Evaluation report

for Odoriferous Substances

IKSR
CIPR
ICBR

Internationale Kommission zum Schutz des Rheins

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Within the strategy aimed at reducing micro-pollutant inputs originating from urban and industrial waste water, evaluation reports are being drafted for 10 groups of substances targeted at summarizing scientific and technical facts and at pointing out gaps of knowledge. Also, the evaluation reports present a variety of possible measures at the source (e.g. registration of substances, limitation of uses) and technical measures in crucial wastewater treatment plants (e.g. introducing a further treatment stage). The “Conclusions” of the evaluation reports list the most efficient measures to be further investigated into within a holistic ICPR strategy. However, these measures are no recommendations the ICPR addresses to its member states. Measures listed in this chapter will be integrated into a survey report of all measures in order to be able to take into account eventual synergetic effects of measures (effects of measures on different groups of substances) when proceeding with the final evaluation. Based on the final evaluation of all measures the ICPR will determine recommendations for the Member States

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1. Introduction

Odoriferous substances are widespread and used at any time. Apart from natural scents such as lavender, rose and vanilla there also exist synthetic odoriferous substances, for which a distinction can be made between nitro musk compounds (among others musk xylene and musk ketone), polycyclic musk compounds (among others the group of galaxolides with HHCB and the group of tonalides with AHTN) and macro cyclic musk compounds (such as cyclopentadecanolides). The last-mentioned group is often considered to be a replacement for nitro musk compounds. This evaluation report concerns polycyclic musk compounds, in particular HHCB (Galaxolide) and AHTN (Tonalide). Together with the nitro musk compounds these two substances represent the major share of musk compounds available (OSPAR, 2004).

HHCB and AHTN are used in different products such as soap, shampoo and cosmetics (42 %), detergents (25 %) and cleaning products (8 %). In Europe, the production of HHCB is estimated to 1,000 to 5,000 t annually (2001) and is located in one plant in the United Kingdom. The production of AHTN equally amounts to about 1,000 to 5,000 t annually (2001) and is located in a site in the Netherlands. In Europe, HHCB and AHTN are processed in 39, resp. 26 formulation works (works which produce the substances for application) into fragrance oil compounds. A major share of the production is exported to countries outside the EU (**E**uropean **U**nion). During 1992 to 2004, the consumption within the EU tended to fall.[1]

The following analysis is based on information derived from the substance data sheet.

2. Problem analysis

Due to the widespread use in households the substances are to be found in municipal wastewater. These substances are also detected in surface water bodies. In the Rhine catchment, mean values of up to 0.15 µg/l HHCB and 0.02 µg/l AHTN are detected, but maximum values may amount to 0.25 µg/l HHCB or 0.06 µg/l AHTN. These maximum values were measured in the R. Main, in the main stream of the Rhine they amount to 0.015 µg/l HHCB and 0.005 µg/l AHTN.

There are no environmental quality standards for HHCB and AHTN. For 4.4 µg/l HHCB resp. 2.8 µg/l AHTN no direct impact on aquatic organisms is to be expected (compared to PNEC values). These values, the value of the IAWR (**I**nternationale **A**rbeitsgemeinschaft der **W**asserwerke im **R**heineinzugsgebiet) of 1 µg/l and the proposals of the German Umweltbundesamt (Federal Agency of Environment) for an environmental quality standard of 7.0 µg/l for HHCB and 3.5 µg/l for AHTN are apparently not being exceeded.

These substances are moderately soluble in water and are highly liposoluble, biologically persistent and highly accumulate in organisms.[2] Although the EU-**R**isk **A**ssessment **R**eports (RAR) do not mention HHCB and AHTN as PBT substances (**p**ersistent, **b**io-accumulating and **t**oxic), high contents of HHCB and AHTN have been detected in fish: In a

[1] EU-Risk Assessment Report (RAR) HHCB (May 2008) and EU-RAR AHTN (May 2008), final approved version, The Netherlands

[2] Hessisches Landesamt für Umwelt und Geologie, internet publication: http://www.hlug.de/medien/wasser/gewaesserbelastung/dokumente/orientierende_messungen/6.14Moschusverbindungen.pdf

study of the Hessisches Landesamt für Umwelt und Geologie a mean concentration of 0.51 mg/kg fresh weight was determined for HHCB and of 0.20 mg/kg for AHTN. In grease, values were 20, resp. 10 times higher. In a water body with a 50 % share of wastewater from an outlet of a wastewater treatment plant, a content of 3 mg/kg DM HHCB and 2.5 mg/kg DM AHTN was measured in trout.

3. Analysis of pathways

Considering the low number of production and formulation works in the Rhine catchment and the considerable use of products in households, the emissions of odoriferous substances mainly originate from wastewater after treatment in a wastewater treatment plant. For HHCB, the mean concentration in the outlet of a wastewater treatment plant amounts to 1.6 µg/l and for AHTN to 0.3 µg/l. Generally, the substances are well eliminated in the wastewater treatment plant (70 – 80 %). About half to well two thirds[3] of the concentration are found in sewage sludge. In Germany and for the years after 2000, the EU-RAR mention contents in sludge in an order of magnitude of 1.2 to 15 mg/kg dry weight and 1.1 to 7 mg/kg dry weight for HHCB resp. AHTN. This must be taken into account when spreading sewage sludge on land, e.g. in agriculture. Therefore, in this connection, measures at the source are of particular importance in order to reduce the pollution of the soil with these substances when spreading sewage sludge on land.

4. Possible measures

In order to reduce emissions of odoriferous substances, emission reduction measures may be taken at different levels:

- Measures at the source;
- Information of the public and the trade public;
- Treatment of wastewater split flows;
- Measures in urban wastewater treatment plants;
- Adaptation of monitoring programmes.

In the following, the potential measures are explained in greater detail.

Measures at the source
Reduction of the pollution of water bodies by:

- Extended environmental impact assessment within market authorisation (e.g. bio-accumulation in biota);
- Product innovation: By developing and using more environmental friendly substitutes (biologically degradable, easier to eliminate) the pollution of the aquatic environment may be reduced;
- Avoid the use of cleaning agents and cosmetics containing odoriferous substances (those who use the products; consumers, trade).

Information of the public
The public, in particular the trade public (trade and those using odoriferous substances in products) must be informed about the impact of odoriferous substances on waters and about possible alternative products. In this connection, consumer products with an EU environment label which may thus no longer contain any HHCB and AHTN should be considered.
Regulations exist for the following consumer products:

- Dishwasher detergents (2003/31/EC), Regulation of 29 November 2002, modified by Regulation of 4 February 2011 (2011/81/EU);
- Detergents (2003/200/EC), Regulation of 14 February 2003, modified by Regulation of 4 February 2011 (2011/81/EU);

[3] http://www.bmu.de/files/pdfs/allgemein/application/pdf/vortrag_08.pdf

- Dishwashing detergents (2005/342/EC), Regulation of 23 March 2005, modified by Regulation of 30 November 2009 (2009/888/EU);
- Household detergents and sanitary detergents (2005/344/EC), Regulation of 23 March 2005, modified by Regulation of 30 November 2009 (2009/888/EU);
- Soap, shampoo and hair conditioner, deep conditioners (2007/506/EC), Regulation of 15 December 2006, modified by Regulation of 30 November 2009 (2009/888/EU).

Decentralized measures – wastewater treatment in split flows and problem avoidance

Single production or formulation plants for odoriferous substances may contribute to the (local) pollution of surface waters with these substances. The following measures may be considered in order to reduce the discharge of odoriferous substances:

- Organizational, in-house measures in the production plants to avoid generating wastewater or to reduce the amount of wastewater and pollutants to be discharged (e.g. recycling);
- Further cleaning stages in order to eliminate the odoriferous substances and eventually other environmentally relevant substances in wastewater; this can contribute to achieve multiple effects.

Centralized measures in wastewater treatment plants

Ozonisation as further treatment procedure may eliminate more than 99 % of HHCB and AHTN (taking into account the traditional outlet of the wastewater treatment plant), and adsorption to activated carbon can achieve an elimination of up to 97% resp. 92%.[4] Further treatment procedures aimed at eliminating micro-pollutions (ozonisation, use of activated carbon) increase the elimination performance of wastewater treatment plants. This will also improve the elimination of the odoriferous substances HHCB and AHTN. The estimated 3,200 wastewater treatment plants in the Rhine catchment cover a total volume of at least 98 million population equivalents. 191 of these wastewater treatment plants (that is 6 % of all wastewater treatment plants) dispose of a total volume of more than 100,000 population equivalents). These wastewater treatment plants thus dispose of more than half of the entire treatment capacity (54 %) in the Rhine catchment[5]. Extending these 191 wastewater treatment plants by the aforementioned further treatment procedures could reduce emissions of odoriferous substances (and of many further micro-pollutants) into the Rhine by at least 30 %. It is not useful to implement further treatment procedures only for odoriferous substances.

Adaptation of monitoring programmes and systems of assessment

Legally binding quality criteria must be derived at the appropriate institutional level in order to assess the ecological/chemical state and to protect drinking water resources.

[4] Final report of the research project “Analysis of inputs and elimination of dangerous substances in municipal wastewater treatment plants – phase 3”, MUNLV NRW, 03/2008

[5] Report to the European Commission on the results of the survey according to Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (article 15(2), 1st indent); (Part A = Overriding Part) State: 18. March 2005, Coordination Committee Rhine 2005 (CC 02-05d rev. 18.03.05).

5. Conclusions

Summary of the most efficient measures aimed at reducing the pollution of the aquatic environment with the odoriferous substances HHCB and AHTN which must be further elaborated and examined.

Measures at the source:

- Changeover to available and successfully used, more environment friendly substitutes of odoriferous substances. If no environment friendly alternatives are available, develop them within product innovation and test them for use;
- Organisational in-house measures (good practice) to reduce quantities used (optimized dosing);
- In-house measures aimed at reducing the quantity of polluted wastewater (recycling).

Decentralized measures:

- In-house measures aimed at reducing the quantity of polluted wastewater and at reducing the degree of wastewater pollution (recycling);
- Wastewater treatment or treatment of wastewater split flows in production and formulation works for odoriferous substances either discharging their wastewater directly into surface waters or indirectly passing by wastewater treatment plants.

Information of the public and of the trade public:

- Due to improved labelling;
- On the impact of these products on the environment and drinking water;
- On the possibility to use eco-labelled products, e.g. products with the European eco label which do not contain any HHCB or AHTN.

In general, the odoriferous substances HHCB and AHTN are well eliminated in wastewater treatment plants. Additional **centralized measures** to further reduce only emissions of odoriferous substances are no subject of discussion.

If further wastewater treatment procedures are implemented in the biggest wastewater treatment plants in the Rhine catchment, the emissions of a wide range of micro-pollutants into surface waters will be considerably reduced. The extension of this reduction depends on the substance, the substance characteristics and the extent of further treatment procedures. A reduction of emissions will include odoriferous substances.

Adapt the monitoring programmes on the basis of simple model estimates, quantities used and field of application, information from licensing procedures and the results of scientific analysis. In this connection, the bio-accumulation in biota must be taken into account.