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Guidance document on the development of National Threshold Limit Values (NTLVs) for dredged materials which could be dumped into the Mediterranean Sea

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GUIDANCE DOCUMENT ON THE DEVELOPMENT OF NATIONAL THRESHOLD LIMIT VALUES (NTLVs) FOR DREDGED MATERIALS WHICH COULD BE DUMPED INTO THE MEDITERRANEAN SEA

Report

April 2009

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1. Introduction

To be completed

2. Dredged Materials

Dredging is an essential activity in order to ensure the navigability of harbours and rivers, for the development of docks, to mitigate the effects of flooding and to remove sediments for other human structures such as water intake structures for industrial processes. The material removed during this essential activity is often disposed of at sea. Generally, the majority of the dredged material is by nature similar to the undisturbed sediment of the coastal sea floor, however a small part is contaminated by anthropic activities. For this reason, the dumping of dredged material or its reuse is subject to a series of environmental considerations and evaluations. Dredged material constitutes the largest quantity of waste material dumped at sea.

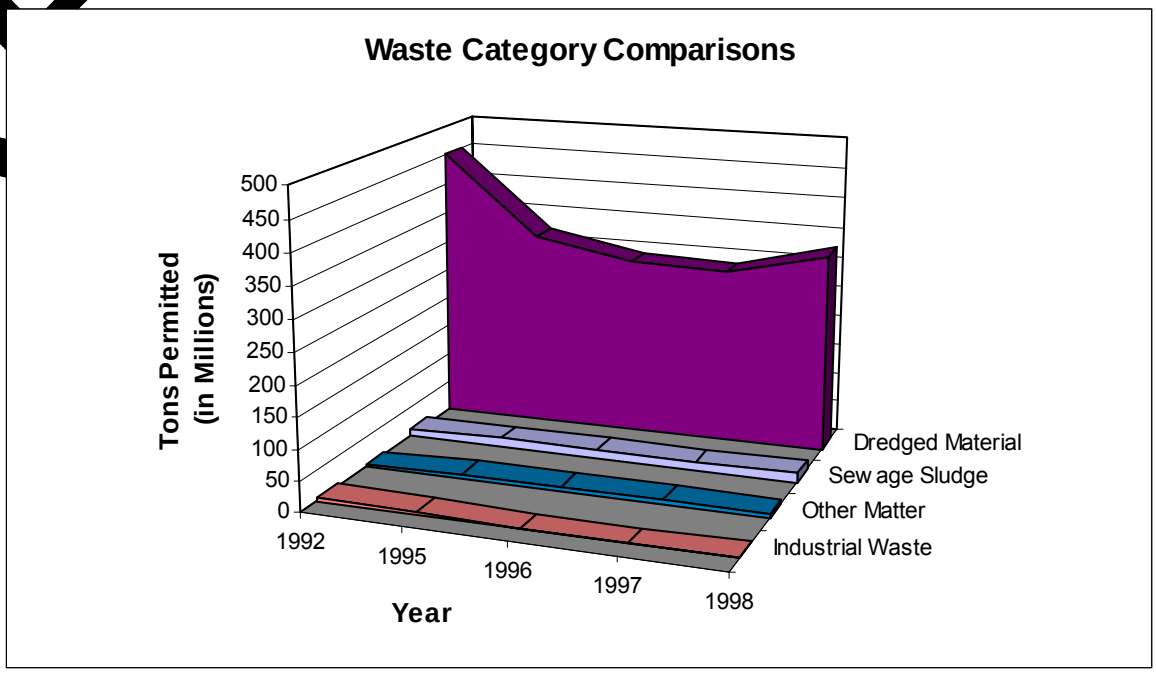


Figure 1: diagram illustrating the quantity of material dumped at sea in the world from 1992 to 1998. Dredged material from harbours constitutes by far the largest quantity of material dumped at sea. (source: London Convention Secretariat)

Dredging resulting in the relocation or in the disposal of sediments can be classified as follows:

- primary dredging (or for investment) – is necessary for navigation, to widen or deepen access channels and harbour areas and to construct new dock areas, underwater structures such as trenches for pipelines and cables, etc.

- Maintenance dredging – is necessary to ensure that channels, mooring areas and other man-made structures maintain their original form and size.
- Dredging for remediation – is necessary to remove contaminated materials which are harmful to human health and the environment.

3. The management of dredged materials into the Mediterranean Sea

The Contracting Parties of the dumping Protocols of the London and Barcelona conventions adopted the following specific guidelines to be referred to when dealing with dredged material:

- *Specific Guidelines for Assessment of Dredged Material*. Adopted in September 2000 by the Contracting Parties of the London Convention during the 22nd Consultative Meeting (www.imo.org/includes/blastDataOnly.asp/data_id%3D17020/1-DredgedMaterial.pdf);
- *Guidelines for the Management of Dredged Material*. Adopted in September 1999 during the meeting of the National Focal Points of the Mediterranean Action Plan (reference document UNEP (OCA)/MED WG.157/Inf.7).

Before initiating the evaluation process for the dredged material and for the disposal options, the question if dredging is necessary must be answered. If during the evaluation process it becomes apparent that acceptable disposal options do not exist, then this question must be raised again.

Ideally, the best way to manage dredged material is to identify and control the sources of pollution of the marine sediment to be removed. The implementation of this preventative strategy requires the collaboration of the relevant authorities and institutions responsible for the control of sources of pollution. This strategy should consider the following aspects:

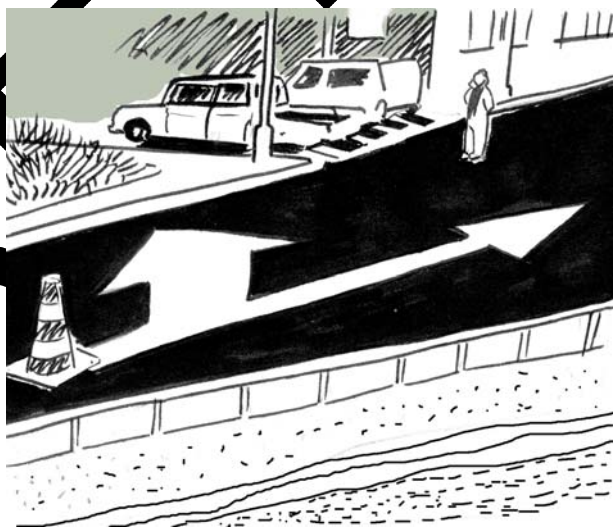
- the necessity to carry out dredging in the future;
- the contribution of each source to the overall danger identified;
- control and monitoring programmes;
- technical and economic feasibility;
- efficiency assessment of the measures adopted;
- appraisal of the consequences of not adopting measures to reduce the contaminants.

The chemical, physical and biological characterisation should indicate if the dredged material is suitable for dumping at sea. Even if this option does seem acceptable, it is fundamental to consider alternative possibilities; for example, it

could be considered a resource rather than a waste product. The possible uses of dredged material are amply dealt with in the relevant literature and are outlined below.

USES IN ENGINEERING

Beach replenishment, land creation, material used in capping, offshore berms, construction of piers and dams, backfilling quarries and old disused canals.



USES IN AGRICULTURE AND FOR THE PRODUCTION OF MATERIALS

Fish farming, building materials, creation of artificial reefs (particularly if the material is made up of rocks). This would require a study of impact on the natural environment.

ENVIRONMENTAL IMPROVEMENTS

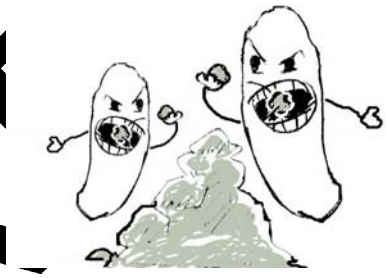
Remediation and creation of marshlands, nesting areas and areas suitable for fishing.

The opportunity to use the material regards mainly primary dredging. If these options are not possible and the levels of contamination are higher than the acceptable values, it is necessary to consider the application of waste disposal techniques involving: a) land disposal b) the reduction of contaminants to a level that does not pose a risk to human health, to living organisms, damage amenities

or interfere with other legitimate uses of the sea. Treatment, such as the separation of contaminated fractions, can render the material suitable for possible use or for dumping. The treatment processes can in general be classified as follows:

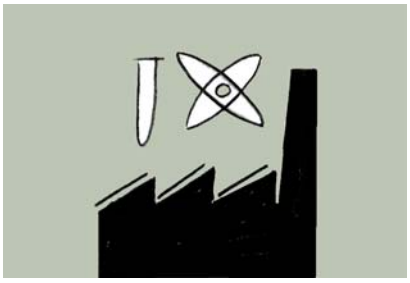
PRE-TREATMENT

The aims are to reduce the volume of the dredged material which requires further treatment and disposal and to improve the physical quality of the material to be treated further. The main pre-treatment categories are: dehydration, granulometric separation, washing; separation by density and magnetic separation.



BIOLOGICAL TREATMENT

Degradation of the organic substance by micro-organisms



CHEMICAL TREATMENT

(pH adjustments, oxidation, ionic exchange, etc.). Treatment that determines the destruction or extraction of the organic constituent and the extraction of the trace elements.

THERMAL TREATMENT

(thermal desorption, incineration, thermal reduction and vitrification). Some of the methods result in the formation of gravel or bricks which can be used as building materials.

IMMOBILIZATION TREATMENT

The contaminants are chemically bound to the solid section (fixation) or the contaminants are physically prevented from moving (solidification).

The costs of treatment are often higher than the disposal costs consequently the cost-effectiveness of treatment is a crucial aspect that must be taken into consideration.

The dumping authorisation must only be granted if it is clear that all alternative uses or disposal techniques are not viable.

The physical, chemical and biological characterisation of the dredged material must be carried out. In addition, the specific guidelines produced to help put the measures of the London Convention Dumping Protocol into action, make specific reference to the aspects included in the GIPME report "Guidance on Assessment of Sediment Quality"[1]. The physical characterisation must take into consideration the following information:

- quantity of material to be dredged (wet gross tonnage);
- dredging method (mechanic, hydraulic, pneumatic or application of Best Environmental Practices - BEP);
- characteristic of the sediment;
- quantity of organic matter.

It is not necessary to carry out the chemical and biological characterisation only when the dredged material is part of one of the following categories:

- material coming from areas far enough away from previous or current sources of significant pollution, to guarantee that it is not contaminated;
- the material made up mainly of sand, gravel and rock;
- the material is composed primarily of undisturbed geological material.

In addition, it is not necessary to carry out the chemical characterisation of the material if it has already been previously undertaken and this can be considered thorough enough to assess if it is possible to dispose of the material at sea. The chemical characterisation must however take into consideration the following aspects:

- the main geo-chemical characteristics of the sediment;
- data concerning previous characterisations of the material or sediments situated in proximity to the material;
- probability of contamination by agricultural, industrial and urban activities;
- accidental leakage of pollution in the past;

[1] Guidance on Assessment of Sediment Quality. Carried out by Global Investigation of Pollution in the Marine Environment (GIPME) (IOC-UNEP-IMO). www.fao.org/gpa/sediments/GIPMESQGreport.pdf

- origin and any previous utilisation of the material to be dredged.

The main possible effects caused by dumping of dredged material to be taken into consideration are as follows:

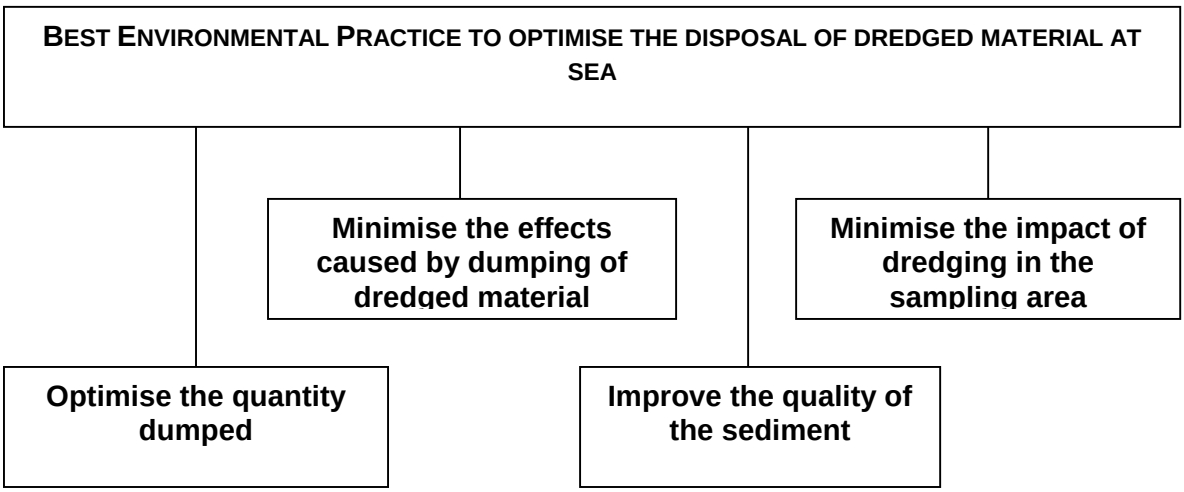
physical impact – caused mainly by the covering of the seabed and the significant increase in the amount of suspended matter. Sediments rich in organic matter can cause a reduction in dissolved oxygen in areas of relatively enclosed water.

Chemical impact – caused chiefly by the dispersion of contaminants associated with suspended matter and the leakage of pollutants from the sediment. The mobility of the substances depends on their chemical form, the groundmass, the physical state of the system (pH, temperature etc.), the currents, suspended matter, the active interactive processes (absorption/desorption, precipitation/dissolution).

Biological impact – the physical covering of the sediment causes immediate asphyxiation of the benthonic organisms. In addition, if the granulometric characteristics of the dredged material are very dissimilar to the material in the dumping site, it can result in modification of the benthonic ecosystem. The variation of composition, biodiversity and abundance of these kinds of ecosystems can also occur as a result of the presence of contaminants in dredged material.

Economic impact – economic impact usually regards fishing. In certain cases, significant accumulation of the material can have an effect on navigation. The clouding of the water caused by the suspended material can create problems in tourist and recreational areas.

In conclusion, the diagram outlined in the specific guidelines of the Dumping Protocol of the Barcelona Convention sets out the Best Environmental Practice (BEP) in order to optimise the disposal of dredged material at sea.



4. The Dredged Materials TLVs criteria in the Barcelona and London Conventions

The use of evaluation criteria for the material to be dumped at sea is a necessary screening mechanism in order to evaluate if a material can be considered suitable for such an operation. These criteria must be developed on the basis of possible effects on human health and on the surrounding environment. The results from the material characterisation are therefore necessary. The London and Barcelona Protocols propose one general criterion to be used in the evaluation of the material, delegating the development of specific, national criteria to the Contracting Countries.

Substances of anthropic origin which have characteristics of toxicity, persistence and potential bio-accumulation are to be considered a priority when applying the evaluation criteria. Particular importance is to be given to compounds included on the already mentioned list (par. 4.2) in annex II of the 1996 Dumping Protocol of the London Convention. These compounds are considered the more toxic, persistent and bio-accumulative substances from anthropogenic sources (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens).

The evaluation criteria must specify the lowest level and if possible, the highest level for every parameter. The lowest parameter level must be fixed in order to avoid toxic effects (acute or chronic) on human health or on fragile and characteristic organisms in the marine environment.

General criteria for the definition and use of evaluation criteria

level 1	Improbable toxic effects	Dumping at sea
1< level <2	Toxic effects to be assessed further	More detailed specific research is required on an individual case to case basis
level 2	Probable toxic effects	Not to be dumped at sea

Using evaluation criteria allows the waste or substances to be divided into three categories:

- waste containing specific substances or that cause high level biological responses (level 2) cannot be dumped at sea, unless it has undergone a treatment process.

- Waste containing specific substances or that cause low level biological responses (level 1) can be considered as presenting a low risk for the environment if dumped at sea.
- Waste containing specific substances or that cause biological responses lower than level 2 but higher than level 1 must undergo more detailed analysis before authorisation for dumping at sea can be granted.

A specific correspondence working group, meeting during the Scientific Group meetings of the London Convention, has set out a specific draft document to be used as the basis for identifying the levels of action for the substances to be dumped at sea. This applies to the Contracting Parties of the London Convention and the relevant Protocol. The last version of this document[2] was presented at the 30th Scientific Group Meeting of the London Convention. It regards solely dredged materials, while further documents will be developed subsequently.

5. Review the dredging materials dumping activities in the Mediterranean

To be completed

6. Regional guidance for the development of NTLVs for dumping of dredge materials in the Mediterranean

6.1 Aim of the Guidance

This Regional Guidance would assists Contracting Parties the Barcelona Convention in developing their own National Action List as well as their National Threshold Limit Values and National Action Levels for dredged material proposed for disposal at sea. In particular guidance is designed to assist with implementation of requirements under the Dumping Protocol of the Barcelona Convention.

A Contracting Party that has developed a National Action List and Action Levels will be in a better position to make a good permit decisions and to be in compliance with the requirements of Dumping Protocol.

The guidance is given with a view to achieving a balance between the best level of assessment possible and the availability of resources and capacity in different countries. The Contracting Party is encouraged to begin with practices that are achievable in the short term, with a view to continuing improvement as capacity and expertise are acquired.

[2] Guidance for Development of Action Lists and Action Levels for Dredged Material.

6.2 Glossary

An Action List (AL) is a set of chemicals of concern, biological responses of concern, or other characteristics that can be used for screening dredged material for its potential effects on human health and the marine environment.

Threshold Limit Values (TLVs) are points on the range of the metric of characteristics included in the Action List (e.g., 30 mg/kg lead, 0,02 mg/kg PCBs) that are used to identify where environmental concern may be low or high. These can be referred to as the lower TLVs and upper TLVs.

Action Levels (ALs) establish thresholds that provide decision points that determine whether sediments can be disposed of at sea.

Differences between Threshold Limit Values and Action Levels: it is important to bearing in mind and recognize the difference between Action Levels, which are intended to represent regulatory decision points, and the upper and lower benchmarks set for the individual characteristics.

First Step: elaboration of a National Action List

First of all, there is no universal mechanism for the selection of Action Lists and the development of Action Levels. The process begins with an identification of the chemical, biological, or physical characteristics that will make up the Action List.

Priority shall be given to toxic, persistent and bioaccumulative substances from anthropogenic sources. The Action List represents the first tool for screening dredged materials on the basis of their potential effects on human health and the marine environment. In other words, a dredged material National Action List is a list or inventory of dredged material characteristics and their metrics that a country decides are important to consider in order making permit decisions.

Particular importance is to be given to compounds also included on the already mentioned list in annex II of the 1996 Dumping Protocol of the London Convention (e.g., cadmium, mercury, organohalogens, petroleum hydrocarbons and, whenever relevant, arsenic, lead, copper, zinc, beryllium, chromium, nickel and vanadium, organosilicon compounds, cyanides, fluorides and pesticides or their by-products other than organohalogens).

Selection of the characteristics and metrics in a National Action List should be based on knowledge concerning the nature of dredged material in the country where the list is to be used. For chemical characteristics, contaminants known to be in the material and those likely to have been deposited in the material from, *inter alia*, known point-source effluent discharges, tributaries, diffuse runoff, atmospheric deposition, accidents and spills, operational discharges and losses and direct dumping may need to be considered. Characteristics that give useful information on the potential for acute or chronic effects on sensitive marine organisms or on health should also be considered.

The elaboration of a National Action List has the necessity to be representative of national concerns but not so large as to reduce the ability to conduct time- and cost-efficient assessments. On the other hand, there are often many site-specific sources of contamination to be taken into consideration. One approach is to set a smaller National Action List that includes only the most prevalent and critical characteristics that must be evaluated as minimum information in all cases and allow for the development and application of regionalized Action Lists that incorporate regional, local and site-specific knowledge of dredged material characteristics and valued resources.

6.3 Second Step: determination of Upper and Lower TLVs

The next step is the establishment of Threshold Limit Values (TLVs) for each characteristic on the Action List. The TLVs are the levels for a particular characteristic below which there would be little concern (lower TLVs), or above which there would be concern due to increased risk or increased probability of effects (upper TLVs).

There are different strategies to establish upper and lower TLVs for the characteristics chosen to be part of the National Action List. TLVs should be developed and applied with an understanding of what valued resources they are intended to protect. In general terms there are two different "philosophies" or approaches: TLVs are often developed using a reference-based approach (comparing to background or dumping site conditions) or an effects-based approach (based on knowledge or direct observation of the effects of exposure).

One of the considerations in evaluating the approaches considered more suitable are meeting the data requirements and the cost, time, and capacity considerations associated with developing the TLVs. Frequently, there will be insufficient data, time or funding to ensure that TLVs are set on purely scientific grounds and that all uncertainties in the methods and the data can be addressed. As an interim measure, when data are insufficient within a Contracting Party to calculate or derive TLVs for specific characteristics on the National Action List, them can also be adopted directly from other countries.

Reference-based Approach

TLVs for physical, chemical or biological characteristics can be set based on knowledge of background or ambient conditions in comparable areas that have not been impacted by dumping as well as the conditions observable in the vicinity of a disposal site.

Reference-based levels are commonly used for setting lower TLVs and Lower Action Levels, as it is reasonable to expect that levels that are similar to background levels would be unlikely to cause unacceptable effects. If metals in the dredged material, for example, would not be expected to elevate metal

concentrations in the receiving environmental media then there should be little environmental concern in relation to dumping of that dredged material.

TLVs may be set at the background concentration for the chemical of interest as well as they could be established using the results of sediment toxicity tests by using reference conditions to compare the responses of test animals exposed to the dredged material and to reference sediment. If these approaches are used there may be many cases in which almost all dredged material within an urbanised or industrialized region will exceed lower "background-based" benchmarks for naturally occurring substances, particularly if pre-industrial or natural background concentrations are used.

When using reference-based approaches to develop TLVs for individual characteristics on the Action List, it is important to distinguish between naturally occurring substances and man-made substances.

The heavy metals are a classic example of the first case. They exist also naturally as components of minerals, as ions, and in complexes with other materials, including organic compounds. For the naturally occurring substances the knowledge of ambient conditions in specific regional area of the Contracting Party is mandatory because the background values may differ greatly.

On the other hand, many substances, whose inputs arise solely from anthropogenic sources, have no natural background levels, including, for example, PCBs, TBT and many pesticides. The presence of compounds such as PCBs in trace quantities may be unrelated to local, or even regional activities, as these compounds can be transported through global circulation in the atmosphere and oceans. For such compounds, reference-based TLVs can be derived from ambient concentrations in sediment. Reference sites used as data sources for determining ambient concentrations should be remote from the influence of local waste streams and past dredged material disposal activities.

Lower benchmarks set using reference-based approaches, either alone or in combination with other approaches, are applied in many countries to make up Lower Action Levels, including Australia, Canada, Denmark, Finland, France, Germany, Hong Kong, China, Ireland, the Netherlands, Spain, Sweden, the United Kingdom and the United States.

Effects-based Approach

TLVs for physical, chemical or biological characteristics can also be based on knowledge of effects that can be produced following exposure to dredged material. Such limits can be based on information concerning the likelihood or magnitude for an effect. Regardless of the characteristic chosen, the resulting TLVs need to be indicative of the potential for effects in the field.

This approach is particularly suitable to establish the upper TLVs that should be set so as to avoid acute or chronic effects on human health, or on sensitive marine

organisms. Therefore, any TLVs used should minimize, to the extent practical, likelihood that dredged material could exceed such values.

Physical effects-based approach

In the case of physical characteristics of the dredged material are taken into consideration in Action List, the effects-based approach can be used to reach conclusions about whether the dredged material is unlikely to cause adverse effects on the environment, i.e. to establish lower TLVs. Sediments found in areas of high current or wave energy and composed predominantly of coarse-grained sediments (e.g., grain size > 2 mm as rock, cobble and sand) have a low potential to carry significant amounts of chemical contaminants because of the relatively small surface area available for sorption of contaminants. Lower TLVs for other physical characteristics include the depth of dredging, well knowing that in areas potentially polluted the upper layers are the most probably contaminated. Physical factors can be used to adjust TLVs set using other approaches.

Chemical effects-based approach

Chemical TLVs are developed using an effects-based approach by making use of calculated or measured relationships between the concentration of the chemical(s) and some form of biological response. The chemical concentration that establishes the limiting TLV can be based on concentrations in whole sediment, a sediment fraction, pore-water.

The results of an analysis of sediment samples will depend in part on the methods used to collect, store, prepare and analyse those samples. It is important to bear this in mind when developing and applying Action Levels. As an example in same cases a specific element or compound is toxic only in a specific form. This is the case of arsenic that show great toxicity when is available in the pentavalent form (As^{+5}) whereas As^{+3} has not evident consequences on marine organisms. For these reason the analytic method available to analyse arsenic is of crucial importance.

Hereinafter some types of measurement of chemical TLVs are indicated:

- Effects Range-Low (ERLs) represent the values at which toxicity may begin to be observed in sensitive species;
- Effects Range-Median (ERMs) represent chemical concentration ranges usually associated with toxicity in marine and estuarine sediments;
- Threshold Effects Levels (TELs) represent the concentrations below which adverse effects are expected to occur only rarely;
- Probable Effects Levels (PELs) are levels above which adverse effects are frequently expected.

ERLs and TELs have been used in some countries to set lower TLVs. ERMs and PELs could be used to set the upper TLVs.

Biological effects-based approach

Plants and animals will come in contact with dredged material-associated substances through one of three primary exposure pathways: 1) through contact with bedded sediment particles; 2) through contact with water; and 3) through contact with contaminants through bioaccumulation and trophic transfer within a food chain. Laboratory and field-based methods are available for generating information about the potential for effects and exposure following the contact with the dredged material. With respect to the chemical effects-based approach, the biological approach account for site-specific geochemical conditions, atypical bioavailability or the effects of unusual mixtures.

Field methods include measurements of benthic community structure or observation and measurement of effects on individual organisms (e.g., cancer in resident fish). Bioaccumulation tests, applied also on field organisms, which measure the movement of contaminants into the tissues of the test organism, are other commonly applied biological tests for collecting information about exposure. The choice of species to be sampled is very crucial: they have to show a limited home-range (consequently a good bioindicator of local environmental conditions) and to live in strict contact with the seafloor (benthic species). Usually, such a measure of exposure might be compared to limits to ensure the protection of humans exposed through consuming fish or shellfish, or similar limits to ensure protection of wildlife. These limits could represent the upper TLVs

Bioaccumulation tests can be conducted also in laboratory exposing test organisms to known quantities of dredged materials. Bioaccumulation, in this case, refers to the movement of contaminants from the dredged material into the tissues of exposed organisms. It is important to recognize that bioaccumulation tests provide a measurement of exposure rather than effect. Bioaccumulation of a compound will not always result in an adverse effect on the organism accumulating the compound. In general, adverse effects from any contaminant will only be manifest after the concentration exceeds a specific tolerance level or toxicological threshold (a possible upper TLV). Laboratory bioaccumulation tests are generally conducted by exposing the test organisms to the test material (e.g., dredged material) under controlled conditions and recovering the animals at the end of the exposure to measure the concentration of contaminants of concern in the tissues of the test organisms.

Laboratory-based toxicity tests are commonly used in dredged material evaluations. Biological TLVs are generally expressed as some type of biological response (e.g., rates of survival, growth or reproduction in the test organism used in a toxicity test, etc.). Biological TLVs could be settled by establishing a threshold for the magnitude of response that must be observed in a toxicity test e.g. > 20% more mortality observed in a dredged material in comparison to a reference sediment.

Effects-based TLVs for dredged material can be based upon direct measures of toxicity using solid phase toxicity tests (Bioassays in whole sediments). These tests involve exposing test organisms, typical of benthic ecosystems, to bedded sediments for a defined period and measuring the responses of those organisms (e.g., rates of survival, growth, reproduction) at the conclusion of the test. To ensure that test results will be protective with respect to the exposure conditions expected at a management site, the species used in such tests should be selected based on their close behavioural association with the sediment and their sensitivity to contaminants. Organisms that live in and/or ingest sediments (e.g., infaunal invertebrates) are expected to have high exposure to sediment-associated contaminants due to their intimate contact with sediment particles and pore water. Tests using infaunal amphipods, polychaetes, bivalve molluscs, urchins, and other taxa have been developed and commonly applied to assess dredged material.

Another series of toxicity tests are those that utilise organisms living along the water column (Water-column Toxicity Tests). These tests generally make use of planktonic species including algae, copepods, and other arthropods (e.g., mysidocerans), as well as larval molluscs, echinoderms, and fish. Such tests are commonly conducted using a dilution series of sediment-water mixtures (e.g. elutriates) in evaluations of dredged material. Tests are conducted by exposing test organisms to water extracts of dredged material that are intended to represent the range of substance concentrations organisms would be exposed to in the field.

Recognized differences among candidate test species, e.g. in terms of their behaviour within sediments, have resulted in a broad consensus on the need for testing using multiple species. Some taxa actively burrow through sediments while others live within semi-permanent burrows or even tubes they construct with mucus and sediment particles. Some species actively ingest sediment particles while others rely more on removing particles from suspensions in the overlying water. Species with these different behavioural characteristics will experience different exposures to contaminants adsorbed to sediment particles or dissolved within pore waters. Selecting a battery of tests that represents this diversity of behaviour will provide for more confidence that the assessment will be protective of exposure conditions at the management site. It must be acknowledged that using multiple tests with different species is a precautionary approach for assessing sediments as well as for deriving TLVs. Moreover, in case a battery of toxicity tests is utilised to express a TLVs, it is important to utilise organisms representatives of more trophic levels as possible.

Uncertainty of TLVs

In every case, the use of any physical, chemical and biological TLVs to build Action Levels will involve varying degrees of uncertainty. For example, using the results of physical/chemical analyses as a basis for reaching conclusions about the potential for adverse effects involves uncertainties related to the fact that these

metrics are not themselves a measure of effect but in some way related to the potential for an effect.

The role of unmeasured contaminants also presents a source of uncertainty in the application of chemical levels. It is not possible to analytically quantify the concentration of every chemical constituent in a sediment sample. Several specific sites could be contaminated by specific dangerous compounds not widely diffused but with a great toxic potential.

Biological TLVs are intended to be indicators of potential impacts and provide for integrating across exposures and effects (i.e., the combined effects of mixtures of chemicals and/or effects of chemicals not measured/determined). Uncertainties related to the use of such levels include the relationship between exposure conditions in the laboratory, for the reference condition, and at the disposal site; inter-specific variation in tolerance or sensitivity to contaminants; and the relationship between effects on individual organisms, populations, and communities. The expertise and facilities required to set TLVs based on biological characteristics may not be as commonly available as is the case for more routine physical and chemical analyses.

As said before each Contracting Party have to make a choice as a result of a balance between the best level of assessment possible and the availability of his resources and capacity.

6.4 Third Step: determination of National Action Levels

As said before, Action Levels are established as decision rules that identify dredged material that may be disposed because the risk for adverse effects is low and acceptable, those that may not be disposed without management controls because the risks for adverse effects would be considered too high, or to identify cases where additional information may be required to make a sound judgement about the potential for the dredged material to cause adverse effects. It is important to recognize the difference between Action Levels, which are intended to represent regulatory decision points, and the upper and lower TLVs set for the individual characteristics. The two definitions may coincide only in the case of a "simple approach" is used to establish Action Levels (see par.).

An Upper Action Level can be created above which there would be concern due to increased potential for effects on human health and the marine environment, and if desired, a Lower Action Level can be created below which there would be little concern for disposal at sea. In other terms, upper Action Levels are intended to indicate the point above which materials will pose an unacceptable risk to the marine environment and human health.

In the case when a dredged material falls between the Upper and Lower Action Levels, additional information would be required before a decision permitting

disposal could be made. This information would be produced through further assessment. Alternatively, a decision could be made to seek a disposal option other than sea disposal, for example, in circumstances where the costs associated with additional assessment are expected to be larger than the differential between sea disposal and the next, least costly option.

In cases when additional assessment are required, further sampling could be undertaken to increase spatial coverage, to increase the depth of coring to examine the vertical distribution of characteristics, to expand the list to chemicals being analysed, etc. This may show that some discrete areas within the dredging zone may be suitable for disposal at sea while others are not. Additional bioassays with different endpoints could be used to better determine the effects associated with identified contaminants.

Approach in Establishing Action Levels

There are a number of approaches for selecting Action List characteristics and to derive levels for dredged material assessment. Contracting Parties have to find a balance between the level of protection they require and their ability and capacity to administer a permit system using Action Levels.

Action Levels are set by integrating the relevant characteristics and TLVs to form a decision rule. These can be simple or complex approaches.

Using the simple approach, exceedance of any *single* upper benchmark would be considered an exceedance of the Upper Action Level. In a complementary manner, following the simple approach, all characteristics of the sediment must be below the lower benchmarks to reach the conclusion that the material poses a low and acceptable level of risk to the marine environment and does not exceed the Lower Action Level.

More complex approaches use decision rules that rely on the exceeding of benchmarks by multiple characteristics to reach a determination that the Upper Action Level has been reached. In this case, the Country has determined that certain characteristics are of greater relevance to the decision process based on the nature of the information they provide. For example, some contaminants are of greater toxicological significance than others, or they may be more persistent and those factors may influence the use made of the TLV in decision-making.

Simple approach

Using upper and lower Action Levels as part of a simple pass/fail approach generally involves setting strict limits based on upper and lower TLVs for each characteristic in the Action List. For example, if the dredged material is below all lower TLVs the material would be considered to pose a negligible risk to the marine environment and human health and is below the lower Action Level. Exceeding any one upper TLV would result in the material being classified as unsuitable for sea disposal without management. If the material is lower than all

upper TLVs, but exceeds any one lower TLV, then additional assessment would be required to determine whether the material presents a negligible or significant risk.

Simple pass/fail Action Levels offer the advantage of enabling clear, transparent and repeatable decisions that can be implemented with relatively little training and experience by a permitting authority. Using a simple pass/fail approach would give no consideration to the magnitude of an exceedance: it is sufficient to have only one value higher than his lower TLV also by 0.1%.

Complex Approach

The use of a complex approach requires a substantial amount of professional judgment in reaching decisions, but has the advantage of potentially integrating all the measured characteristics into the final decision. In such an approach, no one single TLV would ordinarily determine that an upper Action Level is exceeded. Rather, an Action Level would be considered to have been exceeded when a combination of several pre-determined "interpretation criteria" are met.

A number of the Action List chemical, biological and physical characteristics and their TLVs can be considered in parallel, such that each characteristic provides part of the information required to determine whether a particular material is above or below an Action Level. For example, physical characteristics (e.g., grain size) could be used to predict the likelihood of a sediment retaining contaminants, chemical analysis provides information about rates of exposure that organisms could experience, and biological tests provide measures of the bioavailability and toxicity of the sediment. Table xy reports an example of complex approach.

It must be stressed, however, that a complex approach does not eliminate uncertainty. Providing that the necessary levels of professional expertise and experience are available, a complex approach can allow more informed and case-sensitive decision-making than the application of more simplified pass/fail Action Levels.

Review the activities related to TLVs at global and regional levels

To be completed

Review the activities related to NTLVs in the Mediterranean countries

To be completed

Italy

The specific evaluation criteria outlined in these guidelines refers primarily to the approach proposed by the research carried out up till now by ISPRA (EX ICRAM)

for the evaluation of the quality of dredged materials from harbour areas. Particular reference is made to the following documents "*Aspetti Tecnico–scientifici per la Salvaguardia Ambientale nelle Attività di Movimentazione dei Fondali Marini: Dragaggi Portuali*" (Technical and Scientific Aspects for Safeguarding the Environment in Activities Relating to the Handling of Seabed Material: Harbour Dredging) and "*Manuale per la Movimentazione dei Sedimenti Marini*" (Manual for the Handling of Marine Sediments)[3]. It is necessary to underline that this approach is in accordance with the measures established at an international level. However it does reflect experience developed at a national level by ISPRA (EX ICRAM), which may continue to be updated.

The evaluation criteria outlined previously do not apply to ships, platforms or other artificial structures at sea, nor to bulky items comprising primarily non hazardous materials that are intended to be dumped at sea. The criteria regarding these items will be dealt with in paragraphs 5.4 and 5.7.

The evaluation criteria for the proposed material arise from the integration of physical, chemical and eco-toxicological information: Two action levels are taken into account: the "*Livello Chimico di Base*" (Lower Chemical Threshold) (LCB) and the "*Livello Chimico Limite*" (Upper Chemical Threshold) (LCL), other than the results of the eco-toxicological analyses conducted on samples to be tested. The Lower Chemical Threshold indicates the chemical concentration value nearest to the "natural values of the seafloor" which are not associated with evident ecotoxicological responses (absent or low toxicity). In order to determine this level for trace elements at a national level sample sediments are collected in areas which are not presumably impacted by obvious anthropic sources. This indicates the "average" concentration within the national context, and does not include sediment types coming from enriched areas.

On the other hand, the Upper Chemical Threshold represents the concentration value above which positive eco-toxicological responses are highly probable (average, high and very high toxicity).

With regards to arsenic and mercury particular attention must be paid to the definition of the chemical speciation, which influences significantly the toxicity of the substance.

Combining the results of the chemical and eco-toxicological analyses, it is possible to propose quality evaluation criteria that satisfy the general criteria set out by the two Protocols, as indicated in the following tables.

[3] Pellegrini et al., 2002. Aspetti tecnico–scientifici per la salvaguardia ambientale nelle attività dimovimentazione dei fondali marini: Dragaggi portuali, Quaderno ICRAM n. 1, ICRAM.
Corsini S., Onorati F., Pellegrini D., 2007. Manuale per la Movimentazione dei Sedimenti Marini. Realizzato da APAT e ICRAM con il Patrocinio del Ministero dell'Ambiente e del Territorio e del Mare.

Table xy: Lower Chemical Threshold (LCB) and Upper Chemical Threshold (LCL) values related to the main compound classes

Substance/element	LCB (silt<25%)	LCB (silt≥25%)	LCL
Trace elements	(mg/Kg) dry weight		
As	17	23	32
Cd	0.20	0.35	0.8
Cr	50	100	360
Cu	15	35	52
Hg	0.20	0.40	0.8
[illegible]	32	60	75
Pb	25	37	70
Zn	50	100	170
Organic Contaminants	(µg/kg) dry weigth		
Organotin Compounds	4.5		72
∑PCB	5		189
∑ DDD	1.2		7.8
∑ DDE	2.1		3.7
∑ DDT	1.2		4.8
Clordane	2.3		4.8
Dieldrin	0.7		4.3
Endrin	2.7		62
У-CHC	0.3		1
Heptachlor epoxide	0.6		2.7
∑ PAH	900		4000
Acenaphthene	7		89
Anthracene	47		245
Benzo[a]anthracene	75		693
Benzo[a]pyrene	80		763
Chrysene	108		846
Dibenz[a,h]anthracene	6		135
Phenanthrene	87		544
Fluorene	21		144
Fluoranthene	113		1494
Naphthalene	35		391

Pyrene	153	1398

Eco-toxicological requisites (acute toxicity) of the materials to be dumped at sea

Species-test	Column A	Column B	Column C	Column D
Skeletonema costatum	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 ≤ 100%	EC50 < 40%
Dunaliella tertiolecta	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Pheodactylum tricornutum	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Vibrio fischeri (elutriate)	EC20 ≥ 90%	EC20 ≥ 90% e EC50 ≥ 90%	20% ≤ EC50 < 90%	EC50 < 20%
Vibrio fischeri (sediment)	S.T.I. ≤ 3	3 < S.T.I. ≤ 6	6 < S.T.I. ≤ 12	S.T.I. > 12
Brachionus plicatilis	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40 ≤ EC50 < 100%	EC50 < 40%
Amphiura diadema	ΔMortal.≤ 15%	15% < Δmortal. ≤ 30%	30% < Δmortal. ≤ 60%	Δmortal. > 60%
Corophium orientale	ΔMortal. ≤ 15%	15% < Δmortal. ≤ 30%	30% < Δmortal. ≤ 60%	Δmortal. > 60%
Corophium insidiosum	ΔMortal. ≤ 15%	15% < Δmortal. ≤ 30%	30% < Δmortal. ≤ 60%	Δmortal. > 60%
Acartia tonsa	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Acartia clausi	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Tisbe battagliai	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Tigriopus fulvus	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Paracentrotus lividus	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Sphaerechinus granularis	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Dicentrarchus labrax	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%
Sparus aurata	EC20 ≥ 90%	EC20 ≥ 90% e EC50 > 100%	40% ≤ EC50 < 100%	EC50 < 40%

Evaluation criteria for the quality assessment of dredged materials, following the integration of chemical and eco-toxicological analysis

Action	Chemical analyses	Eco-toxicological assessment
Dumping at sea permitted	Values ≤ LCB	Column A or B
	LCB < Values < LCL	Column A
More detailed specific research is required, on a specific case to case basis.	Values ≤ LCB	Column C or D
	LCB < Values < LCL	Column B or C
	Values ≥ LCL	Column A or B
Dumping at sea not permitted	LCB < Values < LCL	Column D
	Values ≥ LCL	C or D

Annex I

The Dumping Protocols of the London and Barcelona Conventions (a synthesis)

The Dumping Protocol of the London Convention

The 1996 Dumping Protocol of the 1972 London Convention came into effect on 24 March 2006. It represents a new approach to the question regarding the use of the sea as a possible dumping ground for waste and other materials. Dumping is indeed prohibited, except for certain materials specifically listed. This is contrary to the original provisions of the 1972 London Convention which permitted the dumping of waste at sea with the exception of certain black listed substances.

The 1996 Dumping Protocol came into effect after being ratified by 26 countries, of which, 15 were Contracting Parties in the original Convention. The Protocol was adopted in November 1996, repealing the measures stipulated in the 1972 London Convention. The Italian Republic assented to the Protocol, with law no. 87/2006 - "accession of the Italian Republic to the 1996 Protocol to the 1972 Convention on the prevention of marine pollution caused by dumping of waste, ratified in London on 7 November 1996, annexes included".

The meetings of the Contracting Countries are held in London at the International Maritime Organisation (IMO). The 1996 Dumping Protocol therefore reflects a new philosophy in marine environment protection and it should contribute to achieving the goals of environment protection laid down in the Global Action for Sustainable Development Plan, adopted by the United Nations Conference held in Rio de Janeiro in 1992.

Article 1 includes several definitions concerning the areas dealt with in the Protocol. It is important to note that included in these, is the definition, according to the Protocol, of *dumping* - intentional disposal of waste from vessels, aircraft, platforms or other artificial structures at sea and, any form of stockpiling of materials on the seabed. The definition of what is not considered *dumping* is also important - the disposal of waste or other materials generated from normal operations of vessels, aircraft, platforms or other artificial structures, the placement of material on the seabed for purposes other than mere waste disposal (e.g. the sinking of ships for tourist purposes or for fish repopulation), depositing of materials at sea for purposes other than waste disposal (e.g. cables, pipelines or instruments for underwater research). The Protocol stipulates that the disposal of waste at sea is the equivalent to disposal of waste on the sea floor or under the seabed. It is also interesting to note that the international agreement does not distinguish between the different means by which polluting occurs. Forasmuch, the emission, disposal or depositing of waste or other materials can be discharged from vessels, aircraft or other marine structures such as platforms.

Article 3 introduces the concept behind the precautionary approach adopted by the Protocol. This involves the employment of appropriate preventative measures, emphasizing the precautionary approach and considering that the material discharged into the sea should be considered harmful to the marine environment,

even in the absence of evidence of a direct relationship of cause and effect between the emission and the effect of the substance. The article also specifies that the body or person causing pollution should, as a matter of principle, be responsible for the costs of the damage involved. It also states that the Contracting Parties should ensure that in applying the Protocol this does not simply result in transferring pollution from one environment to another.

The 1996 Dumping Protocol stipulates in article 4 that the Contracting Parties must prohibit the dumping of any material, with the exception of the following substances listed in Annex 1 of the Protocol, on condition that floating matter is eliminated and that potential pollutants are minimised:

- dredged materials;
- sewage sludge;
- fish waste or material resulting from Industrial processing of fish and other marine organisms;
- vessels and platforms or other artificial structures at sea;
- inert or inorganic geological material;
- organic matter of natural origin;
- bulky items comprising primarily iron, steel, concrete or non-harmful materials, for which the concern is physical impact, and limited to circumstances where the waste is generated at locations, such as small islands with isolated communities, having no practicable access to disposal options other than dumping.

Article 8 deals with the possibility of carrying out dumping operations without following the procedures stipulated in the Protocol. This situation may arise in circumstances of *force majeur* caused, for example, by adverse meteorological or nautical conditions, or in any other situation in which human life is in imminent danger, or the stability of the vessel, aircraft or platform or other artificial structure is compromised. In these situations incineration or dumping of the material is permitted, if this appears to be most appropriate solution in order to minimise danger.

Although, generally speaking, the waters within the State's borders are excluded from the measures outlined in the Protocol, the Contracting Parties have the right to apply the regulations to these stretches of sea.

The Protocol makes explicit reference to connections with measures set out in other International Agreements. For example, the Basil Convention that regulates the control of trans-border movements of harmful waste and its disposal. (www.**basel**.int).

The Contracting Parties are under obligation to elect Public Authorities responsible for:

- granting authorisations for dumping operations;
- producing a database regarding the quantity and type of materials dumped. It will also be necessary to keep records of the coordinates of the dumping sites, the dates of the operation and the methods used;
- carrying out monitoring of the dumping sites.

The relevant authorities must also grant appropriate authorisations for material loaded on ships registered in their own territory, but will be dumped in another State who has not signed this Protocol. Each Contracting Party is under obligation to report the following information to the I.M.O. :

- information regarding dumping operations undertaken (to be reported annually);
- administrative and legal measures adopted in order to implement the provisions stipulated in the Protocol;
- the effectiveness of these measures and the difficulties encountered in applying them.

Annex II of the Protocol outlines the evaluation procedures that the relevant authorities must adopt in order to decide on the appropriateness of a particular dumping operation at sea (paragraph 3.1.1). Dumping authorisations must conform to these procedures. The following guidelines focus mainly on the measures set out in this annex. Article 11 of the Protocol states that the Contracting Party Committee may assist and cooperate in facilitating the application of these measures and procedures. The Contracting Parties are encouraged, through collaboration with the I.M.O. and also with the coordination of other relevant international Organisations, to promote bilaterally and multilaterally prevention, reduction and, where feasible, the elimination of pollution caused by dumping. Scientific and technological research is especially encouraged, particularly through cooperation between the Contracting Parties (articles 13 and 14).

Particular emphasis is given to permanently banning waste incineration at sea (article 5). This was initially permitted by the 1972 London Convention, but was already prohibited in the amendments to the Convention, ratified in 1993.

Figure 2: London Dumping Protocol explicitly prohibits waste incineration at sea. The photograph shows one of the last ships, the M/N Vesta, used to incinerate refuse at sea (source – Greenpeace International)

An amendment to annex 1 of the 1996 Protocol (brought into force on 10 February 2007) was adopted during the meeting of the 28th Advisory Group held in London in November 2006. The amendment specifies an additional form of "dumping", namely, it demonstrates that it is possible the "carbon dioxide (CO_2) sequestration" from under the seabed within the geological strata (Carbon Capture and Storage – CCS). It is advisable to set out specific guidelines, in order to establish appropriate methods and means to carry out this kind of storage. Guidelines are currently being drafted and discussed in a specific working group constituted during the meeting of the Scientific Group of the London Protocol.

This operation is intended as a partial solution to the problems of climatic change. It will be applied to large sources of CO_2 emissions, including thermal electric power stations and steel and concrete production plants. CO_2 may be dumped, in accordance with the Protocol, only if the following conditions are respected:

- disposal must occur within the geological layers;
- the material to be disposed of is mainly comprising CO_2 (other substances coming from the emission source or from the capture process may also accidentally be present)
- additional waste or other materials are not to be added with the intention of including them in the disposal operation.

The Dumping Protocols of the Barcelona Convention

Convention for the Protection of the Mediterranean Sea Against Pollution, better known as the Barcelona Convention, is the legal instrument of the United Nations' Mediterranean Action Plan (MAP). It was signed in Barcelona on 16 February 1976 by 16 governments and came into effect in 1978. Subsequently, an amended version of the Convention was adopted in 1995, entitled - Convention for the Protection of the Marine Environment and the Coastal Regions of the Mediterranean. The aim of the amended version was to promote greater protection of the marine environment, with particular attention to sustainable development along the Mediterranean coast line. This version was ratified by 22 countries bordering the Mediterranean but has not yet been brought into force.

The main objectives of the Convention are as follows:

- protect the marine environment and coastal areas through prevention and the reduction of pollution and, as far as possible, to eliminate both land based and marine pollution;
- promote sustainable development of natural marine and coastal resources, also including both social and economic aspects;
- protect the Mediterranean landscape and its historical sites;
- reinforce cooperation between Countries bordering the Mediterranean;
- contribute to improving quality of life.

These measures are to be put into action by applying the six Protocols regarding these issues:

LAND-BASED SOURCES PROTOCOL aims to eliminate pollution resulting from land-based sources and activities. This focuses mainly on the elimination of bioaccumulative, persistent, toxic substances in the food web cycle.

SPECIALLY PROTECTED AREAS PROTOCOL focuses on the preservation of marine biodiversity and threatened species of Mediterranean fauna and flora, by establishing and managing special protected areas.

OFFSHORE PROTOCOL regulates the exploration and exploitation activities of the continental platform, the sea floor and under the seabed. It also establishes regulations to ensure the continuity of these activities. Although this Protocol is considered to be innovative, it does however leave many loop-holes for harmful activities, such as sinking of offshore platforms at sea.

HAZARDOUS WASTES PROTOCOL prohibits importation, exportation and/or transporting of radioactive and toxic waste from European Union countries to non-EU countries.

EMERGENCY PROTOCOL establishes a relationship of collaboration between the Contracting Parties in the event of an accident in which hydrocarbon or other harmful substances are released into the sea.

DUMPING PROTOCOL regulates all forms of dumping of materials from vessels or aircraft at sea. It was subsequently amended and revised on 10 June 1995 at the Plenipotentiary Conference of the Member States of the Barcelona Conference. It reflects a similar philosophy and structure to the 1996 Dumping Protocol of the London Convention. The Protocol is known by the name – "Protocol for the Prevention and Elimination of Pollution in the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea". The Protocol was incorporated into Italian law no. 175 on 27 May 1999 and came into effect with the signing of the 14 Contracting Countries.

Similar to the Dumping Protocol of the London Convention, the 1995 Dumping Protocol of the Barcelona Convention bans the disposal of any category of substance at sea, except a short list of compounds which require special authorisation. This differs from the original Protocol that stipulates a short list of prohibited substances and an open-ended list of dumping concessions.

The list of substances that may be dumped at sea, set out in article 4, are as follows:

- dredged materials;
- fish waste or matter produced during processing of fish and other marine organisms;
- platforms or other artificial structures in the sea, having ensured that floating matter and other materials which could cause significant marine pollution are removed, as much as possible;
- inert geological material whose chemical constituents are not released significantly into the marine environment.

Until 31 December 2000 the disposal of ships at sea was permitted. From the moment that the Protocol comes into effect the sinking of ships in Italy will be banned.

Consequently, in accordance with the provisions of the Protocol, it is not currently permitted to intentionally sink any kind of vessel. Incineration at sea is prohibited (article 7).

Similar to the Dumping Protocol of London Convention, the potential effects of these substances on the marine ecosystem and on the anthropic activities must be taken into consideration, in order to grant the relevant authorisations (Article 5 and Annex 1). The Annex outlines the factors which must be taken into consideration in order to establish the correct criteria to assess these potential effects. These factors are as follows:

a) characteristics and composition of the material intended for dumping. It is necessary to collect information concerning the quantity of material, its chemical, physical and biological properties, its toxicity, persistence and the probability of the substance effecting fishery resources.

b) type of dumping site and the depositing methods. The following information is required - the location of the selected site and other specific areas pertinent to the site (reproduction areas, fishing grounds, protected marine areas etc.) must be indicated. The rate and methods of disposal, the dispersion characteristics (hypotheses regarding the effects of the currents, tides and winds), the characteristics of the water column and the seabed and finally instances of previous dumping operations in the area.

c) Possible effects on the marine environment and on the uses of marine resources. Particular emphasis is given to the need to evaluate the possible effects on, not only the marine ecosystem, but also on the uses of the sea by humans. One such example regards the impoverishment of the water quality used for industrial purposes. Others concern are the possible interference of navigation caused by materials floating on the surface. The presence of waste and other solid objects on the sea floor can also have an effect on fishing and navigation. Finally, it is necessary to consider the effects of the torpidity of the water, the presence of floating objects and unpleasant odours on the landscape and on areas of natural beauty.

A series of guidelines have been drafted in order to facilitate cooperation between the Contracting Parties regarding the necessary procedures for the issuing of authorisations for dumping substances at sea. This document has taken into consideration the guideline indications.

The Protocol of the Barcelona Convention also envisages the possibility to undertake dumping operations without following the guidelines established by the Protocol. These possible cases regard extraordinary circumstances beyond control; caused by, for example, weather conditions or any other situation which could pose an imminent threat to human life or to the stability of the ship, aircraft, platform or any other artificial structure. In these situations, incineration or dumping of material is permitted, if this appears to be the most appropriate solution in order to minimise the danger (article 8).

The Contracting Parties must nominate a Public Authority to carry out the following:

- issue dumping authorisations;
- produce a database regarding the quantity and nature of the material being dumped. The coordinates of the dumping site, the dates and methods used for the operation must also be recorded.

The relevant authorities must also grant appropriate authorisations for material loaded on ships registered in their own territory, but will be dumped in another State who has not signed this Protocol. Each Contracting Party is under obligation to report the following information:

- information regarding the dumping operations undertaken (to be reported annually);
- administrative and legal measures adopted in order to implement the provisions stipulated in the Protocol;
- the effectiveness of these measures and the difficulties encountered in applying them.

Comparative Analysis of the Two Protocols

As stated previously, the two Protocols have a similar approach in dealing with the issues connected with the problem of dumping. Both Protocols ban the dumping of any category of material, with the exception of a short list of compounds, which need special authorisation to be disposed of at sea.

The first main difference between the two Protocols is as follows: the **1972 London Convention** regulations for pollution prevention from waste disposal and other substances refers to universal action, while the **Protocol** regulations for the prevention of pollution in the Mediterranean Sea from ships and aircraft regards conduct at a regional level.

The 1996 Dumping Protocol of the London Convention differs from the Barcelona Convention Protocol in that it still has to come into effect. Consequently, the measures and guidelines in the Barcelona Convention will only be put into action after the fourteenth member Country has signed. The measures from the Protocol of the Barcelona Convention have been taken into account in the following guidelines. These measures are clearly indicated and refer exclusively to the Protocol, in the understanding that these measures only become mandatory when it is brought into force.

The measures in the Protocol to the Barcelona Convention appear to be more stringent than those in the 1996 Dumping Protocol of the London Convention. The list of materials that can be dumped at sea according to the Barcelona Protocol does not include sewage sludge, organic matter of natural origin, bulky items, nor, since 31 December 2000, any type of vessel. With regards to ships, sinking is permitted for tourist incentive purposes, for scuba diving or fish repopulation, but not as a means of disposal.