THE PRESENCE OF TOXIC POLLUTANTS IN BUILDINGS AND CONSTRUCTION MATERIALS INCREASES THE RISK OF CANCER

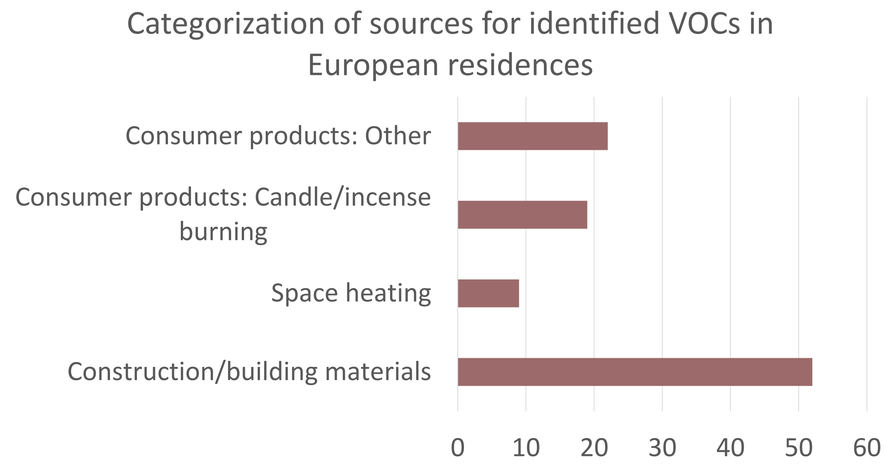
Burgos-Molina AM[1], Ruiz-González OM[2,3], González-Vidal A[3], Ruiz-Gómez MJ[3]

[1]Departamento de Especialidades Quirúrgicas, Bioquímica e Inmunología. Facultad de Medicina. Universidad de Málaga. Málaga, Spain
[2]Escuela Técnica Superior de Arquitectura. Universidad de Málaga. Málaga, Spain
[3]Departamento de Radiología y Medicina Física. Facultad de Medicina. Universidad de Málaga. Málaga, Spain

Individual Volatile Organic Compounds (VOCs) identified through measurements in residences and their calculated Weighted Average Geometric Mean (*WAGM*).

VOC	*WAGM* (μg/m^3)	VOC	WAGM (μg/m^3)	VOC	*WAGM* (μg/m^3)
Ethanol	92.00	Isobutane	4.01	1-Methoxy-2-propanol/propylene glycol methyl ether (PGME)	1.35
Formaldehyde	18.04	2-Ethylhexanol	3.70	4-Ethyltoluene	1.33
Toluene	15.90	Dodecane/*n*-dodecane	3.69	2-Butoxyethanol	1.26
Limonene [inc. *D*-limonene]	13.65	Hexane/*n*-hexane	3.66	2-Carene	1.10
Hexanal/hexaldehyde/ hexanaldehyde	13.30	Heptane/*n*-heptane	3.45	Methyl-cyclopentane	1.04
α-pinene	12.10	Trimethylbenzene (including 1,2,4- Trimethylbenzene)	3.22	Isopropanol	1.00
Butane	12.00	Cyclohexane	2.99	3-Ethyltoluene	0.98
Acetone	11.40	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate (tpddib/TXIB)	2.94	2-Ethyltoluene	0.94
Acetaldehyde	10.14	2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate (tpdmib/texanol)	2.78	Acrolein	0.92
2-Methyl-1-propanol	8.20	Tetracholorethane	2.68	Styrene	0.82
2-Methylbutane	7.80	Methyl-cyclohexane	2.68	Propylbenzene	0.80
1-Butanol	6.16	Tetrachloroethylene/tetrachloroethene	2.24	Tetrachlorocarbon	0.80
Butylbenzene	5.72	Nonane	2.21	Trichloroethane	0.73
Decane/n-decane	5.27	Benzene	1.99	*p*-Isopropyltoluene/*p*-cymene	0.56
m + *p*-Xylene	4.57	Ethylbenzene	1.84	Trichloroethene/trichloroethylene	0.53
Undecane/n-undecane	4.38	Propanal/proprionaldehyde	1.80	Naphthalene	0.50
3-Carene	4.38	Tridecane	1.77	Chlorobenzene	0.42
Pentanal	4.34	Pentane	1.69	Methylbenzoate	0.33
2,2,4 Trimethylpentane	4.33	*o*-Xylene	1.57	1,3,5- Trimethylbenzene	0.33
Octanal	4.30	*α*-Pinene	1.56	Pyridine	0.12
Ethyl acetate	4.30	Benzaldehyde	1.55	1,3-Butadiene	0.11
p-Dichlorobenzene	3.90	Octane	1.54	3-Ethenylpyridine/3-vinylpyridine	0.06

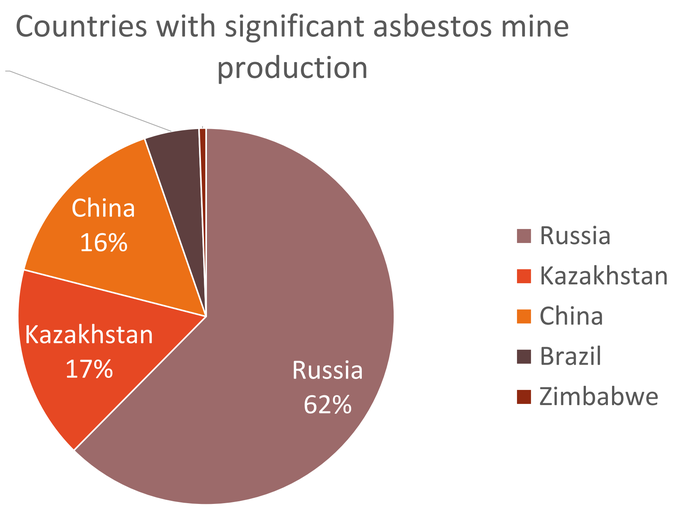
Source: Halios et al. Sci Total Environ 839 (2022) 156201



Asbestos characteristics and applications (Based on ATSDR, 2001a; IARC, 2012; TRIMEDIA, 2015; INCA, 2021).

Name	Chemical formula	Colour	Common applications
Chrysotile (white asbestos)[a]	$[Mg_3Si_2O_5(OH)_4]_n$	White, grey, green, yellowish	Building materials, including cement, roofing materials, brake linings, home appliances, and protective clothing
Amosite (brown asbestos)[a]	$[(Mg,Fe^{2+})_7Si_8)O_{22}(OH)_2]_n$	Brown, green, greenish	Insulation materials and ceiling tiles
Tremolite (asbestos)[a]	$[Ca_2Mg_5Si_8O_{22}(OH)_2]_n$	White to pale green	Stucco, plasterboard, fireproofing materials, and other construction products
Actinolite (asbestos)[a]	$[Ca_2(Mg,Fe^{2+}_5)Si_8O_{22}(OH)_2]_n$	Green	Paints, drywall, and insulation
Anthophyllite (asbestos)[a]	$[(Mg,Fe^{2+})_7Si_8O_{22}(OH)_2]_n$	White green, grey-brown	Asbestos-containing cements and insulation
Crocidolite (blue asbestos)[a]	$[NaFe^{+3}_2Fe^{+2}_3Si_8O_{22}(OH)_2]$	Lavender, blue, green	Asbestos-cement production

[a] In parentheses - generic name.



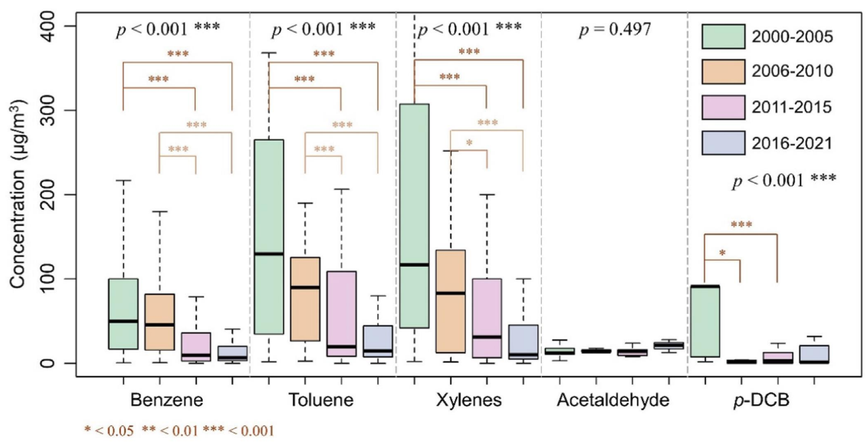
Source: Thives et al. J Environ Management 319 (2022) 115716

Countries where asbestos was banned and the year it came into force (Based on AS, 2021).

Countries	Year
Denmark	1980
Norway, Israel	1984
Sweden	1986
Iceland, Italy	1992
Germany	1993
Kuwait	1995
Bahrain	1996
Saudi Arabia	1998
Djibouti	1999
Chile	2001
Uruguay	2002
Australia	2003
Gabon, Honduras, Mauritius	2004
Argentina, Chile, Egypt	2005
Jordan	2006
New Caledonia	2007
Oman, South Africa	2008
Seychelles, Algeria, South Korea	2009
Qatar, Mozambique, Taiwan, Turkey	2010
Israel, Serbia	2011
Japan	2012
Macedonia (North Macedonia)	2014
Moldova, Iraq, New Zealand	2016
Brazil, Ukraine	2017
Canada	2018

Concentration distributions of volatile organic compounds (VOCs) in residences in different years

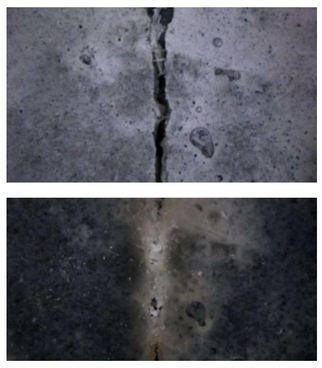
Source: Liu et al. Indoor air 32 (2022) e13091



Source: Diario de Madrid

Green buildings

Bio-concrete



Bioreceptive concrete

Introduction

Potentially carcinogens present indoor are chemicals of different nature and origin. High concentration in buildings contribute to an increased risk of cancer.

Objectives

The aim of this work is to study what type of toxic and carcinogens compounds are present in buildings associated to construction materials which increase the risk of cancer.

Methods

A systematic database search was conducted to look for evidence of indoor carcinogens in buildings. The review is composed or research articles from medical and engineering journals.

Results

Among the most commonly toxic and carcinogen compounds found in buildings are: aromatic hydrocarbons, aldehydes, terpenes, aliphatic hydrocarbons, alkane hydrocarbons, and glycol derivatives. A wide number of compounds are associated with buildings and construction materials (wood, adhesives, bricks, etc.). The use of asbestos has been avoided since 1980 in many countries. However, asbestos is still present in many buildings constructed or renovated before the 1990s. These compounds are still responsible for severe human diseases. Energy used in buildings can influence the indoor environment. More efficient heating and energy saving can improve health. Green buildings contribute to avoid the presence of indoor pollutants for a better quality of life and health. However, energy efficiency retrofits can increase the indoor concentration of radon. In addition, heavy metals such as Cr, Zn, Pb, Cu, Mn, Ni, Hg and Cd are included in petroleum hydrocarbon as pyrolysis residues. They are used for paving and building materials. Therefore, the potential health risk of cancer is high. In this way, improving ventilation could reduce the exposure to indoor pollutants.

Conclusions

To this day, construction materials that contain toxic and carcinogenic compounds are still used. These materials contribute to increase the levels of these compounds inside buildings, thus increasing the risk of cancer. It is necessary to avoid the use of these materials, carry out correct ventilation of buildings, improve energy efficiency, and design and build green buildings in order to reduce the risk of cancer and therefore to improve the health of the inhabitants.