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Working Group for the International Study of the Pollution of the North Sea and its Effects on Living Resources and other Exploitation. A Summary of the Results of Sewage Sludge and Dredging Spoil Analysis in North Europe

by

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INTRODUCTION

At a meeting of the Working Group for the International Study of the Pollution of the North Sea and its Effects on Living Resources and other Exploitation, held in Charlottenlund on 8-9 January, the Working Group agreed on a finalized version of their report (ICES, 1974). In relation to the section on Inputs, it was noted that there was very little information available on the heavy metal, organochlorine pesticide and PCB content of sewage sludges and dredge spoils. It was therefore agreed that, as a matter of urgency, such information should be sought by all the countries represented on the Working Group. This paper provides a brief summary of the information which was supplied up to 31 July 1974.

RESULTS AND DISCUSSION

Not all the countries represented on the Working Group were able to obtain relevant information in time and the results are still not completely representative. Sweden and France reported that work was in progress, but that no figures were yet available; Germany reported that some analyses had been conducted and that collection of the data into a conveniently summarized form would require further time; Norway was able to quote only PCB values for a single sewage sludge; Belgium reported values for the liquid and suspended solids components of sewage discharges.

The results for sewage sludges have been summarized in Table 1a. These are given by reporting country, on a minimum, maximum and mean concentration basis, all calculated on a dry weight composition. The figures provided by Belgium all appear lower than those for other countries and, although it is not clear whether they are on a dry or wet basis, it seems likely to be the latter. Accordingly, the author has calculated a second set of values, on the

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assumption that the dry solids content was the same as for a typical English sewage sludge, i.e. 6.4%. Since the percentage dry solids content of English sludges ranges from 1.7 to 15.6%, the estimates made for Belgium might be low by a factor of c. 3.8 or high by c. 2.4. The values reported by Netherlands were on a range basis only and no mean value is given.

From Table 1a it can be seen that the mercury content of sewage sludge can range from 0.2 to 50 mg/kg. The highest mean value was reported by England but this was heavily weighted by two high content sludges; if these are excluded from the calculations the English mean is 5 mg/kg. For cadmium, the values reported from all sources range from 0 to 300 mg/kg, with an overall mean probably in the range 10-20 mg/kg. Lead concentrations show a very large range in concentrations, from 5 to 5000 mg/kg, but the mean value is probably c. 300 mg/kg. The zinc values exhibit a 500 fold range from 96 to 48 400 mg/kg; if the adjusted Belgian figures are correct, then the maximum is increased to 94 000, i.e. maximal zinc content is 4.8 or 9.4% of the dry solids. In common with the lead and zinc values, chromium concentrations extend over a 1 000 fold range and, although the range reported for copper is not so large, the maximal concentration of 11 950 mg/kg represents 1.1% copper on dry solids basis.

The four figures available for PCB and organochlorine pesticide residue content of sewage sludges show a range for PCBs from 0.2 to 94 mg/kg and for DDT from 0.3 to 9.4 mg/kg. The high mean value of PCBs reported by England is heavily weighted by two very high concentrations; if these are excluded the mean content is reduced to 3.6 mg/kg, which is more directly comparable with the results reported by Norway and Scotland.

Table 1b summarizes the data supplied by Belgium for the various components of sewage. As might be expected, the ranges of metals found in sludge and suspended solids are not radically different.

Only three countries (Netherlands, Denmark and England) were able to provide any data on the metal content of dredging spoils (Table 2). The values reported by Netherlands refer to mean values for four rivers and exclude the dredgings removed from the Rotterdam-Eurapoort area. Although the average content of mercury in all samples was only 3.2 mg/kg, the maximal value found was more than 10 times higher and similar to the maximum content reported for a sewage sludge. Cadmium contents were generally lower than in sewage sludge, and mostly below the detection limit of 1 mg/kg. All the average values for copper, zinc, chromium and lead were below those reported for sewage sludge, but the highest values reported represent concentrations

in excess of 0.1%, even on a wet solids basis. Only two samples of dredgings were reported to have been analysed for organochlorine pesticide residues and PCBs. In both cases the concentrations were below the detectable levels of 0.1 and 1 mg/kg respectively. Further work is in progress at the Burnham-on-Crouch Laboratory, but as the two samples analysed were probably among the highest on the basis of their metal content, the detection limit will have to be reduced if their concentration is to be measured.

CONCLUSIONS

Much more information is now available on the metal content of sewage sludge and dredge spoil entering the North Sea than was the case early in 1974. More information has been promised, and it seems likely that when it becomes available reasonably accurate figures can be calculated for metal inputs both in sewage sludge and in dredging spoil. However, not all the sewage sludges are dumped at sea. Further information is required on the composition of the liquid component of sewage discharges, and the figures provided by Belgium provide a useful start. In order to be able to calculate the input from dredging spoils, an estimate is required of the amount recycled from the deposit area back to the dredged area; in some cases this would be quite high. The metal content of some dredgings approaches and occasionally exceeds 0.1% and clearly represents a high level of discharge to certain estuaries.

Information on the organochlorine pesticide and PCB content of sewage sludges, liquid sewage and dredging spoils has been improved, but much more is required before reasonably reliable estimates can be made of input of these pollutants via sewage and dredging operations.

REFERENCES

ICES, 1974. Report of the Working Group for the International Study of the pollution of the North Sea and its effects on Living Resources and their Exploitation, Coop. Res. Rep., Ser. A., No. 39.

Table 1a Content of certain metals, organochlorine pesticides and PCBs in sewage sludge (mg/kg dry weight)

Country	Number of Works		Mercury	Cadmium	Lead	Copper	Zinc	Chromium	Nickel	Dieldrin	DDT	PCB
Norway	1		-	-	-	-	-	-	-	-	-	1.6*
Denmark	22	A	2.7	5.0	188	106	1218	40	17	-	-	-
		B	32	58	3898	2264	17414	3675	327	-	-	-
		C	5.0	7.0	314	241	1731	36	20	-	-	-
Netherlands	20	A	0	0	300	100	700	0	0	-	-	-
		B	10	300	7600	4350	5500	3000	1200	-	-	-
Belgium	1	A	0.02	-	56	79	1285	9	4	-	-	-
		B	0.42	-	320	-	6000	41	27	-	-	-
		C	0.26	-	138	-	2143	17	10	-	-	-
England	29	A	0.2	3	5	90	96	2	-	-	0.3	0.2
		B	50	76	1210	11950	48400	2440	-	-	9.4	94.3
		C	7.0	21	360	1000	3400	430	-	-	3.0	19.6
Scotland	1	A	3.6	6.0	300	100	1200	-	-	0.05	-	0.5
		B	4.1	23	600	800	3800	-	-	3.6	-	1.8
		C	3.7	14	400	467	2500	-	-	2.5	-	1.0
Belgium (Recalculated see text)		A	0.31	-	875	1234	20000	125	63	-	-	-
		B	9.4	-	5000	-	94500	640	422	-	-	-
		C	4.2	2270	-		33500	260	160	-	-	-

* Calculated assuming 6.4% dry solids

A = Minimum
B = Maximum
C = Mean

Table 1b Content of certain metals in liquid effluent, suspended solids and sewage sludge (Belgium)

		Mercury	Cadnium	Lead	Copper	Zinc	Chromium	Nickel
Liquid (µg/l)	A	0.15	<1	9.3	2	38	<4	<2
	B	13.5	<10	163	36	1925	105	32
	C	3.4	-	53	21	216	-	-
Suspended solids (mg/kg)	A	-	-	37	150	132	16	4
	B	-	-	800	308	4860	68	22
	C	-	-	375	207	2560	35	12
Sludge (mg/kg)	A	0.02	-	56	79	1285	9	4
	B	0.42	-	320	-	6000	41	27
	C	0.26	-	138	-	2143	17	10

A = Minimum

B = Maximum

C = Mean

Table 2 Concentrations of certain metals, DDT and PCB in dredge spoils (mg/kg dry weight)

Source	Number of Spoils		Mercury	Cadmium	Lead	Copper	Zinc	Chromium	Nickel	DDT	PCB
Denmark	1 source	A	-	2.5	38	75	256	50	64	-	-
		B	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	-
Netherlands	4 rivers	A	23	-	600	140	800	180	53	-	-
		B	-	-	800	600	2900	1240	103		
		C	-	-	700	310	1902	605	80		
England	48 samples from 22 sources	A	0.02	<1.0	<10	<1.0	11	2.0	-	<0.1[x]	<1.0[x]
		B	37	6.0	530	302	1260	2400	-		
		C	2.8	<1.0	107	72	235	142	-		

A = Minimum

B = Maximum

C = Mean

x = 2 analyses only