Dutch-German Exchange
on dredged material

Dutch-German Exchange on Dredged Material

- Part 3 –

Hazardous substances in dredged material

March 2005

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The participating members of each authority are listed in Annex I.

Meetings:

December 1999:	Koblenz/D, hosted by the Federal Institute of Hydrology
June 2000:	Lelystad/NL, hosted by AKWA/RIZA
December 2000:	Bonn/D, hosted by the Federal Ministry for the Environment
June 2001:	Rotterdam/NL, hosted by the Port of Rotterdam
June 2002:	Rastatt/D, hosted by the Fedreal Ministry for the Environment
September 2003:	Wageningen/NL, hosted by AKWA/RIZA.
March 2004:	Koblenz/D, hosted by the International Commission for Protection of the Rhine
January 2005:	Koblenz/D, hosted by the Federal Institute of Hydrology

Abbreviations:

DGE	Dutch-German Exchange on Dredged Material
OSPAR	Oslo-Paris Commission
EU-WFD	European Union – Water Framework Directive
ICPR	International Commission for Protection of the Rhine
EINECS	European Inventory of Existing Commercial Chemical Substances
P_{OW}	partition coefficient between octanol and water
LAWA	Länder-Arbeitsgemeinschaft Wasser = Federal States' Committee Water
MTR	Maximaal Toelaatpaar Risico = Maximum Permissible Risk level
CTT	Chemie Toxiciteits Toets = Chemical Toxicity Test
SQC	Sediment Quality Criteria
HABAK	Handlungsanweisung Baggergut Küste = Directive for the Management of Coastal Dredged Material

Hazardous substances in dredged material

Helge Bergmann [1], Dorien ten Hulscher [2] and Marc Eisma [3]

Executive Summary

Within the scope of the "Dutch-German Exchange on Dredged Material" (DGE) a report was prepared on "Hazardous substances in dredged material - comparison and assessment of different lists". The following objectives were agreed on:

- Pinpoint which chemicals are important for dredged material handling.
- Make an inventory and comparison of relevant national/international chemical lists with thresholds and other values which have to be considered for the various handling options (relocation, re-use, treatment, landfill etc.).
- The report collects, compares and comments available information (data) only, no additional measurements were performed.

This report summarises the findings of an inventory of available lists of chemicals and sediment quality criteria and gives the following conclusions and recommendations for the further proceeding:

There are several factors rendering the assessment of sediment and dredged material quality difficult:

- Lists of hazardous substances derived for sediments differ from each other. See below
- Sediment quality criteria are not harmonised but differ widely.
- Assessment procedure for concentration data of hazardous substances in sediments is not fixed.
- Any further work on the basis of the present patchwork of lists, action values and concentration data would hardly lead to any useful overview or comparative assessment [except when used for decisions on national or sub-national scope].

For the assessment of contamination with sediment relevant substances in dredged material several lists of chemicals exist. In case of the River Rhine these lists come from

- OSPAR: list of chemicals for priority action (OSPAR 1998, OSPAR 2000)
- EU-WFD: priority substances
- ICPR: Rhine relevant substances (ICPR 2000)

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These lists overlap only partly. One single list does not cover site-specific problems. Because the quality standards were derived on the base of different objectives, their numerical values differ.

For bilateral and Europe-wide assessment of the quality of sediments and dredged material harmonisation is recommended for:

- the lists of hazardous substances, in particular for sediments;
- the sediment quality criteria;
- the monitoring and assessment procedure for sediments and dredged material.

It is recommended to support or initiate such harmonisation of the quality assessment of sediment and dredged material within the development of technical guidance documents for the European Water Framework Directive.
The objective would be to obtain harmonised guidance for the assessment of sediment quality and for the management of dredged material in river basins.

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1. Introduction and scope

In DGE governmental authorities from The Netherlands and Germany are regularly meeting since the year 1999 (see enclosed document). DGE started as an informal bilateral platform for exchanging knowledge, information and experiences in the field of sediment management. During the past 6 years subjects such as legislation, risk assessment and sediment treatment were discussed. The results of the exchange have been documented in a number of papers and reports (available from internet: www.bafg.de, www.htg-baggergut.de, www.akwa.info). During the 5th meeting of the DGE group (Rastatt 2002) Mr. Eisma and Mr. Bergmann have presented a draft "Hazardous substances in dredged material - comparison and assessment of different lists" [1] based on an earlier project report [2]. After discussion, the Group decided that for a final DGE report additional information regarding the practical relevance of chemicals for dredging projects is needed. The following items were agreed on:

- Pinpoint which chemicals are important for dredged material handling and give ranges about the level of contamination in both countries.
- Make an inventory and comparison of relevant national/international chemical lists with thresholds and other values which have to be considered for the various handling options (relocation, re-use, treatment, landfill etc.).
- The report should collect, compare and comment available information (data) only.

The various steps for subsequent elaboration were the following:

1. check of the lists of hazardous substances
2. check of the selection of hazardous substances for sediments only
3. collection of sediment quality criteria
4. search for sediment monitoring data
5. comparative assessment of sediment quality

This report summarises the findings and gives some conclusions and recommendations.

2. Selection of sediment-relevant hazardous substances

The European Inventory of Existing Commercial Chemical Substances (EINECS) lists over 100,000 chemical compounds. Little is known about the toxicity of about 75 % of these chemicals. In this context, the task to identify compounds, which are hazardous with regard to the aquatic ecosystem or human health via the aquatic exposure route, such as the consumption of drinking water or fish, is challenging. The implementation of monitoring programmes and conduction of risk assessments for this 'chemical universe' is not feasible and not appropriate. One approach to overcome this obstacle is the definition of so-called hazardous substances by combined effect and exposure scoring approaches. Currently of most importance, in Europe or for the North-East-Atlantic including the North Sea, are the new European Water Framework Directive (EU-WFD) and the OSPAR activities.

EU-WFD

The new EU-WFD, adopted by the European Parliament and the Council in December 2000 [3], will have a direct impact on national approaches towards imission and emission control. A list of hazardous substances is proposed and shall be reviewed at least every four years. For substances, included in this list, the EU-WFD demands the European Commission to submit proposals for:

- quality standards applicable to surface water (within 2 to 6 years)
- control of the progressive reduction of discharges, emissions and losses
- control of cessation or phasing out of discharges, emissions and losses (the timetable should not exceed 20 years).

The EU-WFD demands to establish river basin management plans in order to achieve certain quality levels depending on the type of water bodies. For heavily modified and artificial water bodies a lower quality level is required than for surface waters in general. The designation of water bodies will be performed by the individual EU member states. This will be crucial due to the currently 'wide' definition of heavily modified water bodies.

OSLO/PARIS Commission (OSPAR)

In the 'Sintra Statement', OSPAR stated with regard to hazardous substances that the ultimate aim is to achieve concentrations in the marine environment near background values for naturally occurring substances and close to zero for manmade chemicals [4]. This is also considered in article 1 of the EU-WFD.

Focus on aquatic sediments

For focussing on sediments, only those substances were selected from the ranking lists having a high tendency to adsorb on particulate matter (here defined by a partition co-efficient $P_{ow} < 5$). EU [5] and OSPAR [6] ranking and prioritisation lists as well as Rhine relevant substances from the list of the International Commission for the Protection of the Rhine (ICPR) [7] were combined and evaluated. Individual substances and groups of substances amount to a total of 58. In annex III a complete overview of the relevant compounds is presented.

Comparing the OSPAR list of chemicals for priority action with the proposed EU-WFD list and the list of Rhine relevant substances, it is obvious that they overlap only to a limited extent (figure 1).

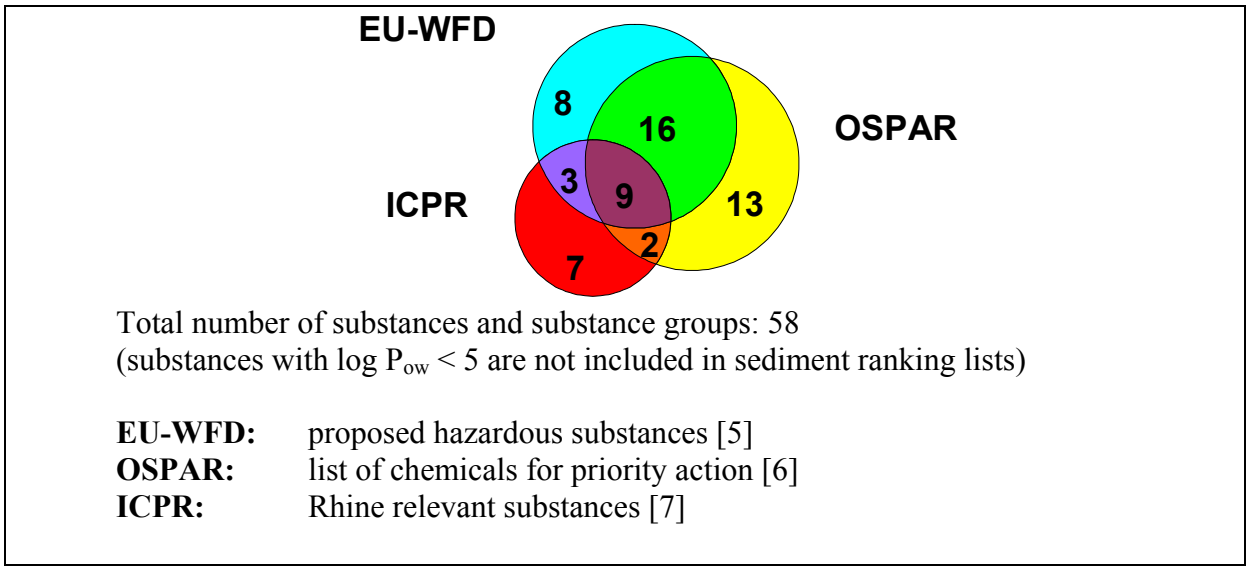


Figure 1: Comparison of lists of hazardous substances of European Union, OSPAR Commission and International Rhine Commission

Ideally, relevant substances should be identified for the river catchment area (as done e.g. by the ICPR for the Rhine), which will be influenced by the proposed EU-WFD list of hazardous substances. For these hazardous substances the setting of quality standards applicable to surface water is demanded by the EU-WFD within the next years and, subsequently if necessary, reduction measures, such as emission control of point and diffuse sources or phasing-out of certain chemicals.

Furthermore, chemicals prioritised under OSPAR, which mainly enter the North Sea via rivers like the Rhine should ideally be included in the EU-WFD list of hazardous substances or at least be taken into account on the catchment level.
In the proposal for establishing the list of priority pollutants in the field of water policy' (Council of the EC, 2000) it is stated that
"The marine environment is not addressed in the proposed WFD per se ... The Commission takes an active part in the present work of prioritisation of substances under the OSPAR convention. If this exercise identifies the need for action on other substances than those proposed for the first priority list, the Commission will consider, on a case-by-case basis either the amendment of the priority list or the application of Article 16, paragraph 7 of the proposed WFD."
Article 16, paragraph 7 of the EU-WFD states that the Commission may prepare strategies against pollution of water by any other pollutants, i.e. substances not prioritised under the EU-WFD.

The ranking and prioritisation of chemicals is an on-going task on the regional/national (river catchments) and international level. For the Rhine catchment and the North Sea the EU-WFD and OSPAR approaches are the most important international ones. As 'new' chemicals become of concern and are/will be prioritised it can be expected that the list of chemical

criteria for the quality of sediments/dredged material will be updated in future. Last but not least, the 'classical' list of chemicals for hazard assessment had the advantage that they could be easily and economically analysed. The great number of new compounds necessitates the introduction of new additional methods (bioassays) for hazard assessment. These methods are not compound-specific but rather try to identify toxicity of the mix of compounds present in water or sediments.

Résumé:
- Within the political bodies of EU, OSPAR and ICPR, lists of hazardous substances have been developed. Sublists can be deducted for aquatic sediments containing only substances with high affinity to solid matter.
- These three lists (total as well as for sediments) overlap only partly. Therefore, authorities responsible for assessing sediment and dredged material quality are obliged to collate these lists and create a new one containing the sum of hazardous substances relevant, in this case, for the Rhine.
- If in place of the river Rhine any other river is to be assessed the substance list of the ICPR has to be replaced by the specific list of that river system.

3. Action levels for hazardous substances

A prerequisite for the assessment of hazardous substances in dredged material is the existence of "guide values" or other valid scales to assess the ecological relevance of observed concentrations. Only if they are available it can be decided whether any, and which, actions might be needed. Therefore, it is necessary to collect information on guide values, action values or similar scales already existing or being developed. In addition, it must be clear for what purpose these values are defined.

Several lists with chemical sediment quality criteria exist already. The OSPAR Commission has summarized a number of such lists of *quality criteria* for assessing sediment pollution [8]. A harmonised list for sediments does not exist in Germany, however, *quality targets* for suspended particulate matter are in use by LAWA (Länder-Arbeitsgemeinschaft Wasser = Federal States´ Committee Water) [9] and the International Commission for the Protection of the Rhine [10]. In the Netherlands MTR values (Maximaal Toelaatbaar Risico) are used for quality assessment [11]. Apart from the criteria to assess the quality of sediments, criteria for handling *dredged material* also exist. In German federal waterways the Directive for the Management of Coastal Dredged Material is applied containing guide values (action levels) for a number of contaminants [12]. In the Netherlands the criteria for relocation of dredged material into the North Sea are since June 2004 based on the Chemical-Toxicity-Test [13].

As shown in the table in Annex II, for some heavy metals the existing criteria may differ substantially. For the compounds listed as hazardous substances in the EU-WFD no sediment quality criteria are available yet. These are being developed by the Fraunhofer Institute [14]. There is already a proposal for the method to derive these criteria.

Résumé:
For an effective discussion on existing levels of sediment contamination and its possible impact on river systems an uniform approach on the assessment of sediment quality is of importance. As a first step a comprehensive inventory of existing approaches might help in this discussion, and is available in the proposal of the Fraunhofer Institute.

However, further work on such a compilation would consume considerable time and personnel resources. In addition, such a broader overview would probably only lead to the same result as deducted from table 1, i.e. the non-agreement of such lists and of the rationales behind the numerical values.

A more effective way for future joint assessments of the quality of sediments and, in particular, dredged material would probably concentrate on a European harmonisation of such guide values, for sediment quality targets as well as for dredged material management.

4. Concentrations of hazardous substances in aquatic sediments: River Rhine

Having compiled the lists and action values of sediment-related substances the next step is to obtain an overview of their concentrations observed in sediments and dredged material. The result should indicate whether any of the substances are of importance in the management of dredged material.

As the river Rhine is of bilateral interest to the Netherlands and Germany this river system was chosen as an example. Data used here were extracted from a sediment monitoring Programme carried out from the upper to the lower Rhine by Germany, France and the Netherlands. Some information on the sampling sites is given in table 1.

The samples consisted of sediment cores. For subsequent analysis of contaminants they were divided into several layers per core sample. Layer 1 represents the uppermost (most recent) layer, layers 2, 3 ... lower (older) layers of that specific core.

Table 1: Sampling sites for sediments

River	sampling site
Rhine	Marckolsheim
	Gerstheim
	Strasbourg
	Gambsheim
	Iffezheim
	Amerongen
	Hollandsch Diep
Main (D)	Eddersheim
Ruhr (D)	Duisburg

Partial evaluation of the data included

- the Rhine with and without tributaries,
- the upper three layers (ca. 20-30 cm) vs. the upper one layer (5-10 cm), and
- application of two sets of sediment quality criteria (SQC): LAWA (D) and MTR (NL) values

The results are shown in figures 2 and 3. They are based on the percentage of contamination related to the respective sediment quality criterion indicated by the coloured horizontal lines (= 100%). The graphs show that depending on the selection of data very different descriptions of the “sediment quality” can be obtained.

As a consequence of this ambiguous result a further evaluation of organic hazardous substances and of dredged material was not pursued any more. Such action will only become useful when clear procedures are worked out for the assessment of sediments and dredged material.

Résumé:

- Concentration data of contaminants in sediments exist on the national and multilateral level. In the case of the investigation programme of sediments from the Rhine sampling and analysis of the samples were agreed prior to practical work.
- However, with regard to the assessment of the concentration data no harmonised procedure is in use. Depending on the selection of sampling sites as well as the number and depth of samples different assessment results are obtained rendering interpretation of the sediment quality ambiguous.

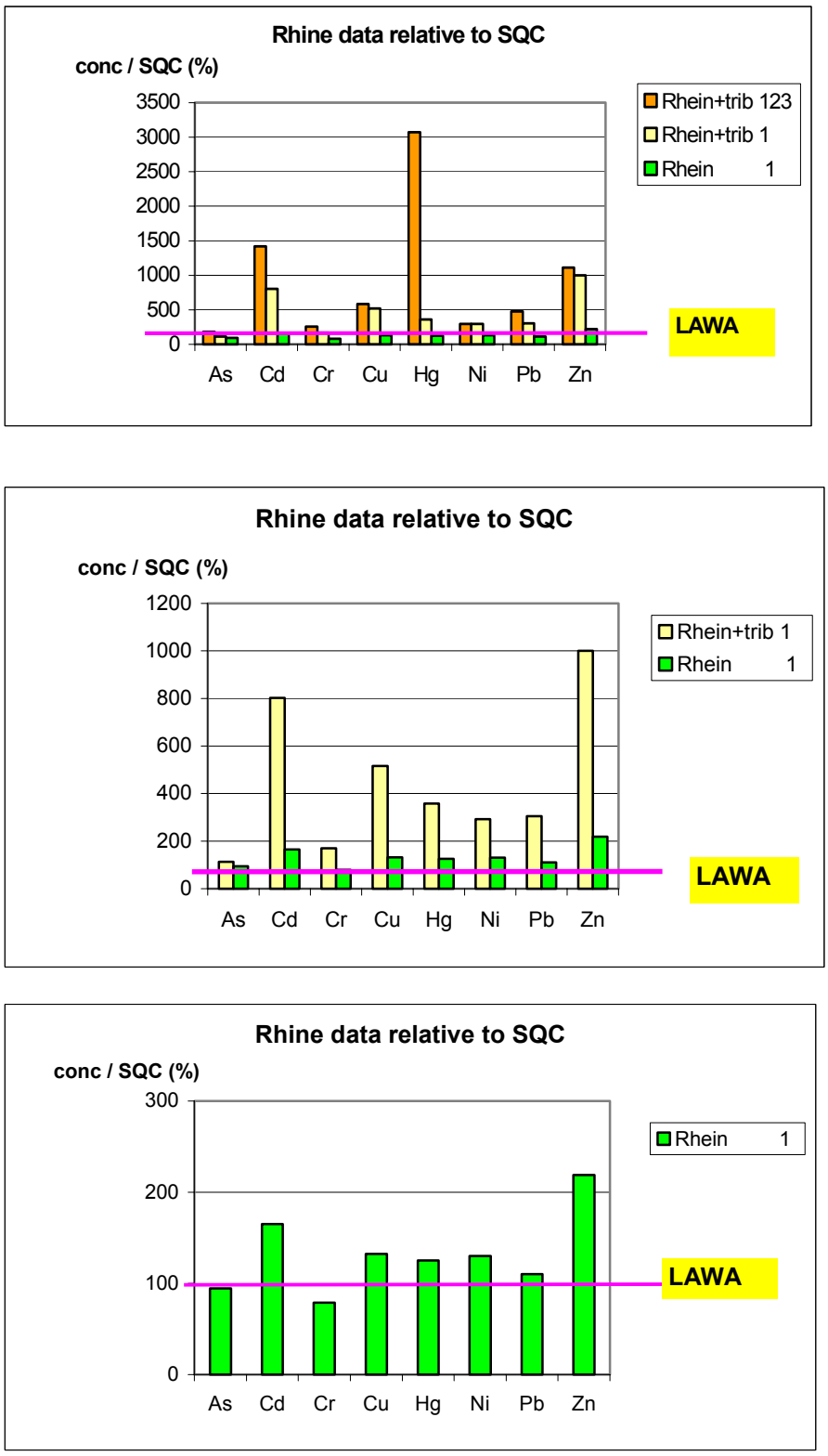
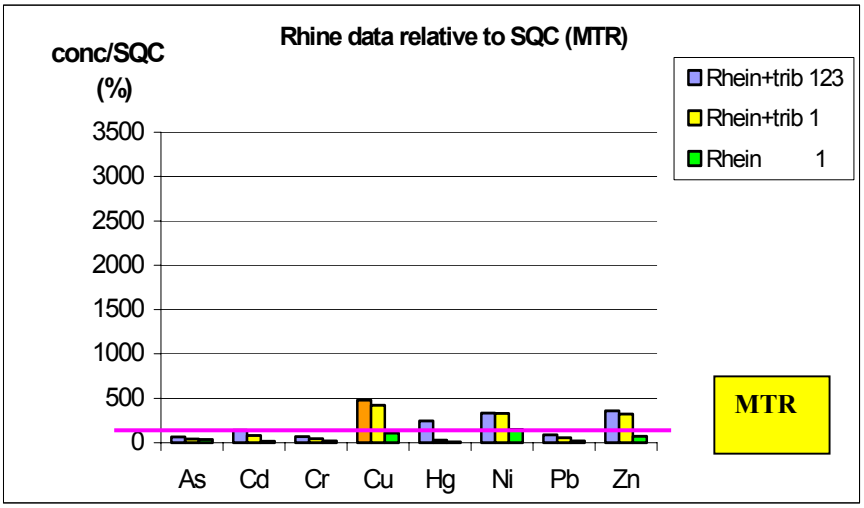
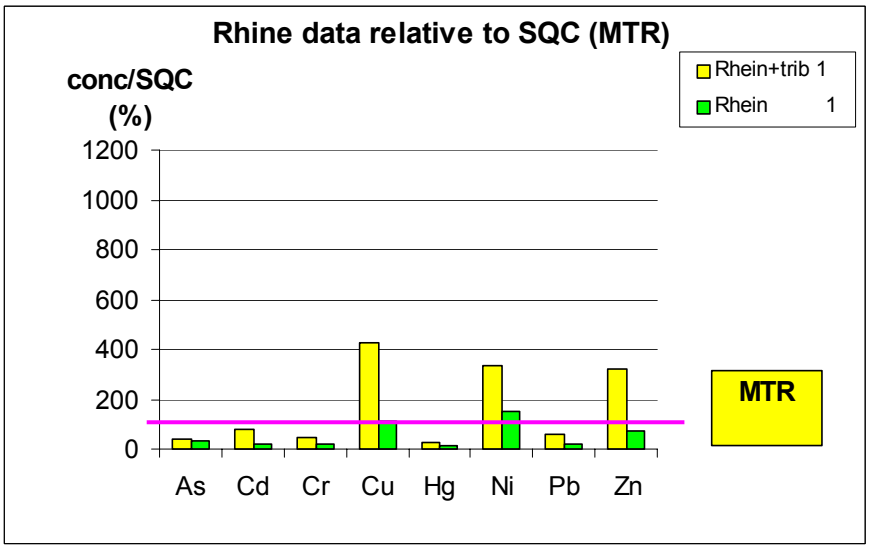


Figure 2: *Assessment of sediment quality of the river Rhine:*
Different sub-sets of concentrations (from top):
a) with tributaries + upper 3 layers,
b) with tributaries + upper 1 layer,
c) without tributaries + upper 1 layer
Sediment quality criteria: ***LAWA*** *(D) (= conc/SQC = 100 %)*





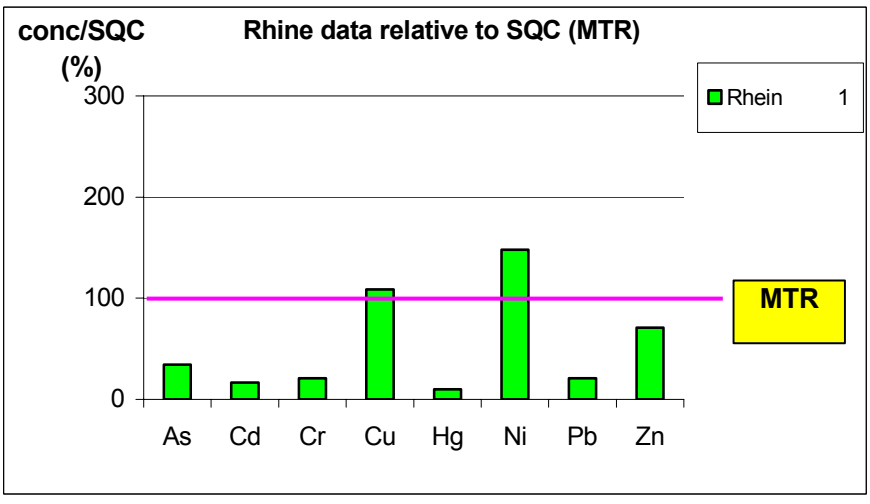


*Figure 3: Assessment of sediment quality of the river Rhine: Same data set as figure above; sediment quality criteria: **MTR** (NL) (= conc/SQC = 100 %)*

5. Results and Conclusions

5.1 Hazardous substances

- Monitoring of, and risk assessments for, existing commercial chemical substances (over 100.000) are neither feasible nor appropriate. Therefore, a severe selection process has to be applied.
- In such a process, of most importance are currently the European Water Framework Directive (WFD) and the OSPAR list of hazardous substances. In addition, for bilateral Dutch-German assessments the list of the International Rhine Monitoring Programme is to be taken into consideration, resulting in a total of 295 substances or groups of substances in water.
- With a view to dredged material management a further reduction in number is achieved by selecting from the three lists only those "hazardous substances" having a strong tendency to be absorbed on sediments. This results in a total of 58 substances.
- Comparison shows that the three lists containing these 58 substances overlap only to a limited extent, i.e. there is hardly any harmonisation of substance lists for sediments.

Conclusions:

- As a consequence a maximum list of all sediment-relevant hazardous substances has to be composed consisting of the relevant substances of the lists of EU, OSPAR and ICPR for the Rhine.
- For other rivers the specific substance list of that river system has to be prepared and used in place of the ICPR list (e.g. Elbe, Scheldt, Saar).

5.2 Action levels

- Sediment quality criteria exist mainly on national levels, however, at present they are not harmonised internationally. The exemption is a list of criteria for freshwater sediments developed in the ICPR for the Rhine. Criteria for coastal sediments proposed by OSPAR are still provisional.

Conclusions:

- As a result the bilateral or international assessment of sediments and dredged material in river systems is not feasible except one of the existing sets of criteria is accepted as common basis (e.g. MTR [NL] [also the term 'MPC'is used in English language], LAWA [D]).
- A set of common sediment quality criteria has to be developed.

5.3 Observed concentrations in river sediments:

- Concentration data exist on national and international level. In the case of the investigation programme of sediments from the Rhine, sampling and analysis of the samples were agreed prior to practical work.
- However, with regard to the assessment of the concentration data no harmonised procedure is in use. Depending on the selection of sampling sites and the number and

depth of samples a different evaluation of the data set is possible rendering results and interpretation on sediment quality with a river basin scope ambiguous.

Conclusions:

- Concentration data of contaminants in sediments have been collected in various monitoring programmes.
- For a comparative assessment of these data a procedure has to be developed and agreed on.

6. Recommendations regarding dredged material management

For bilateral assessment of the quality of sediments and dredged material harmonisation is recommended for:

- the lists of hazardous substances, in particular for sediments
- the sediment quality criteria
- the monitoring and assessment procedure for sediments and dredged material.

It is recommended to support or initiate such harmonisation of the quality assessment of sediment and dredged material when developing sediment management plans on a river basin scale.
The objectives would be to obtain uniform guidance for the assessment of sediment quality and the management of dredged material in those river basins.

7. References

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ANNEX I: Address-List of delegation members of the Dutch-German Exchange on dredged material in 2003 and 2004

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ANNEX II: Examples of sediment quality criteria (SQC); comparison of Dutch and German SQC applied to freshwater and coastal sediments (cf. Chapter 3)

	Freshwater sediments				Coastal sediments		
Substance	**ICPR**	**MTR (NL)**	**LAWA (D)**	**ratio MTR / LAWA**	**OSPAR***	**CTT (NL)**	**HABAK (D)**
Lead	100	530	100	5.3	5 – 50	110	100 **
Mercury	0,5	10	0,8	12,5	0,05 – 0,5	1,2	1
Cadmium	1	12	1,2	10,0	0,1 – 1	4	2,5
Nickel	50	44	50	0,9	5-50	45	50
Arsenic	40	55	20	2,8	1-10	29	30
Chromium	100	380	100	3,8	10-100	120	150
Copper	50	73	60	1,2	5 – 50	60	40
Zinc	200	620	200	3,1	50 – 500	365	350

* ecotoxicolgical assessment criteria that have no legal significance, all values are labelled as provisional

** lower action values

Annex III List of compounds used for the overview presented in chapter 2

			OSPAR	EU	ICPR	Category		
compound	**class**	**IUPAC Name**	**priority substances for sediments**			**A in 3 lists**	**in 2 lists**	**C in 1 list**
Lead and its compounds (OSPAR: incl. organic compounds)	metal	Pb inorganic compounds	X	X	X	1		
Mercury and its compounds (OSPAR: incl. organic compounds)	metal	Hg inorganic compounds	X	X	X	1		
Cadmium and its compounds	metal	Cd inorganic compounds	X	X	X	1		
Benzo[ghi]perylene	PAH	Benzo[ghi]perylene	*(X)*	(X)	X	1		
Indeno(1,2,3-cd)pyrene	PAH	Indeno(1,2,3-cd)pyrene	*(X)*	(X)	X	1		
Benzo[b]fluoroanthene	PAH	Benzo[b]fluoroanthene	*(X)*	(X)	X	1		
Benzo[k]fluoranthene	PAH	Benzo[k]fluoranthene	*(X)*	(X)	X	1		
Benzo[a]pyrene	PAH	Benzo[a]pyrene	*(X)*	(X)	X	1		
Endosulfan	pest	6,9-Methano-2,4,3-benzo-diox-athiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide	X	X	X	1		
4-tert-Octylphenol	raw mat / surfact degr	Phenol, 4-(1,1,3,3-tetramethylbutyl)-	X	(X)				
Nickel and its compounds	metal	Ni inorganic compounds		X	X			
PAHs	PAH	Polyaromatic hydrocarbons	X	X				
Anthracene	PAH	Anthracene	*(X)*	X				

			OSPAR	EU	ICPR	Category		
compound	**class**	**IUPAC Name**	**priority substances for sediments**			**A in 3 lists**	**B in 2 lists**	**C in 1 list**
Fluoranthene	PAH	Fluoranthene	*(X)*	(X)			1	
Naphthalene	PAH	Naphthalene	*(*	X			1	
PCBs	PCB/PCT	1,1'-Biphenyl, chloro	X		X		1	
Trifluralin	pest	Benzenamine, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-		X	X		1	
	pest	Phenol, pentachloro-	X	X			1	
gamma-HCH (Lindane)	pest	Cyclohexane, 1,2,3,4,5,6-hexachloro-(1,alpha,,2,alpha,,3,beta,,4,alpha,,5,alpha,,6,beta,)-	*(X)*	(X)			1	
Tributyltin (TBT)	pest	Tri-n-butyltin compounds	*(X)*	X			1	
Tributyltin cation	pest	Tributyltin cation	*(X)*	(X)			1	
Triphenyltin	pest	Stannylium, triphenyl-	*(X)*		X		1	
Bis(2-ethylhexyl)phtalate	plasticizer	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	X	X			1	
Short-chained chlorinated paraffines	flame retard	Alkanes, C10-13, chloro	X	X			1	
Hexachlorobenzene	raw mat	Benzene, hexachloro-		X	X		1	

			OSPAR	EU	ICPR	Category		
compound	**class**	**IUPAC Name**	**priority substances for sediments**			**A in 3 lists**	**B in 2 lists**	**C in 1 list**
1,3,5-Trichlorobenzene	raw mat / solvent	Benzene, 1,3,5-trichloro-	X	(			1	
1,2,4-Trichlorobenzene	raw mat / solvent	Benzene, 1,2,4-trichloro-	X	( )			1	
1,2,3-Trichlorobenzene	raw mat / solvent	Benzene, 1,2,3-trichloro-	X	(X)*			1	
Nonylphenol isomers	raw mat / surfact degr	Phenol, nonyl-, isomers (OSPAR: incl. ethoxylates incl. related substances)	X	X			1	
4-Nonylphenol	raw mat / surfact degr	Phenol, 4-nonyl-	*(X)*	(X)			1	
Arsenic	metal	As inorganic compounds			X			1
Chromium	metal	Cr inorganic compounds			X			1
Copper	metal	Cu inorganic compounds			X			1
Zinc	metal	Zn inorganic compounds			X			1
PCDDs	PCDD/PCDF	Polychlorinated dibenzodioxins	X					1
	PCDD/PCDF	Polychlorinated dibenzofurans	X					1
Dicofol	pest	Benzenemethanol, 4-chloro-,alpha,-(4-chlorophenyl)-,alpha,-(trichloromethyl)-	X					1
Fenitrothion	pest	Phosphorothioic acid, O,O-dimethyl O-(3-methyl-4-nitrophenyl) ester			X			1

			OSPAR	EU	ICPR	Category		
compound	**class**	**IUPAC Name**	**priority substances for sediments**			**A in 3 lists**	**B in 2 lists**	**C in 1 list**
Clorpyrifos	pest	Phosphorothioic acid, O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) ester		X				1
Parathion-methyl	pest	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester			X			1
Methoxychlor	pest	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis(4-methoxy-	X					1
	pest	Endosulfan, alpha- isomer		(X)				1
	pest / additive	Organic tin compounds	X					1
Dibuthylphthalate	plasticizer	1,2-Benzenedicarboxylic acid, dibutyl ester	X					1
Tetrabromobisphenol A	flame retard	Phenol, 4,4'-(1-methylethylidene)bis[2,6-dibromo-	X					1
	flame retard	Brominated diphenylethers		X				1
	flame retard	Brominated flame retardants	X					1
Hexachlorobutadiene	solvent	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-		X				1
2,4,6-Tri-t-butylphenol (Dodecylphenol)	additive	Phenol, 2,4,6-tris(1,1-dimethylethyl)-	X					1

			OSPAR	EU	ICPR	Category		
compound	**class**	**IUPAC Name**	**priority substances for sediments**			**A in 3 lists**	**B in 2 lists**	**C in 1 list**
musk xylene	additive	Benzene, 1-(1,1-dimethylethyl)-3,5-dimethyl-2,4,6-trinitro-	X					1
Hexamethyldisiloxane	raw mat	Disiloxane, hexamethyl-	X					1
	raw mat	Benzene, pentachloro-		X				1
Hexachlorocyclo-pentadiene	raw mat	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	X					1
3,4 Dichloroaniline	raw mat	Benzenamine, 3,4-dichloro-			X			1
p-tert-Butyltoluene	raw mat	Benzene, 1-(1,1-dimethylethyl)-4-methyl-	X					1
Trichlorobenzenes	raw mat / solvent	Trichlorobenzenes (all isomers)		X				1
Octylphenols	raw mat / surfact degr	4-(n-octyl)phenol (EU-WFD, priority substances: group of octylphenol isomers)		X				1
						9	**21**	**27**
						57		