INDUSTRIEVERBAND
HYGIENE & OBERFLÄCHENSCHUTZ
FÜR INDUSTRIELLE UND INSTITUTIONELLE ANWENDUNG

IHO-Factsheet on the Relevance of phosphate and other phosphorus compounds in professional cleaning chemistry

07.02.2022

Background

In May 2018, the Öko-Institut e.V. in Darmstadt wrote the final report of the study on the "Relevance of commercial textile and tableware cleaning on the input of phosphate and other phosphorus compounds (P) into wastewater"[1] on behalf of the Federal Environment Agency (UBA). The report was published by UBA in 2021.

Short summary of the report

The UBA report analyses the input of phosphorus compounds into the environment caused by professional washing and cleaning products. The study determined the reasons for the use of phosphorus compounds in professional washing and cleaning products, the quantities used and the resulting input of phosphorus into wastewater. Based on these data, an input from phosphates and phosphoric acid of **3,000 to 5,000 tonnes of phosphorus per year** was calculated. The amount of phosphorus entering from phosphonates is given as **120 to 1,332 tonnes per year**. Together, this corresponds to **about 0.7 to 1.6 % of all inputs** of phosphorus compounds into water bodies.
Currently, it is assumed that 50 % of the phosphorus inputs from phosphonates are retained in wastewater treatment plants. This results in an **actual phosphorus input of 60 to 666 tonnes per year**, which is about 0.3 % to 3 % of the total phosphorus inputs to surface waters.

The following is an overview of the use of phosphorus compounds in cleaning chemistry.

[1]Summary from the UBA report: Relevanz der gewerblichen Textil- und Geschirrreinigung am Eintrag von Phosphat und anderen Phosphorverbindungen (P) in das Abwasser (Forschungskennzahl 3716 64 411 0 FB 000591; ISSN 1862-4804) and information from IHO-members

Commercial dishwashing

Phosphates

Phosphates are used in dishwashing detergents primarily as hardness stabilisers, dispersants, and bleach stabilisers.

Technical aspects

- Phosphates ensure the performance of cleaners. Replacing them could lead to a loss of performance.
- Compensating for this loss, e.g., through higher heating capacities or larger quantities of water (see below), machine conversions or corresponding process adjustments may be necessary, which may not be in line with the optimisation of sustainability aspects.

Sustainability aspects

- Phosphates contribute to a notable reduction in water, energy, and detergent consumption, as their use allows a greater concentration of dirt to be dispersed in the cleaning liquor.
- The comparatively more costly production of substitutes could significantly worsen the life cycle assessment of cleaning agents.

Phosphonates

Phosphonates are used in dishwashing detergents as hardness stabilisers and as stabilisers of bleaching agents.

Technical aspects

- Phosphonates are technically critical and difficult to substitute.
- The substitution of phosphonates reduces the cleaning performance of cleaners (e.g., tar edges cannot be bleached in short treatment times).

Sustainability aspects

- Replacing phosphonates could lead to about 5x more water, energy, and detergent consumption.

Commercial textile cleaning

Phosphates

In detergents, phosphates are primarily used as hardness stabilisers and detergency enhancers, with phosphonates predominantly being used for hardness stabilisation. Phosphates are usually used in additional washing aids such as detergency boosters and not in basic detergents for heavily soiled workwear.

Technical aspects

+ Weak alkalisation of the washing lye to pH 9.5 - 10.0, which protects the textiles while reprocessing.
+ Water softening helps to save resources by (a) avoiding textile incrustation and (b) avoiding the deposition of Ca/Mg compounds on machine components.
+ The dispersion of pigments, fats, and oils in heavily soiled textiles from the workwear sector increases the primary washing effect compared to the conventional state of the art.
+ The prevention of redeposition on the washed textile significantly improves the brilliance of blue workwear. The improved quality reduces the need for rewashing and conserves resources by increasing the duration of use of the textile.
+ In individual cases (e.g., hygienisation, soiling by metal abrasion, road dust or colour pigments), the use of phosphates may be necessary to ensure optimum cleaning performance.
+ Certain problems in the operation of the system (e.g., failure of the water softener) may require the temporary use of phosphates.

Sustainability aspects

+ In washing processes designed for the individual cases described above, the substitution of phosphates could mean switching to more energy- and resource-intensive processes.
+ Alternative substitutes based on MGDA-Na_3, GLDA-Na_4 or IDS-Na_4 are not an economically viable alternative for professional laundries, for either significantly higher application concentrations must be used or otherwise a significantly higher post-wash rate is needed. An increased post-wash rate results in an increased use of resources in terms of water, energy, detergent, and personnel. Despite their easy biodegradability, such complexing agents lead to an increase in COD and BOD values in the wastewater, which makes it much more difficult to transfer the untreated wastewater to the municipal wastewater works.

INDUSTRIEVERBAND
HYGIENE & OBERFLÄCHENSCHUTZ
FÜR INDUSTRIELLE UND INSTITUTIONELLE ANWENDUNG

Phosphonates

Phosphonates are used in detergents as hardness stabilisers and to complex metals. These enter the machine via the laundry, from the water, the machine or from pipes. Metal ions can damage the laundry as well as impair the effect of bleaching agents and disinfectants, which can lead to overdosing.

Technical aspects

+ As a stabiliser of bleaching agents and disinfectants in detergents, phosphonates are technically indispensable and difficult to replace (e.g., substitutes are attacked by bleaching agents, whereby the strength of the oxidising effect depends on the bleaching agent and the respective substitute).
+ Effective stabilisation is necessary for bleaching agents and disinfectants to work effectively and thus achieve the desired cleaning performance.
+ Effective stabilisation is essential for chemical disinfectants. The reduced use of materials contributes to the conservation of resources.

Sustainability aspects

+ Substitutes for phosphonates such as MGDA-Na_3, GLDA-Na_4 or IDS-Na_4 or polycarboxylates must be used stoichiometrically or hyperstoichiometrically in contrast to phosphonates.
+ The substitution of phosphonates would mean a change in current washing processes towards processes with higher temperatures and higher water and detergent consumption, thus causing poorer sustainability of the processes.
+ As today's textiles are not designed for higher temperatures, washing at high temperatures will reduce their durability.

Industrial cleaners

Phosphoric acid und phosphates

In industrial cleaners, phosphoric acid and phosphates are used as hardness stabilisers, descaling agents and as corrosion inhibitors.

Technical aspects

- If phosphoric acid is replaced by organic or mineral acids for hardness stabilisation and decalcification, the surfaces are attacked during cleaning due to the lack of passivating effect of the alternatives.
- Polycarboxylates can alternatively realise the necessary dirt carrying capacity but must be used over-stoichiometrically to achieve a comparable cleaning effect.

Phosphonates

Phosphonates are used in industrial cleaners as hardness stabilisers on the one hand and as stabilisers of bleaching and disinfection components on the other.

Technical aspects

- EDTA or polycarboxylates can be used as substitutes for phosphonates ─ in contrast to phosphonates, however, stoichiometrically or hyper stoichiometrically.
- In bleach formulations, substitution of phosphonates or phosphates is not possible in principle, as the substitutes are decomposed by the bleaching agents.

Conclusion

The amount of phosphate that is discharged into nature, or more precisely into surface waters, by commercial cleaning agents cannot be determined exactly. According to calculations that tend to be too high, the phosphorus input by commercial cleaning agents can be estimated at values between 0.7 % and 1.6 % of the total phosphorus input into surface waters.

Measures to reduce the phosphor content in the formulations of professional cleaning chemicals thus hardly make a significant contribution to improving water quality. On the contrary, it is to be expected that potential changes in formulations could lead to an increase in water consumption, chemical inputs (higher COD values) and energy (higher temperatures) in the cleaning processes, thus hindering efforts to design sustainable processes.