ANNEX XV

PRODUCTS AND WASTE DERIVED FROM DISMANTLING

Annex XV

The different products and wastes and their treatment

I. Recovered products

I.1. Finished products:

Insofar as a ship to be dismantled contains equipment which can be resold for direct reuse in the dismantling country or sold abroad, dismantling facilities dismount complete equipment items either before or simultaneously with the dismantling operation. In developed countries, it is mostly handling equipment, deck equipment or energy producing or propulsion units which are removed for subsequent sale.

Aside from special cases, in particular very recent ships or facilities which group together equipment to be sent to Asia (Denmark), such redirect uses in developed countries are marginal in size and value owing to the strong competition from new products available on the market and costs of renovating old equipment. Under these conditions, most old equipment is destroyed, their pollutants being isolated and treated and their secondary raw materials being recycled for use in new manufacturing operations, as is the remainder of the ship.

On the other hand in developing countries, not only this equipment but also numerous other items of operating equipment (galley, navigational, ancillary equipment) or fixtures and fittings of the dismantled ship find direct local outlets (computers, furniture, utensils…). They are resold locally by specialised service providers gravitating in the immediate vicinity of the dismantling site, who recondition these items if necessary and sell them on local or regional markets (Asia).

This entire system making reuse of finished products enables a very numerous population living around the dismantling site to earn a living, and is an essential source of work and profit for the local economies of these countries. On first analysis this practice is globally economical of raw materials and energy resources on a world scale. However, it is a practice which delays the proper recycling time of this old equipment and disperses pollutants in the soil that are generated by equipment that is no longer up to standard (heavy metals, PCBs, WEEE…) which a developing society does not have the capacity to isolate and treat after this dispersal.

It is to be noted that in the Indian subcontinent there is a flourishing, profitable market for maritime instruments (sextants, compasses ...) recovered from dismantled ships and sold back to developed countries, which therefore witness a return of this equipment onto their territory.

I.2. Metal secondary raw materials:

The essential part of recovered raw materials, both in quantity and in value, relates to the metal products extracted from the dismantled ship. In weight and value it is generally ferrous metals which predominate. However the difference in weight value between the different metals recovered (approximately $200/tonne for ferrous scrap compared with $6000/tonne for copper metals) means that the recycling of non-ferrous metals (copper or aluminium alloys) or the recycling of special steels (stainless steel) must not be neglected, even though their comparative weights found on board the dismantled ship are comparatively low.

It is to be noted firstly that as a general rule the manufacture of steel from scrap is a more ecological process (immediate recycling and reduced energy needs) and especially more economical than the manufacture of steel from iron ore using blast furnaces. This reality has not escaped the notice of developing countries, in particular those who have very few ore deposits or energy resources (Indian subcontinent) or financial resources (Bangladesh). However, since these countries only have a recent industrial history they cannot rely on a major, stable source of land scrap. This has led Bangladesh to rely on maritime scrap for 70% of its supplies, and to push up prices of ships to be recycled at a time when there is a shortage of such ships.

In the recycling process of ferrous metals, two competing strategies are to be pointed out, each based on the level of development of the country in which dismantling is carried out:

In developed or strong growth countries (Europe, USA, Turkey, China) all the recycled scrap derived from a ship is directed towards and integrated in the flow of land scrap that is chiefly destined for electric furnaces, and marginally for blast furnaces, to manufacture raw products.
These raw products are then reintroduced into production chains for finished products. High industrial concentration, lobbying for environment issues, pressure of regulations and the search for ever more competitive costs on a world scale have led these industrialists to carrying out frequent modernisation programmes of their facilities which are able to better treat pollutants remaining on this scrap when it arrives at the steelworks.

The scrap generated by the dismantling of ships is marginal compared with the mass of land scrap (in Europe less than 1%) which means that steel producers are little inclined to give any communications on the subject of ship scrap or to launch any specific impact or hazard studies on this kind of scrap. Also, margins in terms of pollutant emission limits for by European steel producing industries (air, water, solid wastes) with respect to regulations are such that steel industrialists are confident that they will be able to absorb even a substantial increase in the share of ship scrap.
Their only concern seems to lie in the guaranteed prior removal of some particular substances, considered to be toxic, from the industrial process of steel production in electric furnaces: asbestos, radioactive products, cuprous products. On this point, scrap from dismantled ships does not bring any additional risk.
Owing to the general good quality of steel used for ship building, and the often greater thickness of ship scrap compared with land scrap, recyclers consider that ship scrap is of higher value and is negotiated accordingly. This attitude could change however if excessive controls are specifically applied to ship scrap, all the more so since the modest share of ship scrap in the face of land scrap supplies does not make it a source that is essential to recyclers.

In the Indian subcontinent, the above process exists but comes up against strong competition from shorter recycling processes under which finished products of lesser quality can be rapidly reintroduced into the chain of local use. For example long plates of steel or strips of metal sheet cut from the hull are sent directly to the forge and then onto other workshops (drawing) to produce concrete reinforcement rods and cages, or are re-rolled to produce metal plates for assembly.

These products of lesser quality are manufactured immediately in close vicinity to the dismantling site and are reused locally or regionally since the building industry is a large consumer of these concrete reinforcements. Compared with the price of crude scrap, they generate an immediate added value of 200 to 300%, independently of the steelworks, and on a local market eager for low-quality products adapted to technological needs that are often fairly basic.

It is this double recycling circuit and the very extensive reuse of complete products in the Indian subcontinent which accounts for the current difference between the purchase price of ships dismantled in Turkey ($200 to $250 per lightweight tonne) and the Indian subcontinent (over $400 per lightweight tonne in Bangladesh).

While in the countries of the Indian subcontinent the scrap sent to electric steelworks is subjected to high temperatures which destroy a substantial part of persisting pollutants despite filtering facilities that are often basic, this is not the case in rural forges or rolling mills which subject their workers and the environment to pollutions which at times are aggravated by the low-temperature processes used (from 600 to 900°C: conversion of PCBs into furanes and dioxins, and incomplete combustion of paints) compared with electric furnace temperatures.

II. Wastes

II.1. Wastes from cargos, operationally generated wastes, onboard wastes:

These wastes which are often found on board a ship at the time of dismantling, particularly if the ship has arrived at the dismantling site under its own propelling means, are identical to those wastes that are disembarked at ports of call during its operating life. If the ship is dismantled in a developed country, these substances are not reused but removed from the ship for recycling (safety management) at the start of the dismantling operation like the accessible hazardous substances. They do not require any specific facilities compared with land waste and mainly consist of recyclable substances and marginally of the following substances:

- Gas or liquid energy and propulsion fuels (reuse or recycling);
- Hydraulic and lubricant oils and greases (reuse or recycling);
- Chlorinated and fluorochlorinated refrigerants (recyclable);
- Fire fighting gases (recyclable);
- Various additives (anti-freeze, anti-scale…) (recyclable);
- Cargo sludges and liquid wastes (recyclable);
- Packaged solvents and paints (reuse or recycling);
- Packaged cleaning or hygiene products (reuse or recycling);
- Medical and pharmaceutical products (recyclable or controlled disposal);
- Galley provisions (disposal);
- Grey/black ballast waters (recycling).

Whereas the wide distribution of recycling facilities does not give rise to any problem for the disembarking of these substances in a port or within the territory of a developed country, this is not the case outside the major ports of developing countries. Yet the essential part of ship dismantling in these countries is conducted away from a merchant port. In this case the workers on the site, like the surrounding populations, are confronted with substances whose dangers, harmfulness and effects are not always known. These substances are disembarked and those known or thought to be useful are reused, but the remainder is frequently dispersed into the environment with no recycling and with no knowledge of the risks.

II.2. Wastes produced during dismantling:

In developed countries, the accessible part of the most harmful pollutants can be isolated and removed from the ship at the start of the dismantling process. The remainder is removed as and when the structure becomes accessible as the dismantling work progresses. By means of this initial and continuous removal, or through sorting that is adapted to the recovery process for secondary raw materials, these pollutants are not dispersed in or diluted with the recycled raw materials. Such pollutants mainly consist of:

- Powder asbestos used for insulation (controlled disposal or vitrified) (see Appendix I and II);
- Asbestos trapped in coatings (controlled disposal) (see Appendix I and II);
- Detectors and measuring instruments containing radioactive components or heavy metals (controlled disposal);
- Electric and electronic equipment (disposal under WEEE regulations);

- Electric cables and wires (recycled or controlled disposal [PCBs]);
- Neon tubes (PCBs and heavy metals);
- Batteries, accumulators (recycled).

In developing countries, and as for the substances derived from the operating wastes and onboard wastes, only those substances which can be directly reused or recovered are removed from the ship at the start of dismantling or during the dismantling operation. The remainder is abandoned or dispersed in the environment throughout the duration of dismantling.

Also, as seen above, some hazardous substances are not removed prior to the recycling process, it being considered that recycling will simultaneously dispose thereof:

- TBT paints;
- Paints containing heavy metals;
- Paints containing PCBs;
- Plastic materials and woodwork (incineration or co-incineration (and) controlled disposal of residues).

Owing to existing filtering equipment that is permanently being improved upon, to the marginal quantities of ship scrap in the total quantity of recycled scrap, and to the respective thickness of pollutant and metal involved in ship scrap, European steel producers have no difficulty in remaining within regulatory limits for the discharge of these pollutants in industrial steel production processes using electric furnaces.

Unfortunately, as we have seen above, the recycling processes of secondary raw materials in developing countries are unable to guarantee the same level of disposal of these hazardous substances. In these countries, for lack of specifications regarding filtering installations, there still remains a high risk of dispersal and even a heightened risk of dispersal regarding PCBs if these pollutants are not removed from their metal supports before entering an electric furnace. If such products are re-rolled the situation is evidently further aggravated.

Appendix I

Methods and costs of asbestos removal

I. Overview of methods

Whenever asbestos is present, preventive measures must be taken to carry out any demolition or removal work. Three main techniques are used:

- the method using a hermetically enclosed space;
- the method using glove bags;
- simple treatment techniques.

The choice of method to be applied will depend on the characteristics of the work site and the condition of the asbestos. If the asbestos is friable i.e. likely to release fibres under the effect of any impacts, vibrations or air movements, then protective measures are to be increased.

Global confined space

Removal work is conducted in a sealed, confined space maintained under negative pressure with respect to ambient. The isolation of the work area is intended to create a physical separation between the site where work is being conducted and neighbouring areas so as to delimit the space in which collective and individual protective measures (respiratory protection equipment, etc…) are to be applied. The air evacuated from the confined space is filtered using high efficiency particulate air filters (HEPAs), called absolute filters. The extraction rate is calculated so as to obtain at least 3 to 4 air renewals per hour within the confined space. The removal of asbestos is always made after first impregnating the friable material to limit the dispersing of dust. Stripping techniques are various: high pressure water jetting, scraping, cutting, etc…

Local confined space

For localized stripping, the glove bag method can be used. This is a type of plastic covering which is fragile and the risk of dispersing asbestos fibres into the atmosphere when removing the bag is high. This is why the working area must be draught-proofed and confined. The concentration of asbestiform fibres in the air must not exceed 0.010 fibre/cm^3, the value being measured before the start of work in the partitioned-off area.

Marked out area

Non-friable asbestos can be removed within a marked out area provided the asbestos is left intact and provided certain precautions are taken to prevent the release of asbestos fibres into the air during the stripping work. These means may include wetting, trowelling, the use of an extractor in recycling mode or the use of a high efficiency particulate air filter.
Different patents implementing these methods are detailed under § 4.

II. Cost analysis

Costs are given inclusive of all taxes and were readjusted for the second quarter of 2006 using INSEE building index costs.

I.1. Asbestos removal operations in public buildings:

I.1.1. General estimate

Analysis of the report having the title "asbestos: questioning regulations" issued by the Paris Chamber of Commerce and Industry in June 1997 gives the following cost items:

DIFFERENT ITEMS MUST BE TAKEN INTO ACCOUNT FOR ASBESTOS ABATEMENT CONTRACTS: DIAGNOSIS AND ANALYSES, TREATMENT OF ASBESTOS ON SITE (REMOVAL OR CONFINEMENT), ASSISTANCE TO PROJECT MANAGEMENT AND, SUBSEQUENTLY, REHABILITATION OF PREMISES, WASTE MANAGEMENT, INSPECTIONS.

Diagnosis: for buildings, the identification of the presence of asbestos costs an average of €0.2 to 0.7 /m² for each surveyed unit, i.e. 2.5% of the overall asbestos abatement cost. Assessment, recommendations, and investigated scenarios work out €3.5/m². Analysis of an asbestos sample costs from €95 to €165 using polarised light optical microscopy and approximately €420 for transmission electronic microscopy. The cost for analysis of an air sample using transmission electronic microscopy ranges from €1170 to €1760.

Treatment of asbestos on site: The cost of removing asbestos / lagging is estimated to be an average of **€190** to **€350/m²**.

Rehabilitation: this accounts for around 50% of the global cost for asbestos removal.

Work assistance: this is the assistance given to project management to prepare an asbestos abatement work site (drawing up specifications, etc.) for which the cost may reach 8 to 12 % of the total asbestos removal costs.

I.1.2. Jussieu Faculty case analysis

The information available on the web site http://www.epa.jussieu.fr is the following:

Asbestos was used for the fire proofing of internal metal structures, both horizontal and vertical, in all the buildings in the part known as "Le Gril", in the central tower as well as on the undersurface of the concrete foundation slab of the Faculty. It was also used, in contained form, in flooring, glues, step nosing, etc. Over the years, in particular subsequent to technical servicing on the buildings, the asbestos fire-proofing released a high number of fibres into the surrounding air. False ceilings and technical enclosures therefore came to be strongly contaminated by dust from asbestos fibres. Also, the presence of contained asbestos, even if it presents no direct risk, requires very complex servicing procedures which make the operating and maintenance of the buildings particularly difficult. After surveying the entire campus and identifying the location of the asbestos, the decision to take emergency protective measures and to proceed with removal of the asbestos in all its forms (fire-proofing, false ceilings, flooring, etc.) was taken in 1996 to ensure the highest degree of safety for users.

The total asbestos-containing surface area is 190 000 m² (net floor area) distributed over the circular buildings and superstructure levels of the thirty-eight buildings called "le Gril" (155 000 m²), part of the foundation slab (24 000 m²) and the central Jussieu tower (11 000 m²).

Total costs of the operation inclusive of all taxes, per m²:

Asbestos dust extraction	€ 77
Furniture removals	€ 35
Asbestos abatement	**€ 535**
Renovation	€ 1515

These costs are calculated solely on actual work costs (i.e. excluding project management, architect costs, etc.). To obtain costs which include consultancy and management costs, on average the following must be added:

Dust extraction	+ 20 %

Furniture removals	+ 20 %
Asbestos abatement	**+ 5 to 6 %**
Renovation	+ 15 %

I.1.3. Case analysis of Tower F, Cité de l'air in Paris, Balard site.

The asbestos abatement operations and rehabilitation of tower F are currently in progress for a total amount in the region of **€18 million.** The cost of work related to asbestos removal is approximately **€ 600 /m^2**, not including diagnostic survey costs.
The work being conducted comprises *inter alia*:

- preparing out the area outside the worksite (worker off-duty area, fencing, security guarding, pedestrian and vehicle access, isolation from Tower G, etc.);
- installing the necessary electric equipment for the worksite including an electricity generator unit;
- conducting necessary stripping work before confinement (removing mobile partitions, doors, etc.);
- confining the building on the outside using scaffolding to carry a tarpaulin and confinement;
- confining the areas to be treated on the inside of the building;
- setting up technical installations specific to dismantling operations (airlock entry for personnel and equipment, clean air production, unit for treating polluted water, vacuum equipment, centralised technical management, etc.) ;
- confined dismounting of equipment giving access to fire-proofing asbestos (false ceilings, heating coils, etc.);
- confined dismounting of the facade curtain wall;
- removing asbestos and polluted material (wood-wool cement bonded boards), thoroughly cleaning and sanitizing confined spaces;
- conducting necessary measurements and inspections to control the proper conducting of the work and its restitution;
- sorting, packaging, evacuating asbestos-containing waste and non-asbestos-containing waste per category;
- conducting demolition work of finishings.

I.2 <u>Asbestos removal operations on naval ships</u>:

At the time of maintenance work on naval ships, asbestos removal operations are carried out on a certain number of compartments (a few dozen). The data contained in contracts permit the following estimation of cost items:

- Confined asbestos removal work: compartments having class 2 classification destined to be upgraded to category 1 spaces after abatement, with removal of wastes within 48h, gives a cost in the order of €140 /m^2 per unit compartment;
- Non-confined asbestos removal work: compartments having class 2 classification destined to be upgraded to category 1 spaces after abatement, with removal of wastes within 48h, gives a cost in the order of €80 /m^2.

- For more large-scale operations (around 1000 compartments) the estimated unit cost of asbestos removal is €110 €/m^2 for easily accessible parts and in the order of €230/m^2 for other parts.

II. Summary

The cost elements grouped together under paragraph 2 allow a price range to be determined for unit cost asbestos removal that lies between **€80 /m^2** and **€600 /m^2**.

This finding translates the fact that the operating costs of an asbestos abatement operation vary according to the type of method used, this choice being dependent on the type of worksite (size, etc.) the risk of release of asbestos fibres (quantity, friable or non-friable asbestos, etc.).

Other industrial sources evaluate the cost of asbestos removal in confined spaces to be in the region of **€150 /m^2** but this cost may be multiplied by **factor 100** according to each particular case. At the current time, some invoices indicate costs amounting to a total of around 1 million euros for 40 tonnes of removed asbestos.

The cost for single-point confined removals is less high, being in the order of approximately **€70 /m^2**.

III. Patents

The description given below of some patents gives an overview of the chief asbestos removal methods, classified in families of claims as per their title and/or abstract.
List of families: Asbestos safe removal;
Asbestos safe disposal;
Asbestos dismantling.

III.1. Asbestos safe removal:

Method for the impregnation of asbestos in view of the removal, transport and disposal thereof
Inventor: LOCASPI ANGELO (IT) **Applicant:** INNOVENTIONS S R L (IT); LOCASPI ANGELO (IT)
EC: B09B3/00H; B08B7/00J; (+1) **IPC:** ***B08B7/00; B09B3/00***; **B08B7/00** (+4)
Publication info: WO2005110632 - 2005-11-24
Describes a method for passivating asbestos-containing materials so that they can be removed without dispersion of toxic dust. The principle is to impregnate asbestos-containing surfaces with a specific liquid which rapidly penetrates into the fibres. On drying, the asbestos blocks are no longer friable. They can then be transported without dispersing any fibres into the environment.

Decontamination system for removal of hazardous substances
Inventor: TODOROVIC MILE (US) **Applicant:** ARCO RESTORATION INC (US)
EC: B01D46/54; B08B15/02G **IPC:** ***B01D46/54; B08B15/02***; **B01D46/54** (+2)
Publication info: US5322533 - 1994-06-21
Describes a decontamination unit to seal off an area under negative pressure for the removal of asbestos-containing materials. The purpose is to prevent the dispersion of hazardous substances (asbestos, lead, toxic chemicals) into the atmosphere outside the contaminated area. The system is very versatile and can be used in practically all environments such as occupied buildings or narrow passageways.

Flexible blanket system for treating asbestos containing materials
Inventor: RATZESBERGER JOHN W (US) **Applicant:** RATZESBERGER JOHN W (US)
EC: B01D47/06; B09B3/00H **IPC:** ***B01D47/06; B09B3/00***; **B01D47/06** (+2)

Publication info: US5284517 - 1994-02-08
Describes a film wrap to provide a continuous misting of fluid for the removal of asbestos, in particular from buildings. The principle is to saturate the asbestos fibres using a solvent and to confine the whole within a film wrap. Therefore, when the asbestos is removed by cutting or scraping the probability that asbestos fibres may escape into the air is considerably reduced.

Mobile air filter and air filter cleaning process - for building demolition with safe removal of asbestos residues
Inventor: VALKAMA PAAVO (FI) **Applicant:** VALKAMA PAAVO (FI)
EC: A47L9/19 **IPC:** ***A47L9/19***; **A47L9/10**; (IPC1-7): A47L9/19 (+3)
Publication info: DE4140547 - 1992-06-11
An air filter that can be used for demolition operations.

Asbestos removal system.
Inventor: HUTCHINS RALPH J; BREWER JOSEPH A **Applicant:** TEKTRONIX INC (US)
EC: B08B15/02G; B23D59/00C; (+2) **IPC:** ***B08B15/02; B23D59/00; B28D1/04*** (+7)
Publication info: EP0347075 - 1989-12-20
Method for dismantling asbestos-containing panels using a surfactant to fix dust. The method claims to reach a level of 0.0024-0.0047 fibres/cm3. The panel is humidified with a product to minimise the formation of dust during sawing operations. A vacuum system collects the debris caused by these sawing operations.

Apparatus and method for the safe and effective large scale removal and disposal of hazardous materials from building components
Inventor: HOLMES RICHARD W (US); ESCOBAR JAIME A (US)
Applicant: ENVIROSAFE CORP (US)
EC: B08B15/02G **IPC:** ***B08B15/02***; **B08B15/00**; (IPC1-7): B08B7/00
Publication info: CA1327517 - 1994-03-08
A sealed device for collecting friable asbestos-containing materials from building components. The component to be treated is placed in a non-rigid body member or enclosure impervious to the hazardous materials. This enclosure is provided with chutes having closed ends in which the hazardous substances are stored.

System for removing asbestos from structures
Inventor: TETER BRUCE W (US) **Applicant:** TETER BRUCE W (US)
EC: B08B15/02G; B09B3/00H **IPC:** ***B08B15/02; B09B3/00***; **B08B15/00** (+2)
Publication info: US4774974 - 1988-10-04
Inventor: TETER BRUCE W **Applicant:** TETER BRUCE W
EC: IPC: ***A47L5/00; A47L7/00; A47L9/00*** (+6)
Publication info: CA1251005 - 1989-03-14
A system for collecting asbestos or other hazardous substances (dioxin, PCBs, …) in an outside separator chamber under negative pressure. A van body is placed in a confined area connected by tubing to a collection tank. The drawing of air from the confined area towards the collection tank allows the asbestos to be collected in this tank (filter).

III.2. Asbestos safe disposal:

Laundering facility and method
Inventor: REINERT SR GARY L (US) **Applicant:** REINERT SR GARY L (US)
EC: D06F95/00 **IPC:** ***D06F95/00***; **D06F95/00**; (IPC1-7): D06F35/00
Publication info: US5329659 - 1994-07-19
A method for laundering the contaminated clothing of operators engaged in asbestos abatement operations.

Method and device for safe and pollution-free disposal of asbestos-containing material.
Inventor: DIETER JOHANNES (DE) **Applicant:** DIETER JOHANNES (DE)
EC: A62D3/00; B09B3/00H **IPC:** ***A62D3/00; B09B3/00***; **A62D3/00** (+3)
Publication info: EP0484866 - 1992-05-13
Method to remove asbestos by water jetting, the water subsequently being treated to extract and neutralise the asbestos. (This is one of the rare methods which remove asbestos without any dismounting). The material containing the asbestos is sprayed with solvent, then the asbestos is removed by a water jet. The mixture of water and moist asbestos is transferred to a furnace where it is heated to a temperature at which the asbestos fibres (chiefly consisting of crocidolite and chrysotile) is converted into a physiologically acceptable, crystalline form, predominantly forsterite.

Vacuum cleaners

Inventor: DOYLE JR DEWEY I **Applicant:** DOYLE VACUUM CLEANER CO
EC: A47L7/00; A47L9/10; (+1) **IPC:** ***A47L7/00; A47L9/10; B01D46/02*** (+4)
Publication info: US4072483 - 1978-02-07
Description of a vacuum cleaner which picks up asbestos fibres. Its filtering system comprises a plurality of filters. The first filter is provided with a bag in which the picked up asbestos fibres can be collected.

III.3. <u>Asbestos safe dismantling</u>:

Dioxins removing method, incinerator dismantling method, and asbestos removing method
Inventor: ASAKURA RIKIYA **Applicant:** ASAKURA KOGYO KK
EC: IPC: ***B08B5/04; B08B3/02; B08B7/00*** (+24)
Publication info: JP2004305904 - 2004-11-04
Method for dismantling an incinerator using a wetting process and sublimal treatment. Claims to treat asbestos and dioxins.

Reuse of heat storage bricks e.g. from storage heaters
Inventor: GUTBIER RICHARD (DE) **Applicant:** GUTBIER RICHARD (DE)
EC: B09B3/00H; C04B18/16 **IPC:** ***B09B3/00; C04B18/16***; **B09B3/00** (+5)
Publication info: DE19501257 - 1996-07-25
Method for washing asbestos adhering to heat storage bricks of a dismantled furnace (applies to storage heaters). After washing, the bricks are dried and crushed. They can be used as building material (dry mortar).

Method of dismantling of equipment contg. asbestos – involves draining off liquid surrounding appts. and dismantling appts. In same location into its individual components which are further treated with binder for residual fibre and stored by type
Inventor: SCHNOOR OLAF (DE); HACKERT RALF (DE); (+1)
Applicant: GENA GMBH (DE)
EC: B09B3/00H; B09B5/00 **IPC:** ***B09B3/00; B09B5/00***; **B09B3/00** (+4)
Publication info: DE4233169 - 1994-04-07
Method for dismantling equipment containing asbestos using a water process. The equipment is placed in a hermetically sealed dismantling basin. The basin is flooded with water and the water is filtered. After emptying the basin, the equipment is dismantled and the various remaining components are cleaned with a solution containing a binder material in order to immobilise any residual fibres.

Decontaminating installations contg. asbestos and material which is not hazardous - also involves conversion of asbestos into unharmful and reusable material, with sluice installed in dismantling room
Inventor: CLEMENS KARL HEINZ (DE) **Applicant:** INVECON GMBH IND UND ANLAGENTE (DE)

EC: A62D3/00; A62D3/00K14; (+4) **IPC:** ***A62D3/00; B08B15/00; B09B3/00*** (+10)
Publication info: DE4205261 - 1993-08-26
Aqueous method for dismantling a building containing asbestos and method for neutralising asbestos at high temperature. On the left of the confined space a conveyor is used to pass broken parts of buildings and installations into a neighbouring room. On the right of the confined space the room is delimited by a wall with openings through which emissions released during dismantling are drawn out under a vacuum and subjected to a filtering system. Personnel proceed with dismantling by passing both arms through air veils. The room is sprayed with water during dismantling to limit dust and fibre emissions.

Disposal plant for appts. contg. harmful substances electric - comprises transportable unit sealed from outside air to prevent escape of harmful substances during dismantling of appts. Into individual components
Inventor: Applicant:
EC: B03B9/06D; B09B3/00H; (+1) **IPC:** ***B03B9/06; B09B3/00; B09B5/00*** (+6)
Publication info: DE4136241 - 1993-05-06
Method for dismantling apparatus containing asbestos. The recyclable components are cleaned to remove all traces of asbestos using a process which comprises one or more steps. The remaining components are packed in a material to seal in the asbestos before it is transferred to another disposal centre.

Process for the disposal of asbestos fibres and/or building materials containing asbestos fibres and equipment for carrying out the process
Inventor: FAHLENBRACH HERMANN DIPL ING (DE); KABISCH SIEGFRIED DIPL ING (DE); (+2)
Applicant: BILFINGER BERGER BAU (DE)
EC: B09B3/00H; C04B14/40; (+1) **IPC:** ***B09B3/00; C04B14/40; C04B41/46*** (+10)
Publication info: DE3902717 - 1990-08-02
On site dismantling method using a water process with neutralisation of the asbestos by binding with container materials and compacting. The substances to be disposed of are taken up by a suction line and fed through a separator before being mixed with a solvent. The mixed product is shaped into a block under a press to reduce its volume to around one half to one tenth of its initial volume.

Appendix II

Different treatments of asbestos-containing waste

I. In relation to the treatment method and type of asbestos

I.1. Storage at a storage centre adapted to the type of asbestos concerned:

This is the method most frequently used in France for powder or friable asbestos. Around one dozen type 1 storage centres exist that are adapted for this type of asbestos, distributed over the entire French territory. For the most part they belong to major groups (Véolia and Suez). They take in charge the asbestos, delivered in lined packages, which are stored in facilities that are monitored to guarantee any risk of dispersion in air or water (separation of wastes and sealed burial). The cost of management and storage is approximately **€300** to **€450 /tonne**.

For so-called contained asbestos (fibre cements, glues, floor coverings ...) the substances to be disposed of are stored in class 2 storage centres, even class 3 storage centres since the publication of new French regulations in Spring 2006. Storage costs total around **€80** to **€200 /tonne** at class 2 centres and around **€20 to €50 /tonne** at class 3 centres (invoiced per volume at class 3 centres).

II.2. Setting in concrete after mixing and compacting:

For powder asbestos this is the method that is most used in Germany, but it is not applied in France. After compacting, the asbestos is mixed with concrete then stored at an adapted storage area and is never reused as raw material or filler. With this method, which can be applied to all types of asbestos (powder or contained), disposal costs total around **€300** to **€500 /tonne**.

I.3. Vitrification by plasma torch:

For the treatment of asbestos this method is only used in France, whereas this method is used by several countries throughout the world for other waste (ash from the incineration of household waste).
It lends itself fairly well to powder asbestos which it transforms into a type of inert silicate that is sometimes recycled for use as sub-layers in road building or as road surface. In this case, the cost of vitrification totals approximately **€1200/tonne**.

On the other hand, this method is much more difficult to apply to contained asbestos since the vitrification of the asbestos binder raises problems and requires the prior mixing of a low proportion of asbestos with a vitrifiable filler. This constraint often doubles the cost of treatment which can reach **€2400/tonne**.

I.4. Thermo-chemical conversion:

This method for the destruction of asbestos and PCBs, given approval in the USA, converts materials (including metal materials) contained by asbestos into inert materials which can be reused in the public building and works sector. The advantage of this asbestos destruction method as compared with the plasma torch method lies in its cost which is apparently 50% lower due to the fewer energy needs of the method. However, this method also requires the setting up of costly equipment that is as complex as the equipment used for the plasma method. This method has so far not been introduced into France where it has not yet received the approval of the relevant authorities.

II. Additional points

These costs do not take into consideration any local taxes on polluting activities (TGAP) which are proportional to tonnage, nor do they take into account the cost of transport for hazardous materials. For storage at class I centres, there are a total of 12 centres in France whereas only one vitrification facility exists that is located in the region of Les Landes; administrative restrictions and corresponding transport costs evidently reflect this situation.

Subsequent to recovery of the hazardous waste and its resale after vitrification using the plasma torch disposal method, the producer of the initial waste thereby transfers ownership of the waste. On the other hand, with the storage method the producer theoretically remains eternally responsible for the destination of the waste it has entrusted into the safekeeping of the storage centre. Should this latter holder of the waste default in any manner (bankruptcy, improper storage), given that this waste is identified, the producer could be led to taking its treatment in charge a further time or to taking back this waste in accordance with regulations which may be in force at the time of any such event.