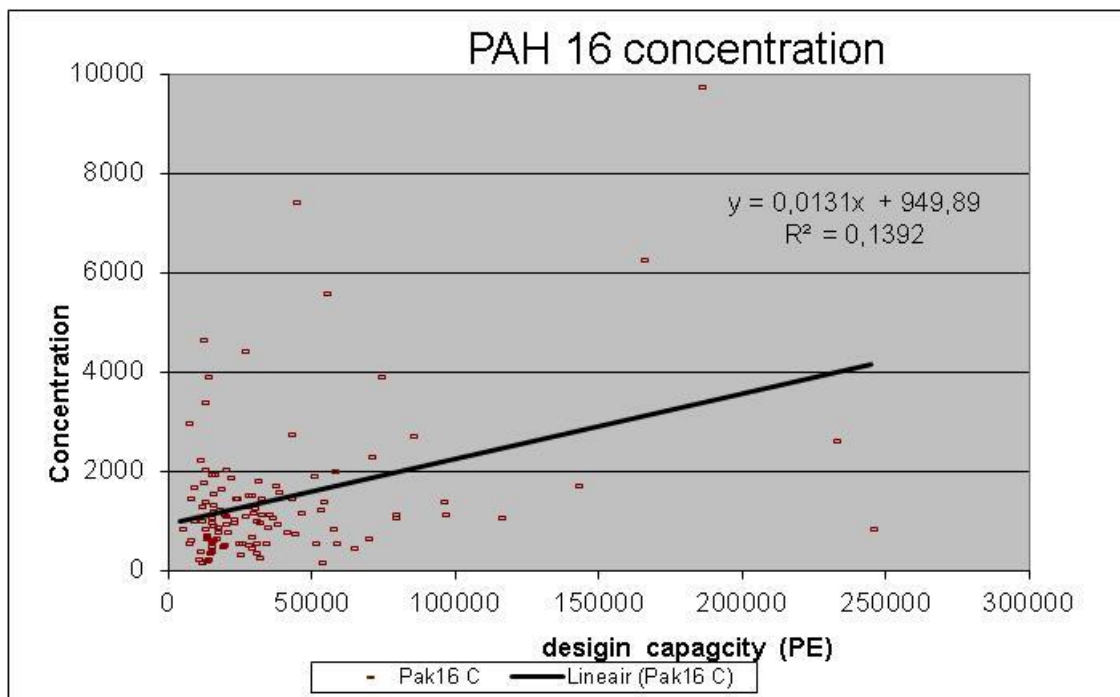
16 PAH were analysed on both the influent and effluent.

Acenaphtene
Acenaphtylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene (b)
Benzo(b)fluoranthene (b)
Benzo(g,h,i)perylene (b)
Benzo(k)fluoranthene (b)
Chrysene
Dibenzo(a,h)anthracene
Phenantrene
Fluoranthene (b)
Fluorene
Indeno(1,2,3-cd)pyrene (b)
Naphtalene
Pyrene

## 2. Results of the influent samples

### 2.1. Concentration

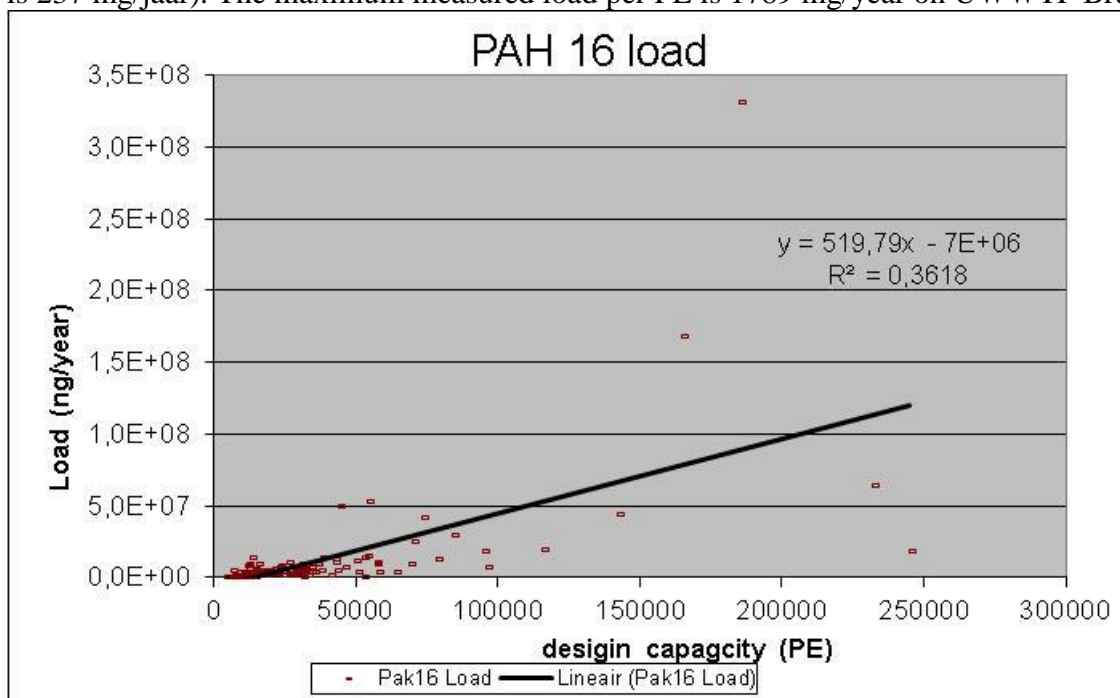
The average concentration of PAH16 in the influent is 1423 mg/L. The maximum measured concentration of the PAH16 in the influent is 9743 mg/L. This maximum was measured in the influent of UWWTP of Brugge.



There is no significant correlation between the PAH16 and the number of people connected to the UWWTP. The UWWTP with the highest concentration of PAH16 are Brugge, Destelbergen, Gent and Roeselare.

## 2.2. Annual load

The total load of PAH16 in 2010 in Flanders is 1340 kg for the monitored UWWTP. By extrapolation for the total connected PE in Flanders, the total load in Flanders can be estimated to be 1634 kg/year. The average load per PE is 320mg/year. (The weighted average is 237 mg/jaar). The maximum measured load per PE is 1789 mg/year on UWWTP Brugge.



From the figure a weak correlation between the PAH16 load and the connected PE per UWWTP ( $R^2=0,36$ ).

The UWWTP with the highest loads are also the largest UWWTP in Flanders: Gent and Brugge. The UWWTP with the highest load of PAH16 are Brugge, Destelbergen, Zelzate, Gent en Roeselare.

### Possible sources of PAH

- Households
- Runoff of paved surfaces (atmospheric deposition, traffic,...): the correlation between the PAH-concentration and the total kilometres of roads is low, but higher than the correlation with the total kilometres of highway.
- Connected industry
- Unexplained load

### Connected industry

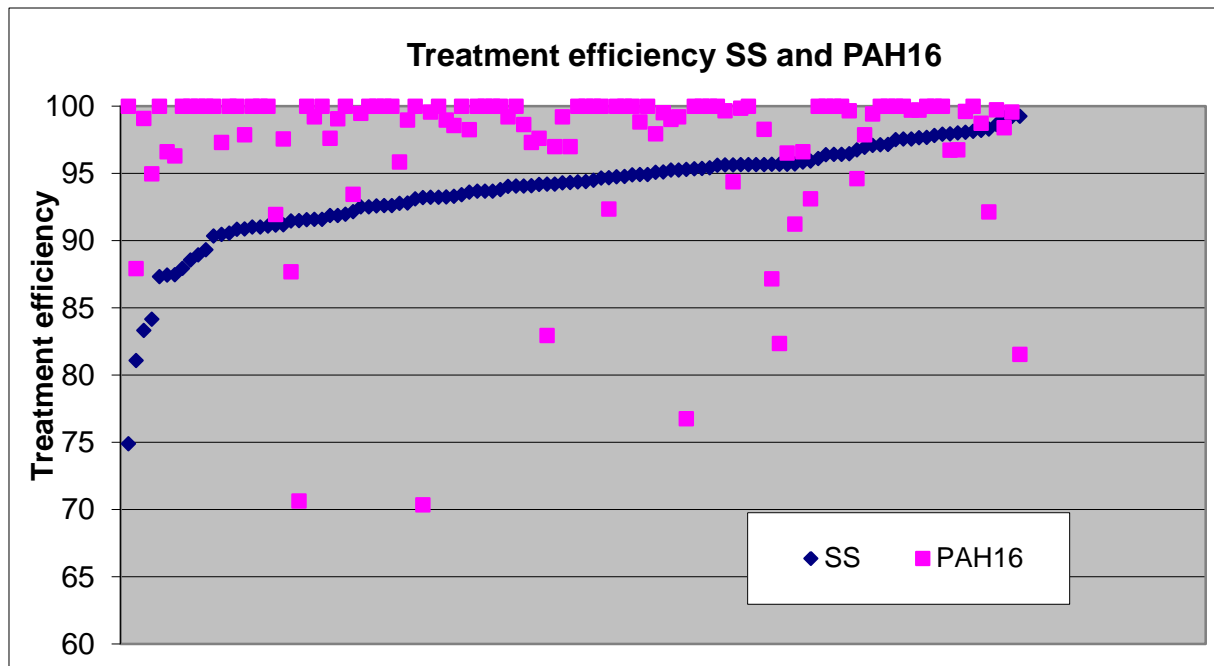
The PAH loads of the connected industry to the UWWTP is only a small fraction of the total influent load. Only 0.4% of the influent load of the monitored UWWTPs can be explained by the industry discharging on the sewer system. When looking at individual UWWTPs, the industrial load represents less than 1% to a maximum of 30% of the total influent load. This means that the industrial load doesn't have a large impact on the total influent load of PAH16.

UWWTP	#PE	Total load PAH16 (mg/year)	Industrial load (mg/year)	% of the total load
Oostende	245100	17827655,37	1799455,334	10,09
Ronse	40400	2025379,277	620868,5884	30,65
Genk	69000	9482458,065	570978,9758	6,02
Deurne	232000	64567543,65	389515,7145	0,60
Waregem	57500	3715893,25	382710,457	10,30
Geraardsbergen	20800	6170585,123	182707,8528	2,96
Ruisbroek	15100	9413546,862	168027,7479	1,78
Merksem	37100	4687600,831	160534,8434	3,42
Oudenaarde	29900	2603688,979	156535,4686	6,01
Morkhoven	42900	4873228,125	125288,2636	2,57
Neeroeteren	31500	5315815,872	68644,25858	1,29

Top ten of the UWWTPs with the highest industrial PAH loads

## 2.3. Treatment efficiency

The average treatment efficiency for PAH is very high: 97.3%, with a variation between 70 and 100%.



The average treatment efficiency for suspended solids (SS) is 93,7%. There is no clear correlation between the treatment efficiency of SS and PAH.

### 3. Effluent (=load to the surface water)

#### 3.1. Concentration

The average concentration of PAH16 in the effluent is 93mg/L. The maximum measured concentration in the effluent is 1235 mg PAH/L (UWWTP Ieper).

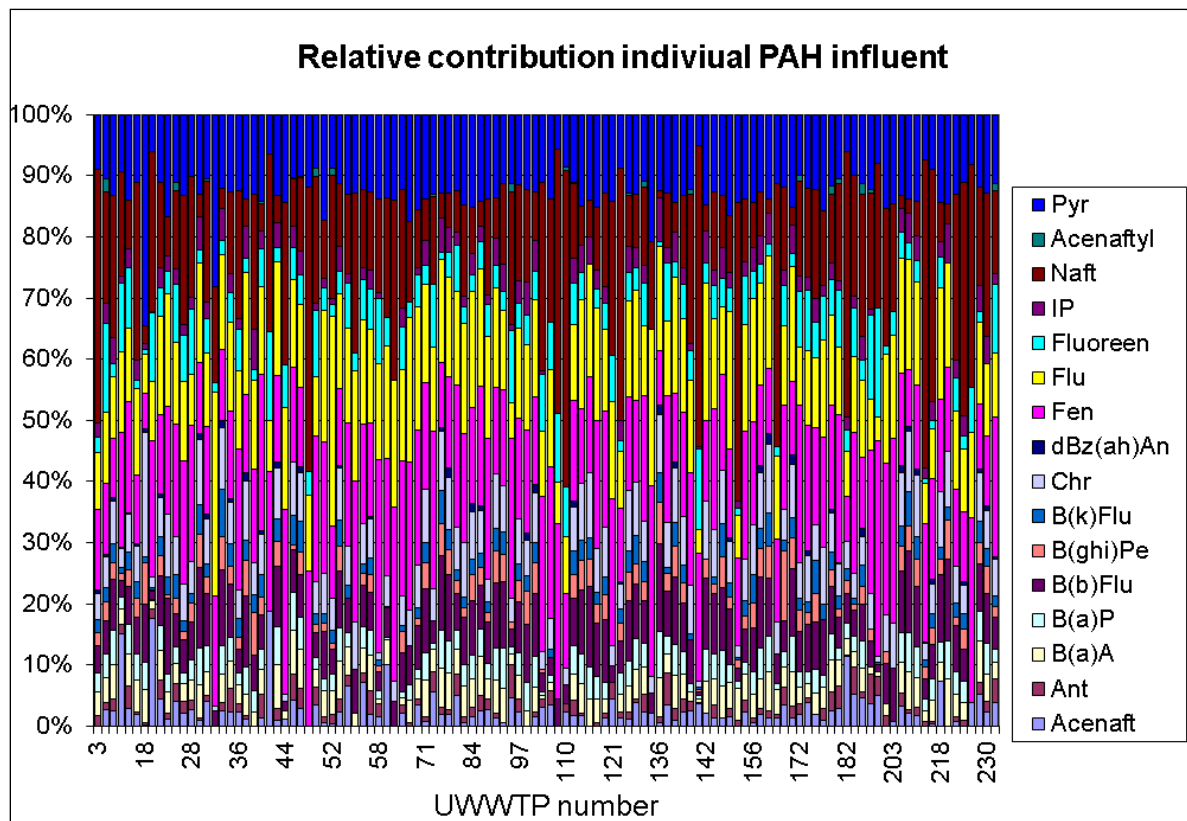
#### 3.2. Load

Due to the very high treatment efficiencies, the loads discharged into the surface water is relatively small. The total load to the surface water for the monitored UWWTP is 28,5 kg. With extrapolation, this can be estimated to be 35 kg PAH for the whole of Flanders. The average load is 7mg/PE/year. (The weighted average is 8 mg/jaar). The maximum measured load is 255 mg/PE/year (UWWTP Ieper).

#### 3.3. Conclusion

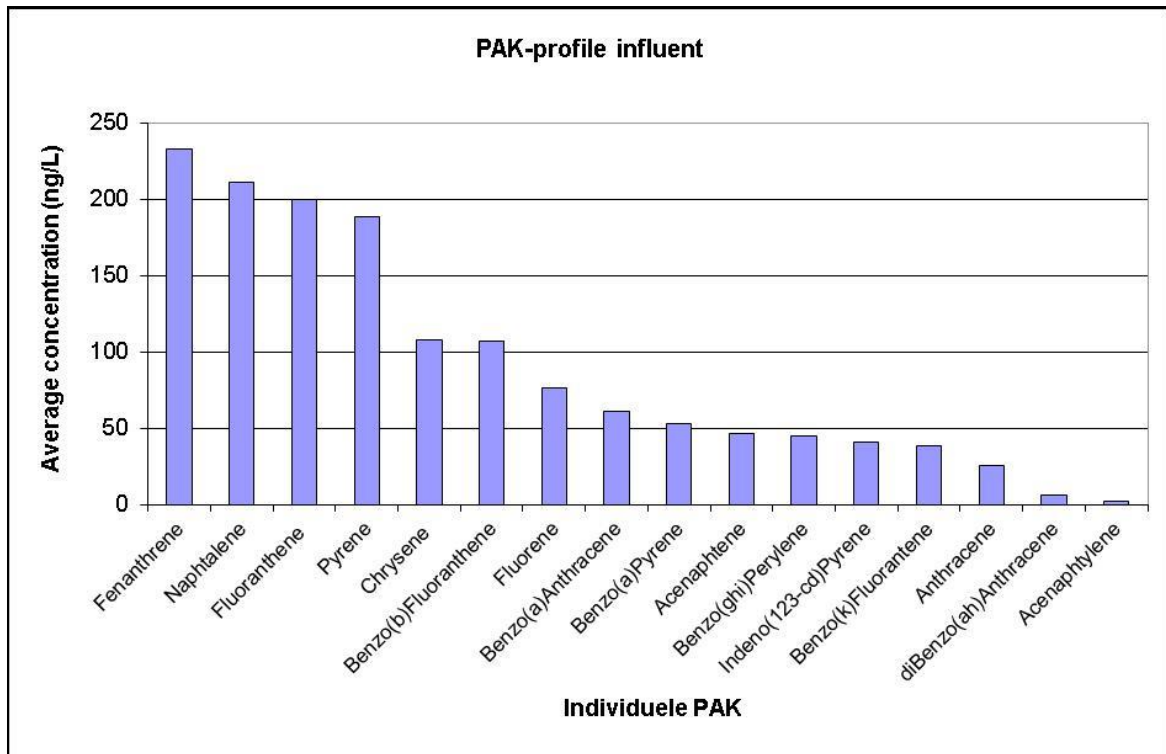
Due to the high treatment efficiency, the total load from UWWTP to surface water is low (28,5 kg in 2010). Industrial load only add a small part of the total influent load and have, after treatment, only a small impact on the surface water.

## 4. Individual PAH



The relative contribution of the different individual PAH in the influent is relatively similar for the different UWWTPs.

The PAH from the effluent with the highest average concentration are Phenanthrene, Naphthalene, Fluoranthene, Pyrene en Benzo[b]fluoranthene.



### **Benzo[ghi]perylene and en indeno(1,2,3-cd)pyrene**

The treatment efficiency for Benzo(g,h,i)perylene en Indeno(1,2,3-cd)pyrene is very high. Both PAHs are only found in 8 and 9 effluents of the monitored UWWTPs, while these are found in about 95 influents of the 116 sampled UWWTPs.

The total load of the surface water of the sampled UWWTP was in 2010 0,687 kg Benzo(g,h,i)perylene and 0,752 kg Indeno(1,2,3-cd)pyrene. The maximum effluent concentration was 59 ng/L for both PAHs.