Carbamazepine

General sectors: Pharmaceutical

(CAS numbers: e.g. 298-46-4, EC number: 206-062-7
/ Entry number in HELCOM list of priority substances: 7)

DRIVERS | ACTIVITIES | PRESSURES | STATE | IMPACTS

Why a HELCOM priority?

Main evidence

P Approximately **2-10 tonnes of Carbamazepine** are estimated to enter the Baltic Sea every year, mainly via Wastewater Treatment Plants (WWTP) / rivers (Undeman et al, 2022[1]; WATERBASE[2]; Langas-MORPHEUS, 2019[3]). Given that the substance is **toxic**[4], current inputs are possibly significant, in terms of risk they pose for the Baltic Sea and its ecosystem services. As mentioned above, levels in Baltic Sea have already occasionally exceeded thresholds. As WATERBASE data covered only ~1% of the Baltic Sea catchment, for the inputs range estimation above were used the Undeman's study on WWTP discharges (2010-2019) and a value derived from the few samples of WATERBASE and of the MORPHEUS study, both focusing on mouth rivers.

S Concentrations of Carbamazepine exceed the applied threshold value in **1** of the 21 examined areas (assessment units) of the Baltic Sea. This is a coastal area. In this area, **100%** of the assessible samples in **water and/or sediment** exceed the threshold value. This is based on monitoring data for the period 2015-2024 from scientific articles/reports[1]. A total number of 422 data points were possible to evaluate for Carbamazepine.

By further considering how much above or below the threshold each concentration is, and how often the substance is detected, Carbamazepine scores **6.0/10** (confidence range: **6.0 – 6.0**) in the scale established when assessing the criticality/significance of current levels in the Baltic Sea pose, where 5 indicates concern and 10 extreme risk, and the range reflects the level of reliability and representativeness of concentrations and the thresholds.

The threshold values for Carbamazepine, for water and sediment, were acquired respectively from the EC proposed Directive amending WFD and EQSD[5] and the ecotoxicology database of the NORMAN Network[6].

I Current levels in the Baltic Sea indicate potential negative impacts on sediment dwelling biota and pelagic biota.

Supporting evidence

P According to literature, carbamazepine has been reported as being frequently found in landfill leachate[7], and is commonly found in wastewaters[8].

A With sales in CPs of ≥9 –15 t/y (2015-2022[9]), the predicted (conservative) river concentration at the proximity of WWTP effluents by using the guidelines of Phase I ERA is 0.2 – 0.4 times the threshold value for freshwater (0.2 when using the sales figure from 2022).

I Carbamazepine is considered to have a concerning **mode of toxicity**, as it is neuroactive[10]. Neuroactive substances cause sublethal neurological impacts like disorientation or altered behaviour that can affect feeding success, predator avoidance, and overall survival.

Overall assessment

When assessing current levels in the Baltic Sea, current inputs, and the severity of the relevant toxicity mechanism, Carbamazepine scores **53-60/100** in the scale established for assessing the overall risk for impacts/threat for the Baltic Sea, where 50 indicates concern, 100 extreme risk, and the width of the span outlines the uncertainty in the assessment.

Facts relevant for management considerations

Causal chain and pathways

A Carbamazepine is an antiepileptic[11]. Based on combined information from countries that contributed to the HELCOM data call on pharmaceutical sales[9], there is a decreasing trend. According to further expert judgement, in Finland sales have decreased ca. 50% over the last 20 years. In Germany, in general sales of antiepileptic drugs are increasing.

P As mentioned above, the substance appears to enter the Baltic Sea via WWTP effluents (released either to rivers or to coastal waters). With landfill leachates also contributing to the overall releases.

S ? *In order to further improve the evaluation of the magnitude of risk, one aspect that could be investigated in the future is possible toxic transformation products, such as 10,11-dihydro-10-hydroxycarbamazepine, which also has been detected in marine water in potentially critical/significant levels.*

Relevant policies (existing or planned measures)

M (on A/P)

- Listed as priority substance in the **EU WFD** update proposal.
- It is one of the 'Category 1' substances (substances that can be very easily treated) in the updated Directive on urban wastewater treatment.

References:

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.11.

[Note: Listing of detailed references will be provided in an upcoming update of the fact sheet – for a listing of the most common references among the different substances see the section at the end of the consolidated document which includes all the fact sheets]