Consultation Questionnaire Exemption No. 4(f) of RoHS Annex III

Current wording of the exemption:

Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex

Requested validity period: Maximum (5 years and 7 years (cat. 8 and 9) respectively)

Xylem is an international water company providing equipment, services and digital solutions helping to solve the worlds water related issues with offerings in transport, analytics and treatment headquartered in the US with approx.16,000 employees and 6 b USD of revenue. In its portfolio, Xylem commercializes UV systems for disinfection of clean water in residential commercial, industrial and municipal applications as well as waste water for discharge and reuse. Technologically, the current offering covers low pressure and medium pressure mercury lamps - in addition, research and product development activities are embracing non-mercury UV C sources. The growth center for Xylem's UV disinfection business includes 3 manufacturing sites with its center in Herford/Germany, involving globally several hundreds of employees in over 100 countries.

1. VDMA and LightingEurope**Fehler! Textmarke nicht definiert.** requested the renewal of the above exemption for the maximum validity periods with the same scope and wording for all EEE of cat. 3 and 5 (VDMA) and cat. 1-10 (LEU).
   a. Please let us know whether you support or disagree with the wording, scope and re-quested duration of the exemption. To support your views, please provide detailed technical argumentation / evidence in line with the criteria4 in Art. 5(1)(a).

We agree with the wording, scope and requested duration of the exemption. For our purpose of water disinfection with UV light it is essential to use high power lamps that have a high UV-C light yield, measured as electrical efficacy. Technical it is not possible to replace a discharge lamp at this point with a different kind of UV light emitting device for many reasons. A few of them are listed below:

- Validation (validation = biological test procedures & certifications for disinfection performance) protocols which are mandatory for municipal drinking water UV disinfection in Germany and Austria - and requested in many other European countries - are only covering mercury discharge lamps. Alternative UV-C-light sources are not allowed for municipal potable water disinfection and not foreseen in further international standards for water and waste water disinfection.
- There is no validated monitoring strategy available for UV systems with non-mercury lamps. The UV sensors for mercury discharge lamps use filters for the specified wave length spectrum. The sensor technology is not developed for the wavelength characteristics of the UV LEDs and corresponding wavelength ranges would not be detected correctly.
- Disinfection performance of alternative lamps at wavelengths different than 254 nm is unclear.
- Current alternatives are not ecologic nor economical when it comes to electrical efficiency, lifetime, coste per W UVC production capacity, cooling requirements.

- Alternative UV-C light sources consume much more electrical power and by that would drastically increase carbon footprint if deployed (e.g. by factor of 10).

- The operability of LEDs is strongly dependent on the water temperature: the production capability of the UVC light, the durability and the efficiency decrease with increasing temperature. That limits / affects the applicability of UV-C LEDs to higher water temperature such as showers, HVAC recirculation loops or industrial applications with warm liquids such as in food & beverage industry. When designed accordingly, mercury based lamps can be adapted to warm water operation maintaining efficiency and lamp life.

From the industry's point of view, shortening the period of validity does not make sense because development on the basis of UV LEDs or other mercury free UV-C light sources requires a lot of time and development in the UV-C sector in particular still faces major challenges. The current wording of the exemption: "Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex" should therefore be retained.

b. If applicable, please suggest an alternative wording and duration and explain your proposal.

Not applicable

2. Please provide information concerning possible substitutes or elimination possibilities at present or in the future so that the requested exemption could be restricted or revoked.

a. Please explain substitution and elimination possibilities and for which part of the applications in the scope of the requested exemption they are relevant.

Some low energy mercury lamps could possibly be exchanged by different kind of lamps, such as excimer lamps or UV LEDs, in the far future. Currently, these possible substitutes show substantially low power efficiencies (e.g.: LED: < 3% vs low pressure mercury: ~35%) which limits their usage to very small flow rates such as Point-of-Use applications if at all.

A use of systems with energy efficiency below 25% multiply the power deployed for generation of the same amount of UV-C light accordingly (3% eff vs 35% efficiency=> 10x more consumption of electrical power) – with corresponding consequences for the carbon footprint reduction targets of e.g. the “EU green deal” aiming at 35% CO2 reduction by 2035%.

The larger UV disinfection system (determined by e.g. flow rate disinfection target and water quality), the stronger and more obvious the disadvantages of alternative UV C sources become. Especially for larger municipal installation, and in addition when applied to waste water, cost and energy consumption would make UV C disinfection inviable.

Disinfection systems in municipal drinking water supply applications (independent form the flow rate) are regulated by local drinking water directives, strictly limiting the disinfection technologies which are allowed to be used. All UV-disinfection units need to be DIN 19294 or ÖNORM M5873 validated in Germany and Austria. Beyond those countries, at least France, Sweden, Norway and Switzerland do refer / require those regulations when UV is applied to municipal drinking water. The validation protocols cited do not know / refer to any other than mercury discharge lamps. The same goes for countries and/or applications where the internationally recognized standard - based “UV Design Guidance Manual (US EPA - UVDGM)” is requested as basis for designing UV systems for disinfection of municipal drinking water or waste water

Chlorination as alternative disinfection method has the potential to product harmful byproducts when reacting with organic substances contained in water or waste water. Some of those byproducts are suspect to cause e.g. cancer. A change back to chlorination as main disinfectant would increase the potential threat to public health and impose safety risk by handling and potentially releasing aggressive chlorinated liquids or gases.

Certain pathogens such as Cryptosporidium and Giardia are very resistant to chlorination, but easily inactivated by UVC, so a change from UV-C light to chlorination would either requiring a drastic increase of chlorination dosage – with the consequence of much higher rate of formation of harmful chlorination byproducts -, or leave those pathogens untreated – with all corresponding risks to public health and or product quality issues by taste & odor in industrial production of e.g. food & beverage caused by chlorination byproducts.

b. Please provide information as to research to find alternatives that do not rely on the exemption under review (substitution or elimination), and which may cover part or all of the applications in the scope of the exemption request.

As a mercury discharge lamp supplier, we are investigating towards more efficient mercury lamp types for a use in water & waste water disinfection. At the same time, as a technology and environment-driven large multi-national company, Xylem is investigating on mercury free alternatives since > 10 yrs - with the result that mercury lamps cannot be replaced economically and environmentally reasonable way by available or near future technology.

c. Please provide a roadmap of such on-going substitution/elimination and research (phases that are to be carried out), detailing the current status as well as the estimated time needed for further stages.

Not applicable

3. Do you know of other manufacturers producing devices of comparable features and performance like the ones in the scope of this exemption request that do not depend on RoHS-restricted substances, or use smaller amounts of these substances compared to the applications in the scope of this exemption?

Accuva and Aquisense are examples of a manufacturer of UV-C LED based systems for water treatment. In the UV-C wavelength range applicable to water disinfection plants one UV-C LED has an optical power of only 100 mW but with an electrical power consumption of 3,3 W which shows that the radiant efficacy of UV-C LEDs is about 3%. In comparison, low-pressure mercury lamps have an optical yield of over 30%-40%. Even hundreds of LED spots would lead to only a few Watts optical power.

A replacement of mercury gas discharge lamps by available products is not possible due to the mentioned reasons above which is not going to change in the near future of the next exemption periods.

The cost per such a unit is disproportionally high in comparison to mercury lamp based system when related to the same capacity of production of UVC light.

4. As part of the evaluation, socio-economic impacts shall also be compiled and evaluated. For this purpose, if you have information on socioeconomic aspects, please provide details in respect of the following:

   a. What are the volumes of EEE in the scope of the requested exemptions which are placed on the market per year?

Market reports state that the European UV-C disinfection market in water & waste water accounts for approximate 500-600 m USD in 2020 with an annual growth rate of 5% (gwiwaterdata.com), March 2021.

b. What are the volumes of additional waste to be generated should the requested ex-emption not be renewed or not be renewed for the requested duration?

The predominant portion of that market would be either unserved or addressed with substantially more costly solutions (e.g. LEDs) or ecologically and from a public health perspective questionable solutions (chlorination).

Plants in the municipal and in industrial sectors would have to be shut off – especially where by-products free disinfection is required like in food & beverage or pharmaceutical industry. Shortage in supply may be a consequence, and / or a supply of products from that industry at higher cost.

c. What are estimated impacts on employment in total, in the EU and outside the EU, should the requested exemption not be renewed or be renewed for less than the re-quested time period? Please detail the main sectors in which possible impacts are expected – manufacturers of equipment in the scope of the exemption, suppliers, re-tail, users of MRI devices, etc.

Based on estimations of sizes of companies in the UV sector as well as the overall market size, the 600 m USD UV-C market volume in EU may correspond to 3000 – 6000 jobs at direct risk; excluding suppliers and sub-suppliers.

d. Please estimate additional costs associated should the requested exemption not be renewed, and how this is divided between various sectors (e.g. private, public, industry: manufacturers, suppliers, retailers).

5. Any additional information which you would like to provide?

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