ASBESTOS AS ENVIRONMENTAL AND LEGAL ISSUE

Vanja-Ivan Savić[a*]
Hana Fajković[b*]

[a] Department for General Theory of Law and State, Faculty of Law, University of Zagreb, Gundulićeva 10, 10 000 Zagreb, Croatia
[b] Department of Geology, Faculty of Science, University of Zagreb, Horvatovac bb, 10 000 Zagreb, Croatia

ABSTRACT

In this article authors examine historical and social context in which asbestos became one of the major building materials in the World and how it became a serious threat to the environment and human health. Authors are focusing on two major topics connected with asbestos, first is geological one: what are the characteristics of asbestos, how it was used and what are concrete medical and environmental problems related to it and the second, which covers comparative legal issues for preventing and sanctioning unlawful use or handling of that hazardous material.

1. INTRODUCTION

Environmental problems are serious and growing world issue and we all are witnesses of that pollution is one of the major problems of our time. Scientists from different fields are working together for better understanding of environmental issues as their only goal. Biologists, ecologists, geologists and many others are presenting information about global warming, disappearance of species, deforestation, decreasing the sources of drinkable water etc. Their aim is to make public familiar with problems and to propose a solution; but for legal disposal it is necessary to have good and acquainted jurisdiction. As a jurist, to be able to protect and conserve

* Corresponding authors.
E-mail address: vsavic@pravo.hr (V.-I. Savić), hanaf@geol.pmf.hr (H. Fajković)

particular aspects of environment, it is necessary to be familiar with all aspects and problems which dangerous substances can cause. That idea was guideline for this paper. Law and geology, two disciplines with not so many contiguous areas, at one hand, but on the other, two disciplines where intervolve is needful, have make its fusion trough this paper with intention to provide information about asbestoses and its dangerous impact on the human health. There are two major topics in this paper, first one is concerning asbestos as mineral with its features and characteristics, as well as industrial use. This is given from geologist point of view. Second topic is legal aspect of the problem connected with asbestos which includes data about allowed exposure limits in the industrial setting, as well as regulations that protect workers. But, the most important part is dedicated to the liability of juristic persons for criminal acts.

2. FEW BASIC FACTS ABOUT ASBESTOS

There are several different definitions of minerals, starting with the economical definition on one side that claims that minerals are all valuable materials which are dug out by mining, or a dietary one that define minerals as chemical elements required by living organisms, or the definition by the IMA Commission on New Minerals and Mineral Names on the other side, which said, that in general terms, the mineral is an element or a chemical compound that is normally crystalline and that has been formed as a result of geological processes[1],[2].

Minerals are having strictly defined chemical composition, however and for each mineral is characteristic its crystal structure. Minerals are differ in many over some features from which one of which is their physical feature – habit. In crystallography, external shape is denoted by the word habit. Crystal habit is a description of the shapes and aggregates that a certain mineral is likely to form. It depends on different geologic settings and condition in which crystal was growing, but it is also the result of the crystal structure and the crystal lattice, which provides a mineral with its ordered internal structure. We can distinguish several deferent habits; some of them are equant, bladed, prismatic, dentric, acicular, massive, reniform, etc.

1 Nickel, E. H. (1995), The definition of a mineral, The Canadian Mineralogist, vol. 33, pp. 689 – 690, http://www.minsocam.org/msa/ima/ima98(04).pdf. (12.9.2007)

2 Tibljaš, D. (2007). Internal Handbook for Students "Opća mineralogija". Faculty of Science, Zagreb, Croatia.

Close to 27% mass of the Earth's crust is made of chemical element silicon. Silicon as an element is a constituent of many minerals such as silicates. The silicate minerals are the most important and abundant group of rock-forming minerals, which can be classified according to the structural arrangement of the fundamental SiO_4 tetrahedron, which are the main building block of the group[3].

Some estimation said that 90% of Earth's crust is made up of silicates. That should be one more reason to try to understand and apprehend the nature and physical aspect of these minerals. Inosilicate and phyllosilicate are subdivision silicates, which can be divided into classes or structural types. The difference between these classes emerges from their different structure and linking types between silicate tetrahedrons ($[SiO_4]$). Inosilicates is a class in which ($[SiO_4]$) tetrahedrons, a central silicon atom surrounded by four oxygen atoms at the corners of a tetrahedron, are linked together by the sharing of oxygen to form a single or a double unbroken linear chain of indefinite length. This type of structure presents one of the prerequisite for typical habit of minerals that are called asbestos - a prismatic crystal that has one elongated dimension and two other dimensions that are approximately equal, needle-like crystal, hair-like, fibrous.

Among the inosilicates are double chain minerals, amphibole. That group includes some minerals with characteristic fibrous habits, asbestos - crocidolite, amosite, anthophyllite, tremolite, and actinolite. Beside asbestos minerals from the amphibole mineral group, there is one mineral from serpentine mineral group belonging to the phyllosilicate classes, chrysotile. Phyllosilicate is a compound with a structure in which silicate tetrahedrons are arranged in sheets. These sheets are held together by weak bonding between the free oxygen on the tetrahedra so that they cleave easily. In a case of chrysotile sheet are curving in the concentric sheets forming the fibres. These six minerals are defined by special type of fibrous habit but each differs in chemical composition.

3 Allaby, A. and Allaby, M. (Eds.) (2003): A Dictionary of Earth Sciences, second edition. Oxford, New York.

Asbestos is a generic name for six minerals used in industry with attributes that qualify them as asbestos. The term is rather commercial than mineralogical. Some general information and chemical composition are present in Table 1. Asbestos minerals are crystallizing in monoclinic crystal system, apart from anthophyllite that is crystallizing in an orthorhombic crystal system. Asbestos fibres are particles longer than or equal to five μm with a length to width ratio greater than or equal to 3:1, whereas the ratio can be higher than 20 or even 1000.

Table 1. Comparative overview of some asbestos features

Name	Chemical Composition	Common Name	Mineral Group	Hardness	Crystal system
Crocidolite	$Na_2Fe_3^{(2+)}Fe_2^{(3+)}Si_8O_{22}(OH)_2$	blue asbestos	amphiboles	5-5½	monoclinic
Amosite	$Fe_2^{(2+)}(Fe^{(2+)},Mg)_5Si_8O_{22}(OH)_2$	brown asbestos	amphiboles	5-6	monoclinic
Anthophyllite	$Mg_2Mg_5Si_8O_{22}(OH)_2$	gray asbestos	amphiboles	5½-6	orthorhombic
Chrysotile	$Mg_3Si_2O_5(OH)_4$	white asbestos	serpentines	2½	monoclinic
Actinolite	$Ca_2(Mg, Fe^{(2+)})_5Si_8O_{22}(OH)_2$	-----	amphiboles	5-6	monoclinic
Tremolite	$Ca_2Mg_5Si_8O_{22}(OH)_2$	-----	amphiboles	5-6	monoclinic

Physical features of asbestos e.g. electrical, thermal, and sound isolation, adsorption capacity, features in matrix reinforcement, flexibility, friction and elongation properties, easily separation from the host matrix is why this material was so embraced in the industry. Intrinsically features are its inflammability, thermal stability, resistance to biodegradation, chemical inertia to most chemicals and a low electrical conductivity.

Result of asbestos fibres industry use is product growth in the deferent field. Clothing and fire protection materials, sound isolation materials, felts for flooring and roofing products, electrical insulation, materials for brake linings and pads, clutches, asbestos-

cement (A/C) products, asphalt roof coatings and compounds – all of this products, and much more use asbestos fibres in production. Asbestos was also used for fire protection of steel beams by spraying thermal insulation.

Industry is not utilising all six asbestos minerals equally. Chrysotile, also called *white asbestos*, is commercially used in more than 95 percent of world's production. Chrysotile posses some features that distinguish it from other asbestos minerals, like softness and flexibility for woven. Other asbestos minerals were used in much lower percentage. Crocidolite, so-called *blue asbestos,* account for 2.2 percent, amosite the so-called *brown asbestos,* accounts for 1.6 percent, and anthophyllite with tremolite account for less than 1 percent of the world production.

3. HISTORICAL BACKGROUND OF ASBESTOS IN INDUSTRY AND WHY IT IS A PROBLEM?

The first recorded application can be traced to Finland approximately 2500 B.C., per reinforce clay utensils and pottery[4]. Some records are tracking that application to even 3000 B.C., in a production of lamp wicks, for funeral dress and crematory clothing. At the beginning of the 19 century asbestos became a popular product especially with Italy as a leader in a textile manufacturing industry The textile industry was the first one which used asbestos fibres but soon the application of asbestos spread on several other industries. At that time asbestos was first used to insulate steam engines in the United States.

Asbestos fibres were used for steam, high-temperature machine glands, boilers insulation , steam pipes and all other high-temperature products, construction industry elements, fireproof roofing and wall materials. High percentage of asbestos was used in a production of asbestos-cement products (A/C products). That field of industry increased in the 20 century. The rise of the automobile industry, which used asbestos fibres in production of clutch components and engine gaskets, also contributed to that increase. During the World War II, asbestos was incorporated in insulating high-

4 A. Europaeus-Äyräpää, Acta Archaeol. 1, 169 (1930)

temperature components for ships. It also found its place in the tobacco industry. Kent, the first filtered cigarette at the market used crocidolite in its "Micronite" filter from 1952. to 1956.[5] Asbestos filters were used also in wine industry but because of health issue, they were substitute for other type. Development of industries grew parallel with increase of products made of asbestos fibres. By 1958, it was reported that asbestos was used in about 3,000 applications[6].

At the end of 1960s and the beginning of 1970s connection between respiratory diseases and asbestos starts to be evidential. Health concern led to asbestos product usage decrease. Asbestos consumption peak was in the 1973 when 800,000 tones were used, and it downsized to 4,650 tones in the year 2003[7].

In the modern epidemiology asbestos-related diseases are widely studied since it was recognized as a potential health hazard. Inhalation of asbestos fibers caused respiratory diseases as asbestosis, mesothelioma and lung cancer, with long latency periods, 10 to 40 years. Asbestos is classified as a known human carcinogen, a substance that causes cancer by the U.S. Department of Health and Human Services, the EPA, and the International Agency for Research on Cancer.

The connection between respiratory disease and asbestos was noticed much before 1960s and 1970s with massive production, when the use of asbestos was reduced. Strabo, (64 B.C.-24 A.C.), Greek historian, geographer and philosopher notes that connection observing slaves. Same conclusion made Pliny the Elder ((24 A.C.- 79 A.C) ancient author, natural philosopher. He notes that slaves working in asbestos mines die young of lung disease and was first to suggest use of transparent bladder skin as a safeguard against dust. From then till the end of the 19 century the connection between asbestos fibres and respiratory disease was not mentioned. Some resources mentioned a Viennese physician as the first one that, in 1897, connected emaciation and pulmonary problems to asbestos, dust inhalation. The first documented case of an asbestos-related death was reported by Dr Montague Murray,

5 Dodony I. (2007): Minerals: definition, Terminology, Structure, Chemistry. Erasmus Intensive Programme in Mineral Sciences, Budapest, Hungary, Aug. 24-Sep. 2, 2007.Asbestos 2007 Budapest.

6 Quebec Asbestos Information Service, (1959)

7 Virta, R.L., (2005), Mineral commodity profiles—Asbestos: U.S. Geological Survey Circular 1255–KK, 56 p. http://pubs.usgs.gov/circ/2005/1255/kk/Circ_1255KK.pdf (12.9.2007)

British physician, in 1906 when the autopsy of an asbestos worker revealed lung fibrosis.
Much research was carried out to that theme and according to some, 5-7 percentage of all lung cancer occur in a year from Europe, North America, Japan, and Australia could be due to asbestos. That means 20,000 cases of lung cancer and 10,000 cases of mesothelioma every year[8].

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Typical characteristic of asbestos is very small width of fibre-shaped particles. This characteristic presents health hazard. According to the shape and the size, asbestos fibres can easily be transported by air and wind. Inhaled asbestos fibres can penetrate deep into the lungs causing severe damages, scarring and inflammation. Diseases connected with asbestos are mesothelioma (cancer of tissue called mesothelium which refer to the thin membrane that surrounds lungs, stomach, heart and other organs), asbestosis (type of fibrous or scarring of the lung caused by asbestos fibres) and lung cancer (starts in the lining of the bronchi, caused by asbestos exposure).

Not all fibre sizes will cause respiratory diseases. Fibres with diameter less than 3 μm are considered non-fibrous particles but respirable ones. Fibers greater than 5 μm in a length, with aspect ratio equal to or greater than 3:1 are considered dangerous and health hazardous, and only those particles are measured and counted during an air-monitoring control.

With time, people' awareness of health issues and asbestos educed and first bans started to occur. First bans and regulations referred to the protection of workers, workplace and concentrations of fibers in the air. Exposure time is defined for workplaces, but varies among countries regulations, and it can be within 4-8 hours,

8 Lin, R.-T., Takahashi K. and Karjalainen A. et al., Ecological association between asbestos-related diseases and historical asbestos consumption: an international analysis, Lancet 369 (2007), pp. 844–849.
doi:10.1016/S0140-6736(07)60412-7 (07.9.2007)

with fibers concentration within 0.1-2 f/cc[6]. Some countries have distinction between asbestos fibres types, where permitted exposure time for amphibole asbestos is shortened from one-half to the one-tenth for chrysotile[10]. That difference is based on the different physical properties and greater probabilities to get one of respiratory diseases connected to asbestos if exposed to amphibole asbestos. Problem of respiratory diseases connected with asbestos and how serious they can be is evidential from the U.S. National Cancer Institute record. Seventy to eighty % of all cases of mesothelioma were exposed to asbestos[11]. Values are also given for asbestos in the internal spaces and in the atmosphere, where concentration of 0.01–0.02 f/cc is acceptable by EPA[12] regulations.

Asbestos minerals are highly resistant and are staying in an environment for a long time. That is specially significant for areas where asbestos minerals were mined and not only nearby the mines but in much wider area. Remobilisation of asbestos fibres is connected with timber harvesting or firewood from trees that were from the areas with high fiber concentration in the air. The bark presents a good reservoir for fibers, which can reach it easily through wind-blown dust. Such scenario was noted in the USA, Libby area, from where trees were distributed. as fuel Fibers from bark were remobilised in new area and caused the secondary pollution[13].

Empirical formula-equation was made from which it is evidential connection between concentration of asbestos fibres in the air (C), also time of exposure, and probability of having some respiratory disease (danger level). Disease occurrence and progression are in a close relationship on total dose over time.

$$\text{Danger level} = 2.3 \times \frac{C}{10}$$

6 fiber per cubic centimetre

10 Summary of Main Features of Asbestos/Health Regulations at the Workplace, AIA Information Memorandum (AIM) No. 3-80, Asbestos International Association, Epson, Surrey, UK, Nov. 1990.

http://wshiivx.med.uoeh-u.ac.jp/asbestos/asbinfo.htm (07.9.2007)

11 National Cancer Institute. Malignant Mesothelioma: (PD) Treatment, Health Professional Version: 2005

http://www.cancer.gov/cancertopics/pdq/treatment/malignantmesothelioma/HealthProfessiona (7.9.2007)

12 U.S. Environmental Protection Agency

13 Ward, T.J. et al. (2006), Trees as reservoirs for amphibole fibers in Libby, Montana. Science of the Total Environment 367, 460–466. doi:10.1016/j.scitotenv.2006.03.041 (07.9.2007)

Some researches demonstrate deferent bearing of amphibole and serpentine asbestos on human health, as a result of different mineralogy and structural type. Even some regulations are distinguishing types of asbestos when legislate permitted exposure time. A main difference is not such resistance of chrysotile in an acidic environment, according to some researches. That is particularly important in the lung where the macrophages are capable of generating a milieu at a pH of ~4.5, which means it is possible to clear chrysotile fibers from the lung[14]. Same research even gave a half-time ($T_{1/2}$) of the lung clearance of fibers longer than 20 μm. For chrysotile fibers, $T_{1/2}$ is 3 to 11 days, and for the amphibole fibers it was $T_{1/2}$ of 500 days to ∞[15]. Clearly, it is a big difference to which type of asbestos fibers is somebody exposed. In the acidic environment, chrysotile is not so stabile and after dissolution/ disintegration chrysotile particles are losing fiber characteristic. If similar situation would contrive to the double-chain of amphiboles, those would break into a set of fragments with fibrous shape.

From abreast tests on animals it is clear that after short exposure time to amphibole asbestos, lungs are shoving pathological response as macrophage aggregates, multinucleated giant cells and interstitial fibrosis. Thought chrysotile will clear out from lung, long exposure to it will lead to respiratory disease and it is a health risk[16]. Deferent bearing and consequences on human health is why it is important to detect which asbestos mineral we are dealing with. Morphological examination and analytical methods needs to be performed for reliable identification. Deferent methods are usually combined since only one analytical method could lead to a false conclusion.

Some of a most common methods are: polarizing light microscopy (PLM), phase contrast optical microscopy (PCM), scanning electron microscopy (SEM), analyse with electron diffraction spectra (SAED) with energy dispersive X-ray analysis (EDXA), powder X-ray diffraction technique (XRD), transmission electron microscopy (TEM).

14 Bernstein, D.M. and Hoskins J.A. (2006), The health effects of chrysotile: Current perspective based upon recent data. Regulatory Toxicology and Pharmacology 45, 252–264.

15 indefinite duration

16 D.M. Bernstein, J.A. Hoskins / Regulatory Toxicology and Pharmacology 45 (2006) 252–264). The health effects of chrysotile: Current perspective based upon recent data

Hence, chemical composition and crystal structures are required for positive identification, whereby asbestos identification is expensive and present a problem for a poor and third world countries, which are in the same time arias that used asbestos products widely duo to a low price.

Table 3. and table 4. are given for oversight and to be aware how asbestos is distended and how many products are containing it. In table 3. are present 20 occupations with the highest mesothelioma mortality rating[17] and in a table 3. are enumerating some suspect asbestos containing materials given by U.S. Environmental Protection Agency[18].

Table 2. Top 20 occupations with the highest mesothelioma mortality rating

1. Metal Plate Workers	**11. Boiler Operators**
2. Vehicle Body Builders	12. Electrical And Electronic Production Fitters
3. Plumbers And Gas Fitters	13. Managers In Construction
4. Carpenters	14. Chemical Engineers and Scientists
5. Electricians	15. Welders
6. Sheet Metal Workers	16. Builders
7. Electrical Plant Operators	17. Professional Engineers
8. Production Fitters	18. Painters And Decorators
9. Construction Workers	19. Managers
10. Electrical Engineers	20. Scaf folders

17 Bryson N. (2005), Preventing workers from being exposed to asbestos fibres, Asbestos Issues in Poland (Poland conference 2005)

18 http://www.epa.gov/Region06/6pd/asbestos/asbmatl.htm (4.9.2007)

Table 3. Sample List of Suspect Asbestos - Containing Materials

Cement Pipes	Elevator Brake Shoes
Cement Wallboard	HVAC Duct Insulation
Cement Siding	Boiler Insulation
Asphalt Floor Tile	Breaching Insulation
Vinyl Floor Tile	Ductwork Flexible Fabric Connections
Vinyl Sheet Flooring	Cooling Towers
Flooring Backing	Pipe Insulation (corrugated air-cell, block, etc.)
Construction Mastics (floor tile, carpet, ceiling tile, etc.)	Heating and Electrical Ducts
Acoustical Plaster	Electrical Panel Partitions
Decorative Plaster	Electrical Cloth
Textured Paints/Coatings	Electric Wiring Insulation
Ceiling Tiles and Lay-in Panels	Chalkboards
Spray-Applied Insulation	Roofing Shingles
Blown-in Insulation	Roofing Felt
Fireproofing Materials	Base Flashing
Taping Compounds (thermal)	Thermal Paper Products
Packing Materials (for wall/floor penetrations)	Fire Doors
High Temperature Gaskets	Caulking/Putties
Laboratory Hoods/Table Tops	Adhesives
Laboratory Gloves	Wallboard
Fire Blankets	Joint Compounds
Fire Curtains	Vinyl Wall Coverings
Elevator Equipment Panels	Spackling Compounds

4. GENERAL LEGAL FRAMEWORK AND PROTECTION FROM HAZARDOUS IMPACT OF ASBESTOS

In previous paragraphs it was mentioned that asbestos and its products could provoke serious illnesses[19] and be a serious threat to the environment. However, when we write about asbestos as a dangerous substance, firstly it is necessary to have in mind the fact that for successful taking care of it and its decreasing influence on the environment it is essential to have serious and reliable legal instruments for covering the area.

When we discuss and look at the regulations which mention asbestos or dangerous substances which have influence on the health and environment, they could be

19 See here page 7

divided into three groups: firstly, regulations which have provisions about asbestos directly written in the texts of those regulations; secondly, regulations which talk about dangerous substances, but not about the asbestos itself; and on the third place regulations which do not mention asbestos or dangerous substances but make the mechanisms which are directly connected to those issues. In this article those regulations/laws will be specially explained, especially Law on criminal liability of juristic persons[20] and Criminal Law[21] (Criminal Code). It is also possible to classify those regulations into some other categories such as: international documents - firstly those are international contracts and conventions (also declarations-e.g. declaration in Rio de Janeiro) and on the domestic ones which can be divided (according to the legal norms hierarchy) to those which have a status of an Act and those which are subordinated to them such as By-Laws, Decisions, Minutes etc.

The former Yugoslavia had signed the Convention of European Economic Council-Directive 76/769/EEC of 27 July 1976 which forbids the use of asbestos (firstly mineral crisotyle). The Republic of Croatia had accepted the obligations from the Convention after the break of the former state by the Notification of Succession, but in reality by the Act on accepting Laws and Conventions[7]. Furthermore, European Conference on asbestos in Dresden[8] had issued Dresden Declaration on Protection of Workers from Asbestos[9]?. With a recommendation a practical manual for handling of asbestos had been delivered . Those documents are not obligatory, however, they are the guidelines for the adequate handling of this dangerous material. Asbestos as a material has been forbidden in the Countries of the European Union, and taking into account that almost all legal systems in the EU recognise criminal liability for juristic persons, many of them could be liable for criminal offences in connection with asbestos.

In this part of the article, in the first place we will examine the liability of juristic persons for criminal offences, because this «new» form of responsibility had brought

20 Official Gazette RoC No.151/2003.

21 Official Gazette RoC No.110/1997., 27/1998., 129/2000.,51/2001., 105/2004., 84/2005., 71/2006.

7 Official Gazette RoC No.53/1991. By this Law the Republic of Croatia had accepted most of the «old» Yugoslavian legal system, and with that most of the environmental related legislature.

8 European Asbestos Conference.

9 Dresden Declaration on Workers Protection against Asbestos.

a revolutionary change to the most European continental legal systems in respect that those systems will except a possibility that juristic persons can be liable for criminal prosecution for environmental crimes and human-health-related crimes as well. This is done by introducing new acts into the legal systems in many European countries. This form of liability is relatively «new» and very broad and for that reason it is adequate for sanctioning severe criminal behaviour which is «expected» from legal entities such are big firms, manufacturers, producers, waste producing firms, etc. Through activities of those legal entities many criminal offences could happen, together with many minor offences like misdemeanours. Those criminal offences are proscribed in Croatian Criminal Law (Code) and from 2003 in Croatian Act on Responsibility of Juristic Persons for Criminal Offences. For that reason this is an area to which special attention has to be paid.

When we discuss about asbestos and similar substances it is necessary to mention that there are some positive regulations which cover this area, especially those which are related to the dangerous waste disposal. For the reason that the production of asbestos and materials with asbestos fibres is forbidden, most of these problems will be related to waste disposal and waste management .

Therefore there are numerous regulations which regulate this area in Croatia. In the first place there is Waste Act[10] and By-law on the Sorts of Waste[11] and the following By-law on conditions for waste handling[12], Government Decision on dangerous waste handling[13] etc. As a non-legal document there is a «Strategy of Waste Management of Republic of Croatia»[14].

Over 60 countries in the World have forbidden any use of asbestos and among those 60 are all countries of the European Union, Australia, Canada but not of the United States of America, where there are still serious debates about this issue[15].

10 Official Gazette RoC No. 178/2004., 111/2006.

11 Official Gazette RoC No. 27/1996.

12 Official Gazette RoC No. 123/1997., 112/2001.

13 Official Gazette RoC No. 50/2005.

14 Official Gazette RoC No.130/2005. Strategy is not a by-law in a strict meaning of that word, but in any case it consists of guidelines which are the base of positive acts and by-laws currently in force. General framework for waste management in the European Union is the Directive 2006/12/EC which bounds Member States to forbid uncontrolled waste disposal .

15 www.industryweek.com, 20.10.2007. ; www.medicalnewstoday.com, 20.10.2007.

When we talk about court proceedings it is necessary to stress that the first connection between asbestos and human health was noticed in 1989 in the document of British Labour Inspectorate and the first law suit against one manufacturer of asbestos was delivered in front of the court in 1929, and in 1982 a retired boiler-repairer James Cavett received a record compensation in the amount of 2.3 million dollars and 1.5 million on the grounds of punitive damages[16]. It is an interesting fact that when we take into account that the criminal liability of juristic persons has existed in the United States for such a long time now (and from where it has been transfered to the legal systems of England and Scotland, and subsequently to the other legal systems of Europe) the suits against asbestos manufacturers are more than common. Therefore Manville Corporation (formerly John-Manville Corporation), once one of the richest companies in the United States was sued in about 16,500 cases which were connected with asbestos and its impact on human health.[17] First case in connection with asbestos has been brought in front of the court in the State of Massachusetts in 1926, when Massachusetts Industrial Accident Board paid damages for the illness caused by asbestos. Up to year of 2004 almost 6% of all claims for compensation were connected with health problems caused by asbestos (mesothelioma).[18] Ron Motley, attorney from South Carolina, USA described this company as the «biggest corporate mass-killer in history»[19].

As it will be mentioned afterwards, juristic persons could be liable for murder in some legal systems .[20]

Many other big world countries, among those many are in the stage of heavy industrial development like India, are facing huge problems, especially in the so-called «non-organized industrial sector», and in the construction industry and business. Poor and weak working and hygiene conditions do not provide an

16 www.lhc.org.uk, 15.10.2007.

17 Ibid. This company has declared bankruptcy under United States Bankruptcy Code

18 http://www.mesolawsuit.com/asbestos_overview.aspx (7.12.2007.)

19 www.ewg.org, 14.10.2007.

20 The so-called "corporate manslaughter, corporate homicide", in the UK or Croatia (According to the current legislature juristic persons could be liable for all criminal offences, therefore even for murder)

atmosphere for decreasing emission of asbestos, or its final removal. In those countries the way to the «asbestos-free air», seems to be far and painful.[21]

The British Parliament has delivered numerous regulations which could and should be a role- model for parliaments and law makers in the other, especially in the European countries, and therefore many regulations cover this area. In the first place it is necessary to mention Health and Safety at Work Act (1974) and then The Asbestos (Licensing) Regulations (1983), The Control of Asbestos at Work Regulations (1987, 1992), The Control of Asbestos in the Air Regulations (1990), The Asbestos (Prohibitions) Regulations (1992), The Control of Pollution Act (1974), The Water Act (1989), etc.

Those regulations forbid the use of the most dangerous materials separately or indirectly in a way that they forbid import, procurement and use of blue and brown asbestos (crocidolite and amosite)[22] and impose strict control over risks which can occur to persons in contact with asbestos, but also to persons who may come in touch with them.

5. CRIMINAL LIABILITY OF JURISTIC PERSONS FOR CRIMINAL ACTS[23]

It was previously stated, the responsibility of juristic persons who produce, store or dispose asbestos will be among other of criminal nature, but without any doubt they will be basis for other liability forms (e.g. civil or administrative). The basis of this article is the criminal one.

On 11 September 2003 the Croatian Parliament had passed an Act on Criminal Liability of Juristic Persons for Criminal Deeds[24]. This Act brought revolutionary change into the Croatian legal system, especially in criminal law which did not recognize this form of liability for juristic persons before.

21 See more in: F.A.Ansari et al.: «Monitoring and identification of airborne asbestos in unorganized sectors, India); specially situation in the province of Rajastan.

22 See in text, page 8

23 Part of this text is adapted and transferred from; V-I..Savić: «Fundamental questions of responsibility of juristic persons for criminal acts and mechanisms for finding the responsible person within the companies», Master thesis (M.Sc.), University of Zagreb, Faculty of Law, 2007.

24 Ftn. 5.; This Law was put into force on 25 March 2004, after vaccatio legis of six months.

It seems that tendencies within the European Union were a major reason and a motivator for this intervention in the Croatian legal system, for the reason that Croatia is a candidate for the membership in the Union and a harmonization of this legal area falls into scope of the changes Croatia is obliged to fulfil.[25] The interesting fact is that this issue is still not completely unified and harmonized within the European Union .[26]

In any case it is obvious that the «old» principle *societas delinquere non potest* was deserted. Apart from the major reason, which is mentioned above, that Croatia is a candidate for the membership in the European Union, there are serious objective reasons for introducing this form of liability into the Croatian legal system, which are same or similar to those in other countries.

It is obvious that we face heavy violations of *ius cogens* from juristic persons today which are so heavy that civil and administrative responsibility is no longer a satisfactory model for sanctioning those legal entities. On the other hand, if we consider the fact that juristic person is incapable for sentencing to imprisonment, social work or death penalty, and it is not possible to impose conditional sentence in a way how a natural person can be sentenced, there is always an objection of criticisms that nothing will be changed.

However, nowadays tendencies are following the idea of broadening of criminal liability to the juristic persons: England, Scotland, Ireland, the Netherlands, Norway, Cyprus, France, Portugal, and Denmark (in some cases).[27] On the global scale Japan, the United States, Canada and Australia could be mentioned as those who have some form of criminal liability for juristic persons within their criminal law(s).[28] Some other European countries have introduced this form of liability relatively recently: Belgium 1999, Slovenia 1999, Hungary, 2001, Estonia 2002, Switzerland 2003, Lithuania

25 See Official Gazette RoC International Contracts 4/2001., and Second Protocol for Protection of European Union's Financial Interests of 19 July 1997 which is still not in force.

26 Acquis Communautaire.

27 F.Bačić, Criminal Law-General part, Informator, Zagreb, Croatia1995, p. 103.

28 Data received at Crown Office, Edinburgh, Scotland, June 2005.

2003, Poland 2003, Bulgaria 2003 and the Czech Republic 2005. Austria did not recognise this until September 2005. [29]

When we talk about introducing criminal liability for juristic persons, as mentioned before, it is necessary to mention that more severe punishment is definitely one of the major reasons for this. Nuclear catastrophes, ecocides, great financial frauds, tax evasions, smuggling etc. «seek» this form of responsibility because civil and administrative measures are not satisfying if we look at the fact how large wrongdoing happened with those criminal acts.[30]

Most legal systems accept derivate model of responsibility and the Croatian legal system also. The Croatian legal system accepts the model of derivate, subjective and cumulative responsibility of juristic persons.

Derivate responsibility also is called an accessory one. Why? This theory takes as its base a natural person who is responsible for criminal act and on his responsibility creates the whole responsibility of a juristic person. If we want for juristic person to be prosecuted for criminal acts it is necessary to find which person (natural) within e.g. company is responsible and according to his responsibility, the juristic person will be liable as well.

It is necessary to find several important elements so that it would be possible to prosecute any juristic person: it is necessary that natural person acts: 1) within the framework of duties imposed by the juristic person, 2) in the name of that legal entity and 3) in favour of the legal entity (financial or any other). We see that there are two steps in determination of liability of juristic person, firstly, finding the responsible physical person and secondly, imputation of that liability to the juristic person, as he performed the duty by himself.[31]

29 See more in: Zlata Đurđević, Comentary on Croatian Law of Criminal Liability for Juristic Persons, Official Gazette, 2005., Zagreb, Croatia., also: Z. Đurđević, Juristic Person as Defendent: Fundamental Rights and Representation, Croatian Criminal Law Yearbook, vol. 12., No.2/2005.

30 See more in John C. Coffee, Jr.: «No Soul to damn-no body to kick» an unscandalized inquiry into the problem of corporate punishment, Michigan Law Review, 1981., page 389.

31 Ibid., ftn.26., page 19.

According to the Croatian Law juristic persons are liable for all criminal offences and it is possible to imagine situations in which juristic person will be liable for criminal act which is caused by unlawful «handling» of materials with asbestos (traffic, waste, production etc.)

6. CROATIAN CRIMINAL CODE AND CONVENTION ON PROTECTION OF ENVIRONMENT THROUGH CRIMINAL LAW

Juristic persons who commit a criminal act in dealing and handling with asbestos will be liable according to the two early mentioned acts: Criminal Code and Act on Responsibility of Juristic Persons for Criminal Acts. Croatian Criminal Code describes crimes against environment in the special section of it – Chapter 19. Those criminal acts are as it follows: environment pollution, article 250. (maximum sentence 5 yrs./imp.), pollution and threatening to the environment with waste, article 252. (maximum sentence 3 yrs./imp.), import of radioactive material (waste) into the Republic of Croatia, article 253. (maximum sentence 5 yrs./imp), heavy crimes against environment, article 262. (maximum sentence 10 yrs./imp).

There is also the Government Decision on Marginal Values of emissions of polluting substances into air from stationary sources; in this Decision Government proscribes that air which contains more than 0.10 mg/m3 of asbestos fibres is contaminated and cancerous (article 24.)[32]

Within the Council of Europe there are numerous documents which cover criminal liability of juristic persons and in this respect there is Convention on Protection of the Environment through Criminal Law[33]. The convention in article 4.2.4. introduces the so-called «corporate liability». The need for measures which will introduce criminal or administrative sanctions is visible in its provisions; it is interesting that there is no need for introducing criminal liability in the strict sense, however, the Convention requires that all countries which signed it, introduce liability for criminal acts in any form which can be administrative or criminal, of course.

32 Official Gazette RoC No.21/2007.

33 This convention is a result of the Rio de Janeiro conference dedicated to environmental law, «Rio Declaration on Environment and Development», June 1002, See more in www.unep.org, 1.2.2007.

7. INDIA AND ASBESTOS

According to USGS Report from 2006. the leading consumers of asbestos in 2003 were Brazil, China, India, Iran, Kazakhstan, Russia, Thailand, and Ukraine; each consumed more than 75,000 t. In 2003, China accounted for 46 percent of the apparent asbestos consumption in Asia and the Middle East, mainly to satisfy its own domestic needs. India was the next leading consumer with 18 percent of the market, followed by Thailand (12 percent) and Iran (7 percent).

During the years, India is showing large increase in production and import of asbestos. Asian markets, subsume India, was small in the 1970s but grow in the 1980s and that trend kept going. Mainly India imported asbestos from Canada, Brazil, South Africa, Cyprus, Zimbabwe and Kazakhstan. India was leading consumer in 2003. for Canadian and South Africans asbestos market, and second leading for Brazilian. Data, which refer on import from South Africa, are alarming since S.A. is the major world supplier for amosite and crocidolite, two most dangerous asbestos minerals. Amount of produced, imported, exported and apparent-consumption asbestos is given in table 4.

To show seriousness of problems connected with asbestos in India, we are giving fragment of an article "Bilateral environmental and occupational health program with India"[34]. "More than 10 million Indian workers are engaged in various industrial or mining operations which expose them to substantial concentrations of mineral dusts. Studies in India suggest there is a 10 to 50% prevalence of dust-induced morbidity among active workers. This means there may be two to three million active workers suffering from exposure to asbestos, and other dusts or fibers (Report of Working Group, 2001)".

34 Allred M. et al. (2003), Bilateral environmental and occupational health program with India.
Int. J. Hyg. Environ. Health 206, 323 – 332.

Table 4. Asbestos production, trade, and consumption in India (data in metric tons)[35]

Production	Imports	Exports	Apparent-consumption	Year
1,847	—	—	1,847	1920
34	—	—	34	1930
297	5,257	—	5,554	1940
211	10,957	8	11,160	1950
s1,711	21,967	26	23,652	1960
10,056	39,766	30	49,792	1970
20,312	41,514	—	61,826	1975
33,716	63,176	—	96,892	1980
29,450	78,075	—	107,525	1985
26,053	93,165	254	118,964	1990
23,844	91,909	14	115,739	1995
21,000	124,433	403	145,030	2000
19,000	175,581	2,548	192,033	2003

8. CONCLUSION

In many countries of the World, as well in Croatia, there are places that are contaminated with asbestos. Some of them are well known to broad population, but some of them are not. Problem lies in old buildings, ceilings, pipes, waste areas, shipyards etc. It is not hard to imagine that juristic persons, which are dealing with dangerous and hazardous substances, as well as those which are handling asbestos, will fall under the pressure of law in regard to criminal liability for offences and criminal acts provoked by their acts. Recently is to be noticed that there are some improvements in this area, but still high level of optimism is not too real.

One thing is sure; many victims of crimes against environment and human health are facing their hard times with low quality of life. Asbestos, which was for a long time a „miracle of geology“, becomes a synonym for pain and death, and problem of industrialized world.

Less developed countries, especially those in Asia, Africa and South America will have serious problems with abandoning asbestos and its materials for a long time. Mineral, which was abandoned by the „western“ world, becomes a big issue for undeveloped or less developed part of the World. This article tends to be a small contribution for focusing broader public on that issue.

35 All data from the Virta, R.L., 2006, Worldwide asbestos supply and consumption trends from 1900 through 2003: U.S. Geological Survey Circular 1298, 80 p.,

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BIBLIOGRAPHY

Allaby, A. and Allaby M. (Eds.) (2003): A Dictionary of Earth Sciences, second edition. Oxford, New York.

Allred M. et al. (2003), Bilateral environmental and occupational health program with India. Int. J. Hyg. Environ. Health 206, 323 – 332.

Ansari, F.A. et al. (2007), Monitoring and identification of airborne asbestos in unorganized sectors, India. Chemosphere 68, 716–723.

Bačić, F. (1995), Criminal Law-General part, Informator, Zagreb, Croatia1, p. 103.

Bernstein, D.M. and Hoskins J.A. (2006), The health efects of chrysotile: Current perspective based upon recent data. Regulatory Toxicology and Pharmacology 45, 252–264. doi:10.1016/j.yrtph.2006.04.008 (14.9.2007)

Browne, M.L. et al. (2005), Cancer incidence and asbestos in drinking water,Town of Woodstock,New York,1980–1998. Environmental Research 98, 224–232. doi:10.1016/j.envres.2004.07.017 (07.9.2007)

Coffee, J. C. Jr. (1981), No Soul to damn-no body to kick- an unscandalized inquiry into the problem of corporate punishment, Michigan Law Review, p. 389.

Dodony, I. (2007): Minerals: definition, Terminology, Structure, Chemistry. Erasmus Intensive Programme in Mineral Sciences, Budapest, Hungary, Aug. 24-Sep.2, 2007.Asbestos 2007 Budapest.

Đurđević, Z. (2005), Comentary on croatian Law of Criminal Liability for Juristic Persons, Narodne Novine, Zagreb, Croatia.

Đurđević, Z. (2005), Juristic Person as Defendent: fundamental rights and reprensentaion, Croatian Criminal Law Yearbook, vol. 12., No.2/2005.

Jones, A.P. (1999), Indoor air quality and health. Atmospheric Environment 33, 4535-4564.

Lin, R.-T. et al. (2007), Ecological association between asbestos-related diseases and historical asbestos consumption: an international analysis, Lancet 369, 844–849. doi:10.1016/S0140-6736(07)60412-7 (07.9.2007)

Nickel, E. H. (1995), The definition of a mineral, The Canadian Mineralogist, vol. 33, 689 – 690, http://www.minsocam.org/msa/ima/ima98(04).pdf (12.9.2007)

Prohić, E. (1998), Geokemija. Targa, Zagreb, p. 554.

Savić, V. (2007), Fundamental questions of responsibility of juristic persons for criminal acts and mechanisms for finding the responsible person within the companies. Master thesis (M.Sc.), University of Zagreb, Faculty of Law.

Summary of Main Features of Asbestos/Health Regulations at the Workplace, AIA Information Memorandum (AIM) No. 3-80, Asbestos International Association, Epson, Surrey, UK, Nov. 1990. http://wshiivx.med.uoeh-u.ac.jp/asbestos/asbinfo.htm (07.9.2007)

Ward, T.J. et al. (2006) , Trees as reservoirs for amphibole fibers in Libby, Montana. Science of the Total Environment 367, 460–465. doi:10.1016/j.scitotenv.2006.03.041 (07.9.2007)

Virta, R.L., (2002), Asbestos: Geology, Mineralogy, Mining, and Uses: U.S. Geological Survey Circular , 1255–KK, p. 28. http://pubs.usgs.gov/of/2002/of02-149/of02-149.pdf (19.9.2007)

Virta, R.L., (2005), Mineral commodity profiles—Asbestos: U.S. Geological Survey Circular 1255–KK, p. 56. http://pubs.usgs.gov/circ/2005/1255/kk/Circ_1255KK.pdf (12.9.2007)

Virta, R.L., (2006), Asbestos: 2006, Worldwide asbestos supply and consumption trends from 1900 through 2003: U.S. Geological Survey Circular 1298, p. 80. http://pubs.usgs.gov/of/2002/of03-083/of03-083.pdf (19.9.2007)

Other sources

Official Gazette RoC No.151/2003.

Official Gazette RoC No.110/1997., 27/1998., 129/2000.,51/2001., 105/2004., 84/2005., 71/2006.

Official Gazette RoC No.53/1991.

Official Gazette RoC No. 178/2004., 111/2006.

Official Gazette RoC No. 27/1996.

Official Gazette RoC No. 123/1997., 112/2001.

Official Gazette RoC No. 50/2005.

Official Gazette RoC No.130/2005.

Official Gazette RoC No.21/2007.

Official Gazette RoC International Contracts 4/2001.

http://www.epa.gov/Region06/6pd/asbestos/asbmatl.htm (15.9.2007)

www.ewg.org, (14.10.2007.)

www.industryweek.com, (20.10.2007.)

www.ihc.ogr.uk (15.10.2007)

www.medicalnewstoday.com, (20.10.2007.)

http://www.mesolawsuit.com/asbestos_overview.aspx (7.12.2007.)

www.unep.org, (1.2.2007.)

A. Europaeus-Äyräpää, Acta Archaeol. 1, 169 (1930)

Bryson N. (2005), Preventing workers from being exposed to asbestos fibres, Asbestos Issues in Poland (Poland conference 2005)

Data received at Crown Office, Edinburgh, Scotland, June 2005.

European Asbestos Conference.

National Cancer Institute. Malignant Mesothelioma: (PD) Treatment, Health Professional Version: 2005 http://www.cancer.gov/cancertopics/pdq/treatment/malignantmesothelioma/HealthProfessiona (7.9.2007)

Quebec Asbestos Information Service, (1959).

Tibljaš D. (2007). Internal Handbook for Students "Opća mineralogija". Faculty of Science, Zagreb, Croatia.