Comparison of different technologies for the removal of pharmaceuticals from drinking water

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Pharmaceuticals in sources for drinking water

Increasing use of pharmaceuticals (>4000 active ingredients)
Pharmaceuticals and metabolites found in drinking water sources
Pharmaceuticals: biologically active, often water soluble, charged compounds
Not only organic micropollutants, but interesting model compounds because of large variety in properties
Adjust purification processes for drinking water for removal of pharmaceuticals.

Goal: Comparison of
- UV/H₂O₂ processes
- (affinity) adsorption
- nanofiltration

Specific energy demand of UV process (kWh/m³)

Effect M affluent

Best rejection for negatively charged and neutral compounds
Concentration polarisation phenomena (electrostatic attraction or repulsion)

Comparison of UV/H₂O₂ and nanofiltration

Energy demand:
- Nanofiltration < 0.3 kWh/m³, RO < 1 kWh/m³
- UV/H₂O₂ < 1 kWh/m³

QSARs
- UV/H₂O₂:
  - Good QSAR for hydroxyl radical rate constant
    - Electronic charges on C atom
    - Topological information on molecular size and distance between atoms
- Moderate QSAR for photolysis
  - Quantum yield
  - Molar absorption
  - Problem; validation with external data set

Nanofiltration: high predictability for this type of membrane
- Number of aromatic bonds
- Number of COOH groups on an aromatic ring
- Topological information

Conclusions

- Applicability UV/H₂O₂ processes, nanofiltration, (affinity) adsorption
- Comparison of technologies based on energy demand and molecular properties of compounds
- Water matrix, dealing with concentrates, fouling, formation of by-products, availability of adsorbents, regeneration possibilities etc. have to be taken into account
- Multi barrier approach probably most effective for removal of mixtures of pharmaceuticals

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