Questionnaire 1 (Clarification) for Request of a new Exemption (BBT)

Requested exemption

Table 1: Wording and scope of the requested exemption

No.	Exemption	Scope and dates of applicability
Annex III	*Optical components made of mercurous chloride monocrystal (Calomel, Hg_2Cl_2)*	*Applies to categories 9 industrial monitoring and control instruments and to category 11* *Expires on* - *21 July[1] 2029 (= 2022 + 7 years) for category 9 industrial monitoring and control instruments* - *21 July 2027 (= 2022 + 5 years) for category 11*

Acronyms and Definitions

Cat.	Category, referring to the categories of EEE specified in Annex I of the current RoHS Directive
COM	European Commission
EEE	Electrical and electronic equipment
RoHS 1	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
RoHS	Directive 2011/65/EU, current RoHS Directive

1. Background

Bio Innovation Service, UNITAR and Fraunhofer IZM have been appointed[2] by the European Commission through for the evaluation of applications for the review of requests for new exemptions and the renewal of exemptions currently listed in Annexes III and IV of the RoHS Directive 2011/65/EU.

BBT submitted a request for the new exemption shown in Table 1 on 19 January 2022. As result of a first review we identified that some information is missing. Against this background the questions below are intended to clarify some aspects concerning the request at hand.

[1] Even though the exemption was submitted on 19 January 2022, the expiry data was assimilated to the expiry of most other exemptions on Annex III.

[2] Implemented through the specific contract 070201/2020/832829/ENV.B.3 under the Framework contract ENV.B.3/FRA/2019/0017

We ask you to kindly answer the below questions until 17 September 2023 latest.

2. Questions

1. **Could you please confirm that Table 1 correctly reflects the requested renewal of the exemption?**

Yes, we are requesting an exemption for optical components made of mercurous chloride monocrystal (also called Calomel, Hg_2Cl_2).

2. **You request the exemption for EEE of cat. 9 IMCI and cat. 11. Could you please let us know where the exemption would be relevant for cat. 11 devices?**

Calomel components could be implemented for state-of-the-art devices such as AOM (acousto-optic modulator), AOTF (acousto-optic tunable filter), an ultra-compact hyperspectral Fourier Transform spectrometer or also QRNG (Quantum random number generator). Since in our opinion no other category includes similar devices, category 11 is relevant.

3. **The use of lead and cadmium in optical components has been exempted since 2005, at that time as exemption 13 of Directive 2002/95/EC (RoHS 1)[3]. The use of mercury in optical components has not been exempted for EEE in the scope of the RoHS Directives (RoHS 1 and RoHS).**

In this context, it should be emphasized that this is not the use of free mercury in the metallic state, but a very stable mercury compound where the mercury is strongly stabilized. Calomel has even been applied as a medicine until recently and even in agriculture, as an antifungal agent in fields, in quantities of tonnes. In our case, the optical components have a weight in grams and are also safely enclosed in housings.

This issue is similar to the situation with extremely poisonous barium (Ba), with barium sulfate (BaSO4) commonly used as a contrast agent in X-ray examinations of the stomach, where a person swallows 1-2 liters of it without any danger because the barium is tightly and safely locked in the compound.

   a. **When were the first calomel optical components placed on the market?**

Around 2019, our standardised products (Glan Foucault and Wollaston polarizers) have been launched. However, some tailor-made products were delivered even earlier.[4]

[3] See the 2005 consolidated version of RoHS 1, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02002L0095-20051025

[4] Attached to this clarification is the oldest traced invoice for the delivery of calomel prizes from 2005 (we have even older ones released before 2000 in paper form)

b. **In which types of EEE have they been used?**

They have generally been used for scientific detection instruments. Often we cannot determine the exact use as these may only be components of larger assemblies. However, we have supplied e.g. beam splitters for laser devices, polarizers for imaging systems, waveplates for microscopes, tailor-made prisms for interferometers and spectrometers, etc.

c. **If the first calomel optical components were placed on the market before 2022 and were used in EEE in the scope of the current RoHS Directive, please explain why the exemption is required now after more than 20 years since the use of mercury has been restricted in EEE.**

At the very beginning, these components were mainly used for R&D and scientific activities, not for commercial purposes. However, over time, the company transformed from a research institute to an SME and therefore focused on commercialisation. At that time, the company realised that RoHS is necessary to facilitate its penetration of the world market (not only the European market, but also the Asian and American markets were being considered). Ultimately, this exemption will significantly increase our competitiveness in the market. The parameters of this optical material significantly exceed those of the components used so far.

4. **The term "birefringence" describes a central property of the calomel optic components. Could you please define the term?**

In an optically anisotropic medium (in this case, a crystal), the speed of light depends on the direction of propagation and polarisation. As a result, the incoming unpolarized light beam splits into two polarised beams (ordinary and extraordinary) whose polarizations are perpendicular to each other. These beams propagate through the crystal at different speeds and as a result propagate in different directions. This phenomenon is called birefringence. For a better idea, please see the picture below.[5]

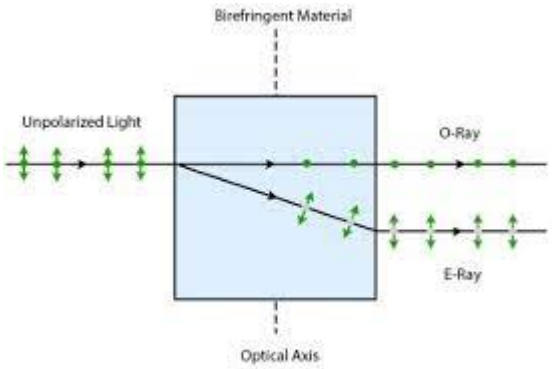

Fig. 1 Description of birefringence

[5] https://www.gophotonics.com/community/what-is-birefringence

Calomel exhibits very strong birefringence and therefore polarization optics based on it have a very high extinction ratio. Which is a crucial parameter for this type of optics ("the higher the better").

5. **You state that calcite and other mercury-free compounds are used as crystal polarizers and illustrate this in figure 3 of your exemption request. This figure also shows that these mercury-free polarizers operate in the wavelength spectrum up to around 5 µm. Similarly, mercury-free materials (you mention TeO_2 explicitly in your exemption request) cover the same wave-length for acoustic optic applications.**

   Can the use of the calomel components be restricted to wave lengths > 5 µm since mercury-free substitutes are available for shorter wave lengths?

In all honesty, in theoretical terms it could be possible, but it doesn't make any sense.

The advantage of calomel is not only that it covers a wavelength > 5 µm, but that it covers a wavelength > 5 µm plus(!) the visible (VIS) and short-wave infrared (SWIR) spectrum. And, each molecule has specific vibrational bands that are characteristic of its structure and chemical bonds, across the entire VIS (visible) and TIR (thermal infrared) bands.

An example is the AOTF (acousto-optic tunable filter). Simply described, this device makes possible the electrical tuning of specific wavelengths. Should the device be placed on a satellite for the purpose of remote sensing of the earth, the greatest added value is the ability to compare over as many wavelengths as possible. The proposed limitation would restrict the use to almost 30%. In addition, we would have to place additional equipment there, which inevitably increases the weight and power consumption, both of which are undesirable. Similar examples may be found for spectrometers.For a better understanding, see the figure below, where the competitive advantage of calomel is more apparent due to the linear x-axis.

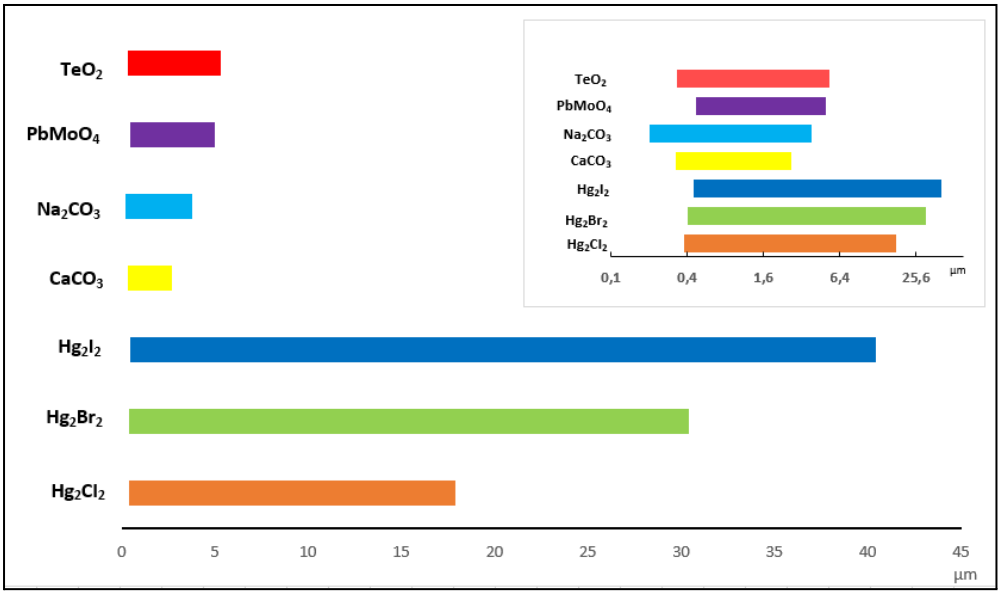

Fig. 2 Comparison of spectral transmittance of selected compounds. (Top right in detail with logarithmic scale.)

6. **In your renewal request, you mention crystal polarizers, acousto-optics and optical elements as three techniques where the calomel optics are used. Are there any other application fields for the calomel optical components?**

We believe that these three technologies are general enough to cover all the systems considered so far. In the last year and a half since the application, we have started activities in, among others, quantum mechanics (development of a random number generator) and terahertz (security, wireless communication). In all these systems, however, the calomel serves as an optical element, which is mentioned in the request.

Please note that answers to these questions will be published as part of the evaluation of this exemption request. If your answers contain confidential information, please provide a version that can be made public along with a confidential version in which proprietary information is clearly marked.

We ask you to kindly provide the information in formats that allow copying text, figures and tables to be included into the review report.

3. References

Baron et al. (2022): Study to assess requests for a renewal of nine (-9-) exemptions 6(a), 6(a)-I, 6(b), 6(b)-I, 6(b)-II, 6(c), 7(a), 7(c)-I and 7 (c)-II of Annex III of Directive 2011/65/EU (Pack 22) – Final Report (Amended Version). Under the Framework Contract: Assistance to the Commission on technical, socio-economic and cost-benefit assessments related to the implementation and further development of EU waste legislation. Author(s): Yifaat Baron, Carl-Otto Gensch, Andreas Köhler, Ran Liu, Clara Löw, Katja Moch, Oeko-Institut e. V. (Pack 22). retrieved from https://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_22/RoHS_Pack-22_final_report_amended_February_2022.pdf.