CATS II CONGRESS

Characterisation and Treatment of

Contaminated Dredged Material

CONCLUSIONS

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CATS CONGRESS II

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Geachte Mevrouw,
Geachte Heer,

Als bijlage vindt u de conclusies van het Internationaal Symposium "CATS II" dat plaats vond te Antwerpen van 15 t/m 17 november 1993.

Hoogachtend,

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SESSION 1 : ENVIRONMENTAL IMPACT GENERAL ASPECTS

Chairman : G. DE SCHUTTER, Provincial Institute of Hygiene, B

As a result of the maintenance of waterways, harbours and harbour entrances, materials are dredged.

Out of environmental and economical reasons it is necessary to make a workable classification of the dredged material from maintenance :
so *Mr. Bernard* made in the first presentation the difference between coarse and silty materials, non-contaminated, slightly contaminated, highly contaminated and polluting silts.
In relation to this classification, the dredged material can be re-used, stored or treated.

We are convinced of the fact that fysico-chemical and ecotoxicological research combined with the BATNEEC principle are essential to classify the dredged material in the right compartement of the classification.
This is not an easy statement.
We are missing clearly defined standard procedures and norms. Or is it just the difficulty to set these standards in general?

In this view *Mr. Wieriks* presented the Impact Hypothesis method where the ecological impact of dumped material is calculated in relation to chemical and hydrografical properties, dispersion and distribution, target areas and target species. Risks expressed in percentage loss of populations and diversity can be compared.
We got also the presentation of *Mr. Felix* who showed clearly the necessity for ecotoxicological testing of the sludge.
A derivation method for reference and limit values for soil pollutants was presented by *Ms Cornelis* and can be interesting for the landscaping projects.
In the different presentations we heard about
- landscaping and landfilling projects for the non-polluting material,
- the Mesli-project, the recycling of non-contaminated dredged material and manure for agricultural purposes,
- dumping activities for dredged material that is declared safe,
- gravel-like pellets made of contaminated silt,
- and the possibilities of according to the ALARA-As Low As Reasonably Achievable-principles to put dredged silt in depots with or without additional or special isolation layers.

Mr. Van der Doef discussed the advection and diffusion phenomena of contamination in a disposal site for sludge - in an artificial island. Tackling diffusion is difficult but can be achieved by creating distance, reducing contact areas, reducing diffusion coefficients or concentration.
Lining-materials can be inert or chemical active through absorbtion.
Whether techniques to reduce the diffusion will be considered further, will depend on both effectiviness and cost. In case of the Ketelmeer, the removal and disposal of the contaminated aquatic sediment into a depot already leads to a reduction of emission of contaminants by a factor of about one hundred compared to the present situation. By eliminating the advective transport, the impact on groundwater is further reduced by a factor 5.
Different linings but also natural degradation of contaminants have been tested or will be in future studies.

The first session of the congress dealt with the general aspects of the environmental impact of handling dredged materials and we looked out if the other sessions gave more specific information, so that we can easier classify the sludge and give it the right destination.

SESSION 2 : CHARACTERISATION/ IDENTIFICATION - CONSOLIDATION

Chairman : L. Meyvis, Dept. of Environment and Infrastructure, Antwerp B

Six papers were submitted in the second session and three on similar subjects were included in the poster presentation.
Three papers discuss the characterisation and identification of contaminated sediments. Two of them report on specific studies dealing with one or two techniques to identify the contamination. Especially the study of *Mr. Tack et al.* is interesting. They conclude that when a large set of sediment samples have to be analysed for several variables, some of these variables may be estimated with often a quite good reliability using multiple regression analysis. Notwithstanding the fact that the method is not giving complete exact results and is only reliable for a limited number of variables, this approach can lead to savings in analysis efforts in areas which have to be regurlarly screened.

The other study of *Mr. Carpels et al.* evaluates the usefulness of two new rather cheap techniques in dredging sludge characterisation, e.g. microtox and A.V.S. analysis.
Although both techniques have some withdrawals, they are promising as first screening techniques used in combination with other procedures such as sequential extraction procedure.

The third paper report on an extensive sediment assessment approach based on the principles of quality assurance and control for the sediments in the Great Lakes of North America.

It is a very fundamental approach including intensive test and research technology of sample design, chemical analysis, toxicity testing, benthic community survey, and fish diseases.
This approach is a real example for countries faced with similar problems. However, I'm afraid that, considering the available budgets it will remain just an example for many administrations.

The fourth paper of *Mr. Van Opstal et al.* deals with a new sludge-sampling system for taking undisturbed samples from thick layers of sludge. The technique also allows determination of the gas contents in the compound and especially the density of the in situ sludge.

The last two papers in this session by *Mr. Thorborg* and *Mr. Toorman et al.* are dealing with the consolidation of dredged sludge in disposal sites. The consolidation of sludge is one of the major parameters for the design and management of disposal sites. Mathematical models simulating the consolidation are commonly considered as the right approach.
However, a lot of parameters as well as some intrinsic characteristics of the silt which have to be taken into account in the simulations are not yet sufficiently known or identified.

The papers of *Mr. Whichmann* and *Mr. Van Essen et al.* presented in the poster presentation are dealing with the determination of the parameters. Field measurements such as settlements,

density profiles and pore water profiles have been measured in the Dutch "Slufter" disposal site and compared with model prediction.
The report of *Mr. Wichmann* indicates that the determination of the gas contents at several heights is necessary in order to deduce the slurry densities and the density profiles.

However, results of the determination of the gas contents show clear differences depending by the procedures of testing and interpretation.

It is clear that further research is necessary in order to improve the experimental determination of these parameters.

SESSION 3 : TREATMENT

Chairman : P. GEUZENS, VITO, B

My conclusions are restricted to a short summary of the papers and posters with respect to treatment and some personal remarks.

The first speaker of the session was *Mr. Stokman* from the Netherlands. He gave us a clear overview of the actual Dutch policy with respect to contaminated sludge.
For the next 2 decades the author estimates the total amount of polluted sediments at about 240 million cubic metres. This volume is partly due to maintenance dredging and the rest has to be removed for environmental reasons. Since operational decontamination techniques are mostly too expensive, confined disposal and isolation of polluted sediments will play a major role in the coming years. In addition a development program (POSW) for sediment treatment is proceeding in the period 1992-1996. This program includes specialised dredging techniques, site investigation methods, particle separation and a range of physical, chemical and biological decontamination techniques. The most promising techniques will be demonstrated and assessed on technical, environmental and financial aspects.

The second author, *Mr. Keillor* from the US, tried to answer the delicate but important question about costs. He started with the establishment that many remediation projects have to deal with an unanticipated cost growth. In his opinion, this can be mostly due to an insufficient preliminary investigation.
Is there indeed any reason to believe that remediation of polluted sediments can be done at reasonable costs?
Reasonable cost is defined in the paper as costs within the same order of magnitude as the costs of dealing with uncontaminated dredged material and sewage sludge.
The author pleads for the development of tools which allow a more detailed analysis of remediation options and their cost consequences. The reasonableness of remediation costs also requires knowledge about environmental and economic benefits resulting from spending the funds.

Mr. Garbaciak reported about the ARCS program (Assessment and Remediation of Contaminated Sediments) which was conducted by the US EPA since 1988. Within this program a set of technologies was investigated. A few of the most promising ones were demonstrated at pilot scale for treating the Great Lakes sediments.
The technologies tested were :
- thermal desorption
- solvent extraction
- sediment washing techniques (hydrocyclones)
- bioremediation

The pollutants of concern were mainly PAH's, PCB's and heavy metals.

Most technologies were demonstrated to be able to remove the pollutants quite efficiently from the sediments. Only the bioremediation method gave poorer results. In general, it could be stated that treatment of sediments will be more costly than the treatment of soils.

Mr. Detzner informed us about the most actual situation in the Hamburg harbour. We all know that the city of Hamburg deals with the problem of the polluted sludge in a rather vigorous way. They realised a unique full scale treatment plant for mechanical separation and dewatering of the sludge.
The total cost for separation and dewatering is about 15 US dollars per cubic metre.

Mrs. Deibel from the Netherlands presented a more or less comparable contribution where, in stead of mechanical means, a separation basin was used to separate sand from silt. It was demonstrated that more than 50% of the tested sediment could be reused as sand for construction purposes. This separation technique was showed to be economically feasible because of saving expensive disposal volume in the Slufter disposal site and by the valorisation of the unpolluted sand.

Mrs. De Vos presented a paper concerning in situ biodegradation of organic matter or organic pollutants in sediments of harbours and waterways. The ABR-CIS technique consists essentially of adding in situ selected micro-organisms, nutrients and oxygen. Several real scale projects were executed. It was demonstrated that the biodegradation of mineral oil and some Poly Aromatic hydrocarbons could be improved.

In session 4 about treatment and disposal we got the contribution of *Mr. Schotel*, which dealt also partly with chemical treatment.
A number of chemical and thermal treatment techniques were examined. No feasible technique for extracting heavy metals in view of costs and environmental benefits has been found until now. The most promising technique seems to be extraction with complexing agents. The present research is focused on wet oxidation processes, which aim at destruction of organic contaminants like PAH and oil compounds.

In the poster presentations I found in addition 6 contributions which deal with treatment of contaminated sediments as well.
The poster of *Mr. Demeyer* deals with extraction of heavy metals using a combination of acid and oxidative treatment. It was demonstrated that rather aggressive methods are necessary to get a significant metal reduction. Environmental benefits are questionable. The poster of *Mr. Detzner* deals with biological decontamination by using micro-organisms and plants. It was demonstrated that this approach wasn't applicable for the Hamburg sediment. Besides fractionation, only thermal treatment with production of ceramic building materials looks promising.
This conclusion was confirmed in the poster of *Mr. Versteeg* from the Netherlands who showed it is possible to produce a well crystallised material with excellent physical and environmental characteristics.

In the posters of *Mr. De Fraye, Mr. Dumon* and *Mr. Joziasse* research projects are described concerning biological treatment. From these contributions it can be concluded that landfarming and treatment of fine grained sediments in aeration basins are the most promising approaches. Nevertheless the results are not always very predictable.

Additionaly, I wanted to make a few general, sometimes critical, remarks.

1. In comparison with CATS I, I established that the number of contributions on treatment decreased considerably, while the number of papers on disposal increased. The diversity of treatment techniques is diminishing as well.

2. The only technique which can be considered as feasible at real scale is, to my opinion, particle separation. Both the Hamburg and the Rotterdam approach are possible. Nevertheless, the feasibility of this technique depends strongly on the beneficial reusing possibilities of the clean sand fraction.

3. Several other techniques seem to be technically feasible. For example solvent extraction and thermal desorption show technically attractive results. The same can be said with respect to thermal treatment of very contaminated sediments for production of ceramic building materials. The economical feasibility at large scale seems to be more questionable than ever.

4. With respect to bioremediation the results differ strongly. From some contributions it could be concluded that landfarming and treatment of fine grained sediments in aeration basins are promising. On the other hand, the results are doubtful for more persistent components (e.g. PCB's) or for in situ bioremediation techniques.

5. Acid leaching of heavy metals is a rather aggressive technique with questionable environmental benefits.

6. An aspect which was strongly stressed by several speakers, concerns treatment costs. It can only be established that the ideas about "reasonable costs" differ strongly.

7. Last but not least, it was frequently mentioned that the problem of contaminated sediments has to be tackled at the pollution source. The problem of contaminated dredged material will hopefully a temporary problem so that we don't have to organise a CATS10 or CATS 20 symposium within several decades.

SESSION 4 : DISPOSAL

Chairman : T.VELLINGA, Public Works Rotterdam, NL

The subject of session 4 included immobilization and disposal of contaminated dredged material.

Regarding immobilization of dredged material there are promising possibilities. Sintering and vitrification can result in marketable secundary construction materials (artificial gravel or rock). The disadvantages though are the high costs and the high energy consumption. Interesting combinations are possible with other waste materials. Very important to be aware of, especially when a low temperature stabilization technique is used, are the leaching possibilities of the immobilized contaminants.
A difficulty that still has to be dealt with is the disturbance of the process through the generally unhomogeneous character of the dredged material.

Regarding disposal : it can be concluded that this subject gained much more attention than during CATS I. It is now that practical experience becomes available from the monitoring of disposal into pits or into a hill-construction. For those purposes special monitoring equipment has been developed in recent years.
A strong debate can be observed on the effectiveness and necessity of liners. Is a liner enhancing the concentration driven diffusion process instead of retarding it? And how effective is long term liner-retardation when considering the natural degradation processes as well?
One thing is for sure, the knowledge about the possiblities, shortcomings and costs of design and construction of liners is increasing fast.

As important disposal site design parameters should be the regarded the ALARA (As Low As Reasonably Achievable) -principle and the concept of "inherently safe" sites.
It should be considered that when the ALARA-principle is applied that the functional use of land and water is an important point to consider, as well as the balance between marginal cost of environmental measures and marginal environmental yield of those measures. The "inherently safe" concept means that failure of design, construction and/or management of disposal sites should not lead to an unstable situation with (possibly unpredictable) adverse effects. Therefore the necessity of a risc-analysis during the design process should be emphasized.
Both principles will lead to the conclusion that the disposal site selection process is very important.

Regarding the disposal site of the future it can be foreseen that the chosen solution should be intelligent (site selection and appropriate combination of environmental measures), flexibel,

with possiblities for partial treatment (recycling sand/clay, contaminant peak shaving etc.) and with possibilities for mixed fill (sewage sludge, contaminated soils etc.).

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