

Pollution of the North and Baltic Seas with Paraffin

Independent Environmental Group of Experts “Consequences of Pollution Incidents” (UEG)

Opinion dated 22 July 2014

Since the Central Command for Maritime Emergencies commenced its duties, it has been assisted and supported by the Independent Environmental Group of Experts "Consequences of Pollution Incidents" (UEG). The UEG was created in 2004 with the approval of Cabinet Ministers from the Federal Environment Ministry in collaboration with the Federal Ministry for Transport and other government departments, together with the Environment Ministries of the five coastal Bundesländer, as a joint Federal-Länder institution. Its members perform impartial assessments and evaluations under the supervision of the Federal-Länder "Coordination Committee for Pollution Incident Control" (KOA-SUB), which must approve the inclusion of new members and its work schedule, among other things. The UEG office is based at the Central Command for Maritime Emergencies.

The Group is comprised of environmental experts, and collaborates closely with environmental authorities and research institutions. Its tasks include documentation of environmental preparedness and the ongoing development of our understanding of the environmental consequences of incidents involving pollutants, and the evaluation thereof for use in decision-making by the Central Command for Maritime Emergencies (CCME), as well as sharing its expert scientific knowledge in various disciplines with the CCME. UEG opinions are also submitted to the Committee on the Environment of the German *Bundestag*. In 2012, for the first time, the Group of Experts was involved at an operational level in a pollution incident, at the request of the CCME (as was the case with the MSC Flaminia disaster).

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Translation approved by UEG 12 September 2014

The UEG discussed the situation regarding chemical products, particularly paraffin, washing up on German and neighbouring beaches, and reached the following conclusion.

UEG assessment and recommended measures to protect the environment

Given the frequent incidence of paraffin wax and other similar chemical products on North and Baltic Sea coasts and a number of recent pollution incidents involving very large quantities of such products, measures are urgently needed to prevent such pollution of the North and Baltic Seas.

These substances are transported in bulk in tankships. They have very low solubility in water and float to the water's surface once discharged ("floaters").

If washed ashore, beaches must be closed to the public, and cleaning up this chemical waste is very expensive. This contravenes the spirit of the MARPOL provisions on the protection of the marine environment. The regulations governing the properties of such products, and in particular limiting the quantities discharged into the marine environment, are evidently inadequate.

The UEG believes that more serious problems could occur at any time in the North and Baltic Seas, such as seabirds dying in large numbers due to the discharge of chemicals, as was the case on British beaches in spring 2013. The severity of this particular incident, was attributed to the fact that the product had been discharged in the immediate vicinity of large bird colonies on the southern English coast and Channel Islands, where large numbers of seabirds had congregated for the spring breeding season.

In this particular incident, the product was assigned to the same MARPOL category as paraffin - where there is no general ban on the discharge of residues into the marine environment. In the light of the severe impacts and strong public pressure, this specific product was rapidly reclassified by the IMO during the course of 2013, and any discharging without prewashing the tanks is now prohibited.

A general ban on the discharge of floating substances such as paraffin in the North and Baltic Sea is urgently needed, but this can only be achieved through international agreements and regulations.

As such, the UEG advises Germany's representatives at the relevant international organisations to highlight the situation immediately and press for a decision. These include discussions on the Convention on the Protection of the Marine Environment of the North-East Atlantic (Oslo-Paris Convention, *OSPAR*), the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention, *HELCOM*) and the development of shipping regulations by the International Maritime Organization of the United Nations (IMO). At national level, this issue should be supported within the context of implementing the Marine Strategy Framework Directive (MSFD) as a corresponding "measure".

In particular, the UEG recommends that Germany supports the UK initiative to the IMO to amend the transport and discharge regulations for tankships carrying noxious liquids in bulk. Supporters of the initiative are calling for a complete revision of the transportation and discharge regulations for the entire group of highly viscous, water-insoluble products such as paraffin, including their reclassification.

The UEG also calls for a better definition of such substances in the international regulations for tanker ships and their unambiguous allocation to product lists with related transportation and discharge regulations, to eliminate any regulatory loopholes.

The UEG also recommends a scientific reassessment of transported chemical products by the competent committees of the IMO, which considers the possibility of hazardous contaminants contained in raw industrial products.

Rationale

When large quantities of paraffin are washed up on German beaches, as was recently the case on Sylt in March 2014 and on Rügen in late April 2014, the competent authorities ask the Central Command for Maritime Emergencies (CCME) to assume overall operational control. On Sylt and Rügen the paraffin was removed from the beaches by the competent authorities under the overall control of the CCME. Surveillance aircraft and vessels were used to ascertain the extent of the problem and identify the perpetrators.

The neighbouring countries of Denmark, Poland and the United Kingdom are also affected by such incidents and have outlined their situation to the International Maritime Organisation.

UEG opinion

1. Substances washed up on German beaches

The Agreement between the Federal Government and the Federal States on Pollution Incident Control (BLV SUB), following a resolution dated 13 November 2012, defines large quantities of paraffin that are washed ashore as a complex pollution incident, with 30 m³ of paraffin waste (or alternatively, a significant area of the coastline polluted with paraffin over a length of at least 10 km) being defined as the threshold value for a complex coastal pollution incident involving paraffin. In complex pollution incidents, the Central Command for Maritime Emergencies in Cuxhaven assumes overall operational control and coordinates the clean-up work. Overall operational control can also be assumed if the competent Water and Shipping Authority submits a request to the Central Command for Maritime Emergencies (CCME) on behalf of the Federal Government or one of the five coastal states. The pollution response costs incurred are then shared between the Federal Government and the Federal States.

However, it should be noted that pollutants are also often removed without the involvement of the CCME. Examples include the partial removal of pollutants washed up onto the beaches of the East Frisian islands from Borkum to Wangerooge, as well as the uninhabited islands of Minsener Oog and Mellum, during June/July 2014. In the past, beaches on the Isle of Sylt have also been cleaned by the local authorities to remove products such as paraffin and vegetable oil products. As such, the cases managed by CCME only represent part of the pollutants washed up on German beaches.

The following section is based on a report by the CCME on behalf of the UEG dated June 2014.

In the period between the inception of the Central Command for Maritime Emergencies' in 2003 and 2014, a total of five complex pollutant incidents involving paraffin were managed under the operational control of the CCME (the first of which occurred in 2007). In the North Sea, two cases involving paraffin have been managed by the CCME up until 2014:

Table 1

Major paraffin pollution incidents on German beaches, 2007-2014
(Complex incidents under the overall operational management of the CCME in Cuxhaven)

Baltic Sea			
Start / end (of overall operational management by CCME)	Name of affected stretch of coastline	Estimated length of affected beach section	Quantity collected Mixture of paraffin and sand
18.05.07/19.05.07	Dierhagen/Darß	10 km	150 m ³
21.05.10/23.05.10	Rügen, north side	30 km	100 m ³
02.06.10/04.06.10	Usedom	10 km	64 t
21.02.12/27.02.12	Fischland-Darß Hiddensee	25 km 25 km	11 t
27.04.14/30.04.14	Rügen/Tromper Wiek	10 km	32.5 m ³
North Sea			
23.07.09/24.07.09	North Frisian islands	Amrum, Föhr, Sylt, Halligen, mainland	138 m ³
20.03.14/25.03.14	Sylt	30 km (entire west side of the island)	73 m ³

Table 1 summarises complex pollution incidents involving paraffin in Germany in the period 2007 to 2014. It lists the start and end of operational management by the CCME, the length of beach affected and the quantity of paraffin-sand mixture collected. Quantities are given either in cubic metres (m³) or tonnes (t). Both are estimates. The proportion of sand in the mixture collected may vary considerably. For this reason, the quantitative data should be considered only as an estimate.

- In the Baltic Sea, the CCME assumed overall operational management on 18 May 2007 following a major paraffin pollution incident. Over a distance of around 10 km along the coast near Dierhagen and along the River Darß, around 150 m³ of paraffin-sand mixture was collected and disposed of.
- On 20 May 2010, a 30 km section of beach on the northern coast of the Isle of Rügen and sections of beach on Hiddensee island were polluted. Around 100 m³ of paraffin-sand mixture were collected and disposed of.
- Between 2 and 5 June 2010, some 64 tonnes of paraffin-sand mixture were collected on Usedom beach in the Freest district, between Zempin and Ückeritz.
- On 20 February 2012, clumps of paraffin were washed ashore in Fischland-Darß and on Hiddensee island. Clumps of paraffin up to 25 cm in diameter were washed up over a length of around 25 km. In total, some 11 tonnes of paraffin-sand mixture were collected and disposed of.
- On 24 April 2014, paraffin pollution was reported on the Isle of Rügen between Glowe and Juliusruh, with some areas significantly affected. In total, around 32.5 m³ of paraffin-sand mixture were collected and disposed of.
- In the North Sea, paraffin pollution occurred on the North Frisian islands on 23 July 2009. The islands of Amrum, Föhr and Sylt were particularly severely affected. Paraffin was also reported on the beaches of the Hallig islands and on the mainland, however, only in small quantities. In total, some 138 m³ of paraffin-sand mixture were collected and disposed of.
- On 19 March 2014, paraffin was washed up along the entire west side of the Isle of Sylt from Hörnum to List, covering a length of around 30 km, and ranging in width from 2.5 m to 10 m. This necessitated the collection and disposed of around 73 m³ of paraffin-sand mixture.

Random samples of the collected materials were analysed, and classified as paraffin in each case. Furthermore, some of the sample analyses indicated that the waxes were contaminated with various chemicals. For public safety reasons, access to the beach was prohibited until the materials had been completely removed.

With land-based pollution incidents associated, for example, with overflows during unloading of tankers, it has always been possible to identify the perpetrators, due to their temporal and spatial proximity to the incident, and charge them for the clean-up costs. With paraffin pollution on the coast, however, it is usually impossible to identify the source, and government as well as local administrations are forced to bear the clean-up costs.

2. Characterisation of washed-up materials based on chemical analyses

Analyses to date indicate that most of the material washed up in large quantities on German shores is hardened paraffin, in some cases mixed with other substances ("contaminants"). However, in the absence of chemical analysis, it is impossible to determine whether a substance really is paraffin. Research into oil-contaminated seabirds and beaches has indicated that more toxic compounds, such as various phenols (including antioxidants), are also found on the coast in the form of small yellow or white paraffin-like pieces, which could be confused with paraffin.

From a chemical perspective, paraffins are a mixture of saturated long-chain hydrocarbons (alkanes). Paraffins are used for insulation and impregnation, as corrosion protection, as an additive to rubber products, and also (in a purer form) in cosmetics and in candle production. They are transported by tankships in large quantities and can be washed up on beaches in the form of solid, wax-like paraffin clumps.

The following account is based on (largely unpublished) chemical analyses performed at the laboratories of the Federal Maritime & Hydrographic Agency (BSH) within the framework of regular ongoing tasks, as well as during an ongoing research project into oil contamination of seabirds and beaches.

The most common paraffin types have a carbon chain length mainly dominated by n-C31. The relative portions of n-alkanes formed a bell-shaped curve ranging from C20 to more than C40 (see Figure 1).

The gas chromatogram shown in Figure 1 of a specimen taken from the Isle of Sylt illustrates the principal components in paraffin wax. These are the n-alkanes shown as lines at regular intervals in the chromatogram. The maximum is in the region of n-C31, and the boiling point ranges from n-C20 (around 6 minutes) to more than n-C40. Other characteristics include the form and height of the undissolved subsurface (between 9 and 10 minutes maximum), which primarily contains branched and cyclic alkanes, as well as aromatic and heterocyclic compounds. This group may include chemical substances that are potentially damaging to health, but were not identified in greater detail by this analysis.

In spring 2012, under the command of the CCME, quantitative chemical analyses of paraffin washed ashore in Mecklenburg-West Pomerania were undertaken in order to identify admixtures and impurities and their content levels. Industrial waxes contained significant portions of polycyclic aromatic hydrocarbons of around 18 mg/kg (in relation to dry mass).

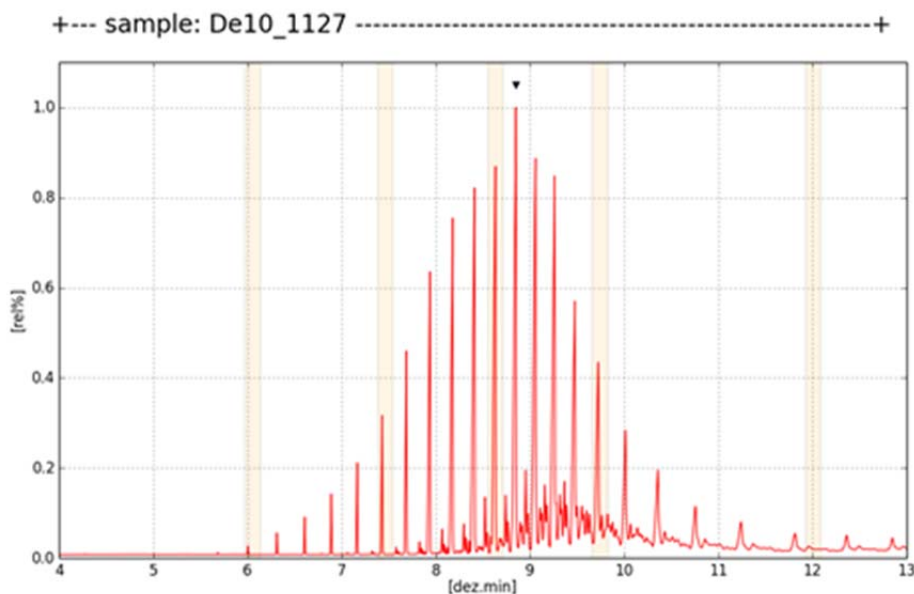
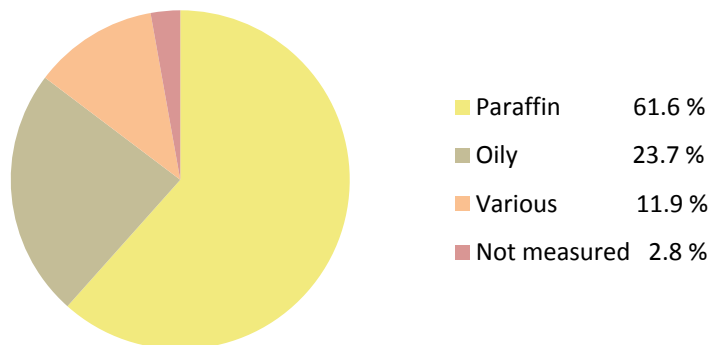


Figure 1: Gas chromatogram of a sample taken from a polluted beach in Sylt.

Within the framework of an R&D project into oil-contaminated seabirds and beaches on the German North Sea coast, a total of 1,271 samples of chemicals washed ashore in the period February 2013 and March 2014 were analysed. Researchers found that 61.6 % of the samples were paraffins (see Figure 2).

Figure 2

Distribution of the 1,271 samples of beached chemicals collected within the context of an R&D project on oil-contaminated seabirds and beaches in the period February 2013 and March 2014



23.7 % of the samples were petroleum and a further 11.9 % was made up of a variety of other substances, primarily palm oil, mixtures of aromatic hydrocarbons and oligomers of ethylene.

These findings suggest that paraffin is the predominant beach pollutant, but other chemical substances with a similar appearance also occur regularly.

3. The origin of material washed ashore

Paraffin

The paraffin washed up onto our beaches is cargo residue discharged at sea by tankers. Based on chemical analyses, the locations where pollution occurs and reports from neighbouring countries, this is the only conceivable source. During initial discussions at the International Maritime Organization (IMO), government and industry delegations have never disputed that discharges from tank ships at sea are the causal factor.

Hamburg is a key transshipment port for paraffin. Tankers start washing their tanks after unloading their cargoes in Hamburg, and residues may be legally discharged as soon as they have left the 12 nautical mile zone and reached the open sea (see section 8 "Regulations on the transportation of paraffin by tank ships in the North and Baltic Seas"). In conjunction with prevailing currents, this could explain pollution incidents on the Schleswig-Holstein coast; however, this does not adequately explain why the East Frisian Islands and the Baltic coast are affected.

Paraffin impurities

For the most part, tankers transport industrial raw products with a low level of chemical purity. The paraffin impurities of polycyclic aromatic hydrocarbons (PAHs) originate from the paraffin extraction process. They may occur in concentrations that pose a threat to humans and the environment (see section 5 "Risks to humans").

Other chemical substances (products)

The products washed up on the British coast, that killed large numbers of birds, are believed to have originated as discharges from tank ships. Analyses by the BSH indicate that they were reactive polyisobutylene, an oligomer of butylene. On the beach, a non-expert could easily confuse these chemically related substances with paraffin.

4. Pollution of the marine environment (paraffin in the marine environment)

Environmental pollution focuses on the physically and chemically determined distribution of paraffin and chemically similar substances in the marine environment. Paraffins and similar substances are so-called "floaters" as they float on the water surface and form pools or, depending on the water and air

temperature, can solidify and form clumps. Under unfavourable circumstances, some of these substances are capable of sticking ' to the plumage of birds causing it to become matted, as illustrated by the incidents on the British coast and earlier cases of pollution with vegetable fats (primarily palm oil). However, the chemical properties of paraffin mean that this risk is very low at temperatures normally experienced in North and Baltic Sea waters.

Germany

Initial surveys of pollutants in the water surface carried out during the project on oil-contaminated seabirds and beaches indicate that significant quantities of small, wax-like clumps of chemical products are prevalent in the German Bight. However, these results still need to be scientifically verified before conclusions on the spatial and temporal distribution of paraffin pollution in the German Bight can be made. If the initial results are confirmed, we must assume that chronic pollution from regular discharges occurs, which demands both targeted research and clear regulatory measures.

The risks to marine life are similar to those of other types of waste. Paraffin fragments are mistaken for food by marine animals and swallowed. The analysis of the stomach contents of dead Northern fulmars washed up on German North Sea beaches found paraffin-like substances in the stomachs of around 20 % of the birds investigated. The threat this poses to the birds involved cannot be quantified at present.

Neighbouring countries

In February 2013, around 3,000 birds covered in a sticky substance were washed up on the British beaches of Devon, Cornwall and Dorset. 2,400 of them subsequently died, with a total of 20 different species affected. The birds were affected by polyisobutene (PIB), a product with similar physical and chemical properties to paraffin, and which therefore falls under the same tankship transport and discharge regulations. The soft or hardened products are easily confused with other substances such as paraffin. The birds' plumage had become matted, impairing thermal insulation and mobility. The overall death toll was thought by the competent authorities to be even higher, assuming that not all birds were washed ashore and not all could be found.

A chemical analysis of the substance involved was undertaken by the BSH in Germany. The substance was identified as "Highly reactive polyisobutylene" (HR-PIB) . In the wake of these incidents, following a proposal by the United Kingdom to the International Maritime Organisation, the transport and discharge regulations for "poly(4+)isobutylene (with a molecular weight of more than 224)" were tightened up, and since 17th December 2013, this specific product may no longer be discharged into the marine environment from tankships without prewashing the tanks in the port.

Principles of marine environmental conservation

The discharge of paraffin and similar materials from tank ships is a form of waste disposal. For ship-owners this reduces the costs of disposal in ports, however, it imposes higher costs on coastal communities and governments, who have to pay for the cleaning up of their shores and beaches. Paraffin incurs the same high clean-up and disposal costs as other forms of waste contamination on the coast. Since the North and Baltic Seas were designated special areas under MARPOL Annex V, the discharge of waste into these two seas is forbidden.

Measures to limit waste pollution play a key role in the ongoing implementation of the Marine Strategy Framework Directive (MSFD) in the OSPAR and HELCOM regions. It is therefore incomprehensible that paraffin clumps may still be legally discharged into both regions in such quantities under current marine shipping laws.

5. Risks to humans

Pure paraffin is not considered hazardous to humans, neither on contact with the skin nor if swallowed. With some liquid paraffins, there is a risk of fluid entering the lungs if swallowed, which could potentially be life-threatening to children. The aspiration risks are particularly acute with paraffin oils. However, as no liquid paraffins float on the water's surface, there is no risk to humans swimming in coastal waters.

As a general rule, tankships do not carry pure paraffin (which is used for cosmetic and pharmaceutical applications); their cargo is normally industrial paraffins with a lower level of purity. Many such paraffins act as irritants to the eyes and can also irritate the respiratory tract if an aerosol of the substance is inhaled.

Longer-term health risks are posed by petrolatum, a special form of paraffin wax; this product is considered carcinogenic (see section 6, "Assessment of risks by the European Commission").

The long-term health risks of most industrial paraffins are attributable to their polyaromatic hydrocarbon (PAH) content. Numerous PAHs are known to be carcinogenic. With PAH levels as high as those measured in Mecklenburg-West Pomerania in 2012, for example, consumer health protection guidelines advise against human long-term contact. These levels exceed the safe limits for children.

Solid hydrocarbon residues (tar balls) may contain very high titres of potentially humanopathogenic bacteria (*Vibrio vulnificus*). Whether this also applies to paraffins is currently unknown.

It is not possible to make a general statement regarding the health risks of paraffins. Whereas pure paraffins are not known to have hazardous properties when in contact with skin, most industrial paraffins irritate the skin and eyes, and some are considered carcinogenic.

The health risk can therefore only be accurately assessed following a reliable chemical analysis of the substances washed ashore. For this reason, the Federal Institute for Risk Assessment (BfR) advises affected countries and the CCME to consider partial beach closures in the case of pollution with paraffin-like substances. Cleaning teams should wear gloves as a precautionary measure.

6. The European Commission's assessment of the risks

The European Commission does not class high-purity paraffins (primarily used in cosmetics or as pharmaceutical components) as hazardous.

Paraffin wax, also known as petrolatum, poses longer-term health risks. According to REACH, petrolatum is defined as:

A complex combination of hydrocarbons obtained as a semi-solid from dewaxing paraffinic residual oil. It consists predominantly of saturated crystalline and liquid hydrocarbons having carbon numbers predominantly greater than C₂₅.

Within the European Union, these products must be treated as carcinogenic substances and labelled "Cat. 1B/H350" (formerly R45), unless documented evidence shows that they do not contain any carcinogenic substances.

Similar health risks also apply to paraffin wax obtained from coal:

Paraffin waxes (coal): Complex combination of hydrocarbons obtained by the treatment of lignite carbonisation tar with activated carbon for removal of trace constituents and impurities. It consists predominantly of saturated straight and branched chain hydrocarbons having carbon numbers predominantly greater than C₁₂.

Classification as a carcinogenic substance with the label "Cat. 1B/H350" (formerly R45) depends on the content of benzo-a-pyrene.

7. The UN's assessment of the risks associated with paraffins

The official classification of paraffin waxes in discharge category Y under MARPOL was based on a scientific assessment by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), which works on behalf of the United Nations (UN) and nine other UN special organisations and institutions dedicated to the protection of the oceans (FAO, UNESCO, IOC, WMO, UNIDO, IAEA, UNEP, UNDP).

When assessing the risks, GESAMP took into account the wide range of paraffins transported under this product name. Between hard paraffins with melting points of up to 70 degrees Celsius and soft paraffins with melting points as low as 40 degrees Celsius, a whole range of different compositions, and particularly purities, are transported by tankships. Assessment indicated that only a handful of them are pharmaceutical purity grade. Raw or soft paraffins with a significant proportion (2 – 30%) of production-related impurities are commonly transported (e.g. as slack wax). These substances can cause minor irritation to skin and eyes and may be significantly contaminated with polyaromatic hydrocarbons.

The GESAMP risk assessment focussed on one particular characteristic of all paraffins falling under this product designation: They float on the water surface and remain there for a long time. This behaviour is highly temperature-dependent. Almost all paraffins harden at around 20 degrees Celsius, and form soft clumps that incorporate water and/or air. In North Sea and Baltic Sea waters such conditions are prevalent even in summer. In warmer waters, in the sun, however, they can form floating pools of liquid. The main concern here is the threat to waterbirds, as paraffin can then stick to their plumage, which becomes matted.

For the past few years, GESAMP has recommended "partial beach closures" when paraffin-like substances are washed ashore. This recommendation is based on an assessment of the risks associated with the products, without a more detailed assessment of possible exposure of humans to the substance or quantities on the beach (so-called "worst case").

Consequently, under certain circumstances, slick-like pools can form on the water, which irritate the skin and eyes. Fishing nets and mussel banks may become stuck together. The substances may form slippery patches on the shoreline, and the contaminant content may be harmful to human health.

Recommendations for a "partial beach closure" refer to large-scale pollution events involving large quantities of material. The recommended partial closures of sections of coastline should be considered as the maximum necessary measure. However, partial closures may also be appropriate to prevent children from coming into contact with the soft substance.

In 2014, the responsible GESAMP working group recommended a re-evaluation of the entire group of products (based on alkanes) during 2015.

8. Regulations on the transport of paraffin by tankships in the North and Baltic Seas

Paraffin is transported by tankships in large volumes. Under international regulations, the following products are allowed to be transported in tank ships:

- "Paraffin wax"
- "Petrolatum"
- "n-alkanes (C10+)"

They are also likely to be transported under the name of:

- Waxes (actually refers to the relatively undefined "hydrocarbon wax", which is often used as a collective term for the above-mentioned three types of paraffin).

These four product groups differ only marginally from one another and do not allow for a product to be clearly allocated to a paraffin class.

Synonyms used in the regulations for tankships include:

- "Paraffin" (for "paraffin wax")
- "Paraffin jelly" (for "petrolatum")
- "Paraffin scale" (for "paraffin wax")
- "Petroleum jelly" (for "petrolatum")
- "Mineral wax" (for "petrolatum")
- "Mineral jelly" (for "petrolatum")
- "n-paraffins (C10-C20)" (for "n-alkanes (C10+)")

These formulations make it impossible for standard paraffin products such as "Hard paraffin", "Soft paraffin" or "Synthetic paraffin" to be clearly classified in the regulations.

The carriage of all such products falls under the regulations of the International Convention for the Prevention of Pollution from Ships (MARPOL1973), specifically the provisions of Annex II on the control of pollution by noxious liquid substances in bulk.

As a general principle, such products should always be transported under one of the aforementioned product designations. This has been more stringently regulated since 1 January 2007, with the new version of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), which regulates the construction of the vessels themselves, as well as the residue discharge limits.

All four of the paraffins listed fall under discharge category Y:

- *Noxious Liquid Substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a hazard to either marine resources or human health or cause harm to amenities or other legitimate uses of the sea and therefore justify a limitation on the quality and quantity of the discharge into the marine environment;*

Depending on when the vessels were built, the following requirements apply to liquid bulk goods in discharge category Y:

- The cargo room pumps must be capable of emptying the tank down to a residue of 75 litres (for new vessels) or 100 litres for IBC-Code ships built before 01/01/2007. Vessels falling under the regulations for BCH-Code vessels, which are only required to observe a residue of 300 litres, are rarely used to transport such substances. However, tanks filled with water are used as the yardstick for correct functioning of the pumps and residual quantities. In practice, therefore, the official levels for the amounts of residues such as paraffin in the tanks are exceeded. Additionally, paraffin adheres to the tank walls (this is known as clingage), and is not removed by the pumps during unloading.
- Furthermore, the physico-chemical properties of many paraffins make them subject to prewash requirements, whereby the water used to wash the tank must be discharged to a reception facility in the port. Cleaning additives may be used, both during the prewash and during subsequent cleaning of the tanks.
- Any remaining residues must be discharged below the water surface. The following criteria must be fulfilled when discharging: The ship must be travelling at a specified minimum speed, it must be at least 12 nautical miles from the nearest land and water depth in the area of discharge must exceed 25 metres.

The only exception to this is the Antarctic region, where there is a complete ban on the discharge of hazardous substances (MARPOL Annex II, regulation 13, para. 8). No other regions are listed as special areas for discharge restrictions, therefore, there is no general ban on the discharge of paraffin and similar products into the North and Baltic Seas.

9. Possible sources of marine and beach pollution

There has been some dispute over whether paraffin washed up on German coasts originates primarily from legal tank washing, or from illegal discharges. When the International Maritime Organization (IMO) debated this topic in 2013, there was no clear information available regarding the proportion of pollution incidents attributable to illegal discharges of cargo residues. Some European countries, led by the United Kingdom, are calling for a tightening up of regulations to prevent such substances being washed ashore in future.

The responsible committee of the International Maritime Organization has identified the following potential sources of significant beach pollution:

- Before discharging residues, tanks must be emptied "as far as is practicable". Trials must be carried out to measure the effectiveness of pumps in reducing residues in tanks and connected pipelines to the legal level (25 – 900 litres are legal levels depending on when the ship was built). Water is to be used as the medium in such trials (MARPOL Annex II, chapter 4, regulation 12 plus Appendix 5). With high-viscosity substances (greasy substances), however, significant quantities will adhere to the walls of tanks and associated pipes (so-called clingage). The admissible residues that could theoretically be discharged with the wash-water are therefore significantly greater.
- The definition of a "solidifying substance" (MARPOL Annex II, chapter 1, regulation 1.15) relates the melting point of a liquid bulk material to the temperature at the time of unloading. The same applies to viscosity. The prewash procedure prescribed in MARPOL Annex II, Appendix 6 is dependent on these definitions. Products with a higher melting point/higher viscosity may be discharged at higher unloading temperatures. This could lead to the discharge of substances that solidify or almost solidify (high viscosity) in the marine environment at ambient temperature. If a higher unloading temperature is selected, prewash regulations do not apply, even though the characteristic of the load itself in terms of its behaviour in the ocean at ambient temperature remains unchanged. As a result, residual quantities of critical products may be directly discharged without prewashing and without delivery to a reception facility. Some experts have questioned the appropriateness of the prewash regulations, particularly in conjunction with the definitions of high viscosity and solidifying substances.
- The definition of "en route" permits the discharge of residues between unloading and loading. Ships can take a loop route at sea in order to discharge residues (MARPOL Annex II, chapter 1, regulation 1.6). This reduces the area over which residues are discharged at sea, allowing large concentrations of pollutants to form, and leading to the possibility of chronic pollution in marine regions where this is common practice.
- The most recent revision to the MARPOL Annex requires substances that float on the water's surface to be transported in double-hull chemical tankers. However, at the time of introducing these regulations, a lack of adequate cargo space was ascertained. An exemption was therefore introduced (MARPOL Annex II, chapter 1, regulation 4.1.3), permitting transportation in so-called product tankers (not applicable to paraffin, but to other substances that float to the surface). These vessels have far larger tanks, which in turn means that larger quantities of the load adhere to the walls of the tank (clingage). During tank cleaning, larger quantities of noxious substances are then discharged.

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