Ships for Scrap VI

Steel and Toxic Wastes for Asia

Findings of a Greenpeace visit to Darukhana Shipbreaking yard in Mumbai, India December 2002

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Summary

In December 2002, a Greenpeace delegation visited the Mumbai shipbreaking yard at Darukhana and took environmental samples from the ship-breaking plots. This was a follow-up to Greenpeace's 1998 investigation published in the report "Ships for Scrap – Steel and Toxic Wastes for Asia - a fact-finding mission to the Indian shipbreaking yards in Alang and Mumbai" Greenpeace, March 1999.

The objective of the follow-up study was to get an impression of change in the environmental conditions with focus on the levels of contamination caused by breaking of toxic ships at the Mumbai shipbreaking yard after four years. Additionally, the 2002 Greenpeace investigation was an attempt to get an understanding of the working conditions at the shipbreaking yards, with focus on handling of hazardous substances.

The visual inspection and scientific analysis of the environmental samples of December 2002 confirm that there is no sign of improvement at the yard, either in environmental conditions or in the working conditions. The results of the analyses of the sediments collected from the yard clearly indicate increased levels of contamination (compared to our 1998 findings) caused by toxic substances released during the breaking of scrap-ships. These toxic substances are inherent in the structure of the ships, as an integral part of their machinery and equipment, or as remains in the cargo and fuel tanks.

The samples taken from the marine sediments of the yard indicate that the breaking up of ships has severely polluted the sediments of the local marine environment of the Mumbai shipbreaking yard with mineral oil, heavy metals, PAHs, PCBs and organotin compounds. The levels of most of the pollutants found in the marine environment from this shipbreaking yard are high enough to warrant clean-up action as per western (Netherlands) standards.

Workers' health at the Mumbai yard is still being constantly put at risk by toxic substances from the ships and unsafe working conditions on the premises. Generally, no personal protection equipment is provided for workers and no measures have been put in place to educate them on how to deal with hazardous substances.

Based on these findings, Greenpeace once again stresses the need to put in place a system for clean-recycling of ships and a ban on dumping of hazardous waste to Indian shores. Decommissioned ships should be decontaminated before being sent to India. It should be concluded that saving (and earning) money by sending hazardous waste ships to Asia cannot be accepted as a responsible practice on the part of the ship-owners.

The shipbreakers who rent the plots from the harbour authorities should take measures to protect their workers and the environment. Finally, the authorities, in particular the harbour authorities, in this case the Mumbai Port Trust, who are responsible for the supervision of rules for shipbreaking have to be criticised for failing to implement basic safety measures and environmentally sound shipbreaking practices.

Supported by this reconfirmed evidence of continued contamination/pollution of our seas and human health caused by dirty ship-breaking practices, Greenpeace urges all stakeholders involved to take responsibility and make environmentally sound ship-breaking a mandatory regime with:

1. Shipbreaking should be subject to a global regulatory regime, rather than being a matter of unilateral measures. Exporting and importing countries should no longer allow the illegal export/import of toxic end-of-life ships and should as a matter of urgency enforce the existing rules as set up under the Basel Convention and the Ban Amendment.
2. The Polluter (Shipowner/operators) must decontaminate the ships-for-scrap prior to export;
3. Shipowners/operators must present a complete inventory of all hazardous material on board the vessel, making a register of the pollutants and analysis of the dangers from the ships;
4. Shipbreaking should be conducted without risk to workers' health or to the environment;
5. Ships must be made gas-free for hot works prior to export for breaking and should be maintained and monitored in a gas free condition and be approved "fit for hot work" during the whole process of shipbreaking;
6. Shipbreaking facilities should be freely accessible by citizen groups, environmental NGOs and trade unions;

Looking ahead, Greenpeace demands that:

1. Existing ships should be made progressively cleaner, by systematically removing, and replacing toxic and hazardous substances during maintenance, repair, refitting and rebuilding programmes and
2. The "next generation" of ships should be "clean ships," i.e. ships that are designed and constructed with a view to eliminating their environmental, health and safety implications upon decommissioning.
3. Shipowners must accept the chain of responsibility for the safe and clean dismantling of ships. They should be held accountable for the environmental and health damage caused by sending toxic ships to Asian beaches.

As is evident from the above demands, Greenpeace is not opposed to either the shipping or the shipbreaking industry. Greenpeace will, however, actively oppose the export of ships that are not decontaminated, and we will continue to stand up against unsound breaking practices that threaten workers' health and the environment.

1 Introduction

Since 1998, Greenpeace has drawn attention to the poor conditions under which ocean-going ships are scrapped on Asian beaches and the consequent environmental and human health havoc caused by the release of toxic substances during breaking. Greenpeace investigations, exposés and scientific analysis of environmental contamination at shipbreaking yards in China, Bangladesh, Philippines, Turkey and India are oriented towards a campaign for implementation of clean-ship recyling practices while addressing the issue of continued dumping of hazardous waste by OECD countries on developing countries in clear contravention of the Basel Convention and various national laws in these countries.

Greenpeace's investigations of December 2002 at the Mumbai shipbreaking yard was to get an impression of any change in working and environmental conditions at the Mumbai shipbreaking yard after four years of our first such investigations, with special focus on the handling of toxics waste and hazardous substances and to determine the extent of contamination caused by the shipbreaking activity.

The team consisted of Greenpeace campaigners from India and the Netherlands, a campaigner from Toxics Link, India, volunteers from Mumbai and Belgium and representatives of the Mumbai Port Trust (MPT). The team was under constant surveillance by ship-breakers and their managers and was repeatedly told to stop work and to leave the yard. This made the work difficult.

Shipbreaking yard in Mumbai

The Mumbai shipbreaking yard lies on the north east of the island city and is about 1500 meters in length. The yard, which began operations in 1910 consists of nineteen plots and covers an area of around 23,541 mtrs. Every plot has an average surface of 1,239 mtrs. According to the statistics supplied by the Mumbai port trust authorities, 340,368 tonnage ship (gross tonnage) or 196,971 tonnage ship (light displacement tonnage, LDT) has been scrapped in the Mumbai shipbreaking yards between April 2001 and March 2002.

The Mumbai Shipbreaking yard is operated under control of the Mumbai Port Trust and plots are leased to private companies/breakers for a period of one year. The port authorities have to see to it that the yards observe regulations, mostly in the form of paperwork toprevent that waste, toxic substances and oil from being released into the water. For each ship-for-scrap the head of the port authorities and the shipbreaker together check the list of conditions. Ships that meet the conditions are allowed to be pulled onto the beach.

The Mumbai authorities are currently in process of privatizing the shipbreaking yards and to lease out the plots for a period of 10 years. The Mumbai Port Trust gives financal incentives to the shipbreakers when they break up a ship very quickly. Greenpeace fears that an incentive meachnisms based on the *speed* of the breaking process – instead on a safe breaking process- contributes to ignore safety, health and environmental standards.

In the four months prior to the Greeenpeace visit to the yard several western ships were brought to the Mumbai shipbreaking yard for breaking-up, examples are:

- the Greek reefer ship Frio Dolphin, built in 1979, Panama flag
- the UK general cargo ship Kerie, built in 1978, SLE flag?
- the German general cargo ship Mercs Wadduwa, built in 1967,
- the Dutch general cargo ship Aboudi II, built in 1967, KMH flag
- the US crude oil tanker Cherry Valley, built in 1974, US flag
- the Italian passenger ro-ro ship Cia Blu, built in 1970, Bolivian flag

2 Visual observations at the Mumbai breaking yard

Ships are usually beached at high tide. They are then cut on the spot with oxyacetylene or oxygen-LPG torches by workers with no personal protection equipment. Hazardous substances contained within the structure of the ships are dumped into the sea or on the beach. The workers are constantly put in life-endangering situations due to lack of adequate personal protection measures, poor working conditions and no formal training in dealing with hazardous materials. Workers, thereby are exposed to an environment, which has potentially negative impact on their health

During our visit to the yards we learnt that around 3000 people, mainly from Orissa, Bihar and Uttar Pradesh were employed in the shipbreaking yards. At the time of the Greenpeace visit, several ships in varying degrees of dismantling were lined in front and up along the shore to be broken up simultaneously. The general cargo ship – Fair Spirit – belonging to a shipowner from the United Arab Emirates had just arrived a couple of days before. Ships were broken up in water and no oil screens were being used.

At the yards all kinds of shipwrecks lie on the beach. Ships with square holes in their hulls and ships with only the stern left. The yards are marked off by steel plates, gas cylinders and pieces of ship's hull. We could see how workers cut steel plates from the ship with large torch cutters. Old shears - there's one at every yard - hoist the steel pieces onto the wharf. Dozens of men twist their bodies in impossible angles to torch cut the steel into little pieces. It's hard physical, dangerous and unhealthy labour. They constantly breathe the toxic fumes that are released by the torch cutting. Steel plates and pieces fall off the ships and shears. None of the workers wear helmets. Only one or two wear gloves or boots. A worker in his late fifties, who has worked at the yard for ten years and has lost two relatives during the shipbreaking work summarises one of the daily concerns for the workers: “If you start working in the yards in the early morning, you never know whether you will return home the same evening.”
A woman in an oil-stained sari walks on another ship. We are being told that each shipwreck has two women collecting small pieces of steel and assorted waste. The women work in small teams and each gets paid around rupees [1]40-45 a day. They work around 8 hours a day. All over the place waste is burnt in open fires. We observed about 50 men torch cutting a ship. Some protected their eyes against the steel fragments flying aroud with sunglasses or old-fashioned pair of goggles. Others had put a rag on their mouths and noses against the toxic and stinking fumes that are released during torch cutting. It is clear that the workers are ill-protected and not equipped or trained to deal with hazardous substances. None of the workers wore dust masks or protective clothing against asbestos. Materials containing asbestos did not appear to be collected separately. According to workers, there was no segregation of asbestos from rest of the waste and asbestos is dumped as normal waste.

We learnt that the men get paid between 50 and 200 ruppess a day depending on their specific tasks. The steel carriers get paid around 50 rupees. The men’s working day is 12 to 13 hours, and usually they work 7 days a week with no holidays.

[1] 1 USD dollar – 45 rs (average, subject to market rates)

3 Investigation of sediments at Mumbai yards

Sample details
At the yard, the sediment was investigated for hazardous substances that are present in end-of-life ships. Greenpeace took two samples from the sediments. The first sample has been taken of the sediment between two ships, around 150 meters away from the first sample; a second sample has been taken from the sediment close to a ship. The substances investigated were:

- mineral oil
- heavy metals
- polyaromatic hydrocarbons (PAHs)
- PCBs
- organotin compounds

Contamination with mineral oil can occur through the leakage of oil from the scrapped ships. Of the heavy metals, particularly copper, lead and zinc from the ship's paint can cause pollution. PAHs come mainly from combustion processes and from leaking oil. PCBs are found in solid (waxy) and liquid (oily) forms in equipment and materials on ships being scrapped (US_EPA, 2000). These equipment and materials which may contain PCBs in concentrations of at least 50 parts per million (ppm) include cable insulation, transformers, capacitors and electronic equipment with transformers and capacitors inside, oil-based paint, anchor windlasses, hydraulic systems. Organotins, mainly tributyltin (TBT), are released from antifouling paint that is used on ships beneath the waterline to discourage the growth of marine life on the ship's surface.

The results are presented in table 4

Furthermore two samples were taken from different insulation material that were found at the yards and have been invetigated on asbestos.

Table 1 Sample details from Mumbai shipbreaking yard

Samp le No.	Sample referred to as:	Date of sampling	Location of sampling
1	1	17/12/02	Sediment at yard
2	2	17/12/02	Sediment at yard

Table 2 Sample details insulation material

Sample No	1: plate material	2: small piece
Location	Yard	Yard
Date of sampling	17/12/02	17/12/02

Information on substances:

Mineral oil

Oils and fuel exhibit toxic characteristics. Main exposure routes are inhalation and consumption of contaminated fish and water. Oil spills threatens birds, mammals and water organisms.

Heavy metals

Toxic heavy metals associated with shipbreaking include lead, mercury and cadmium. Metals can be found in many products onboard a vessel in varying quantities. Paints and coatings might contain metals such as zinc, lead and copper. Both zinc (typically in topcoats) and copper are still present in considerable amounts in modern paints. Heavy metals compounds are also present in anodes, insulation, batteries and electrical compounds. Heavy metals can cause harm to human health and environmental systems. Mercury for example is a toxic heavy metal and a persistent, bioaccumulative pollutant that affects the nervous system. The effects of lead upon human health have been known for a long time. Young children are most vulnerable to its toxic effects. Long-term exposure to even low levels can cause irreversible learning difficulties, mental retardation and delayed neurological and physical develoment.

PAHs

Approximately 250 different polycyclic aromatic hydrocarbons (PAHs) are known. Some 30 PAH compounds and several hundreds of derivatives are classed as carcinogenic. The health hazard from PAHs comes from directly inhaling fumes, which are released primarily during torchcutting, after torchcutting when paints continue to smoulder, or when wastes are deliberately burned. PAHs accumulate in dust and sediment, and tissues of lifeforms. As a result they are available for uptake either through inhalation, dermal contact or via the foodchain.

PAHs cause malignant tumours by interfering with enzymatic breakdown, affecting the lungs, stomach, intestines and skin. The potential of substance mixtures containing high PAHs levels to cause skin cancer is known since 1775.

PCBs

Polychlorinated organic compounds (PCBs) are found in solid (waxy) and liquid (oily) forms in equipment and materials on ships being scrapped. These equiment and materials which may contain PCBs in concentrations of at least 50 parts per million (ppm) include cable insulation, transformers, capacitors and electronic equipment with transformers and capacitors inside, oil-based paint, anchor windlasses, in electrical systems in equipment for cargo handling (such as crane and pump arrangements), in sealing materials and glues used in windows in vessels built up to mid 1980’s, in electrical components in powering systems and in electric lighting including fittings and heat exposed electrical components (condensators). Since PCB was phased out as a compound in ship paintings in the mid 70’s, it is likely that most of the exposed paint structure does not contain this. However, some paint surfaces such as in engine-, pump and boiler rooms and also ground coatings in accommodation areas are most likely of original specifications.

PCBs are highly toxic and persistent pollutants and they bioaccumulate in the environment. Exposure to PCBs has been associated with a variety of adverse health problems. PCBs have been linked to cancer, liver damage, reproductive impairments, immune system damage and behavioural and neurological damage.

Organotins

Tributyltin (TBT) is an aggressive biocode (kills living organisms) that has been used in anti-fouling paints since the 1970s. TBT is considered as one of the most toxic compounds in the aquatic ecosystems; its impact on marine organisms range from the subtle to the lethal. TBT is responsible for the disruption of the endocrine system of marine shellfish leading to the development of male characteristics in female marine snails. TBT also impairs the immune system of organisms. Shellfish are reported to have developed shell malformation after exposure to extremely low levels of TBT in the seawater.

As organotins compounds can damage human health even in small doses, in industrialised nations, legal regulations are in place to protect workers from exposure to antifouling paints containing TBT. Skin, eye and lung protection are mandatory for any contact work with TBT-containing paints.

Information on substances (cont.):

Asbestos Asbestos is used, particularly in engine rooms, for its thermal insulation and fire-resistant properties. It is sandwiched between steel plates in the walls or in the doors. Asbestos is hazardous substance listed in Annex 1 to the Basel convention. It is a major threat to health because when distributed, it breaks into fine fibers, which can be suspended, in the air for long periods. If inhaled, the fibers can lead to fatal diseases such as lung cancer, mesotheelioma and asbestosis. Symptoms of these diseases do not show up for many years. Removal of Asbestos from a ship (or from other installations, for that matter) requires special training, the use of respirators and protective equipments, monitoring and decontamination facilities. In ship-breaking yards asbestos is removed by workers without any breathing apparatus. It is not disposed of properly, creating a hazard for the larger population. Asbestos fibers travel to the workers' accommodation through their clothes, lengthening their exposure and exposing others in the same accommodation well. References: DNV1999, Greenpeace reports 1999 and 2001, ILO 2001 and US-EPA 2000

Comparison

The levels of toxic or hazardous substances found in the samples of the sediments as described in table 4 are compared with:

(1) Parameters for assessing the quality of sediment for fresh water systems in the Netherlands (NL-Council of Ministries, 2000):

Table 3 Dutch parameters for the assessment of the quality of sediment

Criteria	Description: quality of sediment
Equal and below “target” value	Not contaminated
Exceeding “target” value	Lightly contaminated
Exceeding “limit” value	Moderately contaminated
Exceeding ”test” value	Seriously contaminated, sediment must be cleaned up
Exceeding “intervention” value	Very seriously contaminated, sediment must be cleaned up

Note that Dutch criteria are designed for aplication to fresh water environments. Therefore it only provides a tentative basis for comparison with marine environments.

(2) The ecotoxicological assessment criteria (EAC) agreed by the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR, 1997):

- *Provisiona*l criteria for metals, for arsenic (1-10 mg/kg), for cadmium (0.1-1 mg/kg), for chromium (10-100 mg/kg), for copper, lead and nickel (5-50 mg/kg), for mercury (0.05-0.5 mg/kg) and for zinc (50-500 mg/kg);
- Eleven individual PAHs are listed. Of these, *firm* criteria are given for three PAHs (0.05-0.5 mg/kg for naphthalene and anthracene, 0.1-1.0 mg/kg for phenanthrene). *Provisional* criteria are given for a further 5 PAHs, ranging from 0.05-0.5 mg/kg for pyrene to 0.5-5 mg/kg for fluoranthene. For the remaining three, there were considered to be insufficient data available on which to agree criteria.;
- A *provisional* criterium for the sum of PCB of 0.001-0.01 mg/kg; and
- A *provisional* criterium 0.000005 to 0.00005 mg/kg for TBT (tributyltin) in marine sediment. Only with such a low figure damage to marine organisms can be avoided.

Note that the OSPAR criteria are not limits for remedial action but criteria which may be used “to identify potential areas of concern”.

Table 4 Results samples 1 and 2, Mumbai shipbreaking yard

Substances	1	2	Target value	Limit Value	Test value	Interv en-tion value	OSPAR EAC
	mg/kg ds	Mg/kg ds	mg/kg ds	Mg/kg ds	Mg/kg ds	mg/kg ds	mg/kg ds
Mineral oil	**6600**	**5500**	50	1000	3000	5000	------
Metals							
Arsenic	*12*	*20*	29	55	55	55	1-10 (p)
Cadmium	***2.7***	***3.9***	0.8	2	7.5	12	0.1-1 (p)
Chromium	***140***	***300***	100	380	380	380	10-100 (p)
Copper	***240***	***380***	36	36	90	190	5-50 (p)
Mercury	***0.96***	***0.82***	0.3 *	0.5	1.6	10	0.05-0.5 (p)
Lead	***470***	***480***	85	530	530	530	5-50 (p)
Nickel	***66***	***130***	35	35	45	210	5-50 (p)
Zinc	***910***	***1300***	140	480	720	720	50-500 (p)
PAHs							
sum 10 PAHs	**5.3**	**11**	------	1	10	40	------
Naphthalene	<0.05	**0.06**	0.001	0.015	------	------	0,05-0,5 (f)
Phenanthrene	**0.13**	***1,6***	0.005	0.05	------	------	0,1-1 (f)
Anthracene	**0.16**	**0.30**	0.001	0.05	------	------	0,05-0,5 (f)
Fluoranthene	**0.65**	**2.4**	0.03	0.3	------	------	0,5-5 (p)
Pyrene	*1.5*	*2.5*	------	------	------	------	0,05-0,5 (p)
Benz(a)anthracene	**1.0**	***1.6***	0.003	0.05	------	------	0,1-1 (p)
Chrysene	**0.92**	***1.2***	0.1	0.05	------	------	0,1-1 (p)
Benzo(k)fluoranthene	**0.32**	**0.53**	0.02	0.2	------	------	n.d.
Benzo(a)pyrene	**0.60**	***1.3***	0.003	0.05	------	------	0,1-1 (p)
Benzo(ghi)perylene	**0.71**	**1.0**	0.08	0.05	------	------	n.d.
Indenopyrene	**0.80**	**0.68**	0.06	0.05	------	------	n.d.
PCBs							
no 28	**0.073**	**0.043**	0.001	0.004	0.03	------	------
no 52	**0.021**	**0.022**	0.001	0.004	0.03	------	------
no 101	**0.021**	**0.044**	0.004	0.004	0.03	------	------
no 118	**0.036**	**0.079**	0.004	0.004	0.03	------	------
no 138	**0.029**	**0.067**	0.004	0.004	0.03	------	------
no 153	**0.030**	**0.068**	0.004	0.004	0.03	------	------
no 180	**0.024**	**0.061**	0.004	0.004	0.03	------	------
sum 7-PCBs	***0.230***	***0.380***	------	------	0.2	1	0.001-0.01 (p)

Table 4 Results samples 1 and 2, Mumbai shipbreaking yard (cont.)

Organotins							
Tributyltin	***7.33***	***3.31***	0.0001	------	------	------	0.000005-0,00005 (p)
Triphenyltin	<0.05	**0.06**	0.00006	------	------	------	------
Dibutyltin	0.48	0,85	-----	------	------	------	------
Dicyclohexyltin	<0.05	<0,05	-----	------	------	------	------
Diphenyltin	<0.05	0,07	------	------	------	------	------
Tricyclohexyltin	<0.05	<0,05	------	------	------	------	------

* this standard applies for both inorganic mercury and methyl mercury
n.d. = not determined
values **bold**-sediment is lightly or moderately contaminated (according to the assessment of -quality of sediment in the Netherlands)
values **bold** & <u>underlined</u>-sediment is seriously or very seriously contaminated (according to the assessment of quality of sediment in The Netherlands),
*italic e*xceeds the ecotoxicological assessment criteria (EAC) agreed by the OSPAR Commission

Table 5 Asbestos results from 2 samples

Locations		**1**	**2**
		Yard	**Yard**
Material	**Color**	**Mass %**	**Mass %**
Chrysotyl	White	<0.1	<0.1
Amosiet	Brown	<0.1	15-30 contd/-
Crocidoliet	Blue	<0.1	<0.1
Anthofyliet		<0.1	<0.1
Actinoliet		<0.1	<0.1
Tremoliet		<0.1	<0.1
Estimated latency		Not applicable	Loose

Explanation of results

The sediment samples show that all categories of substances exceed the Dutch standards for sediment and the ecotoxicological assessment criteria agreed by the OSPAR Commission. The levels of many of the pollutants found in the marine environment are high enough to warrant clean-up action as per Dutch standards.

Asbestos

Asbestos was found in one of the two samples taken from the shipbreaking yard. The sample that was positive on asbestos contained Amosite with a mass percentage of 15-30.

Oil

The sediment is very heavily contaminated with oil (0.55-0.66% of weight) and is well above the Netherlands' standard requiring clean-up of the river bed.

Heavy metals

The concentrations of all heavy metals exceed the ecotoxicological assessment criteria agreed by the OSPAR Commission. For nickel, copper and zinc the sediments would be described as seriously to very seriously contaminated according to Dutch standards for river beds are seriously exceeded, clean-up is needed.

PAHs
The concentrations of the individual PAH compounds show that the sediment would be described as slightly to moderately contaminated by Dutch standards. The levels of five invidual PAHs are higher than the ecotoxicological assessment criteria agreed by OSPAR.
The total PAH concentration (sum of 10 PAHs) in sample 2 is above the test value in the Netherlands. The sediment would be described as seriously contaminated, need for clean-up.

PCBs
Six PCB compounds and the sum of 7 PCBs are well above the Netherlands' standard requiring clean-up of the river bed.
The sum of 7-PCBs level found in sample 1 is approximately between 23 and 230 times higher than provisional ecotoxicological assessment criteria for the sum of 7-PCBs in marine sediment agreed by OSPAR. The sum of 7-PCBs level found in sample 2 is approximately between 38 and 380 times higher than provisional ecotoxicological assessment criteria for the sum of 7-PCBs in marine sediment agreed by OSPAR.

Organotins
The seriously harmful tributyltin (TBT) was found in the sediments of the yard. It was present at a very high concentration, in sample 1, some 73,000 times higher than the Dutch standard for non- contaminated sediment. The TBT level found here is also approximately between 146,000 and 1.46 million times higher than provisional ecotoxicological assessment criteria for TBT in marine sediment agreed by OSPAR.
The quantity of triphenyltin found in sample 2 is more than 1000 times higher than the Dutch standard for non- contaminated sediment.

TBT worldwide
On the basis of peak values measured, Greenpeace identified 10 TBT hotspots in Europe in 1999/2000 (Maack, T., 2000). These European hotspots have more than five decades of industrial and/or maritime activity. The levels of TBT (not taking into account its degradation products) in the sediment of the Mumbai shipbreaking yard places this yard at par with the 8^{th} most contaminated TBT hotspot in Europe. Alang – the largest scrapping yard of the world – is at 6^{th} place among the top ten European TBT hotspots. (Greenpeace, 2001)

Table 6: Comparison of concentrations of TBT and its degradation products in the sediment of European ports with the TBT levels found in Mumbai shipbreaking yard, shipbreaking yards in China and Alang, India

PORT	**LOCALITY OF SAMPLING**	**SOURCE**	S **MBT, DBT, TBT mg/kg**
Marseille, France	Avant Port Nord Forme 10	Greenpeace, 25-08-00	241
Hamburg, Germany	Norderweft yard	Greenpeace, 17-09-99	106
Piraeus, Greece	Kinosaura harbour	Greenpeace, 10-08-00	94
Antwerp, Belgium	Port	Greenpeace 2000	28
Barcelona, Spain	Fishing harbour	Greenpeace, 01-09-00	22
Alang-Sosiya Gujarat/India	Shipbreaking yard	Greenpeace 06-06-00	21
Odense , Denmark	Lindovaerflets	Danish Energy Ministry, 2000	14
Livorno, Italy	Docks	Greenpeace, 17-08-00	8.8
China, Xinhui City	Gujing shipbreaking yard	Greenpeace, 06-11-00	8.5 (TBT only)
Mumbai	Mumbai shipbreaking yard	Greenpeace, 17-12.02	7.3 (TBT only)
Rostock, Germany	Neptunwerf, Floating dock	Greenpeace, 09-09-99	4.9
Thessaloniki, Greece	Port-Dock 24	Greenpeace, 10-08-00	1.3
Rotterdam, The Netherlands	Eemhaven Port	Dutch Ministry for Transport and waterways, 1999	1 (TBT only)

4 Conclusion

The yard's operations have severely contaminated the sediment comparing with mineral oil, heavy metals, PAHs, PCBs and organotin compounds. The concentrations of mineral oil, copper, nickel, zinc, the total PAH concentration (sum of 10 PAHs) and most PCBs, in fact, are above levels prescribed for clean-up action in the Netherlands. Negative efects on the environment are very likely and measurements for cleanup of sediments is needed.

The presence of asbestos containing materials is a clear danger for workers at the yard and inhabitants of surrounding communities. People working at the yards should be protected to prevent inhalation of the dangerous asbestos fibres. Existing asbestos-containing waste materials should be properly removed, securely stored and returned to the shipowners. More important end-of-life ships containing hazarsous waste like asbestos should not be accepted for import into India.

Appendix 1 The situation in an OECD country (The Netherlands)

Asbestos removal
In the Netherlands the removal of asbestos from scrapped ships is subject to strict regulations. The removal of asbestos takes place under the rules of the Asbestos Removal Decree (NL- Ministry of Environmental Affairs, 1998), according to the general, applicable prescriptions of the Conditions at Places of Work Act, the Conditions at Places of Work Decree and the Policy Rules on Conditions at Places of Work Legislation (NL-Ministry of Social Affairs, 1997). The essence of these regulations is that exposure of workers to asbestos fibre is prevented through numerous technical, organizational and medical measures as the inhalation of asbestos fibres may result in incurable and fatal diseases. A ship intended for scrapping must first be inventoried by a company specially certified to inventory asbestos. A company with a special certification for asbestos removal must then remove the asbestos, after which the asbestos waste is checked and disposed of in a controlled facility. There are also strict regulations governing the removal of asbestos, such as the use of specific breathing equipment and that the work must be carried out under so-called containment. Finally, a suitably accredited laboratory must issue an asbestos-free certificate. Before the asbestos-free certificate is issued, the asbestos areas are inspected visually and the air is sampled for asbestos fibre. The ship is only considered to be safe for scrapping after the asbestos-free certificate has been issued. (Locher, K., 2001) Thus, in the Netherlands, asbestos removal and disposal are strictly controlled with regard to sequence and the companies that do the work.

Oil pollution
When ships are being broken up there is a very great risk of oil pollution. In the Netherlands these risks are minimised by the regulations accompanying an environmental protection licence. The regulations deal, for example, with the scrapping of ships on impermeable slopes, the installation of oil drains as well as water-oil separators and provisions for the controlled disposal of oil. In fact, using a dry dock is the best way to prevent oil pollution when scrapping a ship.

Threat of fires and explosions
Fuel residues left in ships' tanks can lead to dangerous situations during torch-cutting operations. In the Netherlands, fires and explosions are minimized because ships are decontaminated of all fuel and residues prior to scrapping. Before a ship can be scrapped, it has to obtain a gas-free certificate from a company specializing in such certification.

Cables
Burning plastic (PVC)-insulated cables can result in the release of highly poisonous chemicals such as dioxins and furans. Dioxines and furans are two of the most toxic products known because the dose that can cause disease is lower than that for many other man-made chemical. They are linked to cancer and birth defects. (DNV, 1999 and US Office of Technology Assessment, 1989) PCBs are found in solid (waxy) and liquid (oily) forms in equipment and materials on ships being scrapped. Cable insulation may contain PCBs in concentrations of at least 50 parts per million (ppm). PCBs are toxic and

persistent and have been shown to cause a variety of adverse health effects. Chemicals produced when PCBs are heated in fire-related incidents include polychlorinated dibenzofurans and polychlorinated dibenzo-p-dioxins, both of which are believed to be much more toxic than PCBs themselves. (US-EPA, 2000)
The use of hydraulic cutters, rather than open flames for scrapping greatly reduces the likelihood of dioxin generation. The environmental protection licence for ship breakers includes provisions for the disposal of cables. Cables are gathered after removal in special containers and must be transported to special processing companies. In the Netherlands, copper is recovered from insulated cables by a mechanical process and not by burning them. The waste products are subsequently disposed of or further processed by licensed processing companies. The processing and transportation of paper-insulated ground cables is also regulated. The cables are processed by the processing companies through four fractions after which possible PCB-containing fractions, such as paper, jute and bitumen fractions are transported to controlled disposal sites. (Bohmann, R.O., 2001)

Origin of toxic gases from paints and coatings
The paints and coatings on a ship may be flammable or may contain toxic compounds such as ploychlorinated biphenyls (PCBs), heavy metals (such as lead, cadmium, chromium, zinc and copper) and pesticides such as tributyl tin (TBT). (US-EPA, 2000)
Torch cutting generates smoke, fumes and particulates that may have toxic effects. (ILO, 2001)

Waste disposal
The Dutch breaking yards must have water-proof floors to prevent contamination of ground water. The waste that is produced must be sorted. Important categories are hazardous waste, waste containing oil and ordinary waste. This waste must be delivered to appropriate processing companies.

References

- Bohmann R.O., Ministry of Environmental Affairs (The Netherlands), Substances, Waste and Irradiation Department, Personal correspondence 2001
- DNV report No. 99-3065, Decommissioning of Ships, Environmental Protection and Ship Demolition Practises, 1999
- Greenpeace, Ships for scrap: Steel and toxic wastes for Asia, - a factfinding mission to the Indian shipbreaking yards in in Almng and Mumbai, March 1999;
- Greenpeace, Ships for scrap III, Steel and toxic wastes for Asia, - Findings of a Greenpeace Study on Workplace and Environmental Contamination in Alang-Sosya Shipbreaking Yards, Gujarat, India, 2001.
- Greenpeace, dumping of Dutch ships in China; a case over two continents, April 2001
- International Labour Organisation, Workers safety in the shipbreaking industries, A. Andersen, Geneva, February 2001
- Greenpeace, Ships for scrap II, Steel and toxic wastes for Asia, - Worker health & safety and environmental problems at the Chang Jiang Shipbreaking yard operated by the China National Shipbreaking Corporation in Xiagang near Jiangyin, November 1999
- Hamburg Parliament Dredging Sludges Concept (Burgerschaft der Freien und Hansestadt Hamburg Drucksache 16/3080. September 26, 1999, Hamburg Baggergutkonzept).
- Locher K., Ministry of Environmental Affairs (The Netherlands), Substances, Waste and Irradiation Department, personal corespondence 2001
- Maack, T., Greenpeace Germany: “TBT hotspots in Europe”. September 2000
- NL- Ministry of Environmental Affairs, The Netherlands “Asbestos Removal Decree” (*asbestverwijderingsbesluit*; *Stb.* 1993; amendment *Stb.* 1998, 171) NL- Ministry of Social Affairs, The Netherlands: “Conditions at Places of Work Act”(*Arbeidsomstandighedenwet*); “Conditions at Places of Work Decree” (*Arbeidsomstandighedenbesluit;* 1997, *Stb.* 197, 60 and *State journal* 1997, 64); and“Policy Rules on Conditions at Places of Work Legislation ” (*Beleidsregels* Ministry of Social Affairs, *Arbeidsomstandighedenwetgeving*) decision of 27 June 1997, Directorate of Conditions at Places of Work (*Directie Arbeidsomstandigheden, Arbo/AIS* 9701436).
- NL- Council of Ministers, 4th Policy Document on Water Management, The Netherlands, Supplement A: standards, 12 May 2000 State journal 16th of June 2000 (Bijlage A: normen 4e Nota Waterhuishouding, vastgesteld in Ministerrraad 12 mei 2000, Staatscourant 16 juni 2000, nummer 114/page 18
- OSPAR (Oslo Paris) Commission for the Protection of the Marine Environment of the North-East Atlantic, Agreement 1997-15
- P&O Nedllloyd, China, ship recycling, a pilot project, 2000
- U.S. Office of Technology Assessment, Facing America’s Trash, 1989, p.229-30
- US: A guide for Ship Scrappers- Tips for Regulatory Compliance Environmental Protection Agency, 2000