The role of Urban Waste Water Treatment for water protection in the Danube Basin

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The Danube River Basin is Europe's second largest river basin, with a total area of 801,463 km². It is the world's most international river basin as it includes the territories of 19 countries. The ecosystems of the Danube River Basin are highly valuable in environmental, economic, historical and social terms, but they are subject to increasing pressures like serious pollution from agriculture, industry and cities. As Danube is the major tributary of the Black Sea, the activities in the Danube River Basin have essential influence on the Black Sea ecosystem.

The International Commission for the Protection of the Danube River (ICPDR) is a transnational body, which has been established to implement the Danube River Protection Convention. The ICPDR comprises of 15 contracting parties including all countries with an area of more than 2,000 km^2 within the Danube Basin and the European Commission. In 2000 the contracting parties nominated the ICPDR as the platform for the implementation of all transboundary aspects of the EU Water Framework Directive (WFD). A milestone for implementation of WFD was the release of the Danube River Basin District Management Plan in 2009. Within this plan four significant pressures have been identified in the Danube River Basin District:
a. organic pollution,
b. nutrient (nitrogen N and phosphorus P) pollution,
c. hazardous substances pollution and
d. hydromorphological alterations.
Urban waste water treatment plays an essential role in the control of the first three of these pressures.

Due to the economic development of the Danube River Basin Countries the actual situation of urban waste water collection and treatment varies in a broad range throughout the Danube Basin. On the one hand there are countries where waste water from almost all agglomerations with > 2,000 population equivalents (PE) are collected and treated in urban waste water treatment plants including nutrient removal (tertiary treatment). On the other hand in some countries a major part of the urban waste water is not collected at all or is collected but discharged without any treatment (reference years 2005/2006). In total the generated load at agglomerations with > 2,000 PE in the Danube Basin corresponds to almost 95 million PE of which about 40 % are treated in treatment plants with nitrogen and/or phosphorus removal, about 20 % are treated in treatment plants with organic carbon removal (secondary treatment) and about 5 % receives other types of treatment. However, about 35 % are either collected and not treated or not collected at all.

In case of organic pollution (a.) out of a COD load in raw waste water of about 4,200 kt/a from agglomerations with > 2,000 PE about 1,500 kt/a have been released to water ecosystems in 2005/2006. As a consequence urban waste water is the dominant source of emissions of easily biodegradable organic carbon in the Danube Basin, causing severe oxygen depletion and groundwater and river degradation at several regions in the Basin. **The ICPDR's basin-wide vision for organic pollution is zero emission of untreated wastewaters into the waters of the Danube River Basin District.** In order to achieve this vision, significant efforts for improvement of urban waste water collection and treatment have been foreseen in the Danube Basin till 2015.

In case of nutrient pollution (b.) out of almost 350 kt/a nitrogen in raw urban waste water generated in the Danube Basin about 185 kt/a have been discharged to surface waters. For phosphorus out of about 55 kt/a, 37 kt/a are released to surface waters. Total emissions to surface waters from all sources in the Danube Basin actually are about 690 ktN/a and 58 ktP/a. Thus, discharges of urban waste water are about 27 % of the total N emissions but even 64 % of the total P emissions into the surface waters of the Danube Basin. However, especially for P urban waste water treatment already is significantly reducing water pollution on a catchment scale. **The ICPDR's basin-wide vision for nutrient pollution is the balanced management of nutrient emissions via point and diffuse sources in the entire Danube River Basin District that neither the waters of the Danube River**

Basin District nor the Black Sea are threatened or impacted by eutrophication. Scenario calculations show that implementation of requirements of urban waste water directive for sensitive areas significantly would contribute to the achievement of this vision and therefore is foreseen by EU-member countries. Nonetheless, the envisaged load reduction for N discharges via River Danube to the Black Sea down to the values in the 1960ies will probably fail due to the dominating influence of diffuse sources of pollution. For P additional emission reduction by Basin-wide reduction of P in detergents is foreseen and could additionally lead to significant improvements. Nonetheless, for Phosphorous the respective management objective of reducing River Danube loads to the Black Sea down to the values in the 1960ies will not be achieved by 2015 as well. Further measures including N and P removal at urban waste water treatment plants of non EU members and addressing diffuse pollution will become necessary.

In case of hazardous substance pollution (c.) no quantitative assessment of pollution of hazardous substance and its sources is available on Danube Basin level. **The ICPDR's basin-wide vision for hazardous substances pollution is no risk or threat to human health and the aquatic ecosystem in the Danube River Basin District and Black Sea waters impacted by the Danube River discharge.** This is ambitious task that will not be achieved within only few years. From literature it is known that urban waste water treatment plants with nitrification (indicating low loading and high sludge age of the plant) are able to effectively eliminate many of the hazardous substances from urban waste water. Therefore improvement of urban waste water treatment including nitrification and denitrification can contribute to substantial improvements in this field. However, some emerging substances are not removed by biological treatment. There is an ongoing discussion in Europe on the necessity of an additional treatment step after tertiary treatment with nutrient removal for advanced removal of emerging substances (treatment with ozonation, active carbon filtration). In Switzerland requirements in this respect are actually being introduced for urban waste water treatment plants with more than 100,000 PE and for smaller treatment plants discharging to rivers important for drinking water supply or with low dilution.

Another important aspect of urban waste water treatment is the pollution with infectious organisms. This topic is not very much in focus of water pollution control in Europe and the Danube Basin at the moment. Typical waste water treatment plants significantly reduce emissions of these parameters (bacteria and viruses), but do not achieve effluent quality required for e.g. bathing water. In some cases additional disinfection steps (e.g. UV radiation) have already been implemented if a specific focus is on recreational uses of surface water. Hygienic considerations are especially important in case of direct or indirect reuse of waste water and probably will get more in focus at the waste water treatment plants in the future.

All together it is clear that urban waste water treatment plays a major role in water pollution control in the Danube Basin. A lot of progress has already been achieved. Nevertheless, Danube Countries are facing significant challenges in improvement of urban waste water treatment within the next years. ICPDR has taken the lead in coordination of these activities on Basin level. A program of measures for all Danube countries has been jointly developed. All Danube countries are planning to introduce collection and biological treatment for all settlements with more than 2,000 PE. As the whole Danube Basin is seen as sensitive area, nutrient removal at urban waste water treatment plants will be required in all EU-member states in the Basin and fate out of the use of P-containing detergents is foreseen though out the Basin. As these measures probably will be not sufficient to achieve management objectives for protection of the Black Sea ecosystem, additional efforts for reduction of nutrients emissions including diffuse sources of pollution will become necessary in the future.