Pharmaceuticals in the environment

Make ideas work!

Environmental effective treatment and mapping of toxic medicine in hospital wastewater

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Two issues on the agenda

• Treatment possibilities

• Results from mapping of pharmaceuticals in wastewater from Aarhus University Hospital
MBR versus MBBR

- MBR technology working and operating in full scale at Herlev Hospital, Denmark
  - Supplier: Grundfos, Bioboooster

- MBBR Technology still under development in the MERMISS project
  - Supplier: Krüger, Veolia
Project participants in MERMISS

Caroline Kragelund Rickers, Kim Sundmark, Henrik Rasmus Andersen, Erik Bundgaard, Alice Toft Christensen, Kai Bester, Christina Sund, Jeanette Dietz Andersen, Karen Klarskov Møller, Niels Møller Jensen, Magnus Christensson, Klaus Litty, Sabine Lindholst
MBBR Technology

• Moving Bed BioReactor (MBBR)
  • Biological part consists of six reactors
    • Specialized microorganisms
  • Subsequent chemical oxidation with ozone

• Plant has been tested at AUH in 2015
  • Over a period of 9 months

• Is being tested at Herning Vand in 2016
  • Municipal wastewater treatment plant
Results so far (MBR vs. MBBR)

• Effluent concentration of organic compounds after treatment
  • MBBR (MERMISS) : COD ~25 mg/l
  • MBR : COD ~10-20 mg/l
  • Lower content of organic compound (COD) means lower ozonation costs = cheaper treatment

• Test of further removal of N and P
  • Total-N MBBR : 1-2 mg/l
  • Total-N MBR : 2-3 mg/l
  • Total-P MBBR : 0,2 mg/l
  • Total-P MBR : 0,2 mg/l
  • Important if the treated water is discharged to recipient (depending on national regulations)!
We’ll be wiser in 2017

- MERMISS is now up and running in Herning
  - Treatment of treated wastewater (post treatment)
  - Mapping the removal of pharmaceuticals
  - Treatment cost calculation

- Benchmark between local treatment at the hospital and centrally at the municipal wastewater treatment plant
While waiting on the MERMISS project

• Is it the environmentally right thing to treat wastewater locally at the hospital?
  • More ambulant treatment.
  • Increase of 34% (1/3) from 2007 to 2015
  • More medicine is discharged from patients own homes.

• Removal of pharma from wastewater is relatively expensive.
  • Mapping the environmental benefit highly relevant.
Mapping of discharge from AUH

• Only pharmaceuticals where consumption in secondary sector exceeds 2% of national consumption.

• Based on a danish list containing 42 pharmaceuticals (expanding)

• Toxicity in nature based on PNEC

• Precondition: All consumed medicine is disposed directly into the toilet/sewer (conservative estimate)
  • Metabolisation is not in consideration
  • Cocktaileffekt is not in consideration
  • Half-life is not in consideration

• Only pharmaceuticals consumed by Aarhus University Hospital is included.
Mapping of discharge from AUH

- **Essential**: Mapping is based on numbers from EPJ (Electronic Patient Journal) quality assured with data from pharmacy at Aarhus University Hospital
  - Calculated environmental impact for
    - Primary sector
    - Secondary sector

- 6 drugs in specific implies great environmental impact (98% of the total impact):
  - Mycophenolacid (71% alone), clarithromyzin, sulfamethoxazol, sertralin, ciprofloxazin and capecitabin
Calculated environmental impact

- Significant increase in total environmental impact from drugs used at Aarhus University Hospital (summed PNEC)
  - 2011: 14.752
  - 2015: 30.989 (110%)

- Less significant increase in environmental impact from hospitalized patients (summed PNEC)
  - 2011: 3181
  - 2015: 5092 (60%)
Calculated environmental impact

- Increase in relative impact from primary sector (peoples homes):
  - 2011: 78.4%
  - 2015: 83.6%
Conclusion on local scenario in Aarhus

• Time to think, before capital is invested!
  • Risk, that the environmental effect of local treatment fail to materialize.
  • Removal of pharmaceuticals from wastewater is relatively expensive. Therefore the right placement is important.
  • Mapping of distribution of environmental impact between primary and secondary sector is important – even crucial.
  • Treatment of all municipal wastewater will of course be more expensive in total. But if the environmental benefit is even bigger, a central treatment at the municipal wastewater treatment plant would be the right strategy.
  • A common international list on toxic pharmaceuticals is highly relevant.
Thank you!

Questions are of course welcome:

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