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THE SEA AND ITS CONTAMINANTS

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ABSTRACT

Man produces a diversity of contaminants that, directly or indirectly, reach the ocean. Some are of organic origin and are absorbed by normal biological processes, but others such as insecticides resist decomposition and remain for long periods of time in the environment causing different prejudicial effects on both marine and human life.

Key words: toxicity, persistence, bioaccumulation,

1. INTRODUCTION

The misunderstanding in the past with respect to the sea led to the belief that due to it's immense dimensions and auto depuration capacity it could be used as an unlimited receptor of all kinds of contaminants, for which reason it is not surprising that our seas and oceans have deteriorated enormously for not taking into account its limitations both physical and biological.

2. TYPES OF CONTAMINANTS

It has to be emphasized that the contamination itself does not refer to the purity of the seas but to the modifications in its characteristics, the fact is that natural waters present variable grades of purity and also we must not forget that chemically pure water does not favour the development of life.

2.1 MICROBIOLOGICAL CONTAMINATION

Caused by domestic residual waters carried by urban effluents. These waters carry an elevated concentration of microorganisms and pathogens that reach the sea contaminating beaches and fishing banks.

Not al sewage is purified before reaching the sea, and in cases where the sewage is treated in order to eliminate part of the contaminants, the microorganisms are not completely eliminated (In the Canaries 9 out of 10 emissaries pour onto the sea unspecified or partly un purified waters in different stages; study carried out by Richard Haroun, biologist of the ULPGC, on behalf of the local Ministry of Environment). In these waters Bacteria, Viruses, fungus and other opportune microorganisms can be found.

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The risks of infectious illnesses can occur simply by contact with the skin or mucous by bathing in contaminated areas (Otitis, dermatitis, gastric infections, salmonella…) by the consumption of water, seafood and fish from infected areas. (Hepatitis, cólera, polio etc).

The seas and oceans elevated capacity to purify and dissolve contaminants, together with the environmental stress (changes in temperature, salinity, PH currents..) to which the microorganisms are subjected once they reach the sea, explain the low rate of survival and the disappearance of bacteria's and viruses.

The human being has as an indicator certain bacteria commonly known as, intestinal flora, which acts as an indicator to this type of contamination called facial coli forms and streptococcus, which although are not in themselves prejudicial to health, their presence indicates the existence of microorganisms dangerous (pseudomonas, staphylococcus..).

The fundamental factor that contributes to the reduction of this type of contamination is the correct treatment of wastewaters in the purifying stations (EDARS) before emptied to the sea, as well as effective dilution of the effluent in order to favour and not hinder the natural phenomena of purification and auto depuration of the marine environment.

2.2. CONTAMINATION BY NUTRITIOUS SUBSTANCES. EUTROFIZACION.

Once the waste produced by industries, agriculture and sewage reaches the sea these are chemically unfurled by bacteria, originating inorganic substances known as nutrients (remineralization process).

The key nutrients are nitrogen and phosphorus, although both silica and oligoelements are also important (Mn, Co, Ca, K). These are considered as contaminants when their concentration is sufficient to allow the elevated growth of algae, which provoke the exhaustion of the dissolved oxygen due to the biodegradation of the organic material created ($CH20 + 02 \rightarrow H20 + C02$). Also the exhaustion favours the process of decomposition of the organic material via anaerobia ($CH20 \rightarrow H2S + CH4 + NH3$), with the production of sulphuric hydrogen, highly toxic for the life of the sea and foul smelling volatile substances and a significant modification to the ecosystem.

The rapid growth of algae and phytoplankton due to over fertilization of the waters is known as Eutrofization, and can cause great danger to marine life due to the lack of oxygen resulting in, obstruction of the fish's gills and the increase in the growth of toxic algae (red tides).

The aquiculture that is being developed as an alternative to the problem of over fishing produces elevated levels of nutrients. The marine cages float in semi-closed areas with deficient hydric interchanges (which deteriorate the situation) converting the area sensible to the discharges of nutrients and antibiotics etc.

2.3. CONTAMINATION BY HYDROCARBONS

Although hydro carbides are of natural origin, those that are found in the seas and oceans are from human sources (refineries, ships, industries etc...).

Petroleum has become one of the most important contaminants in oceans and seas, deteriorating beaches and the quality of the water, damaging the production of fish and seafood, becoming a serious problem to the world fishing industries. Its adverse effects are due to:

Toxicity

The aromatic polycyclic hydro carbides are the most toxic followed by olefinicos, naftenicos and parafinicos. Those of less molecular weight are, apart from being the most toxic, are also the most volatile, evaporating in just a few days where others persist in the column of water or sediments.

The hydro carbides are highly toxic for marine life when absorbed through the gills and skin of fish, interfering in the nervous system, blocking organs and causing asphyxia in the marine communities, in general destroying their natural habitat

Synergy

The combination with other substances produces far superior effects compared to the effects of individual substances. It has been proven that synergy together with organocloride pesticides and the facility they have to dissolve in the hydro carbides and other tensoactive products, which favour the emulsion and dispersion of the layer of petroleum.

Direct physical action

Certain ecosystems are highly vulnerable to this type of contamination, such as coral reefs, swamps and mangroves. Oil slicks cause damage by covering the fauna and flora, complicating the interchange of oxygen.

Contrary to what public opinion can believe, the spectacular oil spillage of tankers is only responsible for 10 % of the total volume of petroleum found in the marine environment, the rest is due to the contamination caused during the normal operations of loading and unloading at refineries, the cleaning of the ships tanks in harbours and at sea, etc. Also it must be emphasized that the treatments that can be used to eliminate petroleum from the coast line often result more aggressive and devastating than the contaminant in its self.

2.4. CONTAMINATION BY ACUMULATIVE SUBSTANCES

There exist a series of substances created by industries or elaborated as sub products of industrial processes, of difficult degradation, that get to the marine environment, accumulating in the organisms exposed to low or moderate concentrations, passing eventually to the trophic chain and possibly finally to man.

We refer to radioactive substances, persistent organic compositions (POC) and heavy metals. The common characteristics on which its prejudicial effects depend are:

Toxicity

Any substance that is "toxic" has an adverse effect on health, due to the concentration of the compound and exposure time (acute, chronic or teratogenic toxicity). Toxicologist often assure that "there is no toxic complex, but high or low toxic concentrations"

Persistence

It's the easiest or hardest capacity of degradation of an element. When a substance offers a high resistance to chemical and biological degradation it has greater probability to becoming lethal or a nearly lethal concentration.

Bioaccumulation: bioconcentration and biomagnifications

We talk about bio concentration when the substance tends to accumulate in the organic tissue, due to its lipofilic character (affinity to oily tissues) and the impossibility of the organism of keeping the required levels of excretion. The trophic relations in the ecosystems make possible the concentration of contaminants through the trophic chain. This enlargement of the toxicity in the upper levels of the chain is known as bio magnification. Also we have to take into account that when the contaminants of this kind are accumulated on fish or aquatic birds, it's not only dangerous to the local trophic chain, but the toxins can travel long distances with animals and end up in non contaminated areas.

2.4.1. RADIOACTIVE SUBSTANCES

Radioactivity is introduced through military tests, Activities performed by nuclear power stations, radio-isotopes usage in laboratories and medicine, by industrial processes, reactors used in the propulsion of ships, wastes submerged in containers in graves on the sea bed.

The most dangerous radio-isotopes are those stable elements strange to the environment, that tend to accumulate in the sediments of live matter, with an even greater facility in those elements with a lower level of evolution such as marine algae. Often these algae are used as bio indicators and radio-isotopes, for example, calcareous algae for the Stronicio-90, Laminaria digitata for Rutenio-106, different phanerogamous for Magnesium -54 or Cerio -144…

Radioactive contamination is very dangerous, not only for the reason that long periods of exposure damage live organisms causing changes in their somatic order (leukaemia) and genetic order (mutations), but also because this type of waste remains in the environment for longer periods of time.

2.4.2. PERSISTENT ORGANIC COMPOUNDS

These are organic compounds, the majority of which are synthetic and are produced by man, such as, refrigerants, pesticides, solvents, and whiteners from the paper industry.. The most extended are: polyclorated bifenilos (PBBs), pesticides (DDT, TBT), aromatic polycyclic hydro carbides (PHAs).

We are talking here of products that are highly resistant to biochemical degradation and are almost chemically inalterable, they remain for long periods of time in the environment. The aquatic organisms receive these compounds through their environment, incorporating them in their diet, absorbed principally through the gills of the fish and other marine life. The fact is that man has created these contaminants over the past century, and as yet marine life has not developed methods to metabolize. The effects on these organisms are produced on a molecular level, inducing changes in the permeability of the cellular membrane.

The high toxicity of these substances gives way to: insecticides such as DDT that destroy the phytoplankton (causing a descent in the organic material needed to feed other marine organisms), causing mutational effects, the evolution of immunological malfunctions, it also reduces the levels of reproduction; in humans, causes certain types of cancer, mutations in reproduction and evolution, suppression of the immunological system and also decontrol of the endocrine system.

Certain areas of the seas and oceans already have an alarming level of contamination, for example: the North Sea, where the Dieldrin industry is to be found, The Baltic Sea, a sea surrounded by seven industrialized countries that spill into the sea their waste products; the meridional coast of California due to the use of DDT in the control of plagues.

2.4.3. HEAVY METALS

We refer to all metallic chemical elements that have a high density (above a 5) and are not toxic o poisonous in low concentrations. Their presence in the marine environment is due mainly to metallurgic processes, mining explorations, and the production of chemical compounds and dredging operations.. The principal metals considered in having the highest danger levels are, mercury, cadmium, lead, chrome and arsenic.

We refer to natural elements that cannot be degraded and are dangerous because that tend to bio-cumulate. The toxicity of these metals depend on their individual characteristics, the organism in question and their state of development, the environmental conditions and chemical form (organic compounds Hg and Cd are 10 - 100 more toxic than those which are inorganic) and even the level of oxidation (the Cr 3+ is an essential element, on the other hand the Cr 6+ is highly cancerous) in which the metal intervenes.

Once incorporated in the organic tissue, heavy metals are capable of reacting (forming stable compounds), with sulphydric groups, rooted animus, carboxyl, and phosphorus.

Which belong to enzymes and other essential proteins inactivating them. The damage caused by these elements can be globalized as follows: genetic mutations, chromosomal alterations, changes in synthesis and repairing of nucleic acids and cellular transformations.

The disaster in Minamata Bay (Japan in the decade 40-50) created worldwide public alarm and gave mercury the worst reputation of all heavy metals. Of all the types of mercury the most dangerous is without doubt Methymercury (CH3Hg) it can be absorbed rapidly by the phytoplankton and from there to superior organisms. The damages caused by the said substance are: affection of the immunological system, the nervous system, produces abnormal growth of embryos and the alteration in genetic enzyme systems.

Also cadmium is subject to the most severe legislation due to its extreme toxicity, as it is very harmful even in low concentrations, basically for the effect it causes to enzymes. It accumulates in the liver, kidney and the gastrointestinal tract with the following consequences: poor mineralization of the bones, retarded growth, anaemia, problems in tonsils and kidneys.

Finally reference also has to be made to lead, as its size and weight can substitute calcium, being an area of accumulation of osseous tissue. Causing the following damage: the development and growth of foetus, the nervous system, disorders in behaviour and neurological deficits.

2.5. CONTAMINACION BY GARBAGE

We refer here to solid waste such as, paper, tins, bottles, plastics, tires …, which threaten marine life provoking death by asphyxia, ingestion, or being entangled in them. These are persistent materials that are abandoned near the coastline destroying natural habitats and affecting coastal biological production for this reason investigation is vital to find ways and means of eliminating this type of contamination and how to stop the seas and oceans becoming the final destination of our waste.

2.6. CONTAMINATION BY RESUDUAL HEAT

Thermal contamination due to the heat produced as a sub product from many industrial processes, for example power stations, waters used as refrigerants that can reach as much as 12º C higher than the environmental temperature of the water.

Heat as a contaminant when it reaches the aquatic environment causes alterations in seasonal variations in the temperature of the water, changing the natural reproductive cycle of the organisms and therefore producing a higher number of individuals than food, causing death. The increase in the superficial temperature of the water can reach vital limits or induce changes in solubility of dissolved oxygen, diminishing its concentration with the consequent modification of the ecosystem.

3. CONCLUSIONS

We do not pretend to create a catastrophic picture of this problem, but make the point that the anthropic pressure to which our populated coast lines are submitted are extremely excessive. It is only our intention to open people's eyes before a problem that exists and whose results are obvious. There must be an immediate change in the attitude that governments and the world's population in general manifest towards our seas and oceans. We have to minimize the environmental risks, protect as many natural areas as possible, create effective policies to protect our coastline, demand efficient purifying systems for sewage and waste together with a long etc etc… *in environmental material there is still a lot to do.*

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APENDICE: EL MAR Y SUS CONTAMINANTES

RESUMEN

El hombre produce diversidad de contaminantes que, directa o indirectamente, llegan al océano. Algunos de origen orgánico se desintegran por procesos biológicos normales, pero otros como plaguicidas, resisten la descomposición y subsisten largo tiempo en el ambiente, ocasionando distintos efectos perjudiciales sobre la vida marina y salud humana.

Palabras claves: toxicidad, persistencia, bioacumulación.

1. INTRODUCCIÓN

El desconocimiento del medio marino de tiempos atrás, propiciaron que se viera en el océano un depósito favorable que por inmensas dimensiones y capacidad de autodepuración podría utilizarse como receptor ilimitado de todo tipo de contaminantes, por lo que no es de extrañar que la salud de nuestros mares se vea mermada por un uso indiscriminado que no tuvo en cuenta las limitaciones del medio físico y biológico.

2. METODOLOGÍA: TIPOS DE CONTAMINACIÓN

Cabe destacar que la contaminación no se refiere a la " pureza " de las aguas, sino a las modificaciones de sus características, pues las aguas naturales presentan un grado de pureza variable y además, no hay que olvidar que el agua químicamente pura no es favorable para el desarrollo de los seres vivos.

2.1. CONTAMINACIÓN MICROBIOLÓGICA

Ocasionada por aguas residuales domésticas que portan los efluentes urbanos. Son aguas que contienen una elevada concentración de microorganismos, muchos patógenos, que al llegar al mar contaminan playas y pesquerías.

2.2. CONTAMINACION POR SUSTANCIAS NUTRITIVAS EUTROFIZACIÓN

Los desechos procedentes de la industria, agricultura y aguas residuales al llegar al mar son desdoblados químicamente por las bacterias, originando sustancias inorgánicas que denominamos nutrientes (proceso de remineralización).

2.3. CONTAMINACIÓN POR HIDROCARBUROS

Aunque los hidrocarburos son de origen natural, los que se encuentran en el medio marino costero provienen de fuentes antrópicas (refinerías, transporte marítimo, escorrentía industrial y urbana…).

El petróleo, convertido en uno de los contaminantes más extendidos en los océanos, deteriora playas y la calidad del agua, daña la producción de peces y crustáceos, llegando a ser un problema de gran importancia para las pesquerías mundiales.

2.4. CONTAMINACIÓN POR SUSTANCIAS ACUMULATIVAS

Existen una serie de sustancias creadas por la industria o elaboradas como subproductos de procesos industriales, de difícil degradación, que llegan al medio marino acumulándose en los organismos expuestos a concentraciones bajas o moderadas, pasando posteriormente a la cadena trófica y pudiendo llegar así hasta el hombre.

Nos referimos a sustancias radioactivas, compuestos orgánicos persistentes (COP) y metales pesados.

2.5. CONTAMINACIÓN POR BASURAS

Hace referencia a desechos sólidos, tipo papel, latas, botellas, plásticos, neumáticos..., que amenazan la vida marina al provocar la muerte por asfixia, ingestión o enredándose

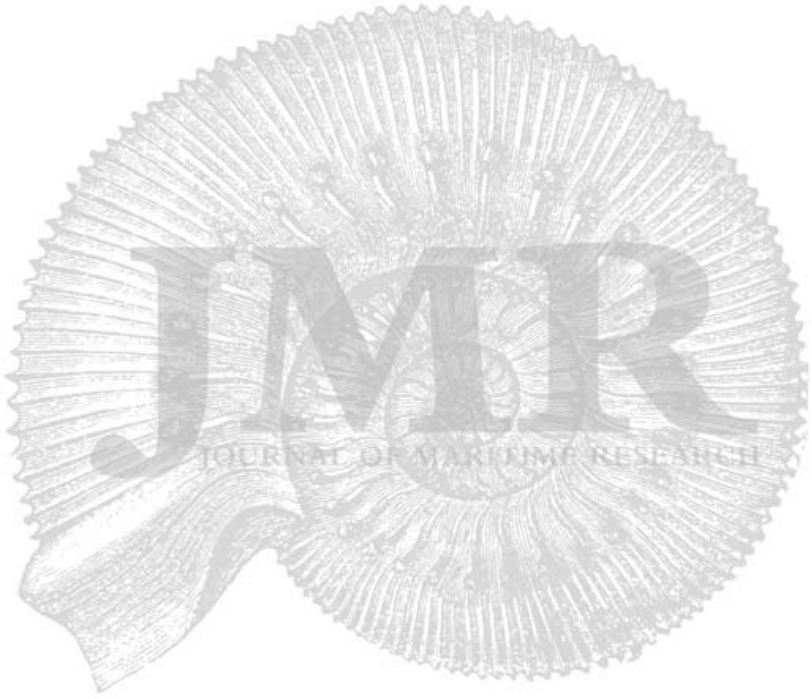
en ellos. Son materiales persistentes que se abandonan en el medio costero destruyendo habitats y afectando a la producción biológica costera, por lo que se hace necesario investigar, cómo eliminarlos y cómo frenar la dinámica de convertir al océano en el depósito final de los residuos.

2.6. CONTAMINACIÓN POR CALOR RESIDUAL

Contaminación térmica debida al calor desprendido como subproducto de muchos procesos industriales, como el de la energía eléctrica, y aguas usadas como refrigerantes que pueden llegar a alcanzar hasta 12 ºC de diferencia con las del medio.

3. CONCLUSIONES

No pretendemos crear una idea catastrofista del problema, sólo dejar constancia de que la presión antrópica que reciben los litorales más poblados es excesiva. Nuestra intención no es otra que abrir los ojos ante un problema que existe y que resulta ineludible. Debe cambiar de manera inmediata, las actitudes que gobernantes y ciudadanos manifestamos hacia el mar. Hay que minimizar los riesgos ambientales, proteger amplias zonas naturales, crear políticas efectivas de gestión del litoral, exigir sistemas eficientes de depuración de desechos y un largo etcétera… *en materia ambiental queda mucho por hacer.*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