Ships for Scrap

Steel and Toxic Wastes for Asia

The health and environmental hazards in recipient states

A fact-finding mission to the Indian shipbreaking yards in Alang and Bombay

GREENPEACE

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Eberhard Weckenmann/Greenpeace (S. 8 u.)

published by
Greenpeace e.V.
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March 1999

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1 Introduction

It is widely known and has been repeatedly described how decommissioned ocean-going ships are scrapped in Asian states, especially on the Indian subcontinent. This is usually presented as a curio: hundreds of workers taking apart a huge ship largely by hand.

The concerns highlighted in this context have sometimes included the abysmal working conditions, the lack of worker health and safety controls and the frequent accidents. By contrast, the acute and medium to long term impacts upon the health of workers and local residents have aroused scarcely any interest. The authorities in the north-west Indian state of Gujarat have allegedly investigated the dispersal of contaminants from the dismantled ships to the environment. However, these data, which refer to Alang, the largest scrap yard of the world, have not been disclosed to the public.

Recently criticism has been voiced in some rich OECD countries that ship owners assume no responsibility for the often very toxic substances long contained in their roughly 30 year old vessels. Instead, the owners sell the ships as pure steel to Asia, and make a good profit on this, while fully aware that the unsuspecting people there will be directly exposed to the hazardous substances; fully aware, too, that the authorities there do not meet their obligations to protect their citizens, be it out of negligence or impotence.

Since 1 January 1998, Greenpeace and the environmental movement at large have a further cause for calling attention to the illegality of this process: Through the transposition of the 1989 "Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal" into European Union – and German – waste legislation, all of the contaminants examined in the present report have become subject to a ban on exports to non-OECD countries.

In the expectation the new legal situation would give renewed initiatives to improve the situation a higher chance of success than before, Greenpeace International decided to tackle the issue once again. In a first step, a mixed team from India and Germany, in cooperation with the international Basel Action Network, undertook a fact-finding mission to two shipbreaking yards in India: the Mumbai (Bombay) Scrapping Area and the Alang Ship Breaking Yard in Gujarat state, about 180 miles to the north-west of Bombay.

Our purpose was to make an eyewitness record, photographically and on video, of the conditions at these shipbreaking yards, and to make these known to the public. We were able to take samples of material from the ships and environmental samples from the soil and sediments at various locations.

However, neither the photographing and filming nor the sampling could be rigorously systematic. The team was under constant surveillance and was repeatedly told to stop work and leave the place.

The environmental samples were taken directly after the end of the continuous monsoon rains. It must be assumed that contamination levels will rise considerably in the course of the dry season, then again be diluted and washed into the soil in the next monsoon period.

Analysis of the samples reveals dramatic to substantial workplace contamination by various toxic heavy metals from the ship paints. Workplace and environmental contamination by organotin compounds (tributyl tin, TBT) from the antifouling paints on the ship hulls was similarly severe. Asbestos, after being stripped from the ships without any kind of safeguards, was omnipresent: in the working areas, on shop counters and tipped along farming tracks. The 40,000 people working in Alang are additionally exposed to polycyclic aromatic hydrocarbons (PAHs) and dioxins in their working and leisure environments. These come from incessant, open burning of non-recoverable wastes on the beach – this is plain to the most casual observer.

The occupational physician and Occupational Health Officer of the German state of Bremen, Dr. Frank Hittmann, has publicly stated in an interview with ARD-TV (First German TV) that the lack of safeguards in handling the various contaminants means that every fourth worker in Alang must be expected to contract cancer. (14)

The report uses the medical literature to appraise the human health impacts of the lack of safeguards in handling the materials, flame cutting and burning the paints and wastes. German and European occupational health and safety regulations are contrasted with the practices in Bombay and Alang.

We aim to show how seriously the problems are now taken in the ships' countries of origin – problems of which the Asian workers have no inkling.

The hazards to aquatic ecosystems that proceed from the tributyl tin (TBT) contained in the antifouling paints of ships are an environmental problem that, once generated, will persist for a long time to come. Sixteen years of shipbreaking in Alang has contaminated a previously unpolluted region with the poorly degradable environmental poison TBT.

We are not solely concerned with insisting on the letter of the law, demanding that the uncontrolled exportation of these environmental hazards from the European Union is stopped. Our aim is primarily to ensure that the situation in Asia is swiftly and effectively improved.

A medium term aim is that the ships still in service today are rapidly freed of these contaminants, and that new ships are built as far as possible without their use. This is a task that goes far beyond the scope of the Basel Convention. It concerns the entire ship industry, and needs to be tackled more intensively by, among others, the International Maritime Organization (IMO), which is under the United Nations umbrella, and the European Union and the International Labour Organization (ILO, Geneva).

We sincerely hope that this report can make a contribution to these efforts. ■

2 Asia - the final destination

There are about 45,000 ocean-going ships in the world: container ships, general cargo ships, roll-on/roll-off ships, refrigerated cargo ships, tankers, ferries, cruise liners and special ships for research or cable-laying – warships not counted. About 700 are taken out of service every year, after an average service life of 29 years at sea.

In the 1970s shipbreaking was still a highly mechanized industrial operation carried out in the berths of shipyards, mainly in Great Britain, Taiwan, Spain, Mexico and Brazil.

Since the early 1980s, shipbreaking has been increasingly shifted to poor Asian states. By 1993, half of all ocean-going ships were scrapped in China. Now, at the end of the 1990s, India has taken first place (70%), followed by Pakistan, Bangladesh and China. Vietnam and the Philippines are new entrants to this business.

The annual tonnage due for scrapping is predicted to double by the year 2005. This is connected with massive new orders of ships in the early 1990s, lower shipping rates due to the Asian crisis, new safety regulations, above all for tankers, and disarmament programmes.

Ship steel is claimed to contribute 15% to India's annual steel production. The ship graveyard of Chittagong is the sole 'iron ore mine' of Bangladesh.

When a ship reaches the end of its sailing life because it is no longer profitable, its classification certificate – the 4-year special survey – expires, and it is no longer able to meet safety requirements, it is as a rule offered to brokers in Hamburg, London or New York, who pass on the business to Asia. One kind of business for the broker consists of attaining a good price; another lies in converting payments in the form of a non-convertible Asian currency into prices in US dollars. The dollar price per tonne of unladen weight (l.d.t.) reached $170 when times where optimal and in March 1999 was around $105.

Numerous Russian ships seem to find their way to Asia without going through this internationally established broking system, and therefore do not appear in many of the relevant statistics.

When a ship is formally purchased, it makes its way to Asia with a minimal crew on board. Wrecked ships are towed, as are "demilitarised" warships like the Germany Navy's training ship,

the *Deutschland* (in 1993). There they are anchored off the coastline or directly "beached". ■

3 Why is an old ship toxic waste?

Without having seen pictures of how old ocean-going ships are broken (in the *Baltimore Sun, GEO, MARE,* or in film footage and photographs taken by Greenpeace Germany), it is hard to imagine how scrapping old ships can poison people and the environment.

At least 95% of the mass of an ocean-going ship consists of high quality steel.

The main purpose of dismantling these ships is to recover the steel.

The remaining 5% (which, for a cargo ship weighing 10,000 t, still means a considerable 500 t) is made up of non-ferrous metal components, paints and coatings, insulation and sealing materials, electric cabling, cabin walls, decorative tiling, floor coverings and so forth. These materials are firmly installed on the ship or even inseparably bonded to the valuable iron, and need to be stripped, disposed of or at least taken into consideration in the process of breaking the ship.

Ship fuel remnants, bilge oils, spent machine, gear and lubricating oils, insulation and heat transfer fluids are also on board in considerable quantities and need to be removed from the wreck.

In order to be able to assess the hazards and the extent of environmental contamination and human exposure to contaminants that arise when old ocean-going ships are broken up, we need to examine more closely the non-metal materials used in shipbuilding in the 1970s.

In the 1970s, in the absence of substance bans, materials were chosen exclusively according to maximum fulfilment of the function for which they were intended. Ships were not to burn, therefore large amounts of asbestos were used. They had to be highly visible even in poor light and fog, so bright colours were needed. The ship should not rust – therefore anticorrosives were

Wreck of the Columbus New Zealand in Alang, Gujarat

used: lead oxide and zinc chromate. The hull should not be overgrown by algae, molluscs and barnacles which would create frictional drag and raise fuel consumption, so antifouling paints were applied. At one time antifouling paints still contained mercury and arsenic, and later contained TBT.

Carcinogenic asbestos is heat-proof, chemically inert and fireproof, making it an excellent thermal insulation material. Asbestos fibres can be readily processed to fabrics. Although, at the time the ships today about to be scrapped were being built, in the 1970s, the health hazards were already known, materials containing asbestos were not only used for the insulation of the hot parts in the engine room and the hot exhaust gas piping, but for wall cladding and cable insulation. Asbestos was even used by the ton as an injection material to fill out cavities. The use of asbestos was phased out in Germany between 1986 and 1990.

Asbestos bears a special warning symbol

Minium (lead (II,IV) oxide), zinc chromate, strontium chromate and lead carbonate used in ships' paints are toxic to highly toxic, but excellent anticorrosives.

Zinc chromate is carcinogenic

TOXIC

These substances, too, were painted onto ocean-going ships by the ton. The pigments used were also full of heavy metals. Cadmium-containing paints – red and yellow – and lead chromate pigments – yellow, red and green – are heat-proof, bright and cover well. They were mainly used above the water line on deck. Up to 10 t of paint are used in the first coat (layers of primer, anti-corrosion and anti-fouling paint, coating lacquer, etc.) in painting a 650 foot long container ship.

PCBs (polychlorinated biphenyls) were omnipresent in the 1970s. They were in particularly widespread use as additives in mineral oil products (hydraulic oils, lubricants, softeners for plastics, rubber, lacquers and adhesives), in order to give them low combustibility and more durability. It is quite possible that while ships no longer hold PCB-containing oil remnants, they can still have PCB-containing solids on board, with the latter present as cable insulation, joint filler, insulating material or paint. Manufacture of PCB was stopped in Germany in 1983, and its use has been banned since 1989.

In many areas of use PCB has been replaced as a flame retardant by chlorinated and brominated flame retardants such as chlorinated paraffins and polybrominated diphenyl ether, or PBDE. These substances are also harmful to health, have low degradability in the environment, and in the event of fire are a source for the production of dioxins and furanes.

The antifouling paints contained not only mercury, arsenic, and lead, but also TBT (tributyl tin), with the extremely toxic TBTO (tributyl tin oxide) and TBTCl (tributyl tin chloride) being used against the colonisation of organisms on the outer hull. TBTCl is no longer made in Germany, and the use of paints containing TBT for ships of a length less than 25 metres was banned in the European Union in 1989.

The first generations of TBT paints contained substantially more active ingredients than the presently utilised paints, which now have lower release rates but continue to create high TBT emissions.

Tributyl tin compounds

TOXIC

When ships are manually dismantled, it is unavoidable that workers come into contact with the toxic substances. The present shipbreaking operations in the tidal zone of the ocean necessarily lead to sea water, air and the soil being contaminated by the pollutants.

Labourers at the Mumbai Port Scrapping Area, Bombay

The contamination of ship parts by toxic and carcinogenic substances whose use have in the meantime mostly been banned in Germany reaches such high levels in the older ships that ocean-going ships taken out of service must be viewed as toxic waste. ■

(see Annex 2: What is the legal situation?)

4 Worker exposure and environmental contamination

It was possible to comprehensibly observe the working procedures from the arrival of a ship to the removal of the last remains of material from the scrapping site, and what subsequently happened to the material flows. ■

(See Annex 3: working procedure for shipbreaking)
(See Annex 4: material flows from the ships).

Women carry remnants of asbestos-containing insulation material to the sea and dump it in the water, Mumbai Port Scrapping Area, Bombay

Ripping asbestos insulation layer in the Mumbai Port Scrapping Area, Bombay

4.1 Asbestos everywhere

What first strikes a visitor to the shipbreaking yards in Alang and Bombay is the open, careless handling of asbestos without any kind of safeguards. The eye trained in asbestos detection sees the material everywhere: on the ships, next to the ships, on the beach, in big bowls on the heads of the women and on uncontrolled dumps on the land behind.

This way of handling asbestos is drastically opposed to the rules, regulations and laws that apply – and are largely observed – in Germany. ■

What is the procedure for properly removing asbestos from a ship in the port of Hamburg?

1. According to Directive F7 of 1992 of the Hamburg Marine Occupational Health and Safety Agency concerning protective measures when handling asbestos, all materials containing asbestos must be registered and documented on every ship.

Asbestos cleanup in Germany

2. The intention to work with asbestos-containing material must be notified to the responsible supervisory authority at least 14 days in advance. A description of the planned protective and monitoring measures is attached to this notification.

3. The removal of asbestos-containing material can only be carried out by companies that are acquainted with the work involved, the hazards that arise in this and the necessary protective measures, and that have the necessary special equipment and clothing.

4. Work can only proceed under the supervision of a specially trained and accredited expert.

5. Before work begins, a working plan is prepared.

6. The number of employees who can be exposed to asbestos is to be limited as far as possible.

7. Personal protection: Dust protection mask with P-3 filter, disposable protective suit.

8. Working areas where there is any likelihood of asbestos fibres occurring must be closed off to unauthorised persons with notice boards stating "Stop, access prohibited".

9. Asbestos wastes must be collected and disposed of in marked and closed containers without hazards to human health or the environment, in accordance with the LAGA German inter-State working group's memo on the disposal of wastes containing asbestos.

10. The protective measures can only then be dispensed with when measurements after whirling up any asbestos fibres that are present show a fibre concentration in the air of less than 500 F/cubic metre with fibre lengths above 5µm.

In Alang and Bombay, by contrast, asbestos-containing material is stripped from the ships in everyday clothing, without protective masks and with bare hands, and subsequently picked apart with the same disregard for safeguards. In the *Columbus New Zealand,* previously owned by the German Hamburg-Sued shipping company, so much blue asbestos fixed with a little cement had been built into the ship that the very dusty material was collected and offered for sale in open bags in a shop nearby.

In India, the use of asbestos is not yet banned. ■

No.	Sampling location (ship)	Description of sample	Finding
106	Bombay (Kapitan Kissa)	woven fibre	amosite chrysolite
109	Bombay (Kapitan Kissa)	fluffy material	chrysolite
112	Bombay (Murray Express)	coating on steel surface	chrysolite
113	Bombay (Murray Express)	insulation material	chrysolite
115	Bombay (Murray Express)	foamed material	chrysolite
201	Alang (Columbus New Zealand)	decorative tiling from the interior of the ship	amosite
210	Alang (Columbus NewZealand)	blue-white insulating layer	crocidolite
212	Alang (Columbus NewZealand)	thermal insulation layer of a cable	chrysolite
302	Shop, plot 286	blue material collected from ships	crocidolite
317a	On the roadside from Alang to Sosiya	tipped remnants of insulating material, attachments to fibres	chrysolite
318a	On the roadside from Alang to Sosiya	tipped remnants of insulating material, mixed sample from the floor	amosite
320a	On the roadside from Alang to Sosiya	tipped remnants of insulating material, fabric and attachments	chrysolite amosite

Table 1: Asbestos detected in ship materials

Samples were taken from three ships, in all of which large quantities of all kinds of asbestos were found: white asbestos (chrysolite), blue asbestos (crocidolite) and brown asbestos (amosite).

Asbestos is a hazardous, carcinogenic working substance that is subject to notification duties in Germany.

White asbestos (chrysolite) breaks down particularly easily into fibres. These fibres mostly have a diameter of less than 1 micrometre (µm). In old ships, the asbestos material is frequently weathered, which accelerates the formation of asbestos dust. Blue asbestos (crocidolite) forms the most hazardous asbestos fibres because they have a particular tendency to split longitudinally.

Most fibres in asbestos dust are thinner than 1 micrometre (µm) and between 5 and 100 µm long.

Blue asbestos from the Columbus New Zealand is picked apart with bare hands and without any kind of protective mask, and is laid out for drying before further use.

The carcinogenic potential of asbestos fibres depends upon the form of the fibres. Where these have a diameter of 1 µm and less and a length of 5 µm or more they are carcinogenic with certainty. Carcinogenic potential increases with the thinness and length of the fibres, and with the period of time that they are in human tissue. They lock into human tissue and can also move through the body, e.g. from the lung to the peritoneum. As they are very resistant to chemical influences, the body's liquids are not able to render them harmless by dissolving them.

The ingestion of fine asbestos dust irritates the eyes and mucous membranes and can cause shrinking processes in the connective tissue of the lung (asbestosis) and lung cancer or pleura and peritoneum cancer (mesothelioma). Mesothelioma is almost exclusively caused by asbestos. In smokers the cancer risk is increased 100-fold.

These diseases are rated in Germany as occupational diseases for which compensation must be paid to the victim, and they must be notified to the authorities.

The workers in the Alang shipbreaking yard are mostly young people, some as young as 17 years old. This group of persons is exposed to a particular hazard due to asbestos dust, as the group still has a long lifetime ahead of it and is threatened not only by the acute dangers to health from asbestos, but also to its medium and long-term hazards. The types of cancer caused by asbestos often only emerge after decades. In Germany young people are in some cases subject to stricter occupational protection provisions.

The approximately 100 ship breakers in Alang employ about 40,000 workers who live in accommodation directly next to their workplace on the 184 plots into which the beach is organised. The makeshift accommodation along the beach is only separated from the scrapping yards by the main road running along the beach.

Due to the constant inflow of material from the many ships that are broken daily, asbestos dust is omnipresent both at the workplace and where the labourers sleep. The heavy traffic on the road whirls up the dust, which then settles on the tables and chairs on the roadside where the

Indian labourers spend their leisure time. Many people sleep on the floor or very close to it. The accommodation is open, and it can be assumed that the composition of dust on the road and in houses scarcely differs. Asbestos dust on worker garments further contributes to the spread of asbestos in the housing areas.

Numerous useful items taken from the ships are sold in the shops that thrive on this trade along the access road to the scrapping area. This could be viewed as a sensible form of further use.

Selling useful items from the ships

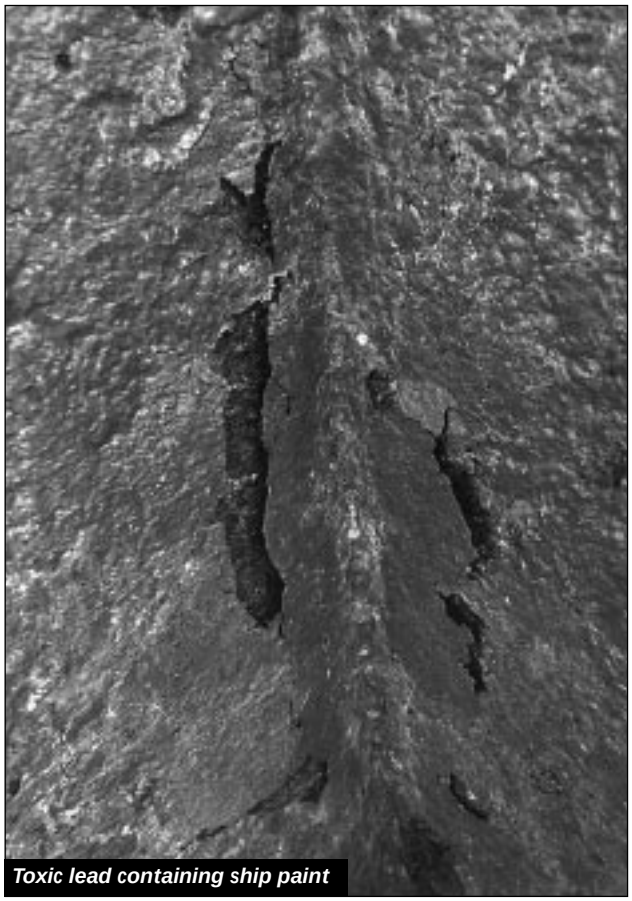
The farming tracks inland from the Alang Scrapping Yard are lined with rubbish tips onto which asbestos material is thrown

However, in addition to valuable fittings, the items on offer also include asbestos-containing decorative tiling, panels and insulating materials. Alang is in a rural region. The demand for consumer items that the farmers cannot produce themselves is met by the ship breakers' shops. ■

4.2 When the paint comes off

The typical form of employment in the shipbreaking yards is the cutting of steel parts with small cutting torches. These torches are in operation day and night; oxygen and propane flasks lie around everywhere. This work is also done without protective masks. Some of the cutters tie light woven cloths in front of their mouths at their own initiative. After 15 minutes in the yard, visitors already have a metallic taste on their tongues.

As long as the wreck still stands upright, much cutting is carried out in the interior of the ship. In order not to suffocate during this work, openings are cut into the hull. Nonetheless, many deaths have occurred during cutting work, caused by gas explosions and fires, mainly in the interior of the ships.



Toxic lead containing ship paint

After a gas explosion in which 50 people died, the government made the wearing of protective helmets mandatory by law in 1997. In fact we saw a minority of workers wearing helmets in Alang but almost none in Bombay. All the same, accidents happen everyday and the workers run this risk quite consciously. However, there is no awareness of the broader health hazards. In addition to exposure to asbestos dust, the workers are permanently exposed to toxic vapours emanating from multilayered coatings when the metal is cut apart.

It appears that far too many people work on small areas, maximising the risk of accidents.

They are exposed to the pollutants not just for eight hours, as is required by the provisions for safety at work, but day and night. They have no opportunity to recover from this exposure because they also live in the immediate vicinity of their work, from which they are separated only by a low wall and a two-lane road, so they are exposed to the pollutants twenty-four hours a day.

Sample No.	108	117	213	214	215
Date	2.10.98	2.10.98	4.10.98	4.10.98	4.10.98
Site (ship)	Bombay (Kapitan Kissa)	Bombay (Murray Express)	Alang (Columbus New Zealand)	Alang (Columbus New Zealand)	Alang (Columbus New Zealand)
Material	Paint green	Paint 1 mm	Paint above water line	Paint above water line	Paint above water line
Findings	mg/kg dry matter	mg/kg dry matter	mg/kg dry matter	mg/kg dry matter	mg/kg dry matter
Arsenic	< 0.2	5.5	0.88	0.42	0.84
Lead	21 400	6 380	34 000	33 300	51 000
Cadmium	1.4	0.83	0.33	1.8	0.84
Copper	600	8.5	58	200	37 000

Table 2: Heavy metals and arsenic detected in paints

Slowly developing health hazards are not acknowledged. As well as pollution from asbestos dust, workers are permanently exposed to toxic vapours coming from substances in the multi-layered coats of paint when the metal parts are taken apart.

In developed industrialised countries, too, welders and members of the metalworking professions are exposed to above-average health and accident hazards. The incidence of lung cancer is higher in this group of persons than in the general public (8). Handling combustible gases is a hazardous activity, as all combustible gases have a comparatively low inflammation temperature and are explosive when mixed with air or oxygen. The sparks that fly during welding and flame cutting are molten or burning metal and slag droplets. Their temperature is about 1200 to 1600 ºC. If they fall on inflammable materials, these can be set alight and can cause a fire. In Germany, welders have to observe many regulations and technical guidelines designed to prevent accidents at work. These rules require appropriate workwear, safety goggles, ear protection in certain cases, and that welding equipment be in a proper state and gas flasks handled safely. The accident prevention regulations are issued by the Occupational Health and Safety Agencies (Berufsgenossenschaften; the employers' liability insurance associations). In large companies, welding is often only permitted if a safety engineer has issued a safety permit.

Scientific studies have shown that flame cutters who work in demolition companies and scrapyards have higher dioxin concentrations in their blood fat than flame cutters and welders employed in metalworking companies processing clean, uncoated steel (9).

Ship paints, particularly the older ones, can have components containing chlorine that tend to lead to dioxin forming – e.g. chlorine rubber used in underwater paints, vinylidene chloride used as a paint medium, or chloride ions in TBT antifouling paints. Sodium chloride from deposited sea salt can likewise cause dioxin to form on a considerable scale.

In the past, paints and lacquers and anticorrosive agents containing lead were frequently used for painting ships. Later the old coats were often simply painted over. Analyses of multi-coat paint layers, in particular in the samples taken on the German ship *Columbus New Zealand*, revealed lead concentrations of up to 5%.

The high temperatures that arise when coated steel is flame cut lead to the formation of toxic lead fumes. The paint often even continues to burn after cutting.

Paints are set on fire during flame cutting and continue to burn afterwards

A study commissioned by the Labour Ministry of Singapore has shown that the concentration of lead in the air of shipbreaking workers breathe, closely correlates with the lead concentrations found in the paints of the ships that these workers broke. The study recommends that workers should change shifts frequently and that they should be equipped with gas masks and breathing equipment in order to minimise the risk (10).

Sample		Chromium	Iron	Nickel	Copper	Arsenic	Lead	Zinc
No. 110 (Bombay)	mg/kg dry matter	776	282	347	888	163	806	2112
No. 306 (Alang)	mg/kg dry matter	77	90	108	112	35	<2	74
No. 317 (Velavadar)	mg/kg dry matter	-	-	-	58	2	10	53
Holy soil (Palitana Temple Area)	mg/kg dry matter	-	-	-	34	2	4	80

Table 3: Heavy metals in soil at scrapping site and background levels

Lead is a potent blood, nerve and kidney poison. Both metallic lead and its compounds are toxic. These can enter the human body through ingestion, inhalation and skin absorption.

If there is a steady intake of lead, even very slight amounts impair the blood count and damage the nervous system. Low levels of lead exposure already contribute to cancer of the stomach and duodenum. Lead accumulates in the human body.

Lead poisoning (as the result of chronic exposure) is characterised by tiredness, painful colics, feebleness, pallor of the skin, anaemia and muscular weakness. It can manifest itself in the "lead line", the bluish line on the gums that results from deposition of lead sulphide there.

These diseases are rated in Germany as occupational diseases for which compensation must be paid to the victim.

Lead compounds are by no means the only workplace contaminants that arise from dismantling metal parts. In Bombay, a soil sample (No. 110) was taken directly at the scrapping site, another soil sample in Alang (No 306), one kilometre inland from the scrapping site. In order to be able to assess the concentrations found, a series of samples from the region (Velavadar Black Buck Nature Reserve, No. 317 and Palitana Temple District "Holy soil") were taken to serve as background levels:

Handling substances containing arsenic can cause arsenic poisoning. (An intake of as little as 0.1 g arsenic immediately causes death, according to Agatha Christie.) Arsenic is a vascular poison and neurotoxin, causing polyneurosis with paralysis, and skin and liver cancer.

Arsenic poisoning is rated in Germany as an occupational disease for which compensation must be paid to the victim.

The nickel contamination and a part of the chromium contamination of the soil is due to the composition of the ship steel. The other part of the chromium contamination comes from the paints.

Hexavalent chromium compounds (chromates) can cause eczema, chromate dust disease of the lung and chromate cancer of the lung.

These diseases are rated in Germany as occupational diseases for which compensation must be paid to the victim.

Extremely toxic organic tin compounds such as tributyl tin oxide (TBTO) and tributyl tin chloride (TBTCl) have been used in anti-fouling paints in

Sample / No.	Sampled site	MBT	DBT	TBT	TTBT
		µg Sn/kg dry matter	µg Sn/kg dry matter	µg Sn/kg dry matter	µg Sn/kg dry matter
Soil / 110	Mumbai scrapping yard	145	349	1090	67
Sediment at sea / 310	Alang scrapping yard, eastern fringe	18	33	119	<1
Sediment at sea / 314	Alang, 500 metres from eastern fringe	6	3	5	<1
Sediment at sea / 315	Alang, 4000 metres from eastern fringe	7	3	9	<1
Sediment at sea / 401	Alang scrapping yard, western fringe	22	31	170	2
Sediment at sea / 402	Alang scrapping yard, western fringe	11	25	184	4
Sediment of pond/ 306	Alang freshwater pool, 500 metres inland from scrapping yard	<1	<1	<1	<1

Table 4: TBT at the workplace and in the environment

shipping since the beginning of the 1960s. Anti-fouling paints containing tributyl tin have defined leaching rates which determine the release of TBT and thus the efficiency of the paints. This highly toxic substance thus enters water in a way which is systematic and intended, harming the entire aquatic ecosystem.

The wrecks at the scrapping yards at Alang and Bombay continually discharge tributyl tin into the sea water on account of its "leaching as planned". But there is a second source of hazard for people and the environment resulting from the dissembling of metal parts coated with TBT paints.

The labourers hammer, saw and weld the steel without protective masks, thereby inhaling TBT vapours and dusts. Organotins are additionally absorbed through the skin. The high concentrations of mono-, di-, tri- and tetra-butyl tin compounds in soil sample no. 110 from Bombay is clear evidence of the pollution at the workplace.

The toxicity mechanisms in organotins in people are very complex and not known in detail. Organotins accumulate in the human body and are distributed to varying extents in the blood, liver, kidneys and brain. The absorption of organotins in the nervous system is especially dangerous on account of their marked neuro-toxicity. TBTO has an acutely poisonous and strongly caustic effect; it is genotoxic and influences the endocrine hormone system.

The function of TBT in ship's paints below the waterline is to kill off algae, barnacles and mussels. The literature on the subject extensively describes the way in which TBT in water endangers all other marine animals, killing off oyster larvae, deforming shells, and causing deformations and infertility in different kinds of snails, and harmful changes in fish and crabs.

A publication made in 1997 by the Oslo-Paris Convention, OSPAR, for the protection of the marine environment in the North-east Atlantic, may be referred to here in order to make an

assessment of the pollution from TBT in the sediment from the coast at Alang. This proscribes an interim guideline of 0.005-0.5 µg/kg for TBT content in sediment; only with such a low figure can damage to marine organisms be avoided. ■

4.3 Oil remnants in the sea

Fuel remnants and bilge oil are pumped directly into the sea in Bombay. At Alang, however, left-over oil is often burned. ■

4.4 Everything Burns

Waste oil is often burned on the shore at Alang "in order to prevent the sea from being polluted". Rotten ropes are thrown into these fires of used oil together with pieces of wood, unusable parts of ships and their superstructures, simply everything which cannot be sold but which will burn – with the help of the oil.

These fires burns constantly and their deep black smoke plumes can be seen for many miles inland. Most of the materials made in building ships contain flame retardants intended to make it "difficult for them to catch fire". Burning such flame-resistant substances usually produces "smouldering fires". The more incomplete the incineration is, the more pollutants are produced and contained in gases and residues from the fire.

In burning organic matter not everything is ever completely burned, that is, oxidised to CO_2. A certain residue of incompletely burned matter always remains. These products of incomplete combustion (PIC) include diverse hydrocarbons, the simplest of which is carbon monoxide. But they also include polyvalent hydrocarbons which have several interconnected benzene nuclei - polycyclic aromatic hydrocarbons, or PAH.

PIC come into existence in practically all fires (with the possible exception of controlled combustion with oxygen). Which PIC are produced, and the question of whether and how many PAHs are produced in a fire, depends on

Fig.11: Used oil keeps the waste burning

Fig.12: Smoke and fires everywhere

the conditions pertaining, such as the availability of oxygen, temperature, the material itself which is on fire, and so forth. PAHs enter into soot, gases in fires, and the solid residues from them (ash and cinders).

PAHs are regarded as health hazards. Some of them are indeed carcinogenic or classified as suspected of causing cancer.

If matter containing chlorine, or brominated flame retardants such as PBDE, for example, are also incinerated as well as organic substances, dioxins and furanes (PCDD/PCDF and their brominated equivalents) are produced. It is very likely that both sources of halogens are present on ships (with brominated and chlorinated flame retardants, PVC) and on the shore of a sea (in sea salt). ■

5 Summary

People working at the scrapping yards in Alang and Bombay are therefore exposed daily to free asbestos fibres and vapours and dusts which contain heavy metals, arsenic, TBT, PAHs and possibly also dioxin.

The incidence of cancer to be expected in these working conditions is 25 per cent, says the occupational and industrial physician, Dr Frank Hittmann. (14)

After 16 years of shipbreaking, environmental pollution is generally very apparent both in Bombay and in Alang. Even if activities were stopped at these sites, the high concentration of TBT in the marine sediment and thus the food chain will remain in the next 10-20 years. Heavy metals, asbestos dust and poorly degradable pollutants from the combustion processes are also contaminating people living in neighbouring areas. The subsequent damage includes the dangers to health resulting from the further use of ships' materials containing asbestos, and emissions in secondary steel rolling and smelting arising from the paint still remaining.

Annex 1

Sampling and analysis report

All environmental and material samples in Bombay and Alang/Sosyia were taken between October 4 and 9, 1998, by Nitiyanand Jayaraman, Judit Kanthak and Andreas Bernstorff, working for Greenpeace.

The analyses were commissioned by Greenpeace Germany to be made at the Chemieberatung Wartig GmbH Laboratory for Development and Analysis in 22763 Hamburg, Friesenweg 4, Germany, and at GALAB Analytik - Beratung - Entwicklung, 21502 Geesthacht, Germany.

The results published in Tables 1-4 are documented in the following reports:

Untersuchungsbericht B 989014-1A of 19 Nov 98, Analysis of material samples for asbestos, Labor Wartig

Untersuchungsbericht B 98.762 of 21 Oct 98, Analysis of paints, Labor Wartig

Untersuchungsbericht 98330 of 27 Oct 98, Analysis of sediment and soil samples, Labor GALAB

Untersuchungsbericht 98355 of 19 Nov 98, Analysis of soil samples, Labor GALAB

The reports of these analyses are on file at Greenpeace Germany. ■

Annex 2

What is the legal situation?

Internationally and in Europe

Since 1 January 98, the Basel Convention has banned the export from the EU to non-OECD countries of ships for scrapping that are contaminated with asbestos (Y36), arsenic (Y24), PCBs (Y10), heavy metals (Y22,Y23,Y26,Y31) and TBT paints (Y12, H12).

The Basel ban is a constituent part of the European Community Regulation (EEC) No. 259/93 of 1 February 1993 on the supervision and control of shipments of waste within, into and out of the European Community, as last amended on 6 Nov 98.

Under the German Materials Conservation and Waste Management Act (Kreislaufwirtschafts-gesetz), following the EC Waste Framework Directive, the following materials are defined as "wastes subject to special controls" (besonders ueberwachungsbeduerftige Abfaelle), in other words hazardous wastes, "if their holder wishes to or must dispose of them":

- 060403 Wastes containing arsenic
- 060405 Wastes containing heavy metals
- 080101/2 Old paints and lacquers
- 1301 Spent hydraulic oils
- 1302 Spent machine, gear and lubricating oils
- 1303 Spent insulation and heat transfer oils
- 1304 Bilge oils
- 1306 Oil wastes
- 1401 Wastes from machine maintenance
- 1607 01/2 Wastes from cleaning tanks on ocean-going ships
- 100601 Insulating material that contains free asbestos

These wastes must be declared by their holders, and their disposal must be proven to the German authorities through to the last step, in accordance with the Technical Rules for Hazardous Substances (Technische Regeln fuer Gefahrstoffe) issued by the Federal Minister for Labour and Social Affairs and in accordance with the German Federal Chemicals Act (Chemikaliengesetz). Furthermore, when ships are broken in Germany, the provisions of the German Federal Emission Control Act (Bundes-Imissionsschutz-Gesetz) and of the German Federal Environmental Impact Assessment Act (Gesetz ueber die Umwelt-vertraeglichkeitspruefung) must be observed.

The German Federal Chemicals Act (Chemikaliengesetz) prohibits the use of asbestos, of arsenic compounds, of lead carbonates and lead sulphates, of PCBs and of organotin compounds such as TBT, with the exception of TBT in antifouling paint for ships with a total length of more than 25 m (80 feet).

Concerning TBT: The toxicity of TBT (tributyl tin) justifies a general ban on all its uses. The exemption that is currently still applied is based on the circumstance that no alternative solution is yet available for ocean-going ships. Smaller vessels can be lacquered with silicon-based paints that can be easily cleaned by mechanical methods. These lacquers, however, have a poor abrasion resistance and are likely to be damaged by the high mechanical stresses that arise when large ships dock. New alternative paints for ocean-going vessels are currently being tested.

The international shipping industry is well aware of the global pollution of the oceans caused by the use of the hormone disrupter TBT. In November 1998 the International Maritime Organisation (IMO) declared itself ready to see "a ban on application of organotins used as biocides in anti-fouling paints by 2003 and a ban on its presence on vessels by 2008".

In India

Under Indian law imports of toxic waste from OECD countries and shipbreaking work in tidal ocean zones are prohibited.

1. The Indian Supreme Court decided on 5 May 1997:
"No import should be made or permitted by any authority or any person of any hazardous waste which is already banned under the Basel Convention or to be banned hereafter with effect from the date specified therein."

Besides this, several other Supreme Court judgements reaffirm that the Government of India is obliged to incorporate promptly international conventions to which it is a party.

2. The Indian Environment Ministry decreed the following ordinance on 19 February 1991:

Reference: Coastal Regulation Zone Notification of 19 February, 1991.
Ministry of Environment & Forests, (Department of Environment, Forests & Wildlife)

"For regulating development activities, the coastal stretches within 500 meters of the high tide line of the landward side are classified into 4 categories, namely:
Category I (CRZ I):
(i) Areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests, wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty / historical/ heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rising sea level consequent upon global warming and such other areas as may be declared by the Central Government or the concerned authorities at the State/Union Territory level from time to time.
(ii) Area between Low Tide Line and High Tide Line. . ."

Paragraph 2 of the Notification lists out the Prohibited Activities and exceptions. The following activities are declared as prohibited within the Coastal Regulation Zone, namely:
Para 2 (ii): manufacture or handling or storage or disposal of hazardous substances as specificied in the Notifications of the Government of India in the Ministry of Environment and Forests No. S.O. 594 (E) dated 28 July 1989, S.O 996 (E) dated 27th November 1989 and G.S.R.1037 (E) dated 5th December 1989.
Para 2 (v): discharge of untreated wastes and effluents from industries, cities or towns and other human settlements. . .

3. The Central Pollution Control Board's states in its "Environmental Guidelines for Shipbreaking Industries" that:

"Old vessels containing or contaminated with any of the above substances [PCBs, waste asbestos dust and fibre, lead and lead compounds] are accordingly classified as hazardous materials. The customs authority and/or the concerned State Maritime Board should ensure this and issue a certificate to this effect that the vessel is free from the prohibited materials." ■

Annex 3

Breaking up a ship – the procedure

The procedure is roughly as follows: During periods of three to four days with very high tides or around the spring tide, the ships run at full steam or are towed towards the beach. The new owner of the ship, the shipbreaker, sticks a flag in the beach towards which the helmsman of the ship aims. The breaker and the captain are in radio contact. Depending upon the draught of the ship, it remains stuck in the sediment several hundred metres from the beach, or can come closer.

During the next three days, two things happen:

1. The ship is stripped. Everything that is not fixed or can be easily removed is extracted by a general buyer.

2. An agent of the new owner tours the ship and draws up the scrapping plan. This determines, according to structural aspects, the order in which the individual parts of the ship are to be demolished. The ship must not break apart, nor must it tilt, and it must certainly not topple over. This is no easy task, as during the first phase in which the ship is still on the sediment flats the high tide can move it, particularly during storms. The ships are therefore in principle dismantled symmetrically, with load-bearing parts tackled last.

As long as the ship is still on the sediment flats, i.e. relatively far away from the beach, a number of large but transportable parts are separated from the hull with cutting torches and are drawn on land using winches.

The first step before work commences within the ship is to create roughly six-by-ten foot openings and windows in the hull. This is because, after stripping, the ships are completely dark inside, and the openings further serve as vents and escape routes when fires break out. Often these openings are not cut out fully at their base, but are pressed outward to form a horizontal slab. One can often see labourers sitting on these lids, taking in a breath of fresh air and resting.

Within four weeks, the ship loses one third to one half of its volume. At every high tide, it is drawn further towards the beach. Most ships have been demolished and disappear from the site within eight weeks. We describe the further fate of the materials below.

In Alang in Gujarat state we observed that the individual sections of the beach (plots) are completely cleared and tidied before arrival of a new ship.

All samples taken from the beach in Alang thus come from the ship that was being processed at that time. In Mumbai, the whole situation made a less orderly appearance and it was not so easy to assign material to a specific ship.

Living and working conditions in Alang-Sosiya and Mumbai Port

In Alang we gained direct access to a plot on the beach, the mud flat and a wreck there.

We further visited the southern end of the Sosiya yard, meeting fishermen there who were hunting crustaceans and fish, and we took a number of environmental samples.

We finally visited Plot 154D, where we witnessed the beaching process but did not take any samples.

In both Alang and Bombay we saw dozens of men working under extremely confined conditions, torch-cutting, sawing, hammering and carrying heavy slabs and iron and steel parts to the exit of the fenced-in plot towards the road, where trucks pick the material up to transport it to the nearest rerolling mill and diverse other locations for further processing. The confined conditions are in themselves a serious source of accident hazards. Unlike in Bombay, we saw that in Alang some men now at least wear plastic helmets and rubber boots. Most of them, however, only have a cloth wrapped around their head, and many work in vests or short-sleeved shirts. Shins and arms are mostly uncovered. Most wear light shoes, some even sandals.

Only some cutters have gloves and goggles, but even these usually do not use their goggles to protect their eyes during torch-cutting. All workers constantly inhale the fumes of burning

paint and waste piles. Blue asbestos is separated from the steel plates by hand.

The labourers' workplace is the holds and decks of the ships, the mud flats and the six-mile beach. Work is around the clock in various shifts. The labourers make an extremely disciplined impression. The teams of carriers, towers and hammerers harmonize their work through rhythmic sequences of loud calls.

A three to ten foot high wall separates the working zone from a gravel road broad enough to let two trucks pass. Along this road, to the landward side, there is a narrow but compact row of single-storey provisional accommodation. Here some 40,000 young men live in very cramped conditions.

Food is prepared directly on the roadside. Here and there vegetable shops are open to the road.

The workplace health and safety literature is based on contaminant exposure at work during one (8-hour) shift. In both Alang and Mumbai this precept fails to apply. The labourers work, eat, sleep and spend their leisure time all in the immediate vicinity of the workplaces and emission sources. There are no means of transport, the labourers do not leave the yard, and their regeneration in an uncontaminated atmosphere is impossible.

The reported number of deaths due to accidents at work ranges between 40 and 400 per year. The saying goes in Alang: "Every day one ship, every day one dead". The most frequent causes of death are explosions and fires in the ships, usually due to cutting into piping that still contained fuel remnants. Many are fatally hit by falling steel parts.

The most frequent injuries are, accordingly, burns and fractures. Two clinics in Bhavnagar, the capital of the province, have set up special departments for these two types of injuries suffered by Alang labourers. The special departments are directly financed by the shipbreakers.

Given the presumably very high levels of workplace exposure to asbestos dusts, heavy metal fumes, polycyclic aromatics, dioxins, etc., an array of diseases must be expected, and some are fatal. This may partly explain the obviously very low average age of the labourers.

Observations at the Mumbai Port Scrapping Area

We gained access to Plot 5 and then walked over Plot 6 to Plot 7. On this tour, we were able to see five ships or their remnants at close quarters. Of these, the names of two were still legible: the general cargo ship *Kapitan Kissa* and the Norwegian cattle carrier *Murray Express*. The other three were a refrigerated cargo ship, a semi-container and an all-container ship.

The actual beach has disappeared under a three foot high layer of waste. The top is composed of a soft, cloddy, brownish substance. On top of this lie steel slabs cut out of the ships, on which labourers move around, torch-cutting pieces out of them and carrying the pieces to the road where they are thrown onto trucks.

Dozens of labourers work together with their cutting torches, usually sitting down and in very confined conditions. The burning paints emit a pungent odour. The whole site is bathed in fumes.

From two ships, black oil is pumped into the sea. (In Alang it is burned.)

Fragments of insulating material broken out of the ships lie around everywhere. Most of this material contains asbestos.

Most of the labourers come from Bihar state. In contrast to Alang, Mumbai also employs women labourers.

The women carry partially asbestos-containing insulating material in bowls on their heads and throw it into the sea. ■

Annex 4

Material flows from the ships

Direct re-use

Many parts, such as the ship's engine, auxiliary diesel motors, pumps, winches, cranes, radar and electronic equipment, are directly re-used. A shipbuilding yard which purchases some of these parts was recently opened about 20 miles from Alang.

Tools, auxiliaries, lamps, TVs, fax machines, radios, tables, beds, fluorescent tubes, kitchen fittings, benches, ropes, safes, cables, ornamental plastic sheeting – all of this is marketed by resellers plying their trade on the access road to Alang. Coastal fishers work from ships' lifeboats, a scarecrow wears an orange-red survival suit. Huts are built out of ornamental plastic sheeting taken from the ships. Drums containing lubricants are sold directly on site.

These activities lead to the practically complete re-use of materials.

While looking for a ship's bell as souvenir, we learnt that a brass ship's bell is never melted down or sold. The shipbreaker keeps it at home and donates it upon certain occasions to a church or a Hindu temple. And indeed, in the temple just outside of Alang we found a Russian ship's bell with the word "pozde" engraved on it.

Recycling/reprocessing

All iron and steel parts are sorted by quality and then consigned to the steel industry for reprocessing. The 400 to 500 ocean-going ships scrapped annually in India deliver more than 9 million tons of steel, thus supplying about 15% of the annual requirement of the Indian steel industry.

All non-ferrous metals, such as the ship's propeller and bearings (bronze), light structures (aluminium) and copper piping, are carefully separated and marketed.

Fuel remnants are pumped out and consigned to a refinery.

We saw one man stripping blue asbestos from a ship and filling it in bags with his bare hands, with no kind of protective clothing whatsoever. We later found such bags in a shop (Plot 286, the shops are also counted by plots), where the shop-owner told us that someone regularly buys them up for re-use "in a factory". We collected loose flakes of the material from the shop counter and floor.

Handling of unrecyclable residues

Bilge oil is pumped directly into the sea in Bombay; in Alang we did not observe this.

On Alang beach, waste oil is burned in open fires "in order to prevent pollution of the sea". Unserviceable and oil-soaked cordage, wood parts, unmarketable residues of ship fittings and structures – in short, everything that cannot be sold but burns – is thrown into the waste oil fires. These fires burn constantly and their jet-black plumes are visible for many kilometres into the country.

Storage and handling in the shops in turn leads to discards and waste. These unmarketable residues are distributed systematically in the landscape. The farming tracks around the shipbreaking yard are lined with waste piles, sometimes veritable embankments, consisting of broken insulation material, ornamental sheeting and similar materials.

In Bombay, insulating material which has been removed manually and frequently contains asbestos is collected by women who carry it in large bowls on their heads directly into the sea.

Rejects

One type of waste is discarded directly in the mud flats: We saw a pile of about 50 toilet bowls in the mud that had evidently been thrown down from ships. There is no market for discarded toilet bowls in India.

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