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# Tertiary treatment and residua of organic compounds in wastewaters

Czech – Israeli Water Seminar, Prague 19 SEP 2019

Wastewater treatment:

Primary: Mechanical – sedimentation etc.

Secondary: Biological treatment – *a standard today*.

Tertiary: Abatement of Phosphorus and Nitrogen (mitigation of eutrophication) – *common*.

Quarternary: Abatement of PPCPs, EPs. - *near Future*.

## What are abilities of our present (tertiary) WWTPs:

Degrade non-specific organic carbon (waste) to $CO_2$, ($+CH_4$), bacterial biomass, sludge etc.

Eliminate Phosphorus and Nitrogen.

## What do we wont/need now (quarternary):

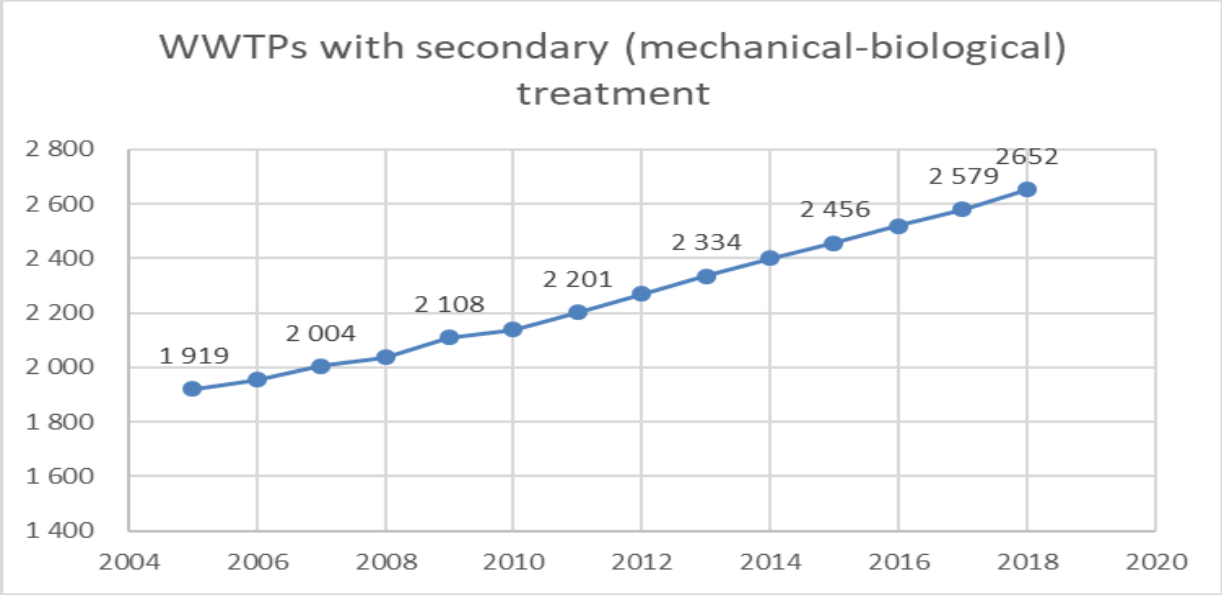
Micropolutants: PPCPs etc. – threat to river ecosystems, groundwater, drinking water production, general health...

The source is the public use:

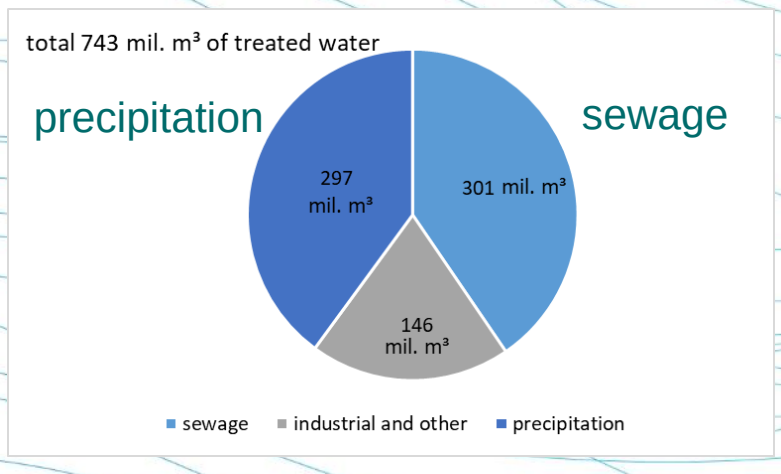
We all are polluters, supplying them to the sewerage and WWTP systems.

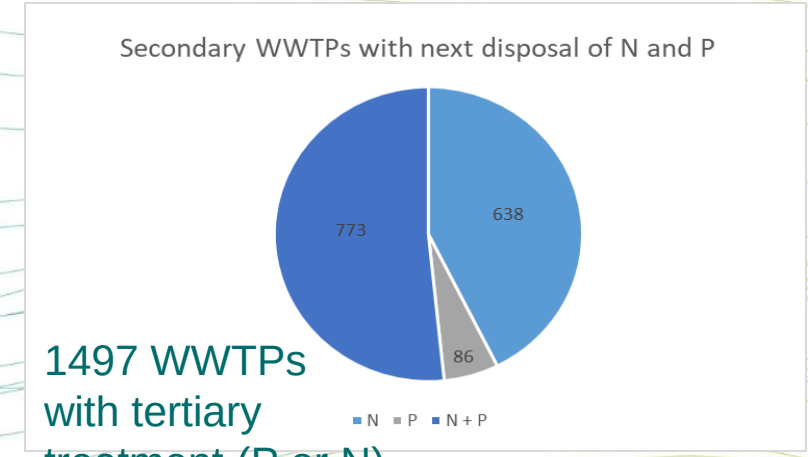
So, what do we know and what we are able to do?

# WWTPs in the Czech Republic (2018):




Ca. 86% population connected to WWTPs.




1497 WWTPs with tertiary treatment (P or N)

# Tertiary treatment:

Elimination of mineral nutrients (P and N) from treated wastewater:

- Nitrogen – controlled denitrification ( ↑ $N_2$+$N_2O$).
- Phosphorus – mostly chemical precipitation (Fe or Al salts).

*Abatement of the precipitate:*

Sedimentation with the sludge, filtration (sieves, membranes), separated tertiary precipitation…

*Recycling of phosphorus.*

# Tertiary treatment:

Elimination of „other“ pollutants from treated wastewater:

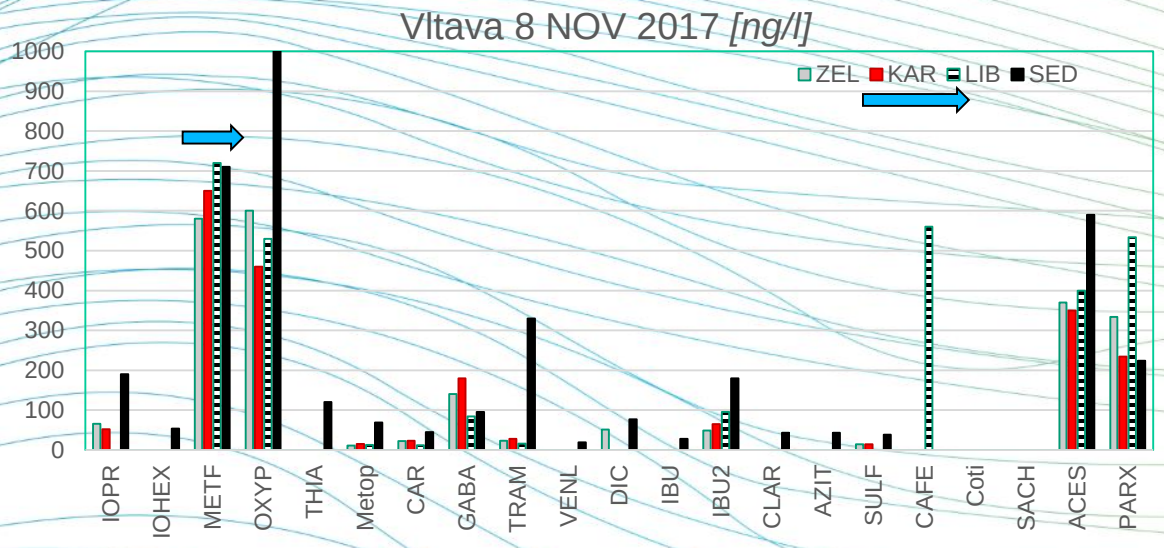
- Disinfection:
  Standard hygienic protection from bacteria etc.
  UV and chlorine are used, relatively low doses.
- Elimination of specific pollutants – step to **Quarternary treatment:**
  Very specific, according to wide array of chemical structures, e.g. to chemical and physical properties of thousands compounds.

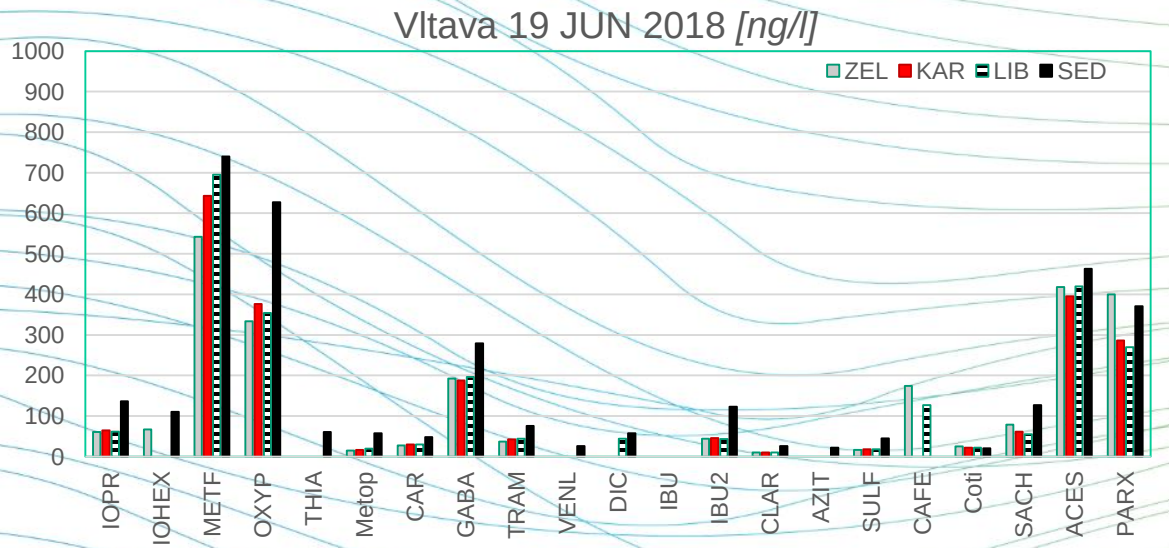
# Prague and Vltava

View from upstream

View from downstream

# Real PPCP: Pharmaceuticals in Vltava in Prague (resistant ones come from upstream):

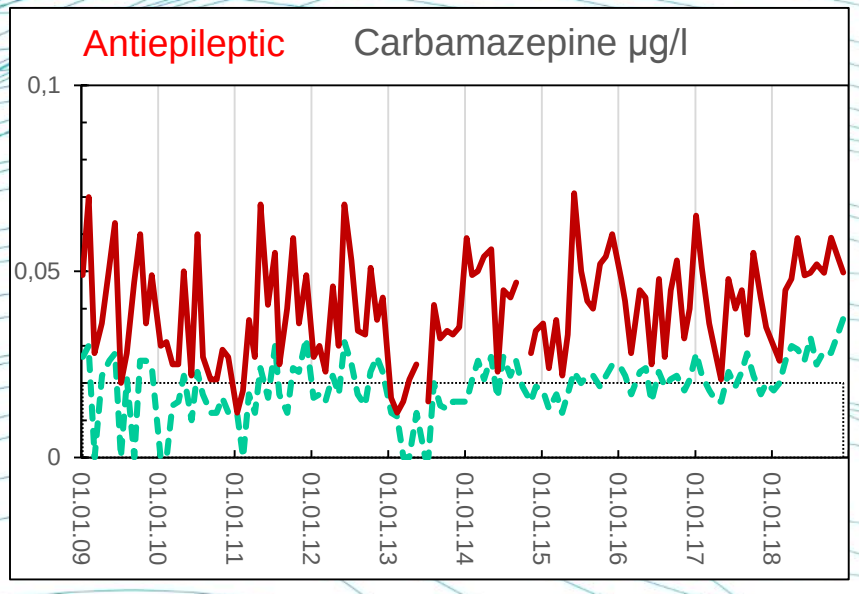


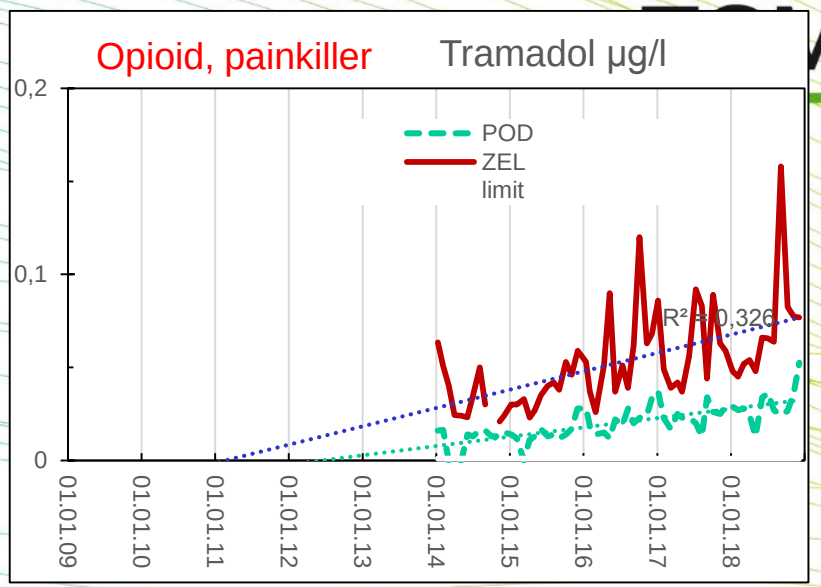



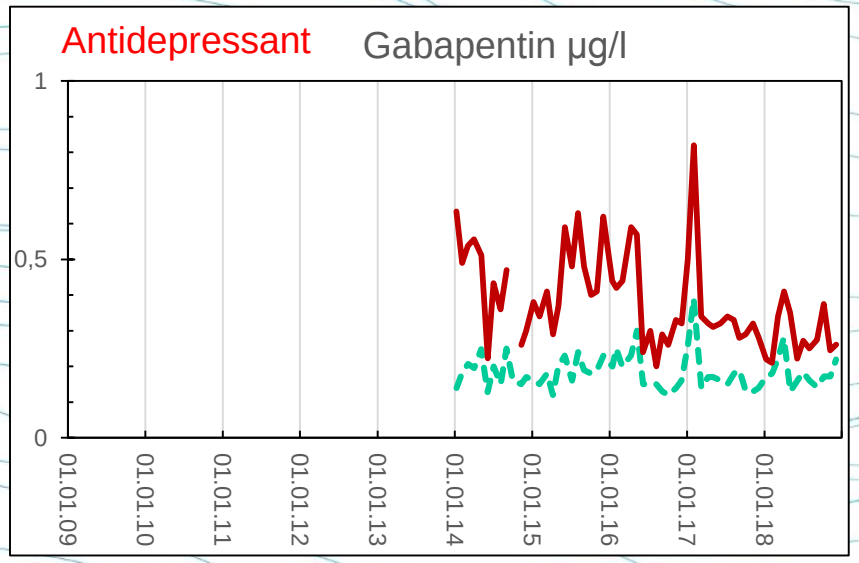

| | |
|---|---|
| **Iopromide** | **IOPR** |
| **Iohexol** | IOHEX |
| **Metformin** | METF |
| **Oxypurinol** | OXYP |
| **Hydrochlorothiazide** | THIA |
| **Metoprolol** | Metop |
| **Karbamazepin** | CAR |
| **Gabapentin** | GABA |
| **Tramadol** | TRAM |
| **Venlafaxine** | VENL |
| **Diclofenac** | DIC |
| **Ibuprofen** | IBU |
| **Ibuprofen-2-hydroxy** | IBU2 |
| **Clarithromycin** | CLAR |
| **Azithromycin** | AZIT |
| **Sulfamethoxazol** | SULF |
| **Caffein** | CAFE |
| **Cotinine** | Coti |
| **Saccharin** | SACH |
| **Acesulfam** | ACES |
| **Paraxanthine** | PARX |

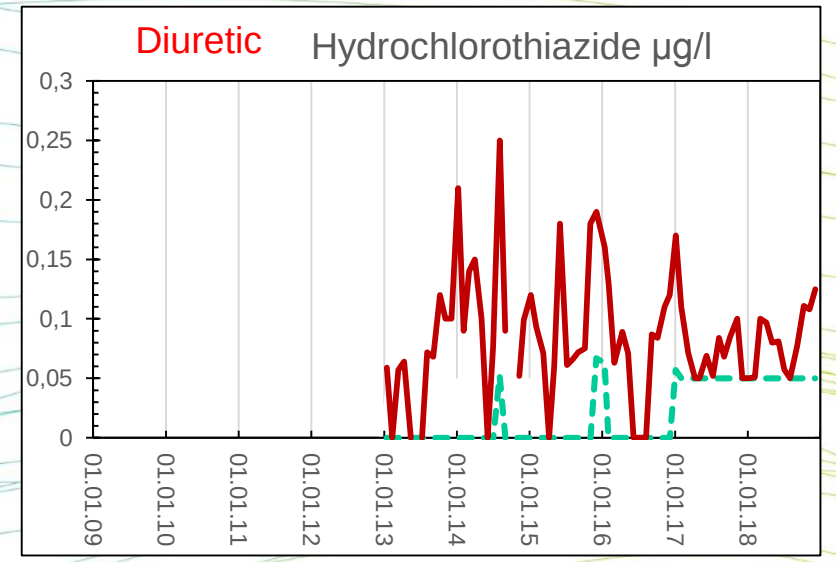
Columns from left: → Upstream to downstream through the City.

# Data from standard monitoring by the Vltava River Board:

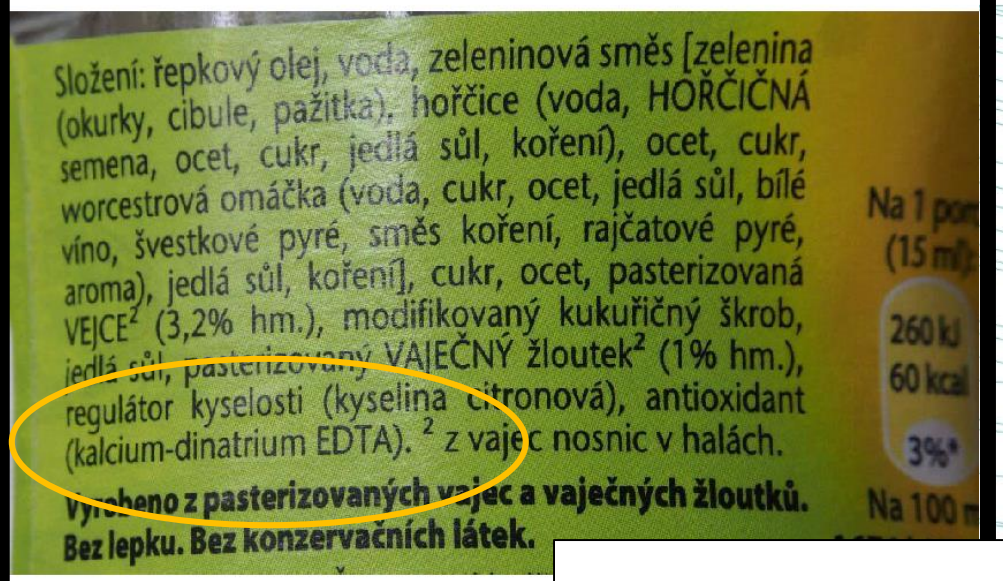


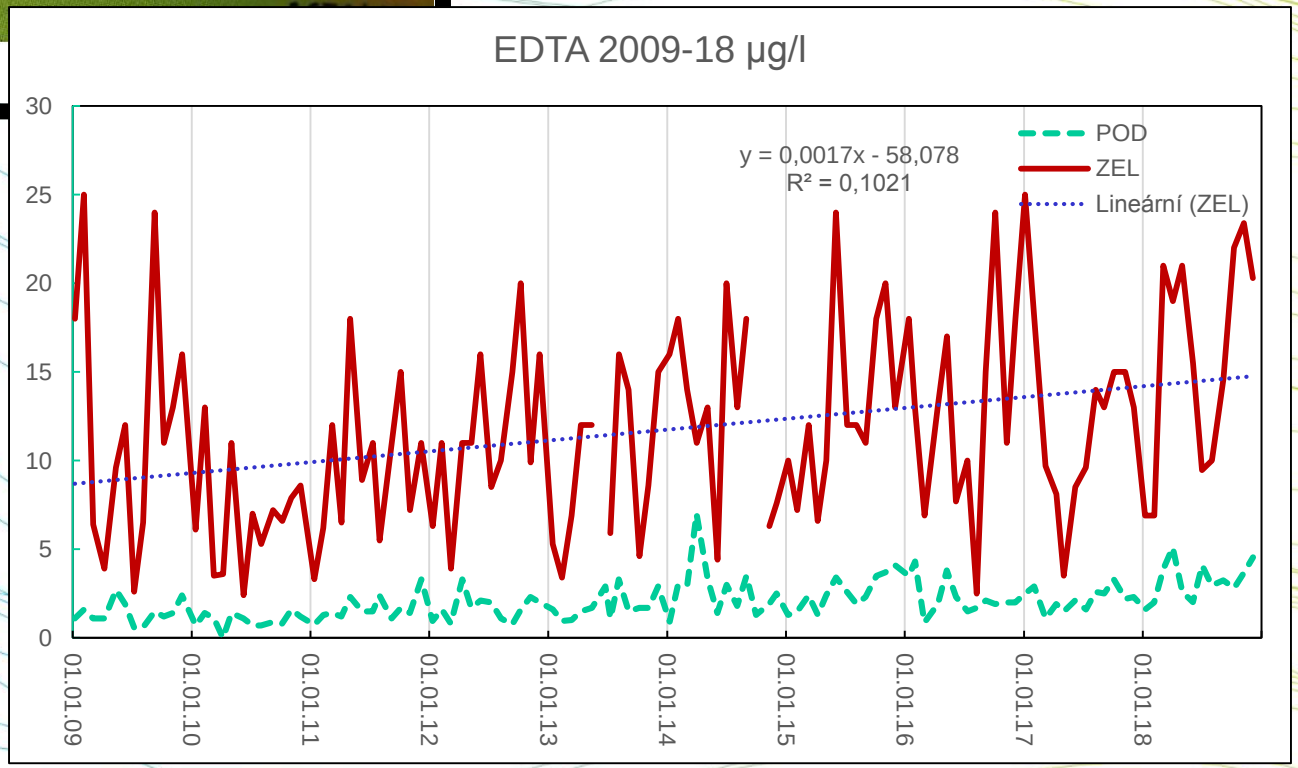
Common Sauce Tartar




Ethylene-diamino-tetraacetic acid:
Chelaton:

- Industry,
- Laundries, cosmetics,
- Food production…

EDTA,
an old companion.
No info on
health risk.



# Elimination of specific pollutants. from treated wastewater.

- UV – treatment.
- Ozonization.
- Advanced oxidation – ozonation etc.

  Problems:

  - residua of non-specific carbon
  - unknown abiotic products.
- Sorption: Mostly on POC (active coal):

  Main advantage: No „products“!!!

  Disadvantages: Expensive (is it???),

  bulk of waste, residua of non-specific carbon…

  Sorption seems optimal !!!

# Relevant activities of VUV TGM – T.G. Masaryk Water Research Institute:

Water Plant Testing Laboratory :

Testing Station of low-capacity WWTPs.

*Any technology and fate of any pollutant could be tested.*

Abatement of specific pollutants in waterworks (active coal sorption).

Abatement of specific pollutants from wastewater, pilot scale experiment on real WWTP (2000PE). Sorption (PAC) after membrane separation of sludge.

Impact of WWTPs discharge on rivers during a long-term drought.

Illicit drug transport by WWTPs.

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We are ready to co-operation.
Thanks for the attention.

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