

**RISK ASSESSMENT
OF
NAPHTHALENE**

CAS Number: 91-20-3
EINECS Number: 202-049-5

**ENVIRONMENT ADDENDUM
OF DECEMBER 2007**

FINAL APPROVED VERSION

Introduction

An environmental risk assessment of naphthalene produced in accordance with Council Regulation (EEC) 793/93 was published in 2003 (EC, 2003). This identified a risk to the environment from use in the manufacture of grinding wheels based on site-specific information from one plant. Further information was also required to refine the indirect human exposure assessment for this scenario. Information from another plant using naphthalene in the manufacture of grinding wheels indicated that there should be no adverse effects arising from its use at that location.

An initial environment risk reduction strategy was developed in 2000 (RPA, 2000). A human health risk reduction strategy for naphthalene has also recently been developed (RPA, 2007). During this work it became apparent that there are several more sites within the EU manufacturing grinding wheels using naphthalene. As a result, and to complement the human health risk reduction strategy, further information on emissions of naphthalene from use in grinding wheels has been obtained.

This updated report considers the consequences of these new data for the conclusions drawn in the original risk assessment. In addition a PBT assessment has been performed for completeness (based on an earlier document that was circulated to the TC NES in 2002). No other scenarios have been reviewed, and the published risk assessment should be consulted for additional information.

Rapporteur: United Kingdom

Contact (environment): Environment Agency
Chemicals Assessment Unit
Red Kite House, Howbery Park, Wallingford,
Oxfordshire, OX10 8BD
Fax: +44 1491 828 556
E-mail: ukesrenv@environment-agency.gov.uk

The scientific work on the environmental sections was carried out by the Building Research Establishment Ltd (BRE) under contract to the rapporteur.

0 OVERALL RESULTS OF THE RISK ASSESSMENT

ENVIRONMENT

Based on updated information, it is expected that the risk for all environmental protection goals from the use of naphthalene in the manufacture of grinding wheels is now low.

No risk characterisation for the marine environment has been carried out for this use pattern since industry has not identified any sites that are located at the coast.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

PBT assessment

Naphthalene meets the screening criteria for P and vP but does not meet the criteria for B, vB or T. Therefore naphthalene is not a PBT or vPvB substance.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

HUMAN HEALTH

HUMANS EXPOSED INDIRECTLY VIA THE ENVIRONMENT

Haemolytic anaemia

Exposure in the locality of grinding wheel plants is estimated to be up to 1.4×10^{-3} mg/kg/day. It is not possible to quantitatively assess the risks for haemolytic anaemia, because of the absence of information on the NOAEL and dose-response characteristics for this endpoint in humans. However, given the low level of exposure for this local scenario, the risk to human health is not considered to be of concern.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Repeated inhalation toxicity and carcinogenicity

The airborne levels of naphthalene in the locality of grinding wheel plants are estimated to be up to 3.9 µg/m³. This is three orders of magnitude lower than the LOAEL for local respiratory effects in rats of 5 mg/m³. Therefore there is no cause for concern for human health from this exposure.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

CONTENTS

0	OVERALL RESULTS OF THE RISK ASSESSMENT.....	3
1	SUMMARY OF KEY PROPERTIES.....	6
2	USE OF NAPHTHALENE IN THE MANUFACTURE OF GRINDING WHEELS	7
2.1	BACKGROUND TO UPDATED RISK ASSESSMENT	7
2.2	USE IN THE MANUFACTURE OF GRINDING WHEELS	7
2.2.1	Process description.....	7
2.2.2	Emission scenario.....	12
2.2.3	Predicted Environmental Concentrations (PECs).....	13
2.2.4	Risk characterisation.....	14
2.2.5	Exposure of humans via the environment.....	15
2.2.6	Other considerations.....	16
2.2.7	Conclusions.....	17
3	MARINE RISK ASSESSMENT.....	17
3.1	RISK CHARACTERISATION FOR THE MARINE ENVIRONMENT	17
3.2	PBT ASSESSMENT	18
3.2.1	Persistence.....	18
3.2.2	Bioaccumulation.....	18
3.2.3	Toxicity.....	18
3.2.4	Conclusions for the PBT assessment.....	19
4	SUMMARY OF OVERALL CHANGES TO THE CONCLUSIONS FOR NAPHTHALENE.....	20
4.1	ENVIRONMENTAL ASSESSMENT FOR GRINDING WHEELS	20
4.2	PBT ASSESSMENT	20
4.3	HUMANS EXPOSED INDIRECTLY VIA THE ENVIRONMENT	20
5	REFERENCES.....	22

1 SUMMARY OF KEY PROPERTIES

The key properties used in the published naphthalene risk assessment (EC, 2003) are summarised in Table 1. More recently, an assessment of coal-tar pitch, high temperature (CTPHT) has been carried out under the ESR programme (ECB, 2007). Naphthalene is a component of CTPHT, and the latter assessment uses slightly different property values¹ than were used in EC (2003). These are given in Table 1 for comparison.

Table 1 a Summary of key physico-chemical, fate and behaviour properties for naphthalene

Property		Value used in original risk assessment report (EC, 2003)	Value used in CTPHT risk assessment report ² (ECB, 2007)
Molecular weight		128.2 g/mole	128.2 g/mole
Melting point		80°C	81°C
Boiling point		218°C	218°C
Vapour pressure (at 25°C)		10.5 Pa	11.2 Pa
Water solubility		0.03 g/l	0.0319 g/l
Octanol-water partition coefficient (log Kow)		3.70	3.34
Organic carbon-water partition coefficient		1.25×10 ³ l/kg	1.35×10 ³ l/kg
Rate constant for reaction with atmospheric hydroxyl radicals		2.4×10 ⁻¹¹ cm ³ molecule ⁻¹ s ⁻¹	2.16×10 ⁻¹¹ cm ³ molecule ⁻¹ s ⁻¹
Biodegradation rate constants	Surface water	4.62×10 ⁻³ day ⁻¹ (half-life = 150 days)	0.098 day ⁻¹ (half-life = 7 days)
	Bulk soil	2.31×10 ⁻³ day ⁻¹ (half-life = 300 days)	9.8×10 ⁻³ day ⁻¹ (half-life = 70 days)
	Bulk sediment	2.31×10 ⁻⁴ day ⁻¹ (half-life = 3,000 days)	3.0×10 ⁻³ day ⁻¹ (half-life = 230 days)
Assumed biodegradation classification		Inherently biodegradable	Not clear
Predicted removal during waste water treatment plant		27.4% to air 11.2% to sludge 26.6% degraded 34.8% to waste water	38.7% to air 12.6% to sludge 1.5% degraded 47.2% to waste water
BCF in fish		427	Not clear (reliable values in the range 300-1,000 l/kg are given)

¹ CTPHT contains several polycyclic aromatic hydrocarbons (PAHs). To carry out a risk assessment, a self-consistent set of properties were chosen for the PAHs and this resulted in some differences in the values used for naphthalene compared with those used in EC (2003). The respective risk assessment reports should be consulted for further details.

² Although the CTPHT assessment is still a draft, the key properties used in the assessment have been agreed by the TC NES.

Table 1 b Summary of Predicted No Effect Concentrations (PNECs) for naphthalene

Property	Value used in original risk assessment report (EC, 2003)	Value used in CTPHT risk assessment report (ECB, 2007)
PNEC for fresh water	2.4 µg/l	2.0 µg/l
PNEC for freshwater sediment	67.2 µg/kg wet weight	2,900 µg/kg dry weight (~630 µg/kg wet weight)
PNEC for marine water	Not derived	2.0 µg/l
PNEC for marine sediment	Not derived	290 µg/kg dry weight (~63 µg/kg wet weight)
PNEC for waste water treatment plants	2.9 mg/l	Not derived
PNEC for soil	53.3 µg/kg wet weight	1,000 µg/kg dry weight (~880 µg/kg wet weight)
PNEC for secondary poisoning	Not derived	Not derived

Both sets of values will be used in the exposure assessment and risk characterisation to examine whether the differences have any consequences for the assessment.

2 USE OF NAPHTHALENE IN THE MANUFACTURE OF GRINDING WHEELS

2.1 BACKGROUND TO UPDATED RISK ASSESSMENT

The original risk assessment identified a risk from the manufacture of grinding wheels based on information received from one site within the UK. Emission reduction measures have since been put in place at that site (RPA, 2000). Since the original process was based on old technology, it is necessary to revisit the emission scenario assumed in EC (2003).

2.2 USE IN THE MANUFACTURE OF GRINDING WHEELS

This Section revises Section 3.1.1.5 of EC (2003).

2.2.1 Process description

Further information on the process used in the manufacture of abrasive materials, including grinding wheels, has become available. In particular a BREF document on the ceramics manufacturing industry has been published (EC, 2007) and a further survey of grinding wheel manufacturers in the EU has been undertaken (Federation for European Producers of Abrasives (FEPA), 2007). The relevant information is summarised below.

There are three basic forms of abrasives (Rue, 1991):

- Grits (loose, granular or powdered particles);
- Bonded materials (e.g. grinding wheels); and
- Coated materials (where the particles are applied as a coating to paper, plastic, cloth or metals).

Naphthalene is used in the manufacture of inorganic-bonded materials, in particular grinding wheels. Grinding wheels are the most important bonded abrasive products produced, but other shapes (e.g. segments, cylinders, blocks and honing stones) are also manufactured (Rue, 1991).

Two main types of bonding agents are used in the manufacture of bonded abrasives. These are vitreous (inorganic) bonding agents (glass or ceramic, e.g. feldspar, silicates, quartz, frits, kaolin, clay or nepheline) or resins (usually phenolic resin). Other types of bonding agents such as rubber, shellac, sodium silicate, magnesium oxychloride or metal are sometimes used for specialist applications (Rue, 1991). Naphthalene is only used in the manufacture of inorganic-bonded abrasives (FEPA, 2007).

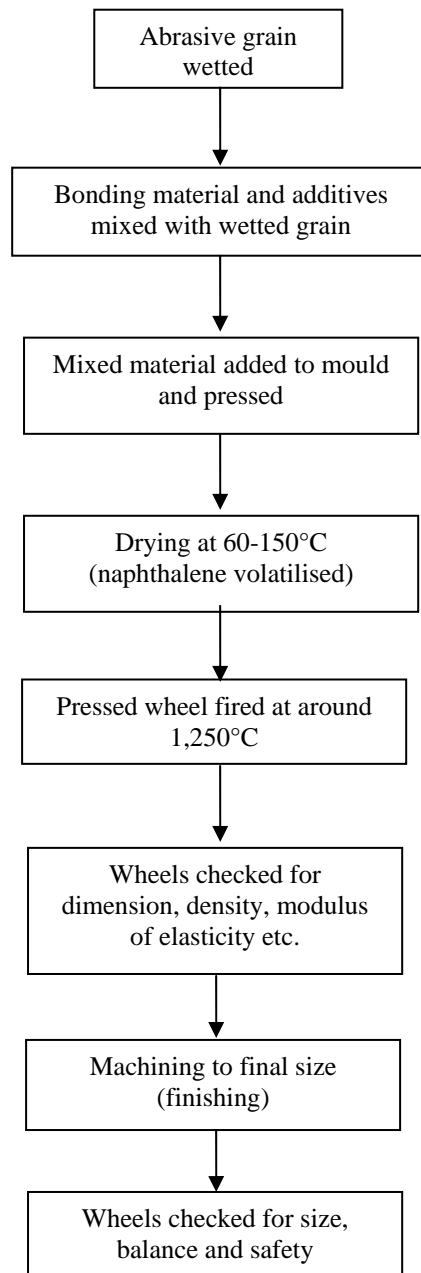
Typical abrasive materials (grit) used for inorganic-bonded abrasives include fused alumina (aluminium oxide), synthetic corundum and black and green silicon carbide (EC, 2007). Cubic boron nitride or diamond are also used. The materials are pre-screened to a uniform grit size before use.

As well as the grit and bonding agent, auxiliary substances are also used in the manufacturing process to enable the required characteristics and shapes to be achieved (EC, 2007). These are added to the abrasive product during the manufacturing process but do not form part of the final product. For example, temporary binding agents (e.g. water-soluble glues, wax emulsions, converted starch, polyoxyethylene preparations, lignosulphonates, converted urea-formaldehyde condensation products and synthetic resins) are added to maintain the correct shape of the material prior to firing or curing. Naphthalene is used as an auxiliary substance, and acts as a pore-forming agent. It is mixed with the other constituents of the abrasive and evaporates/sublimes during the drying and/or firing process.

The overall process used for the manufacture of inorganic-bonded abrasives is outlined in Figure 1 (based on EC (2007), RPA (2000), Rue (1991) and Kopf (1996)). In the process a weighed quantity of abrasive grain is first wetted with a low viscosity liquid pick-up agent (usually water or a glue solution for inorganic-bonded materials). The amount of liquid added is usually around 1-3% by weight of the grit. A weighed quantity of the bonding material and other additives (fillers) is then mixed with the wetted grain by tumbling until each grit particle is coated. The required weight of the now free-flowing mixture is then added to a mould and pressed to a pre-determined bulk density. Inorganic-bonded wheels are usually cold-pressed (i.e. pressed at room temperature for 1-2 minutes at pressures of 2,000 to 5,000 psi (~14 to ~35 MPa)). Following pressing, the wheels are dried (in chamber driers or vacuum driers) at temperatures of between 50-150°C for several hours (up to 45 hours may be needed in some cases to ensure crack-free drying). During this period the naphthalene present in the wheel is volatilised leaving behind the required pore spaces within the wheel.

The pressed and dried wheels are then heat-treated to fuse the inorganic-bond. Inorganic-bonded materials are fired in continuous tunnel or periodic kilns. The firing temperatures vary but are commonly around 1,250°C (range 850-1,300°C). Firing cycles can take between 40 and 120 hours depending on the size of the wheel.

Figure 1 Schematic diagram of the inorganic-bonded abrasive manufacturing process



EC (2007) indicates that total volatile organic compounds (VOCs) in the flue gas from the firing process for inorganic-bonded materials can be reduced from $>100-150 \text{ mg/m}^3$ to $5-20 \text{ mg/m}^3$ (daily average values as total carbon) by the use of thermal afterburners. These figures are equivalent to a removal efficiency of around 87%-97% of the total carbon by the thermal afterburners.

After firing, the wheels are checked for proper dimension, density and modulus of elasticity, and sometimes sandblast resistance, to ensure the grade is correct. The wheels are usually pressed slightly oversize and are then finished by machining (using computer-aided lathes or grinding machines) to the final size and customer requirements. After finishing, the wheels are given a final inspection and checked for balance, size and safety (speed testing).

RPA (2000), RPA (2007) and FEPA (2007) give typical compositions of “wet” product (before drying and firing) used for the manufacture of grinding wheels using naphthalene as follows:

Constituent	Percentage of wet product
Aluminium oxide or silicon carbide (grit)	30-50%
Ceramics (bond)	10-30%
Naphthalene	20-40%

In contrast to this, EC (2007) indicates that the usual ratio of grit to bond material is 9:1 by weight for a vitrified bond abrasive product. EC (2007) also gives usage figures for grit, bonding agents and auxiliary additives at three plants manufacturing inorganic-bonded abrasives in the EU. However, FEPA (2007) have indicated that these figures are not representative for the manufacture of inorganic-bonded abrasives using naphthalene as not all plants use naphthalene as pore-forming agents (it is not stated in EC (2007) whether the figures given are from plants using naphthalene). Therefore the above figures from RPA (2000) and FEPA (2007) are considered to be representative of compositions using naphthalene.

Air emissions from sites using naphthalene in the production of grinding wheels have been of concern historically because of their local nuisance (odour) effect. Consultation with industry carried out by RPA (2000) and FEPA (2007) has indicated that emissions to air from such sites now appear to be well controlled, with most sites having incinerators/afterburners (with and without energy recovery) in place. Incineration at 750-875°C has been found to be sufficient to reduce the emissions to below 1-2 ppm (~5-10 mg/m³) from such sites (RPA, 2000). Often the gases extracted from the firing kilns are used to pre-heat the dryers before the waste gases from both processes go to an incinerator.

RPA (2000 and 2007) also reported that although some companies have undertaken recovery of naphthalene from the process, this has now generally been abandoned in favour of incineration for two main reasons:

- i) Naphthalene is explosive above certain concentration limits in air, and recovery must therefore be undertaken carefully.
- ii) Recovery is difficult as the naphthalene used in the process is required to be pure and of a uniform set size. Therefore further processing of any recovered naphthalene would be required before it could be re-used in the manufacture of grinding wheels, and this is not generally cost-effective.

In EC (2003) the information available for one site in the UK was that the naphthalene driven-off during the process was collected over water in a recovery oven. This process had the potential to lead to significant emissions to waste water, and this was the main cause of the risks identified from the process. Further information on the process used at that time is

now available (RPA, 2007). The process involved removal of naphthalene from the wheels using steam (the (partially) dried wheels were placed inside an oven and steam injected). The naphthalene driven off during the process was carried in the steam and recovered from the subsequent condensate.

According to RPA (2000) risk reduction measures have since been put in place at this site (it is understood that no recovery is now carried out at the site). The naphthalene driven off during the production of grinding wheels is now incinerated or treated by other thermal means, and so has little potential for emission to waste water. The maximum concentration in the treated air from the process is likely to be around 5-10 mg/m³ at the point of discharge.

It is currently unclear if any other sites within the EU carry out recovery of naphthalene. FEPA (2007) has indicated that as far as they are aware, no member company of the Federation for European Producers of Abrasives currently recovers naphthalene by steam recovery. The survey carried out by FEPA (2007) also indicated that, although thermal treatment of exhaust gases from kilns and drying chambers is commonplace, other forms of air treatment, for example biological air cleaners in combination with regenerative re-crystallization chambers, are in use at some plants. The potential for emissions of naphthalene from this type of process is not clear at present and so has not been considered further in the assessment³.

EC (2007) indicates that the main source of process waste water is from cleaning of the preparation/mixing units (cleaning of aggregates), the casting units or as grinding water from the finishing process (naphthalene is burnt-off during the firing process, so the fired products (and hence cleaning water from the finishing process) do not contain naphthalene). Dry processes are also used. The main contaminants of the process water are thought to be mineral components. The waste water is only generated intermittently and is sent to waste water cleaning units prior to discharge or disposal. Waste water cleaning units usually consist of sedimentation basins, with flocculation and coagulation agents being used to assist in the removal of minerals from the waste streams. The amount of waste water generated from the cleaning process is <20 tonnes/year for a typical site (FEPA, 2007). FEPA (2007) has tried to obtain further information on the waste water – it is thought that mixers are generally cleaned by a dry cleaning process. In cases where wet cleaning is used, the water is collected in sedimentation tanks and then disposed of by authorised waste disposal companies.

Process waste includes broken wheels which can occur during the shaping and drying. In some cases this can be recycled into new wheels.

Dust emissions can occur during the mixing of the components of grinding wheels. FEPA (2007) indicates that bag filters of different types are typically used in mixing plants. The dust from the mixing plants is exhausted directly at the point of origin and the exhaust is fed either to one central dust separator or to one of several local separators. RPA (2007) indicates that exposure of workers to dust can also occur during cleaning activities (for example routine hand brushing out of residual material from mixers and the tops of mould presses) and from more extensive plant cleaning and workshop activities. RPA (2007) notes that at some plants water hoses are used for washing down to aid dust suppression.

³ There is no further information currently available on the emissions from this process as it is still undergoing development/optimisation (FEPA, 2007).

2.2.2 Emission scenario

The exact number of companies and sites producing grinding wheels using naphthalene in the EU is unclear. The best current estimate is that there are now around 15 companies (possibly up to 20-25 sites) within the EU manufacturing grinding wheels using naphthalene (FEPA, 2007; RPA, 2007). It should be noted that the number of companies responding to the RPA (2000 and 2007) and FEPA (2007) surveys was significantly below this number.

EC (2003) gives the amount of naphthalene used in the EU in the manufacture of grinding wheels as around 350 tonnes/year. The current European consumption of naphthalene for this use is understood to be higher than this value⁴, although precise figures are difficult to establish due to confidential relationships between grinding wheel producers and their customers. The increase is thought to be linked to the better coverage of the companies using naphthalene than was the case previously and the increased production of high-tech mechanical parts in Europe (e.g. turbine blade manufacturing) (FEPA, 2007). However, the production of grinding wheels for some other applications has moved outside Europe and, overall, it is thought that the use of naphthalene in the production of grinding wheels in Europe is likely to be relatively stable over the short- to medium-term.

RPA (2000) reported that, based on a consultation exercise, the maximum amount of naphthalene used at a site manufacturing grinding wheels would be around 100 tonnes/year, although FEPA (2007) have indicated that this could now be up to around 150 tonnes/year.

Based on the information given in Section 2.2.1 the emissions of naphthalene to both air and waste water would be expected to be low from sites manufacturing grinding wheels, although limited qualitative information is available. The default emission factors from the Technical Guidance Document may not be appropriate for this type of process and so an alternative approach is considered here.

Based on the process description, it is clear that the main potential source of emission to air comes from the drying process, and also possibly the subsequent firing process. Here it can be assumed that essentially all of the naphthalene added to the grinding wheel will evaporate/sublime and enter the waste stream from the drying unit or kiln. This waste stream will be treated (by, for example, incineration) before it is discharged from the plant. Assuming a removal efficiency of around 95% for incineration⁵, the following worst case emissions to air can be estimated for a generic plant manufacturing grinding wheels:

⁴ RPA (2007) estimated that the amount of naphthalene used in the manufacture of grinding wheels in 2006 was around 1,200 tonnes/year.

⁵ Naphthalene is expected to be readily removed by thermal treatments. The typical naphthalene concentration after thermal treatment is 1-2 ppm (~5-10 mg/m³), equivalent to a removal efficiency of ~93-97%. A value from the middle of this range is therefore selected. This compares to a default removal efficiency of 98% for thermal oxidation cited in the draft Risk Management Measures library being developed under REACH Implementation Project 3.2-2.

Assumed amount of naphthalene used at a site	= 100 tonnes/year
Number of days of use	= 300 days/year
Emission from dryer unit before treatment	= 100% = 333 kg/day
Efficiency of air treatment	= 95%
Emission to air after treatment	= 16.7 kg/day ⁶

It appears that the only source for emissions to water is the washing of the mixing unit. Although the mould and the final grinding wheel are also washed in some cases, any naphthalene present would have been volatilised before the washing stage.

Information from FEPA (2007) indicates that the waste water undergoes sedimentation/settlement before disposal (by an authorised waste disposal company). Therefore the maximum concentration of naphthalene that could be present in the water would be limited by its water solubility. The equivalent emission of naphthalene to water can be estimated as follows:

Total amount of waste water generated from washing	= 20 tonnes/year (~20,000 l/year)
Water solubility of naphthalene	= 0.03 g/l
Maximum amount of naphthalene present in this waste stream	= 0.6 kg/year
Number of days of operation	= 300 days/year
Daily emission in waste stream	= 0.002 kg/day

2.2.3 Predicted Environmental Concentrations (PECs)

The PECs for production of grinding wheels resulting from the revised emission estimates above are summarised in Table 2. These have been estimated using EUSES 2.0.3 and the following total regional and continental emissions (from production and all uses of naphthalene) taken from EC (2003):

Total regional emission	12,037 kg/day to air 40.52 kg/day to waste water 35.94 kg/day to industrial soil
Total continental emission	109,571 kg/day to air 154.4 kg/day to waste water 159.7 kg/day to industrial soil

These estimated regional and continental emissions include a total consumption of 350 tonnes/year of naphthalene in the production of grinding wheels. As indicated in Section 2.2.2, the current usage of naphthalene in this application is now thought to be higher. However, when considered in relation to the emissions of naphthalene to the environment from all uses, the contribution from grinding wheels to the total is very small (<0.2% of the total regional emissions based on the data in EC (2003)). Therefore the increased usage in grinding wheels would be expected to have only a minor effect on the predicted regional emissions and hence regional PECs.

⁶ The equivalent figure for a site using 150 tonnes of naphthalene/year would be 25 kg/day.

The PECs have been calculated twice, firstly using the properties for naphthalene taken from EC (2003) and secondly using the properties for naphthalene taken from the CTPHT assessment (ECB, 2007), as summarised in Table 1a.

Table 2 Summary of PECs for production of grinding wheels

PEC	Calculated using properties from EC (2003) ^b	Calculated using properties from ECB (2007) ^b
Local PEC in surface water	0.082 µg/l	0.081 µg/l
Local PEC in waste water treatment plant	0.35 µg/l	0.47 µg/l
Local PEC in freshwater sediment	2.3 µg/kg wet weight	2.4 µg/kg wet weight
Local PEC in air	4.7×10 ⁻³ mg/m ³ [7.1×10 ⁻³ mg/m ³]	4.7×10 ⁻³ mg/m ³ [7.1×10 ⁻³ mg/m ³]
Local PEC in agricultural soil (averaged over 30 days)	5.3 µg/kg wet weight [7.5 µg/kg wet weight]	2.1 µg/kg wet weight [2.8 µg/kg wet weight]
Local PEC in agricultural soil (averaged over 180 days)	5.2 µg/kg wet weight [7.4 µg/kg wet weight]	1.9 µg/kg wet weight [2.6 µg/kg wet weight]
Regional PEC in surface water	0.048 µg/l	0.034 µg/l
Regional PEC in freshwater sediment	1.9 µg/kg wet weight	0.93 µg/kg wet weight
Regional PEC in agricultural soil	0.25 µg/kg wet weight	0.11 µg/kg wet weight

Note: a) Emissions to water are assumed to be spread over 300 days.

b) Values estimated for a plant using 100 tonne/year of naphthalene based on RPA (2000). The equivalent values for a plant using 150 tonnes/year of naphthalene are shown in square brackets where these differ. The size of the plant has no significant effect on the other PECs calculated.

2.2.4 Risk characterisation

The risk characterisation ratios are summarised in Table 3. These have been estimated using both the PNECs from the original risk assessment report for naphthalene (EC, 2003) and those derived for naphthalene in the CTPHT risk assessment (ECB, 2007), as summarised in Table 1 b.

Table 3 Summary of risk characterisation ratios for production of grinding wheels

Endpoint	Calculated using properties and PNECs from EC (2003)	Calculated using properties and PNECs from ECB (2007)
Surface water	0.034	0.041
Waste water treatment plant	1.2×10 ⁻⁴	1.6×10 ⁻⁴
Freshwater sediment	0.034	3.8×10 ⁻³
Agricultural soil (averaged over 30 days)	0.099	2.4×10 ⁻³

Note: a) Ratios estimated for a plant using 100 tonne/year of naphthalene based on RPA (2000). The equivalent values for a plant using 150 tonnes/year of naphthalene are all <1.

Similar to the case in EC (2003), no risk characterisation for secondary poisoning is carried out⁷.

The risk characterisation ratios indicate that no risks to the environment would be expected based on the revised emission estimates for use of naphthalene in grinding wheels.

2.2.5 Exposure of humans via the environment

In the previous version of the risk assessment (EC, 2003) a conclusion (i) was drawn in relation to local exposure of humans via the environment from sites producing grinding wheels.

The estimated revised exposure of humans via environmental routes associated with sites using naphthalene in the production of grinding wheels is summarised in Table 4. These figures have been estimated using EUSES 2.0.3 based on the emission scenario outlined in Section 2.2.2.

Table 4 Summary of exposure of humans via the environment from production of grinding wheels

Source of exposure	Calculated using properties from EC (2003) ^a		Calculated using properties from ECB (2007) ^a	
	Concentration	Daily dose	Concentration	Daily dose
Fish	0.033 mg/kg	5.3×10 ⁻⁵ mg/kg/day	0.072 mg/kg	1.2×10 ⁻⁴ mg/kg/day
Root crops	0.011 mg/kg [0.016 mg/kg]	6.1×10 ⁻⁵ mg/kg/day [8.7×10 ⁻⁵ mg/kg/day]	1.7×10 ⁻³ mg/kg [2.4×10 ⁻³ mg/kg]	9.4×10 ⁻⁶ mg/kg/day [1.3×10 ⁻⁵ mg/kg/day]
Leaf crops	9.9×10 ⁻³ mg/kg [0.015 mg/kg]	1.7×10 ⁻⁴ mg/kg/day [2.5×10 ⁻⁴ mg/kg/day]	4.6×10 ⁻³ mg/kg [6.8×10 ⁻³ mg/kg]	7.9×10 ⁻⁵ mg/kg/day [1.2×10 ⁻⁴ mg/kg/day]
Drinking water	2.3×10 ⁻⁴ mg/l [3.3×10 ⁻⁴ mg/l]	6.7×10 ⁻⁶ mg/kg/day [9.5×10 ⁻⁶ mg/kg/day]	7.8×10 ⁻⁵ mg/l [1.1×10 ⁻⁴ mg/l]	2.2×10 ⁻⁶ mg/kg/day [3.1×10 ⁻⁶ mg/kg/day]
Meat	1.5×10 ⁻⁴ mg/kg [2.2×10 ⁻⁴ mg/kg]	6.3×10 ⁻⁷ mg/kg/day [9.4×10 ⁻⁷ mg/kg/day]	4.4×10 ⁻⁵ mg/kg [6.5×10 ⁻⁵ mg/kg]	1.9×10 ⁻⁷ mg/kg/day [2.8×10 ⁻⁷ mg/kg/day]
Milk	4.7×10 ⁻⁵ mg/kg [6.9×10 ⁻⁵ mg/kg]	3.7×10 ⁻⁷ mg/kg/day [5.5×10 ⁻⁷ mg/kg/day]	1.4×10 ⁻⁵ mg/kg [2.1×10 ⁻⁵ mg/kg]	1.1×10 ⁻⁷ mg/kg/day [1.7×10 ⁻⁷ mg/kg/day]
Air	3.9×10 ⁻³ mg/m ³ [5.8×10 ⁻³ mg/m ³]	1.1×10 ⁻³ mg/kg/day [1.7×10 ⁻³ mg/kg/day]	3.9×10 ⁻³ mg/m ³ [5.8×10 ⁻³ mg/m ³]	1.1×10 ⁻³ mg/kg/day [1.7×10 ⁻³ mg/kg/day]
Total		1.4×10 ⁻³ mg/kg/day [2.1×10 ⁻³ mg/kg/day]		1.3×10 ⁻³ mg/kg/day [1.9×10 ⁻³ mg/kg/day]

Note: a) Values estimated for a plant using 100 tonne/year of naphthalene based on RPA (2000). The equivalent values for a plant using 150 tonnes/year of naphthalene are shown in square brackets where these differ. The size of the plant has no significant effect on the other PECs calculated.

⁷ Naphthalene has a log K_{ow} of 3.73, and some bioaccumulation factors greater than 100 have been measured. However, naphthalene does not carry the risk phrases T or T+, R47, R48 or R60-73. Therefore it is not necessary to carry out a risk characterisation for secondary poisoning (EC, 2003).

Based on the revised emission scenario, the daily human intake from exposure via the environment from sites producing grinding wheels would be around 1.3×10^{-3} to 1.4×10^{-3} mg/kg/day⁸. This compares with the figure of 0.25 mg/kg/day estimated in EC (2003) for this use.

In EC (2003) two endpoints were considered to give rise to a conclusion (i), haemolytic anaemia and repeated inhalation toxicity and carcinogenicity. The impact of the revised exposure estimates on these two endpoints is considered below.

Haemolytic anaemia

Exposure in the locality of grinding wheel plants is estimated at up to 1.4×10^{-3} mg/kg/day. It is not possible to quantitatively assess the risks for haemolytic anaemia, because of the absence of information on the NOAEL and dose-response characteristics for this endpoint in humans. However, given the low level of exposure for this local scenario, the risk to human health is not considered to be of concern. Therefore conclusion (ii) is reached.

Repeated inhalation toxicity and carcinogenicity

The airborne levels of naphthalene in the locality of grinding wheel plants are estimated at $3.9 \mu\text{g}/\text{m}^3$. This is three orders of magnitude lower than the LOAEL for local respiratory effects in rats of $5 \text{ mg}/\text{m}^3$. Therefore there is no cause for concern for human health from this exposure and conclusion (ii) is reached.

2.2.6 Other considerations

Naphthalene is on the list of priority substances under the Water Framework Directive (EC, 2001). EC (2006) sets out the Environmental Quality Standards (EQS) that have been proposed. The EQS for naphthalene is $2.4 \mu\text{g}/\text{l}$ as an annual average for inland surface waters and $1.2 \mu\text{g}/\text{l}$ as an annual average for other surface waters. In addition, EU Member States are required to establish an inventory of emissions, discharges and losses of all priority substances (including naphthalene) for each river basin within their territory. These EQS's are similar to the PNECs for surface water derived in EC (2003) and ECB (2007).

The Water Framework Directive itself does not introduce any additional control measures on sites using naphthalene. The mechanisms available to member states to ensure that the EQS is met are likely to be limited to those already in existence, particularly Integrated Pollution Prevention and Control (IPPC Directive 96/61/EC (EC, 1996)). The production of inorganic-bonded grinding wheels is covered under Section 3.5 of Annex I to Directive 96/61/EC (related to manufacture of ceramic products) provided the kiln production capacity is more than 75 tonnes/day or the kiln capacity is more than 4 m^3 and the setting density is more than $300 \text{ kg}/\text{m}^3$. It is understood that there are only a small (limited) number of sites producing inorganic-bonded abrasives using naphthalene that are covered by IPPC and that many sites in the EU would not be covered by IPPC.

⁸ These figures are for a site using 100 tonnes/year of naphthalene based on the information in RPA (2000). For a site using 150 tonnes/year of naphthalene (as could be the case in more recent years), the figures are similar at 1.9×10^{-3} - 2.1×10^{-3} mg/kg/day.

In summary, the EQS proposed from naphthalene is likely to effectively control the possible future emissions from sites producing inorganic-bonded abrasives using naphthalene operating under the IPPC regime, but many smaller sites will not be currently covered by IPPC.

2.2.7 Conclusions

Further information has become available on the emissions of naphthalene from the production of grinding wheels. Although the information is mainly qualitative in nature, it can be concluded that the risks to the environment at most, if not all, sites in the EU are likely to be much lower than assumed in EC (2003). The risks to the environment that were identified in the original risk assessment report appear to originate mainly from a process involving the steam recovery of naphthalene from the drying ovens. Changes to the process at the site in question have been carried out reducing the risk from this site.

On the basis of the information now available, it is expected that the risk to the environment from this use is now low. Although the surveys carried out so far may not cover all of the sites in the EU producing grinding wheels using naphthalene, FEPA (2007) has indicated that as far as they are aware, there is no indication that any member company currently recovers naphthalene by steam recovery⁹.

The inclusion of naphthalene as a priority substance under the Water Framework Directive should mean that any future emissions to surface water from the use of naphthalene in grinding wheels (and any other industrial use of naphthalene) should be adequately controlled from sites covered by the IPPC Directive, but not all sites will be currently covered by IPPC.

The conclusion (iii) for this use drawn in EU (2003) can therefore be changed to a conclusion (ii).

3 MARINE RISK ASSESSMENT

3.1 RISK CHARACTERISATION FOR THE MARINE ENVIRONMENT

FEPA (2007) indicates that, as far as the industry is aware, there are no grinding wheel manufacturing sites located at the coast. One site has been identified that is near to the coast, but no waste water from this site goes to sea (the air emissions from the site are treated using incineration technologies and waste water from the mixing process is collected and disposed of by an authorised waste disposal company). Therefore it is not necessary to calculate PECs for the marine environment, or to carry out a PEC/PNEC comparison for the marine environment.

⁹ One further site in the EU carries out an air treatment process using biological air cleaners in combination with regenerative re-crystallization chambers, but little is currently known about the potential emissions from this process as it is undergoing development/optimisation (FEPA, 2007). Therefore the emissions from this process have not been assessed in the current assessment.

3.2 PBT ASSESSMENT

No assessment of the properties of naphthalene against the PBT criteria was carried out in EC (2003). An assessment of the properties of naphthalene against the criteria for a persistent, bioaccumulative and toxic substance is therefore given below. The information is taken from the existing published environmental risk assessment for naphthalene (EC, 2003), along with information on naphthalene given in the draft risk assessment report for coal tar pitch high temperature (CTPHT) (ECB, 2007).

3.2.1 Persistence

A substance is considered to be persistent (P) or very persistent (vP) if it has a half-life of >60 days in marine water or >180 days in marine sediment. In addition a substance is also considered to be persistent if it has a half-life of >40 days in freshwater or >120 days in freshwater sediment.

Naphthalene is considered to be inherently biodegradable. The default biodegradation half-lives for an inherently biodegradable substance are 150 days in freshwater and around 3,000 days in sediment (EC, 2003). The CTPHT risk assessment (ECB, 2007) gives estimates for the biodegradation half-life of naphthalene as around 7 days in surface water and 230 days in sediment. Based on the data for sediment, naphthalene can be considered to meet the screening criteria for P and vP.

3.2.2 Bioaccumulation

A substance is considered to be bioaccumulative (B) if it has a bioconcentration factor (BCF) >2,000 l/kg or very bioaccumulative (vB) if it has a BCF >5,000 l/kg.

EC (2003) gives the BCF for naphthalene in fish as 427 l/kg, with values of up to 1,158 l/kg being determined for individual tissues. ECB (2007) gives the range of reliable values for the BCF for naphthalene in fish as between 300 and 1,000 l/kg. Based on these values, naphthalene does not meet the criteria for a B or vB substance.

3.2.3 Toxicity

The available ecotoxicity and mammalian toxicity data for naphthalene are summarised in the published risk assessment report (EC, 2003). A substance is considered to be toxic if it has a chronic NOEC <0.01 mg/l or is classified as carcinogenic (category 1 or 2), mutagenic (category 1 or 2) or toxic for reproduction (category 1 or 2) or where there is evidence of chronic toxicity, as indicated by the classifications T, R45, R46, R48, R60 and R61 or Xn, R48, R62, R63 and R64, or where there is substantiated evidence of long-term toxicity (for example endocrine disrupting effects).

The classification for naphthalene is as follows (EC, 2003).

Carc. Cat 3; R40.

Xn; R22

N; R50/53

Therefore naphthalene does not have the required human health classification to meet the T criterion.

The lowest NOEC from tests with aquatic organisms given in EC (2003) is 0.12 mg/l from a five week test with fry of the pink salmon (*Oncorhynchus gorbuscha*). ECB (2007) gives a lower NOEC of 0.020 mg/l for naphthalene from an early life stage study with rainbow trout (*Oncorhynchus mykiss*). Neither value is below the T criterion.

Naphthalene therefore does not meet the T criterion on the basis of either aquatic or mammalian effects.

3.2.4 Conclusions for the PBT assessment

Naphthalene meets the screening criteria for P and vP but does not meet the criteria for B, vB or T. Therefore naphthalene is not a PBT or vPvB substance.

4 SUMMARY OF OVERALL CHANGES TO THE CONCLUSIONS FOR NAPHTHALENE

4.1 ENVIRONMENTAL ASSESSMENT FOR GRINDING WHEELS

Based on updated information, it is expected that the risk for all environmental protection goals from the use of naphthalene in the manufacture of grinding wheels is now low. Therefore the conclusion should be changed from (iii) to (ii).

No risk characterisation for the marine environment has been carried out for this use pattern since industry has not identified any sites that are located at the coast.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

4.2 PBT ASSESSMENT

Naphthalene meets the screening criteria for P and vP but does not meet the criteria for B, vB or T. Therefore naphthalene is not a PBT or vPvB substance.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

4.3 HUMANS EXPOSED INDIRECTLY VIA THE ENVIRONMENT

The indirect exposure of humans via the environment in the vicinity of grinding wheel manufacturing plants has been revised based on the new information provided.

Haemolytic anaemia

Exposure in the locality of grinding wheel plants is estimated at up to 1.4×10^{-3} mg/kg/day. It is not possible to quantitatively assess the risks for haemolytic anaemia, because of the absence of information on the NOAEL and dose-response characteristics for this endpoint in humans. However, given the low level of exposure for this local scenario, the risk to human health is not considered to be of concern.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

Repeated inhalation toxicity and carcinogenicity

The airborne levels of naphthalene in the locality of grinding wheel plants are estimated at $3.9 \mu\text{g}/\text{m}^3$. This is three orders of magnitude lower than the LOAEL for local respiratory effects in rats of $5 \text{ mg}/\text{m}^3$. Therefore there is no cause for concern for human health from this exposure.

Result

Conclusion (ii) There is at present no need for further information and/or testing and for risk reduction measures beyond those which are being applied already.

5 REFERENCES

EC (1996). Council Directive 96/61/EC of 24 September 1996 concerning Integrated Pollution Prevention and Control. Official Journal of the European Communities, L256, 10.10.96, pp 26-40.

EC (2001). Decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC.

EC (2003). European Union Risk Assessment Report: Naphthalene. 1st Priority List, Volume 33. European Commission, Joint Research Centre, EUR 20763 EN.

EC (2006). Proposal for a Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC. COM(2006) 397 Final. Commission of the European Communities, 17.7.2006.

EC (2007). Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry. European Commission, August 2007.

ECB (2007). European Union Risk Assessment Report: Coal-tar pitch, high temperature. Draft environmental risk assessment report, R323_0705_env, May 2007, Rapporteur: the Netherlands. European Chemicals Bureau.

FEPA (2007). Personal communication.

Kopf P. W. (1996). Phenolic resins. Kirk-Othmer Encyclopedia of Chemical Technology. Fourth Edition, Volume 18, pp603-644.

RPA (2000). Risk Reduction Strategy and Analysis of Advantages and Drawbacks for Naphthalene. Stage 4 Report. Contract No. CDEP 1/41/17. Report prepared for the Department of Environment, Transport and the Regions, Risk & Policy Analysts Limited (available from http://www.defra.gov.uk/environment/chemicals/pdf/naphthalene_rrs.pdf).

RPA (2007). Human Health Risk Reduction Strategy and Analysis of Advantages and Drawbacks for Naphthalene. Final Report. Report prepared for the Department for Environment, Food and Rural Affairs and Health and Safety Executive, Risk & Policy Analysts Limited.

Rue C. V. (1991). Abrasives. Kirk-Othmer Encyclopedia of Chemical Technology. Fourth Edition, Volume 1, pp17-37.

The report provides an Addendum to the comprehensive risk assessment of the substance naphthalene. It has been prepared by the United Kingdom in the frame of Council Regulation (EEC) No. 793/93 on the evaluation and control of the risks of existing substances, following the principles for assessment of the risks to man and the environment, laid down in Commission Regulation (EC) No. 1488/94.

The comprehensive risk assessment of naphthalene was published in 2003. This identified a risk to the environment from use in the manufacture of grinding wheels. Further information was required to refine the indirect human exposure assessment for this scenario. During the development of the risk reduction strategy further information on emissions of naphthalene from use in manufacture of grinding wheels has been obtained. This addendum considers the consequences of this new information for conclusions drawn in the original risk assessment. In addition a PBT assessment has been included.

The Addendum concludes that there is no concern for man and the environment from the use of naphthalene in the manufacture of grinding wheels. Naphthalene does not meet the PBT or vPvB criteria. No other scenarios have been reviewed. The published comprehensive risk assessment should be consulted for additional information.