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The asbestos industry in Belgium (1945-2001)

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Introduction

Belgium was a major international manufacturer of asbestos products in the post-war years. However, specific information on Belgian asbestos industries is scarcely available. In light of the serious health effects of asbestos exposure, knowledge on exposure circumstances is a vital key to understanding the magnitude of the asbestos problem in Belgium.

De term 'asbestos' refers to a group of six naturally occurring minerals, as shown in figure 1. Because asbestos minerals can be split into microscopic fibres, numerous different applications are possible. Asbestos often occurs in blends with resin, cement or plastics. Uniquely, asbestos minerals can also be spun into textile. In addition to the versatility of the material, one of the main advantages is that asbestos remains unaffected by fire and heath. Asbestos is a durable, lightweight, electrically non-conductive material with great insulating properties due to a high resistance to water, acids and microorganisms. Finally, it has a number of economic advantages: it is abundant and inexpensive to mine. These advantages made asbestos, in many respects, an ideal material for an industrializing and electrifying world.[1]

Two mineralogical groups of asbestos can be discerned: serpentines and amphiboles. The serpentine group is characterised by curled fibres that split crossways. The only asbestos type within this group is chrysotile asbestos, used most commonly for industrial purposes. The amphiboles have straight, needle-like fibres that split lengthwise. Amphiboles crocidolite and amosite are commonly used in industrial applications.[2]

All types of asbestos minerals have been associated with adverse health effects. Asbestos exposure causes malignant mesothelioma, lung cancer, laryngeal cancer and ovarian cancer. Non-malignant asbestos-related diseases include asbestosis, pleural fibrosis and pleural plaques.[3] Studies indicate that amphibole types are even more hazardous than chrysotile asbestos, because of their physical and chemical characteristics. However, the degree of risk related to the type, shape and size of the fibres remains a matter of on-going debate.[4]

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[1] PWJ Bartrip (2004) 'History of Asbestos Related Disease', *Postgraduate Medical Journal*, 80.940, 72–76.

[2] Robert L Virta (2002) 'Asbestos: Geology, Mineralogy, Mining and Uses' (Open-File Report 02-149).

[3] International Agency for Research on Cancer (2012) 'Asbestos (Chrysotile, Amosite, Crocidolite, Tremolite, Actinolite, and Anthophyllite)', in *A Review of Human Carcinogens. Part C: Arsenic, Metals, Fibers, and Dusts/ IARC Working Group on the Evaluation of Carcinogenic Risks to Humans*, Volume 100 (Lyon, France: International Agency for Research on Cancer), 219–309.

[4] Ronald F Dodson, Mark A L Atkinson and Jeffrey L Levin (2003) 'Asbestos Fiber Length as Related to Potential Pathogenicity : A Critical Review', *American Journal of Industrial Medicine*, 44, 291–97; D Wayne Berman and Kenny S Crump (2008) 'Update of Potency Factors for Asbestos-Related Lung Cancer and Mesothelioma.', *Critical Reviews in Toxicology*, 38 Suppl 1, 1–47

The long history of industrial asbestos use is now unravelling, with severe implications on population health in Belgium. Due to the long latency periods of asbestos-related diseases, the impact of asbestos exposure on health becomes apparent decades after exposure.[5] Global mortality rates are increasing for malignant mesothelioma, which is caused almost exclusively by asbestos exposure.[6] Recent research shows Belgium has one of the highest mesothelioma death rates in the world.[7]

A large proportion of victims have been occupationally exposed due to extensive asbestos use in various industries.[8] The impact of asbestos exposure can only be fully comprehended when we have a clear understanding of the exposure circumstances in these industries. Information on employment size and production processes may help determine the population at risk. Knowledge on the number of exposed and the level of exposure may provide some indications about future asbestos-related mortality. Dutch research shows how historic exposure measurements and data can be used in analyses with the help of a job exposure matrix.[9] Information on exposure circumstances may also lead to new insights in the profile of highly exposed workers, possibly increasing vigilance among workers and health professionals. Finally, identifying the sources of occupational exposure may also shed some light on environmental exposure to asbestos.

Figure 1 Six types of asbestos fibres
Original image by Asbestorama[10], lay out modified by authors.

[5] E Jamrozik, N de Klerk and AW Musk (2011) 'Asbestos-Related Disease', *Intern Med J*, 41, 372–80.
[6] V Delgermaa and others (2011) 'Global Mesothelioma Deaths Reported to the World Health Organization between 1994 and 2008', *Bull. World Health Organ.*, 89, 716–24C.
[7] Laura Van den Borre and Patrick Deboosere (2014) 'Asbestos in Belgium: An Underestimated Health Risk. The Evolution of Mesothelioma Mortality Rates (1969-2009).', *International Journal of Occupational and Environmental Health*, 20.2, 134–40.
[8] Asbestfonds/Fonds amiante (2012) *Het Asbestfonds. 5-Jarig Bestaan (2007-2012)* (Brussel), 44 p.
[9] A Burdorf and P Swuste (1999) 'An Expert System for the Evaluation of Historical Asbestos Exposure as Diagnostic Criterion in Asbestos-Related Diseases.', *The Annals of Occupational Hygiene*, 43, 57–66.
[10] Asbestorama, *Asbestos Awareness Minerals*, 2013

Methodology

This study aims to provide an inventory of the available information on the Belgian asbestos industry in order to understand exposure circumstances among Belgian asbestos product manufacturers and identify possible sources of non-occupational exposure related to these industries.

Four specific research objectives are formulated:

a) Identify asbestos product manufacturers;
b) Gain insight in the manufacturing process, complete with available information on exposure levels, type of asbestos used and period of asbestos use;
c) Record information on employment size and working conditions;
d) Report potential sources of environmental or second-hand exposure to asbestos, related to the identified manufacturers.

We focus on the manufacturers that were active in 1945-2001. This period is chosen because of the high level of industrial asbestos use in post-war years and the significance on recent and future population health. Belgium banned all industrial asbestos use in 2001. Some of the asbestos companies have had long histories of asbestos use. In order to gain a full understanding of the manufacturing process and the duration of asbestos exposure, available information preceding this period is also included in the description of asbestos companies active in 1945-2001.

A comprehensive literature review is performed in order to achieve the four stipulated research objectives. The search of asbestos exposure data is complicated by the dispersal of records. As a result, a variety of sources have been consulted.
A first line of inquiry focused on academic literature. However, only few Belgian sources mention specific asbestos manufacturers.[11] Secondly, various government documents were scrutinized, including committee hearings and annual statistics on trade and production.[12] In addition, we examined legislative documents such as proposals for new bills and the ruling of the Belgian Eternit trial.[13] The Crossroads Bank for Enterprises has also been consulted. The federal register contains information on all legal Belgian enterprises, both active and non-active. Some inaccuracies may occur, as the responsibility of reporting lies with the

[11] R Vande Weyer (1973) 'Bilan de L'indemnisation de L'asbestose.', *Acta Tuberc Pneumol Belg*, 64, 304–51; Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015) *Post-War Building Materials in Housing in Brussels 1945-1975* (Brussels: Vrije Universiteit Brussel), 437 p. ; H. Van De Voorde and others (1967) 'Doodsoorzaken bij de bevolking woonachtig rond en bij de arbeiders werkzaam in een asbestverwerkende nijverheid in het noorden van Brabant', *Acta Tuberc Pneumol Belg*, 58.6, 924–42.
[12] Flemish Committee for environment, nature conservation and planning. Meeting 26 April 2011, *Vraag Om Uitleg van de Heer Kris Van Dijck Tot Mevrouw Vera Dua, Vlaams Minister van Leefmilieu En Landbouw, over de Sanering van de Gronden van Balmatt* (Commissie voor Leefmilieu, Natuurbehoud en Ruimtelijke Ordening); Nationaal Instituut voor de Statistiek, *Jaarlijkse Produktiestatistieken-Statistiques Annuelles de La Production 1973-1994* (Brussel).
[13] Belgian Chamber of representatives. Legislative proposal (1988) *Wetsvoorstel Betreffende de Bescherming van Mens En Milieu Tegen de Schadelijke Gevolgen van Asbest*, V. Feaux and E. Tomas, 35 p.; Rechtbank van eerste aanleg te Brussel (2011) Eindvonnis op tegenspraak in de zaak Jonckheere-Vannoorbeeck vs. Eternit, 48 p.

enterprises.[14] Furthermore, company records were investigated. Despite considerable effort, only few sources were located.[15] Because many companies went bankrupt as regulations became stricter, we believe much information may have been destroyed. Four of the former asbestos products manufacturers have been able to make the switch to asbestos-free materials. Their company websites have been visited. Existing inventories such as databases of information on historical heritage and the Dutch 'asbestos map' have also been used to obtain information on Belgian asbestos industries.[16] Specific information on asbestos victims in Belgium is available at the Funds for Occupational Diseases, the Asbestos Fund and the Belgian Association for Asbestos Victims (ABEVA).[17] Finally, local, national and international media have been consulted using the GoPress database.[18]

Although many industries have used asbestos or asbestos-containing materials, we have chosen to focus on the primary asbestos industry. Only companies using raw asbestos fibres for the fabrication of (semi) finished goods are featured in this study. If at least two independent sources acknowledged asbestos use in the manufacturing process, the company has been included in our inventory. A map of the locations of asbestos product manufacturers has been made using QGIS-software.[19]
We further distinguish eight different types of industries. Classifying companies in types of industries was sometimes ambiguous. Considering the difficulties in determining the specific composition of the products, we have chosen to differentiate based on the function of the asbestos products. For example, asbestos cement was used in some types of insulation materials. Rather than classifying these manufacturers in the asbestos cement industry, we assigned these manufacturers to the insulation industry.

The results of the literature review are presented below. Considering the difficulties in accessing information on asbestos products manufacturers, our findings cannot be considered as an exhaustive inventory of asbestos industries in Belgium. Additional sources of information are still being scrutinized to improve the inventory and add new information if possible.
First, we first provide a brief overview of industrial asbestos use in Belgium in the post-war years. Second, we have listed the identified asbestos product manufacturers by the type of industrial activity. A summary of the available information is stated per asbestos product manufacturer.

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[14] 'Crossroads Bank for Enterprises (CBE)', *Kruispuntbank van Ondernemingen- Banque-Carrefour Des Entreprises*, economie.fgov.be/nl/ondernemingen/KBO/#.Vr…
[15] E van der Rest and L Moerenhout (1980) *Eternit. 1905-1980.* (Kapelle-op-den-Bos, Belgium: Eternit N.V.; Eternit S.A., *Jaarverslag – Rapport Annuel, 1983-1998* (Kapelle-op-den-Bos, Belgium: Eternit N.V.).
[16] 'Onroerend Erfgoed', https://www.onroerenderfgoed.be/nl//; 'Asbestkaart. Producten', http://www.asbestkaart.nl/asbestkaart.html
[17] Asbestfonds/Fonds amiante (2012) *Het Asbestfonds. 5-Jarig Bestaan (2007-2012)* (Brussel), 44 p.; Fonds voor de Beroepsziekten (2004) *Beroepsziekten Veroorzaakt Door Asbest. Criteria Voor Diagnose En Schadeloosstelling* (Brussel) 19 p.; Michel Verniers (s.d) 'La Vie à La S.A. Fabrecim Coverit Racontée Par Michel Verniers', 25 p.
[18] 'GoPress', http://www.gopress.be/info/nl
[19] *QGIS*, version 2.8.1 Wien.

Historical overview of asbestos use in Belgium.

Belgium has no natural deposits of asbestos minerals. All asbestos was imported since the emergence of the Belgian asbestos industries in the late 19th century. Belgian asbestos companies experienced a first powerful impetus with the reconstruction after the First World War. The United States became a prime outlet for Belgian asbestos cement products. Owing to the economic turmoil during the Great Depression, the Belgian asbestos industry turned to its domestic market and began further differentiation in asbestos cement products.[20] The Second World War made manufacturing grind to a halt. Virta has compiled international data on supply and consumption trends of raw asbestos, including data for Belgium.[21]

Because of an economic partnership established in 1921, records for Belgium and Luxembourg are combined.[22] The vast majority of asbestos was used for manufacturing in Belgium as shown by the comparison with national records from the Belgian asbestos cement industries in 1970-1992.[23] Table 1 shows the amount of raw asbestos fibres used in Belgium and Luxembourg at four time points, as reported by Virta,[24] and the corresponding amount of asbestos used in the Belgian asbestos cement industry, as reported in the Belgian census of production.[23] We have calculated the proportion of asbestos consumption in Belgian asbestos cement industries within the total consumption in Belgium and Luxembourg as a percentage. The two sources show some inconsistency, as evidenced by the excess of 100% in 1985. Despite possible rounding or registration differences, it is clear that the vast majority of asbestos was intended for Belgian asbestos industries.

Table 1 Raw asbestos used in the Belgian asbestos cement industry and in Belgium and Luxembourg, in metric tons, 1975-1990

Year	Belgian asbestos cement industry [24]	Belgium and Luxembourg [23]	% within Belgium and Luxembourg
1975	50978	58828	86.66
1980	47128	47823	98.55
1985	25069	24884	100.74
1990	25562	26204	97.55

[20] R Cleemput (1948) 'Monographie van Het Asbestcementfabriek A.L.F.I.T.', Dissertation KU Leuven (Leuven).
[21] Robert L Virta (2006) *Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003* (Reston (VA): U.S. Department of the Interior- U.S. Geological Survey Report No.: Circular 1298, 80 p.
[22] Eduard Somers (2012) 'Belgium Luxemburge Economic Union', *Max-Planck Encyclopedia of Public International Law*, 1, 869–74.
[23] Data derived from Nationaal Instituut voor de Statistiek, *Jaarlijkse Produktiestatistieken-Statistiques Annuelles de La Production 1973-1994*.
[24] Data derived from Robert L Virta (2006)

Figure 2 shows consumption data of raw asbestos for Belgium and Luxembourg in 1930-2001. The negative value in 1940 indicates an export from stock at the start of the Second World War. After the war, asbestos use increased steeply. By 1950, levels of consumption even exceeded pre-war levels.

Although not immediately apparent from the absolute amount of asbestos used, Belgium dealt in asbestos more so than other countries. According to Nawrot and colleagues, Belgium had one of the highest asbestos consumption levels per capita in the world during the sixties.[25] For a population of 10 million, 53,790 metric tons of asbestos was used on average every year during the 1960s.

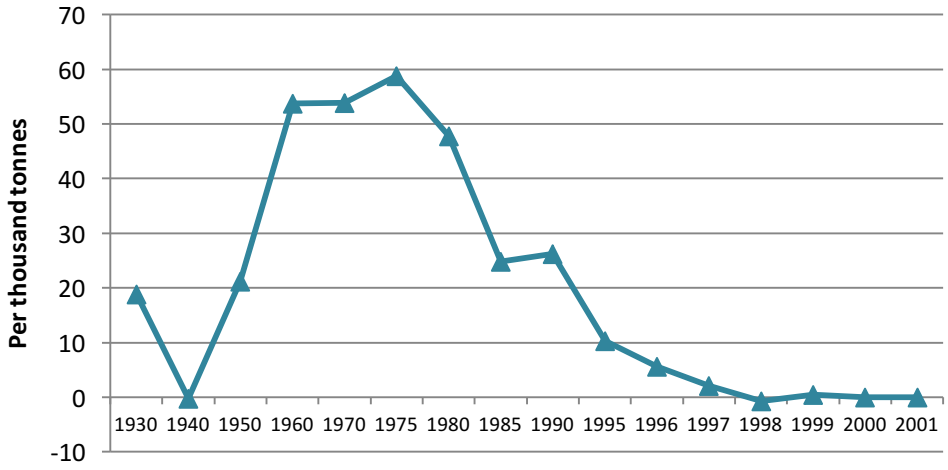

Figure 2 Apparent consumption of raw asbestos fibres in metric tons, Belgium and Luxembourg, 1930-2001 [26] [27]

Despite reports on the adverse health effects of asbestos exposure since the 1930s, consumption kept rising during the 1960s and 1970s.[28] After the fire in the shopping centre Innovation in Brussels in 1967, the use of asbestos-containing materials was even further promoted in Belgium.[29] Asbestos consumption peaked in 1975, after which a gradual decline set in. A number of legislative restrictions were implemented in the 1980s, mainly driven by European directives. Unlike other countries, public awareness of asbestos-related health risks remained low in Belgium.[30] From the late 1970s onwards, the public broadcasting company of the French speaking community in Belgium (RTBF) reported on the health

[25] TS Nawrot and others (2007) 'Belgium: Historical Champion in Asbestos Consumption', *Lancet*, 369.9574, 1692.

[26] Data derived from Robert L Virta (2006) *Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003* (Reston (VA): U.S. Department of the Interior- U.S. Geological Survey Report No.: Circular 1298.p 41-74.

[27] Apparent consumption has been calculated by Virta (2006) as import minus export for Belgium and Luxemburg. Data are provided in a 10-year time intervals for the period 1930-1960, in 5-year time intervals for 1970-1995, and annually for 1996 -2003.

[28] R Doll (1955) 'Mortality from Lung Cancer in Asbestos Workers.', *British Journal of Industrial Medicine*, 12.2, 81–86; ERA Merewether and CW Price (1930) 'Report on Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry' (London: HMSO); JC Wagner, CA Sleggs and P Marchand (1960) 'Diffuse Pleural Mesothelioma and Asbestos Exposure in the North Western Cape Province', *British Journal of Industrial Medicine*, 17, 260–71.

[29] Evelien de Kezel (2013) *Asbest, Gezondheid En Veiligheid. Ontwikkelingen in Het Aansprakelijkheidsrecht* (Antwerpen: Intersentia), 756 p.

[30] Ibid.

hazards of asbestos on several occasions.[31] Still, the broadcasts did not create much of a stir the general public.[32] More alarming were the reports of environmental exposure in the prison of Jamioulx (1984) and the offices of the European Community (1986).[33] However, media attention for asbestos remained relatively low until the mid-1990s.[34] By then, the use of sprayed-on asbestos was banned (1980), the use of crocidolite was restricted (1980), maximum exposure levels were stipulated and gradually became stricter (1980; 1983; 1986; 1991; 1993). Only in 1998, a formal ban on all types of asbestos was passed. A number of specific industrial applications were still allowed for chrysotile asbestos until 2001.[35] After 1998, small amounts of imported asbestos are reported.[36] This can be explained by transhipments in the Antwerp harbour.[37]

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[31] Marie-Anne Mengeot and Salvator Nay, 'Work and Health: To Die for Asbestos-Le Travail Où La Santé: Mourir de L'amiante' (*RTBF*), television production 1977.

[32] Ibid; Belgian Senate. Legislative proposal (1986) *Voorstel van Wet Betreffende de Bescherming van Mens En Milieu Tegen de Schadelijke Gevolgen van Asbest. Zitting 1986-1987: 4 December 1986*, 32 p.

[33] Belgian Senate. Legislative proposal (1986).

[34] Marc Molitor (2010) *Négociations et Tensions Autour de La Création Du Fonds Amiante*, Courrier hebdomadaire du CRISP (Brussels: CRISP- Centre de Reserche et d'Information Socio-Politiques), 61 p.

[35] Evelien de Kezel (2013) *Asbest, Gezondheid En Veiligheid. Ontwikkelingen in Het Aansprakelijkheidsrecht* (Antwerpen: Intersentia), 756 p.

[36] Robert L Virta (2006) *Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003* (Reston (VA): U.S. Department of the Interior- U.S. Geological Survey Report No.: Circular 1298, 80 p.

[37] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.

Primary asbestos industry

We have identified 22 manufacturing sites in 16 Belgian municipalities, as shown in figure 3. Labels refer to the headings of the asbestos companies, which are described below. Companies are classified in eight different industries: Asbestos cement manufacturing (A); Flooring (B); Insulation (C); Textile (D); Automobile (E); Electricity (F); Paper and Felt (G); and Aluminum foil (H).
15 out of 22 manufacturing sites were located in Flanders, which is the northern part of Belgium. We found two companies in the Brussels Capital region and five in Wallonia. Table 2 presents an overview of the locations of identified companies and the period in which they used asbestos. 13 companies started manufacturing asbestos products before 1945. During the heydays in the 1960s, 18 asbestos companies were active. Seven companies continued to use asbestos until the late 1990s.

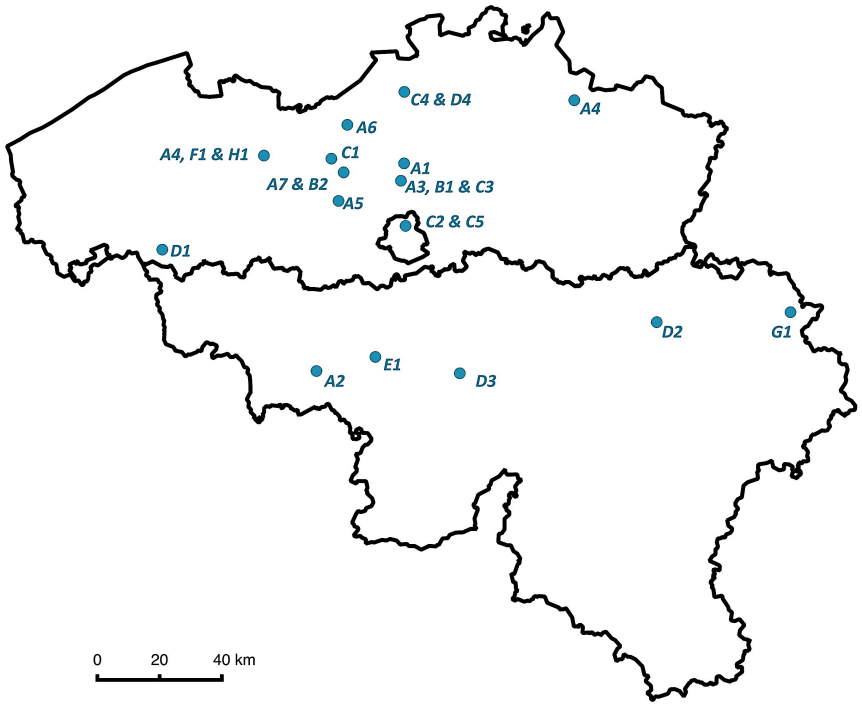

Figure 3 **Belgian asbestos industries active in 1945-2001.**

Table 2 Identified asbestos products manufacturers in Belgium active in 1945-2001 with location and period of asbestos use.

Name of the company	Location	Period of asbestos use
A1 Alfit	Tisselt (Willebroek)	1933 → 1971
A2 Coverit	Harmignies (Mons)	1924 → 1987
A3 Eternit	Tisselt (Willebroek)	1929 → 1998
A3, B1 & C3 Eternit	Kapelle-op-den-Bos	1924 → 1996
A4 JM Balmatt	Mol	1923 → 1997
A4 JM Balmatt	Ghent	1962 → 1997**
A5 Modernite	Hofstade (Aalst)	1965 → 1984
A6 Scheerders- Van Kerchove (SVK)	Sint-Niklaas	1923 → 1998
A7 Asbestile	Schoonaarde (Dendermonde)	1913 → 1951
B2 Fademac	Schoonaarde (Dendermonde)	*
C1 Aeroplast	Zele	1967 → 1969**
C2 Etablissements Ernest Lenders	Ixelles (Brussels)	1945 → 1955
C4 Fourisol	Wilrijk (Antwerpen)	*
C5 Société Belge Isolex	Ixelles (Brussels)	1950 → 1974**
D1 Charles Delvoye	Kortrijk	1946 → 1970**
D2 Douha Dor	Jemeppe-sur-Meuse (Seraing)	1939 → **
D3 La Filature des feutres et amiantes d'Auvelais	Auvelais	1905 → 1977
D4 Belgische Asbest- en rubberfabriek	Deurne (Antwerpen)	1905 → **
E1 Don International	Manage	1966 → **
F1 Vynckier	Ghent	1922 → 1998**
G1 Von Asten	Eupen	1885 → 1998
H1 Usines Pol Madou	Ghent	1897 → 1975

*No information available; **Approximation of time period based on available information

A. Asbestos cement industry

The Austrian inventor Ludwig Hatschek first patented the technical process of asbestos cement in Austria in 1900. Raw asbestos was transformed into pulp and then mixed with cement and water. The proportion consisted of 10-15% asbestos fibres and 85-90% cement.[38] Predominantly chrysotile fibres were used.[39] The use of amphiboles amosite and crocidolite has also been reported in Belgian asbestos cement industries to further increase tensile strength.[40]

Asbestos cement products are the most important application of asbestos worldwide.[41] Because of the versatility of asbestos cement, applications are numerous. Popular products include corrugated sheets, roof slates and pipes, but also asbestos cement counter tops and decorative ornaments were produced.[42]
In Belgium, the large majority of imported fibres were used in the production of asbestos cement products, as indicated in table 1. Cleemput corroborates the importance of asbestos cement in the Belgian asbestos industry in the late 1940s in his dissertation.[43] Further implementation of asbestos in other industries, such as textiles, did not play a significant role in Belgium as opposed to the U.S.A. or the U.K.. According to the association of asbestos manufacturers, the Committee of Information for Asbestos Benelux (CIAB), the asbestos cement industry used 93 % of the 31,000 tonnes of asbestos that was consumed in Belgium in 1985.[44] The Flemish public waste management services (OVAM) estimates that the manufacturing of asbestos cement products constitutes 96% of all asbestos production in Belgium.[45]

Figure 4 presents the employment size in the asbestos cement industry for the period 1973-1994. Almost 5,000 people were working in 6 asbestos cement companies in the early 1970s. Only three manufacturers remained in 1994. Over the period of 21 years, the number of employees has decreased with 65% in the asbestos cement industry. The number of manual workers has fluctuated over time between 82% and 85% of all employees. The large majority of asbestos cement workers were male: less than 1 out of ten manual workers was a woman. Among non-manual workers, approximately 26% was female.

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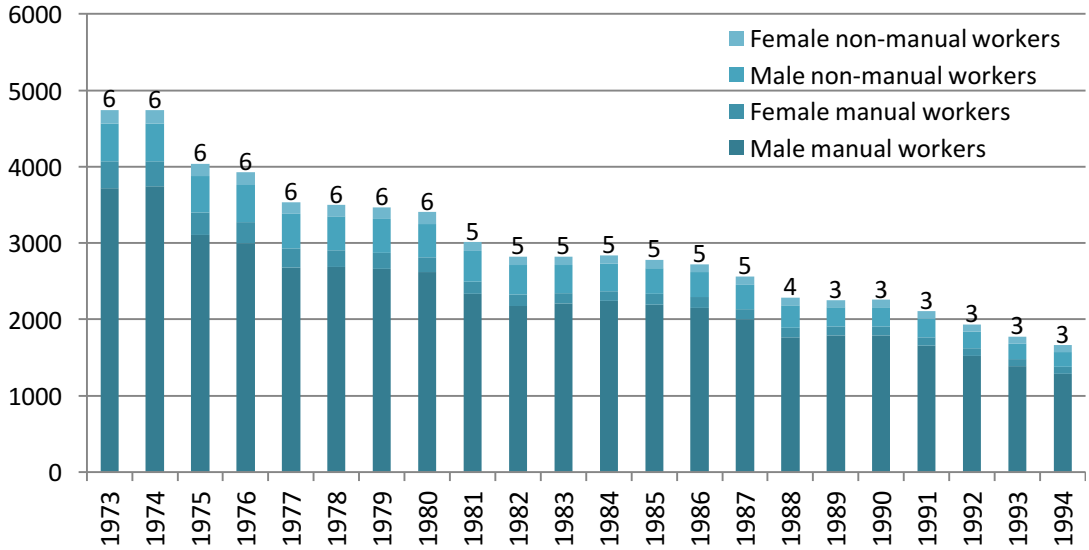
[38] H Frey (1940) 'L'Eternit: L'evolution de Ses Procédés de Fabrication', *Bulletin Technique de La Suisse Romande*, 66, 273-81; Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015) *Post-War Building Materials in Housing in Brussels 1945-1975* (Brussels: Vrije Universiteit Brussel), 437 p.
[39] AM Pye (1979) 'A Review of Asbestos Substitute Materials in Industrial Applications', *Journal of Hazardous Materials*, 3.2, 125–47.
[40] Rechtbank van eerste aanleg te Brussel (2011) Eindvonnis op tegenspraak in de zaak Jonckheere-Vannoorbeeck vs. Eternit, 48 p.
[41] Robert L Virta (2006) *Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003* (Reston (VA): U.S. Department of the Interior- U.S. Geological Survey Report No.: Circular 1298, 80 p.
[42] Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015).
[43] R Cleemput (1948) 'Monographie van Het Asbestcementfabriek A.L.F.I.T.', Dissertation KU Leuven (Leuven).
[44] Belgian Chamber of representatives. Legislative proposal (1988) *Wetsvoorstel Betreffende de Bescherming van Mens En Milieu Tegen de Schadelijke Gevolgen van Asbest*, V. Feaux and E. Tomas, 35 p.
[45] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.

Figure 4 Employment size in absolute numbers in the Belgian asbestos cement industry, 1973-1994[46] [a]

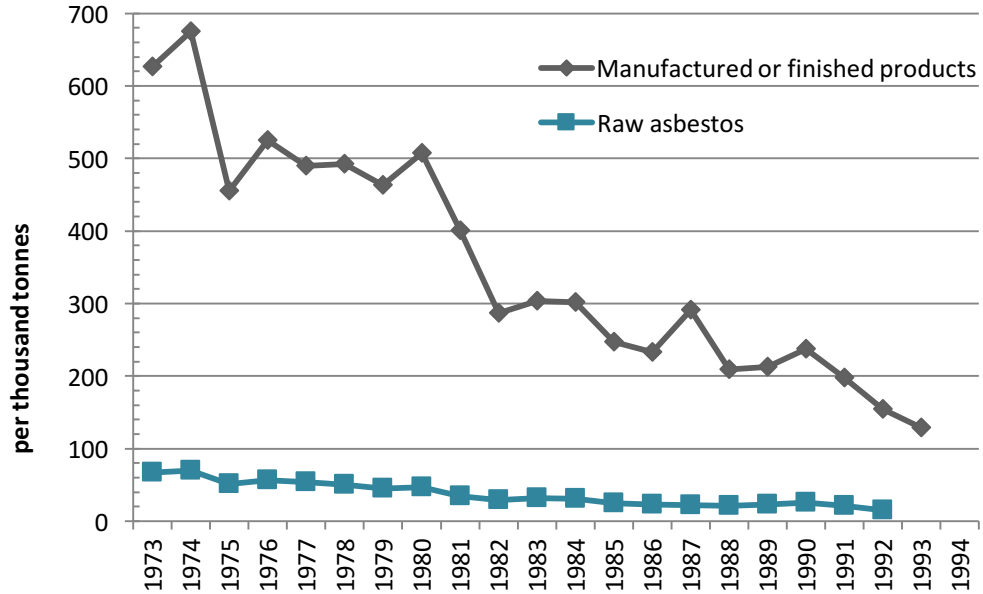


a Number above bars represent the number of asbestos cement companies in Belgium at the time.

Figure 5 presents the raw asbestos consumed by the Belgian asbestos cement industries from the early 1970s to the early 1990s, as well as the manufactured asbestos cement products at this time.[47] Corresponding to the decline in employment, use and manufacturing dropped with approximately 80% over the 20-year period. Considering the large quantity of asbestos used in the Belgian asbestos cement manufacturing until 1998, health effects due to occupational asbestos exposure are of high concern. The sheer volume of manufactured goods provides an indication of the level of activity on the factory floor. In addition, it may also indicate the size of potential secondary asbestos exposure. As many asbestos cement products are still in place today, fibres may be released in the environment due to deterioration or handling of the products.[48]

[46] Nationaal Instituut voor de Statistiek, *Jaarlijkse Produktiestatistieken-Statistiques Annuelles de La Production 1973-1994*.
[47] Ibid.
[48] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.

Figure 5 Manufactured or finished products and raw asbestos used in Belgian asbestos cement companies in metric tons, 1973-1993.[49] [50]



We have located seven manufacturing sites of asbestos cement products in Belgium. All seven are listed below in alphabetical order, with a summary of the available information.

A1. Alfit in Tisselt (Willebroek)

The company Alfit manufactured asbestos cement products in Tisselt in the period 1933-1970.[51] Previously, the Amelinckx family owned the factory, known then as Amelit.[52] The factory produced corrugated sheets, pipes and slates in asbestos cement.

Alfit was the topic of a dissertation in economics by Cleemput in 1948.[53] The result is a detailed description of this asbestos cement factory in the early post-war years.
At full capacity 70 people were employed. Work was divided in three shifts, allowing the company to manufacture night and day. The factory had two machines to produce asbestos cement plates. Pipes were constructed by hand. According to the floor plan, the different production units were located in the same large factory hall. In other words, raw asbestos fibres were handled in the same room as the repair work. Administrative services were located in an adjacent room to the main factory hall. Usually, finished products consisted of 10-15% asbestos fibres. Asbestos fibres originated mostly from Canada, South Africa and

[49] Nationaal Instituut voor de Statistiek, *Jaarlijkse Produktiestatistieken-Statistiques Annuelles de La Production 1973-1994*.
[50] Since 1993, the annual census of production no longer includes the amount of raw asbestos in tonnes. Since 1994, the amount of manufactured products has also been omitted.
[51] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.
[52] Agentschap Onroerend Erfgoed, 'Tegelfabriek Emannuel Rottiers', *Inventaris Onroerend Erfgoed*, https://id.erfgoed.net/erfgoedobjecten/1844 [accessed 4 January 2016].
[53] R Cleemput (1948) 'Monographie van Het Asbestcementfabriek A.L.F.I.T.', Dissertation KU Leuven (Leuven).

Italy.[54] Considering the natural deposits in these countries, Alfit may have used chrysotile (Canada, South-Africa and Italy), amosite (South-Africa), crocidolite (South-Africa) and tremolite (Italy) in the late 1940s.[55] The company had three trucks to transport the raw materials and finished products. The canal Willebroek-Brussels was in the immediate proximity of the factory, but inland shipping was only seldom employed for transport.[56]

We found indications of considerable environmental exposure in the past. The proprietor of the Alfit factory also owned the nearby nature reserve Blaasveldbroek. Because the site was abounding in water, asbestos waste was used to elevate pathways and banks until 1970. This area was remediated by the public waste management services in Flanders (OVAM) during the 1990s.[57] According to OVAM, both chrysotile and amphibole types were used to raise a total of 2.5 km of paths and embankments. The volume of asbestos-containing materials in the area was estimated to be 12,000 m^3.[58]

A2. Fabrecim-Coverit in Harmignies (Mons)

Fabrique Réunies de Fibro-ciment-Coverit, in short Coverit, was the only asbestos cement manufacturer in the Walloon region in the south of Belgium.[59] Originally, Coverit started out as a division of the company Ciments Portland Artificiels Belges D'Harmignies in 1924.[60] The company produced mainly white Portland cement, which is the white version of a common cement type. The Coverit division was responsible for the production of asbestos cement products. The company was taken over by the Cimenteries et Briqueteries Réunies (CBR) and the Comptoir Mobilier et Financier in 1963. CBR was one of the most important cement manufacturers in Belgium at the time.[61] The company still produced Portland cement under the new name Fabrecim-Coverit.[62] However, work efforts were now mainly focused on asbestos products manufacturing. The company produced slates and pipe in asbestos cement.[63]

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[54] Ibid.

[55] Robert L Virta (2006) *Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003* (Reston (VA): U.S. Department of the Interior- U.S. Geological Survey Report No.: Circular 1298, 80 p.

[56] R Cleemput (1948) 'Monographie van Het Asbestcementfabriek A.L.F.I.T.', Dissertation KU Leuven (Leuven).

[57] Flemish Committee for environment and nature conservation, agriculture, fishing and rural policy, planning and historic buildings. Committee hearing 10 January 2007, *Hoorzitting over de Verspreiding van Asbest in Het Milieu (Commissie voor Leefmilieu en Natuur, Landbouw, Visserij en Plattelandsbeleid en Ruimtelijke Ordening en Onroerend Erfgoed),* report by Joke Schauvliege and Rudi Daems (Brussel).

[58] OVAM, 'Asbest En Bodem. Soorten Asbestbodemverontreiniging',http://www.ovam.be/asbest-en-bodem [accessed 26 January 2016].

[59] René Brion and Jean-Louis Moreau (2007) *Inventaire Des Archives Du Groupe Cimenteries CBR Cementbedrijven. 1854-2002* (Association pour la Valorisation des Archives d'Entreprises a.s.b.l. Archives Générales du Royaume Inventaires), 416 p.

[60] Michel Verniers (s.d) 'La Vie à La S.A. Fabrecim Coverit Racontée Par Michel Verniers', 25 p.; De Block (1933) 'Cinquième Exposition Internationale Du Bâtiment', *La Cité. Revue Mensuelle Belge D' Architecture et D' Urbanisme*.

[61]CRISP (1963) 'L'industrie Cimentière En Belgique.', *Courrier Hebdomadaire Du CRISP 1963/42*, 222, 23 p.

[62] Ibid.; René Brion and Jean-Louis Moreau (2007).

[63] Marc Molitor (2010) *Négociations et Tensions Autour de La Création Du Fonds Amiante*, Courrier hebdomadaire du CRISP (Brussels: CRISP- Centre de Reserche et d'Information Socio-Politiques), 61 p.

Although we cannot pinpoint the exact timing, the company became in need of financial support, probably during the late 1970s and early 1980s.[64] A new investor stepped in: Eternit became majority stockholder of 99% of the company.[65] Société Générale, one of the large investors of CBR, held the remaining one per cent.[66] The factory at Harmignies closed with 257 people on the payroll in 1987.[67] The motives remain unclear. According to Michel Verniers, former employee at Coverit, the company claimed to have difficulties keeping up with the high quality recommendations for their products. Verniers himself believes the decision was induced by the increasing number of reports of asbestos-related diseases among workers.[68]

Michel Verniers started his career at Coverit at the age of 14 in 1956 and worked there for nearly 30 years. He recorded his experiences before his death due to peritoneal mesothelioma in 2009. The document provides a first hand testimony of the employment conditions at Coverit from the late 1950s onwards.[69]
According to Verniers, chrysotile and crocidolite were used in the production process. The mixture consisted of 2,858 l water, 231 kg asbestos and 1,500 kg cement. Raw asbestos was imported in burlap sacks via trucks or railway. Approximately 180 men and 30 women worked on the factory floor. Workers did not use masks or gloves.[70] According to director Philippe Janus, protective masks were available at the factory but workers only wore them seldom.[71] All divisions shared the same dressing rooms, thus possibly exposing workers that did not work directly with asbestos. The male dressing room had two showers, which were reserved for workers responsible for shredding and mixing raw asbestos. Female dressing rooms did not have shower facilities. The majority of workers went home covered in dust. Verniers notes additional work-related health risks such as accidents related to the machinery and exposures to coke gases and diesel exhausts from the forklifts.[72]
Awareness of asbestos-related health risks grew among workers in 1977, when the Walloon public broadcasting company (RTBF) featured the factory on television. A couple of months later, the workers received information on asbestos-related health risks. The document was composed by the Committee for information on asbestos for the Benelux (CIAB), an association of major asbestos manufacturers. [73]
Since 1984, more protective measures were implemented. The factory was modernized with new ventilation systems. Separate dressing rooms and showers were installed for male workers at the highest exposure levels. Attentive of health hazards associated with asbestos exposure, Verniers kept a list over the years registering the causes of death of his colleagues. At his last entry in May 2007, 132 of his former colleagues had died due to an asbestos-

[64] 'Cementgroep Groeit Uit Tot Konglomeraat Voor Bouwprodukten', *De Tijd*, 24 September 1994.
[65] Marc Molitor (2010) *Négociations et Tensions Autour de La Création Du Fonds Amiante*, Courrier hebdomadaire du CRISP (Brussels: CRISP- Centre de Reserche et d'Information Socio-Politiques), 61 p.; Michel Verniers (s.d) 'La Vie à La S.A. Fabrecim Coverit Racontée Par Michel Verniers', 25 p.
[66] Michel Verniers (s.d); René Brion and Jean-Louis Moreau (2007) *Inventaire Des Archives Du Groupe Cimenteries CBR Cementbedrijven. 1854-2002* (Association pour la Valorisation des Archives d'Entreprises a.s.b.l. Archives Générales du Royaume Inventaires), 416 p.
[67] Marc Molitor (2010).
[68] Michel Verniers (s.d).
[69] Ibid.
[70] Ibid.
[71] 'Fabriek van de Dood', *Gazet van Antwerpen*, 14 July 2004, p. 6.
[72] Michel Verniers (s.d).
[73] Ibid.

related disease.[74] The Belgian association of asbestos victims (ABEVA) continued his work and reported 171 deaths and 31 cases of asbestos-related diseases in 2013.[75]

The waste disposal site near the factory was sealed in 1998. Exposure levels have been measured at the site by the Walloon public waste management services (SPAQuE) in 2005-2006. No environmental asbestos exposure was found at the site at that time.[76]

A3. Eternit in Kapelle-op-den-Bos and Tisselt (Willebroek)

When Hatschek discovered the procedure for asbestos cement manufacturing, he decided to call the new material 'Eternit' to reflect its durability.[77] Alphonse Emsens was one of the first to acquire a license for manufacturing this new type of asbestos cement. The Belgian Eternit started just north of Brussels in the little town of Haren in 1905. Three machines were used to manufacture asbestos cement slates and sheets.[78] In 1924, the company relocated to Kapelle-op-den-Bos. In 1929, a second Eternit factory opened in the nearby Tisselt where asbestos cement pipes were produced.
Eternit started looking beyond the Belgian borders in the 1930s, when it acquired five asbestos cement-manufacturing sites in the Netherlands. As a result, some of the production units were shifted between factories during the economic crisis in the early 1980s to solve the problem of excess capacity in the different Eternit branches. The production of corrugated sheets moved from Kapelle-op-den-Bos to the Dutch Eternit factory in Goor. Flat sheets were still being produced at the site. The factory in Tisselt became responsible for the entire production of asbestos cement pipes in the Low Countries.[79]
The Belgian Eternit Group grew out to be an important multi-national asbestos cement manufacturer, with important ties to the Swiss Eternit Group.[80] In the early 1990s, Eternit was active in over 32 countries across four continents.[81] The group changed its name to Etex Group in 1995. The last company in the Etex group stopped manufacturing asbestos cement products in 2003.[82]

The Eternit factories in Kapelle-op-den-Bos and Tisselt were the frontrunners of the Belgian asbestos cement industry. Belgian journalist Nay reports that the manufacturing site in Kapelle-op-den-Bos used approximately 35,000 tonnes of chrysotile; 3,000 tonnes of crocidolite and 1,000 tonnes of amosite in 1977.[83] Considering that 53,806 tonnes of raw asbestos was used in six Belgian asbestos cement companies in 1977, the supremacy of Eternit on the Belgian market is clear.[84]

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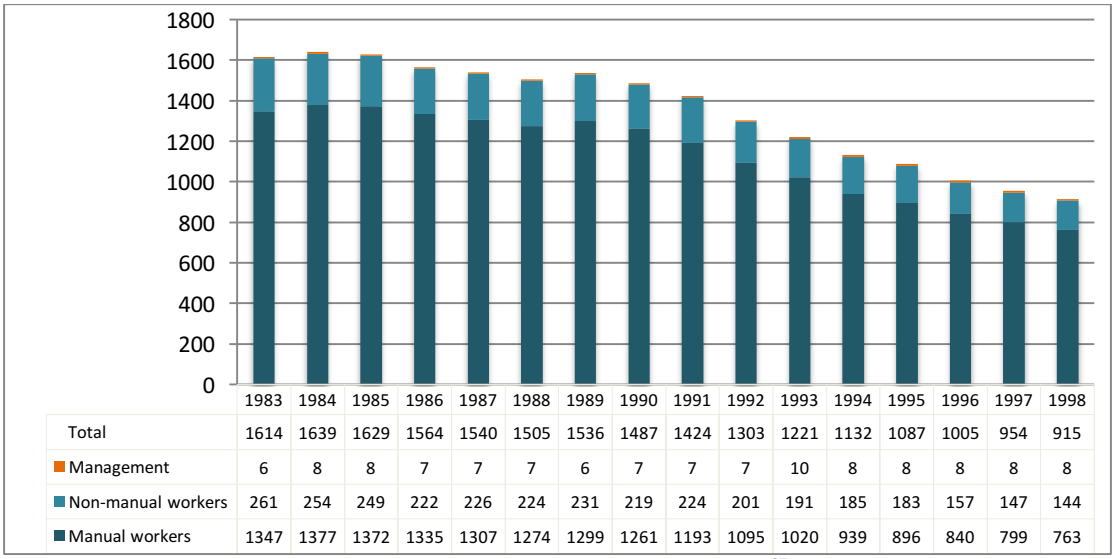
[74] Ibid.
[75] 'Asbest. De Stille Killer Wint Veld.', *Humo*, 14 May 2013, p. 124–31.
[76] 'Risque Maîtrisé Chez Coverit. Jusqu'ici...', *Le Soir*, 31 January 2008. p. 11.
[77] H Frey (1940) 'L'Eternit: L'evolution de Ses Procédés de Fabrication', *Bulletin Technique de La Suisse Romande*, 66, 273-81
[78] E van der Rest and L Moerenhout (1980) *Eternit. 1905-1980.* (Kapelle-op-den-Bos, Belgium: Eternit N.V.
[79] Robert Frank Ruers (2012) 'Macht En Tegenmacht in de Nederlandse Asbestregulering', Doctoral dissertation Erasmus Universiteit Rotterdam (Rotterdam).
[80] Ibid.
[81] Eternit S.A., *Jaarverslag – Rapport Annuel, 1991* (Kapelle-op-den-Bos, Belgium: Eternit N.V.).
[82] Robert Frank Ruers (2012).
[83] Salvatore Nay (1997) *Mortel Amiante* (Bruxelles: EVO).
[84] Nationaal Instituut voor de Statistiek, *Jaarlijkse Produktiestatistieken-Statistiques Annuelles de La Production 1977* (Brussel).

During the heydays in the 1960s and 1970s, over 3,000 people worked at the manufacturing sites in Kapelle-op-den-Bos and Tisselt.[85] Nay reports that out of the 2,500 employees in the late 1970s, only 80 workers had direct contact to raw asbestos.[86] Figure 6 shows the employment size by occupational category in the period 1983-1998, as published in annual company reports. Employment size has decreased with more than 40% over the 15-year period.



	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total	1614	1639	1629	1564	1540	1505	1536	1487	1424	1303	1221	1132	1087	1005	954	915
Management	6	8	8	7	7	7	6	7	7	7	10	8	8	8	8	8
Non-manual workers	261	254	249	222	226	224	231	219	224	201	191	185	183	157	147	144
Manual workers	1347	1377	1372	1335	1307	1274	1299	1261	1193	1095	1020	939	896	840	799	763

Figure 6 Size of employment in absolute numbers at Eternit NV in 1983-1998.[87]

Nay reports hazardous working circumstances in the 1970s.[88] Eternit confirms some of the employment conditions, but explains them as a sign of the times.[89] Dust extraction systems were installed during the 1950s and were modernized in the years thereafter. The use of protective masks was obliged from the early 1970s on but only for workers in charge of emptying the bags of raw asbestos. The production process was revised in the mid-1970s. The asbestos was kept wet during the entire manufacturing process to decrease exposure to asbestos dust. Plastic bags replaced burlap bags for transport. At the end of the 1970s, packaging further improved and the bags were provided with clear labels. By then, bags were opened automatically or manually with a filtering installation.[90]

According to Eternit, crocidolite was used only in specific products during the 1950s and 1960s. The factory in Tisselt used crocidolite to manufacture pipes until 1980. The use of amosite lasted until 1979 in Kapelle-op-den-Bos and until 1982 at the manufacturing site in Tisselt.[91] In order to adapt to the changing market demands, Eternit reports exploring new asbestos-free technologies in 1983.[92] Six years later, products without asbestos fibres

[85] Rechtbank van eerste aanleg te Brussel (2011) Eindvonnis op tegenspraak in de zaak Jonckheere-Vannoorbeeck vs. Eternit, 48 p.; 'Een Industrie Die Haar Sporen Niet Laat Uitwissen', *Knack*, 10 Augustus 2005, p. 44.
[86] Salvatore Nay (1997) *Mortel Amiante* (Bruxelles: EVO).
[87] Eternit S.A., *Jaarverslag – Rapport Annuel, 1983-1998* (Kapelle-op-den-Bos, Belgium: Eternit N.V.).
[88] Salvatore Nay (1997).
[89] Rechtbank van eerste aanleg te Brussel (2011) Eindvonnis op tegenspraak in de zaak Jonckheere-Vannoorbeeck vs. Eternit, 48 p.
[90] Ibid.
[91] Rechtbank van eerste aanleg te Brussel (2011).
[92] Eternit S.A., *Jaarverslag – Rapport Annuel, 1983* (Kapelle-op-den-Bos, Belgium: Eternit N.V.).

account for 71.6% of the total production (pipes excluded).[93] Eternit stopped using chrysotile asbestos in Kapelle-op-den-Bos in 1996 and in Tisselt in 1997.[94]

Van Cleemput and colleagues analysed the relation between the size of pleural plaques and cumulative exposure levels among asbestos cement workers. [95] Although the company name or location is not specified, we believe these workers were employed at Eternit. The acknowledgement section stipulates that Eternit paid for the CT-scans of the workers' lungs. The study reports estimates of exposure levels in three job categories, based on fibre measurements between 1970 and 1985. Mean exposure levels in 1975 were approximately 1.5 f/ml for product finishing; 1.8 f/ml for the production and storage of products; and 9.0 f/ml for the handling of raw asbestos material.

The factories did not only have an important economic impact on the surrounding towns, Eternit also fulfilled a societal role in the area as a meeting-place for various social and athletic clubs.[96] With approximately 79% of personnel living in a 10 km-radius of the factory, Eternit was firmly embedded in the region.[97]

Environmental exposure in the vicinity of the factories may have been substantial. Eternit and the Flemish public waste management services (OVAM) started remediating the factory grounds in the 1990s. Remediation was only completed in 2000.[98] OVAM has spent considerable effort in the remediation of the Kapelle-op-den-Bos and Tisselt area. Moerenhout and colleagues describe these projects in more detail, including the covering of the waste disposal sites in Kapelle-op-den-Bos (in 1988), Tisselt (in 1988) and Boom (in 1983).[99] Asbestos waste was also used frequently to elevate embankments and harden grounds in the area. As a result, pathways and driveways in private homes may also contain asbestos waste. The Flemish public waste services started a project in 2015 to remediate contaminated sites in 19 municipalities in the area.[100]

A4. J.M. Balmatt in Mol and Ghent

J.M. Balmatt started as a family business when six local families opened 'N.V. Beton en Mollith' in 1923. The company manufactured asbestos cement products in a new factory building near the Bocholt-Herentals canal. The American asbestos group Johns-Manville invested in the company some 5 years later. The new 'Johns –Manville' prospered after the Second World War with 150 to 200 workers employed in 1953.[101] A second manufacturing

[93] Eternit S.A., *Jaarverslag – Rapport Annuel, 1989* (Kapelle-op-den-Bos, Belgium: Eternit N.V.).
[94] Rechtbank van eerste aanleg te Brussel (2011).
[95] J Van Cleemput and others (2001) 'Surface of Localized Pleural Plaques Quantitated by Computed Tomography Scanning: No Relation with Cumulative Asbestos Exposure and No Effect on Lung Function.', *American Journal of Respiratory and Critical Care Medicine*, 163.3, 705–10.
[96] E van der Rest and L Moerenhout (1980) *Eternit. 1905-1980.* (Kapelle-op-den-Bos, Belgium: Eternit N.V.; Alain Finet and Romina Giuliano (2012) *Eternit. Outil de Destruction Massive* (Editions Estaimpuis).
[97] E van der Rest and L Moerenhout (1980).
[98] Rechtbank van eerste aanleg te Brussel (2011) Eindvonnis op tegenspraak in de zaak Jonckheere-Vannoorbeeck vs. Eternit, 48 p.
[99] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.
[100] OVAM, 'Inventarisatiefase Asbestproductieafval-Projectregio Kapelle-Op-Den-Bos/Willebroek', *Nieuwsbrief*, April 2015, 4 p.
[101] 'Staking Op de "Mollite" in 1953', *De Desselaar*, May 2012, p. 20.

site opened in Ghent in 1962.[102] Employment size rose up to 520 during the 1960s, with the large majority of workers remaining in Mol.[103] The company was sold to a number of board members and employees in 1983 after financial difficulties at the American company headquarters. This change in ownership was reflected in yet another change in name: J.M. Balmatt.[104] At this time, it was gradually dawning that asbestos exposure entails serious health risks and European legislation began implementing regulations on asbestos use.
J.M. Balmatt in Mol employed approximately 370 people in 1988. The company had stopped manufacturing asbestos products six months before the bankruptcy in July 1998.[105] At the time, the factory in Mol provided jobs to 187 manual workers and 48 administrative employees. Approximately 30 workers from the site in Ghent lost their jobs.[106]

The manufacturing site in Mol was heavily contaminated with asbestos, heavy metals and various chemicals.[107] OVAM estimated that the site contained approximately 58,500 m^3 of asbestos waste.[108] The remediation project was one of the biggest in Belgium. In 2003 and in 2005 some preliminary measures were taken, including the removal of the most hazardous asbestos waste. The site was sold to the Flemish government in 2007, after which OVAM and the Flemish Institute for Technological Research (VITO) started executing a major soil remediation project.[109] Rematt, the subsidiary of J.M. Balmatt, became an independent company in 1993 and still remains active at the remediated site in Mol as an asbestos disposal company.[110]

A5. Modernite in Hofstade (Aalst)

Little is known about asbestos cement manufacturer Modernite. The factory was a family business, according to Coverit-employee Michel Verniers.[111] Asbestos cement slates and pipes were manufactured between 1965 and 1984.[112]

Moerenhout and colleagues report that the factory grounds were elevated using asbestos waste. In addition, a waste disposal site was located on the site, which was covered in 1999. The size of the deposited waste is has been reported to have a volume of 15,000 m^3 by OVAM,[113] and of 24,000 m^3 by local media.[114] The waste has been covered and further remediation awaits financial influx.[115]

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[102] 'J.M. Balmatt Gooit Handdoek in de Ring - Molse Cementproducent Met 260 Werknemers Vraagt En Krijgt Gerechtelijk Akkoord', *Gazet van Antwerpen* (Kempen), 13 May 1998, p. 3.
[103] R Vande Weyer (1973) 'Bilan de L'indemnisation de L'asbestose.', *Acta Tuberc Pneumol Belg*, 64, 304–51.
[104] 'Staking Op de "Mollite" in 1953', *De Desselaar*, May 2012, p. 20.
[105] Flemish Committee for environment, nature conservation and planning. Meeting 26 April 2011, *Vraag Om Uitleg van de Heer Kris Van Dijck Tot Mevrouw Vera Dua, Vlaams Minister van Leefmilieu En Landbouw, over de Sanering van de Gronden van Balmatt* (Commissie voor Leefmilieu, Natuurbehoud en Ruimtelijke Ordening)
[106] 'J.M. Balmatt Gooit Handdoek in de Ring - Molse Cementproducent Met 260 Werknemers Vraagt En Krijgt Gerechtelijk Akkoord', *Gazet van Antwerpen* (Kempen), 13 May 1998, p. 3.
[107] OVAM, 'Mol - Balmatt Site', http://www.ovam.be/mol-balmatt-site [accessed 26 January 2016].
[108] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.
[109] OVAM, 'Mol - Balmatt Site'.
[110] ; 'Asbestbedrijf Rematt Draait Zonder Vergunning', *Het Nieuwsblad*, 1 December 1998,p. 14.; 'Crossroads Bank for Enterprises (CBE)', <economie.fgov.be/nl/ondernemingen/KBO/#.Vr…>.
[111] Michel Verniers (s.d) 'La Vie à La S.A. Fabrecim Coverit Racontée Par Michel Verniers', 25 p.
[112] Tim Moerenhout and others (2014).
[113] Ibid.

A6. Scheerders- Van Kerchove's Verenigde fabrieken (SVK) in Sint-Niklaas

The couple Léon-Jean Scheerders and Camilla van Kerchove started their business in 1905. The company performed a number of services including industrial bookbinding, the sale of coals and the manufacturing of bricks and tiles.[116] Scheerders-Van Kerchove's Verenigde fabrieken started producing asbestos cement products in 1923.[117] Although a new production unit was set up to manufacture asbestos-free corrugated sheets in 1990,[118] the use of asbestos in cement products lasted until 1998.[119] Vande Weyer reports an employment size of 420 people in 1953-1972.[120] Almost 700 were employed at SVK in 1994.[121]

A7. Asbestile in Schoonaarde (Dendermonde)

Not much is known about the asbestos cement manufacture N.V. Asbestile. The company produced asbestos cement products in the period 1913-1951.[122]

B. Flooring

Asbestos was used in flooring in a number of ways, as it could be used from main component to a mere filling agent. The most important type was vinyl flooring, considering the production size of these products, as well as the amount of fibres used in manufacturing.[123] We found two manufacturers of asbestos floors in Belgium.

B1. Eternit in Kapelle-op-den-Bos

Eternit also manufactured asbestos cement products for flooring. Three different types of panelling were produced: a solid panel 'Massal' which was most suitable for floors; a panel

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[114] 'Sanering Asbeststort Ligt Stil', *Het Laatste Nieuws (Denderstreek)*, 9 July 2011, p. 13.; '3,6 Miljoen Euro Voor Sanering Asbestsite', *Nieuws* (Tv Oost), http://www.tvoost.be/nieuws/3-6-miljoen-euro-voor-sanering-asbestsite-21484, [accessed 20 January 2016].

[115] Ibid.

[116] 'Ik Doe Mijn Werk Nog Altijd Even Graag Als Op de Eerste Dag', *Gazet van Antwerpen (Waasland)*, 22 November 2011, p. 18.

[117] SVK, 'Historiek', *SVK Company Website,* http://www.svk.be/nl/over-svk/historiek [accessed 20 January 2016].

[118] Ibid.

[119] 'SVK Produceert Geen Asbestmaterialen Meer', *Gazet van Antwerpen (Waasland)*, 13 November 1998, p.1.

[120] R Vande Weyer (1973) 'Bilan de L'indemnisation de L'asbestose.', *Acta Tuberc Pneumol Belg*, 64, 304–51

[121] 'SVK Wil 20 Jaar Zekerheid - Stad Organiseert Vanavond Hoorzitting over Milieuvergunning', *Gazet van Antwerpen*, 17 februari 1997, p. 10.

[122] 'Geschiedenis van Schoonaarde'(2009), http://www.dendermonde.be/product.aspx?id=1547 [accessed 29 January 2016].

[123] S Harmsma and HFHM. Mulder (2006) *Asbest in Kaart. Historisch Onderzoek Asbestgebruik Methode Asbestkansenkaart* (Groningen: ReGister), 164 p.

'333' which was to be used for floors and fire places; and hollow elements 'ACE' for stairs and fire places.[124]

B2. Fademac in Schoonaarde (Dendermonde)

Eternit N.V. was co-owner of Fademac.[125] The company was specialized in producing flexible synthetic materials for walls and floors, based on asbestos and polyvinyl chloride (PVC).[126]
A local newspaper published an advertorial on the factory in 1965. The article includes a description of the product Floorflex, which is a tile made of PVC and asbestos fibres. At the time of publication, the factory employed 32 administrative employees and 120 workers.[127]

C. Insulation

The Flemish public waste management services (OVAM) estimated the amount of asbestos-containing products for Flanders indirectly, building on asbestos consumption data from Belgium and Luxemburg and product information from the Netherlands. Assuming similar Flemish and Dutch manufacturing patterns, insulation materials accounted for approximately 3.2% of the total asbestos manufacturing industry. The study estimates that 81,556 tonnes of asbestos-containing insulation materials were produced in Flanders until 2001.[128] Although often used as insulation, estimates for sprayed asbestos coatings were performed separately. Sprayed-on asbestos is a very hazardous material, as it can contain up to 95% of asbestos fibres. The material is highly friable and high levels of exposure may occur as the material is sprayed directly on the surface with a spray gun.[129] A Belgian case report mentions the use of sprayed-on asbestos containing approximately 90% amosite.[130] The procedure was invented in the UK in 1932.[131] The use of sprayed asbestos coatings was banned in Belgium in 1980.[132] Approximately 12,998 tonnes of sprayed-on asbestos were produced in Flanders, under the assumption that 0.8% of all asbestos fibres were used in this industrial branch.[133]

C1. Aeroplast in Zele

Information on Aeroplast N.V. is scarce. The company developed an acoustic insulation material called Acousticplast. This type of plaster contained asbestos fibres, vermiculite and

[124] Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015) *Post-War Building Materials in Housing in Brussels 1945-1975* (Brussels: Vrije Universiteit Brussel), 437 p.
[125] 'Fabrieken van Bij Ons: De N.v. Fademac Te Schoonaarde', *De Voorpost. Het Weekblad Voor Dendermonde En Omliggende*, 23 January 1965, p. 1; p. 9.
[126] Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015).
[127] 'Fabrieken van Bij Ons: De N.v. Fademac Te Schoonaarde', *De Voorpost. Het Weekblad Voor Dendermonde En Omliggende*, 23 January 1965, p. 1; p. 9.
[128] Tim Moerenhout and others (2014) *Inventarisatiestudie Asbesthoudende Materiaalstromen in Vlaanderen* (Mechelen: OVAM), 79 p.
[129] Pascal Dumortier and Paul De Vuyst (2011) 'Asbestos Exposure during Uncontrolled Removal of Sprayed-on Asbestos.', *The Annals of Occupational Hygiene*, 56.1, 49–54.
[130] Dumortier and De Vuyst (2011).
[131] Robert Frank Ruers (2012) 'Macht En Tegenmacht in de Nederlandse Asbestregulering', Doctoral dissertation Erasmus Universiteit Rotterdam (Rotterdam).
[132] *Royal Decree of 15 December 1978 in Moniteur Belge-Belgisch Staatsblad on 2 February 1979*.
[133] Moerenhout and others (2014).

a binding agent. The plaster had to be applied directly to the surface with a trowel.[134] According to the Crossroads Bank for Enterprises, Aeroplast N.V. started in Zele in 1967 and went bankrupt two years later.[135]

C2. Etablissements Ernest Lenders in Ixelles (Brussels)

Only few sources mention Etablissements Ernest Lenders. The company produced a large variety of boards and panels, mainly for acoustic insulation between 1945 and mid-1950s. Etablissements Ernest Lenders manufactured asbestos-containing panels, named Paxtile, as well as aerosol asbestos (Sprayed Limpet Asbestos S.L.A.).[136] Advertisements of the company have been included in an online image archive assembled by Brussels researchers in a project on post-war construction materials and building techniques.[137] The ads show the company was first located in rue de Mutualité, Uccle (Brussels) and then moved to Rue du Sceptre, Ixelles (Brussels) two years later.[138]

C3. Eternit in Kapelle-op-den-Bos

Eternit had a wide range of mineral and synthetic insulation materials, but also produced asbestos-containing insulation. The product Menuiserite was a panel in asbestos cement with cellulose fibres.[139] Menuiserite panels are manufactured without asbestos since 1994.[140]

C4. Fourisol in Wilrijk (Antwerpen)

Little information is available on Fourisol in Wilrijk. The company produced acoustic insulation based on asbestos fibres, called Asbestos Spray.[141]

C5. Société Belge Isolex NV in Ixelles (Brussels)

Isolex produced a type of sprayed-on asbestos, called Sprayed Limped Asbestos (SLA).[142] The

[134] Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015) *Post-War Building Materials in Housing in Brussels 1945-1975* (Brussels: Vrije Universiteit Brussel), 437 p.
[135] 'Crossroads Bank for Enterprises (CBE)', economie.fgov.be/nl/ondernemingen/KBO/#.Vr…
[136] Van de Voorde, Bertels and Wouters (2015).
[137] Van de Voorde, Stephanie, Bertels, Inge and Wouters, Ine, 'Image Archive. Post-War Building Materials in Housing in Brussels (1945-1975)', *Post-War Building Materials in Housing in Brussels (1945-1975)*, http://materiauxdeconstructiondapresguerre.be/history/ [accessed 20 January 2016].
[138] Van de Voorde, Stephanie, Bertels, Inge and Wouters, Ine, 'Image Archive. Post-War Building Materials in Housing in Brussels (1945-1975)', *Post-War Building Materials in Housing in Brussels (1945-1975)*, http://materiauxdeconstructiondapresguerre.be/history/ [accessed 20 January 2016].
[139] Stephanie Van de Voorde, Inge Bertels and Ine Wouters (2015) *Post-War Building Materials in Housing in Brussels 1945-1975* (Brussels: Vrije Universiteit Brussel), 437 p.
[140] Damiaan De Backer (2008), *Asbest in Ons Milieu* (Mechelen: OVAM), 124 p.
[141] Van de Voorde, Bertels and Wouters (2015); 'De Man Die Berlaymont Spoot', *Het Nieuwsblad,* 21 December 2000, p. 7.
[142] Van de Voorde, Bertels and Wouters (2015).

company was located in Ixelles (Brussels) from the early 1950s to the mid-1960s.[143] Records from the Crossroads Bank for Enterprises indicate the company went bankrupt in 1974.[144]

D. Textile

Textile was one of the first applications of asbestos fibres in history. Reports have been made of asbestos shrouds for Egyptian pharaohs in 2000-3000 BC. [145] Industrial manufacturing of asbestos textile started in Italy in the early 1800s. Even as asbestos was increasingly used in various industries, the manufacturing of asbestos textile remained a small but valuable industry.[146] We have identified four asbestos textile manufacturers in Belgium.

D1. Charles Delvoye N.V. in Kortrijk

Charles Delvoye started the production of asbestos textiles in 1946.[147] 60 people were working at the manufacturing site in the early days.[148] Asbestos textile manufacturing lasted until the early 1970s. Afterwards, Charles Delvoye produced ceramic-based textiles for thermic insulation. Approximately 35 employees lost their jobs when the company went bankrupt in 2005.[149]

D2. Etablissements H. Douha Dor in Jemeppe-sur-Meuse (Seraing)

Little is known about Douha-Dor. According to records from the Crossroads Bank for Enterprises, the company was founded in 1939.[150] Douha Dor was a small manufacturing site with approximately 20 to 40 workers in the period 1953-1972.[151] The company produced fire-resistant clothing and gloves.

D3. La Filature des feutres et amiantes d'Auvelais in Auvelais

This weaving mill produced asbestos textiles, including asbestos cords, in 1905-1977.[152] The factory was featured in a television broadcast called 'Work and Health: To Die for Asbestos'

[143] Van de Voorde, Bertels and Wouters 'Image Archive. Post-War Building Materials in Housing in Brussels (1945-1975)'; 'Crossroads Bank for Enterprises (CBE)', economie.fgov.be/nl/ondernemingen/KBO/#.Vr….
[144] 'Crossroads Bank for Enterprises (CBE)'.
[145] Samuel P Hammar and others (2008) 'Neoplasms of the Pleura' in *'Pulmonary pathology'* by JF Tomashefski, PT Cagle, CF Farver and A Fraire (eds.). (New York: Springer) p. 558–734
[146] Robert L Virta (2006) *Worldwide Asbestos Supply and Consumption Trends from 1900 through 2003* (Reston (VA): U.S. Department of the Interior- U.S. Geological Survey Report No.: Circular 1298, 80 p.
[147] 'Textielbedrijf Nv Charles Delvoye Uit Kortrijk Failliet', *De Standaard*, 5 October 2005, p. 50; Salvatore Nay (1997) *Mortel Amiante* (Bruxelles: EVO).
[148] 'Delvoye Overgenomen', *Krant van West-Vlaanderen*, 14 October 2005, p. 1.
[149] 'Textielfabriek Is Failliet', *Het Volk (Kortrijk-Waregem-Menen)*, 6 October 2005, p. 15.
[150] 'Crossroads Bank for Enterprises (CBE)', economie.fgov.be/nl/ondernemingen/KBO/#.Vr…. .
[151] R Vande Weyer (1973) 'Bilan de L'indemnisation de L'asbestose.', *Acta Tuberc Pneumol Belg*, 64, 304–51.
[152] Office du travail et inspection de l'industrie de Belgique, *Industries Du Caoutchouc et de L'amiante*, Monographies Industrielles (Brussel, 1907); Nay (1997).

on RTBF in 1977.[153] The broadcast presented a female weaver at work, although already affected by the adverse health effects of asbestos.

D4. Belgische Asbest- en rubberfabriek -La Manufacture de l'amiante et de caoutchouc in Deurne (Antwerpen)

According to records in the Crossroads Bank for Enterprises, the company was founded in 1905.[154] La Manufacture de l'amiante et de caoutchouc was a small producer of asbestos textile.[155] Approximately 60 people were employed in 1953-1972.[156]

E. Automobile industry

Asbestos was also used in the manufacturing of brakes, gaskets and other friction materials for various means of transportation, such as cars, trains and airplanes. Usually chrysotile asbestos was used in the production.[157] We have located one manufacturer of car parts containing asbestos in Belgium.

E1. Don International in Manage

Don International manufactured asbestos-containing brake linings for automobiles.[158] Records from the Crossroads Bank for Enterprises show Don International was founded in 1966.[159] The English BBA group, previously called British Belting and Asbestos, owned the company in the early 1990s.[160]

F. Electricity

Asbestos is highly suited for electrical applications, as it is electrically non-conductive and has great insulation qualities.[161] One Belgian manufacturer of electrical materials was identified.

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[153] Marie-Anne Mengeot and Salvator Nay, 'Work and Health: To Die for Asbestos-Le Travail Où La Santé: Mourir de L'amiante' (*RTBF*), television production 1977.
[154] 'Crossroads Bank for Enterprises (CBE)'
[155] Office du travail et inspection de l'industrie de Belgique (1907); Marc Molitor (2010) *Négociations et Tensions Autour de La Création Du Fonds Amiante*, Courrier hebdomadaire du CRISP (Brussels: CRISP- Centre de Reserche et d'Information Socio-Politiques), 61 p.
[156] Vande Weyer (1973).
[157] S Harmsma and HFHM Mulder (2006) *Asbest in Kaart. Historisch Onderzoek Asbestgebruik Methode Asbestkansenkaart* (Groningen: ReGister), 164 p.
[158] 'Strengere Wetten Geen Probleem Voor Belgische Asbestsektor', *De Tijd*, 5 April 1991.
[159] J. Forsyth (2013) *Major Companies of Europe 1991/92: Volume 2 Major Companies of the United Kingdom*, The Major Companies Series (Springer Science & Business Media).
[160] J. Forsyth (2013); BBA Aviation, 'Our History', *BBA Aviation website*, http://www.bbaaviation.com/about-us/history.aspx [accessed 19 January 2016].
[161] PWJ Bartrip (2004) 'History of Asbestos Related Disease', *Postgraduate Medical Journal*, 80.940, 72–76.

F1. Usines Vynckier Frères et Cie - Vynckier in Ghent

Vynckier was founded in Brussels in 1920 by three brothers as Usines Vynckier Frères et Compagnie. The company moved to Ghent two years later.[162] Since 1937, the business expanded and moved into three former textile factories at Nieuwevaart in Ghent.[163] Vynckier was one of the largest Belgian manufacturers of electrical materials for installations at low voltage. Some electrical switch-boxes for industrial purposes were manufactured using asbestos fibres.[164] During the late 1980s and early 1990s, approximately 1650 people were working at the manufacturing site in Ghent.[165]

G. Paper and felt

The first accounts of industrial applications of asbestos report the manufacturing of asbestos paper in Norway and Russia in the 18th century.[166] Usually, only chrysotile is used to manufacture asbestos paper and carton, with proportion of approximately of 80% to 100% of asbestos.[167] In Belgium, we find one asbestos paper manufacturer.

G1. Von Asten in Eupen

Von Asten started manufacturing paper machine clothing in Eupen at the end of the 19th century.[168] The finished products were used in the papermaking process. Forming fabric, press fabric and dryer fabric are used to make flat dry sheets out of pulp. Eduard von Asten, son of the company-founder Oscar, patented one the company's revolutionary products in the 1920s. Asbestos was used to produce felts, designed for drying in paper machines. The felt could consist of wires covered in asbestos or of wefts of asbestos treads.[169] During the period 1953-1972, the company employed 50 workers.[170] We know little about the use of asbestos in the production process afterwards. It is highly likely that the company switched to synthetic fibres well before the asbestos ban in 1998.

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[162] 'CAD/CAM En CAE Al Lang Een Realiteit Bij Vynckier', *De Tijd*, 18 October 1988.
[163] Agentschap Onroerend Erfgoed, 'Vynckiersite', *Inventaris Onroerend Erfgoed*, ID 18527, https://inventaris.onroerenderfgoed.be/dibe/relict/18527 [accessed 19 January 2016].
[164] 'Strengere Wetten Geen Probleem Voor Belgische Asbestsektor'.
[165] 'CAD/CAM En CAE Al Lang Een Realiteit Bij Vynckier'; 'IS0 9001 Voor Gentse Producent van Elektrisch Materiaal', *De Tijd*, 2 October 1992.
[166] Robert Frank Ruers (2012) 'Macht En Tegenmacht in de Nederlandse Asbestregulering', Doctoral dissertation Erasmus Universiteit Rotterdam (Rotterdam).
[167] S Harmsma and HFHM Mulder (2006) *Asbest in Kaart. Historisch Onderzoek Asbestgebruik Methode Asbestkansenkaart* (Groningen: ReGister), 164 p.
[168] 'Die Firma von Asten Un Ihr Einfluss Auf Die Moderne Papierherstellung', *Grenzecho*, 19 November 2010.
[169] Patent by Eduard Von Asten (1920), 'Improvements in Felts for Use on the Drying Portion of Paper and Paste-Board Machines', 2 p.; Patent by Eduard Von Asten (1925), 'Improvements in Felts for Use on the Drying Portion of Paper and Paste-Board Making Machines', 2 p.
[170] R Vande Weyer (1973) 'Bilan de L'indemnisation de L'asbestose.', *Acta Tuberc Pneumol Belg*, 64, 304–51.

H. Aluminum foil

H1. Usines Pol Madou in Ghent

The factory Pol Madou manufactured a type of asbestos-containing aluminium foil, called Asbral.[171] The company manufactured roofing paper, paperboards in Ghent since 1897.[172] 140 people were employed in 1978.[173] No records of the industrial activities at Pol Madou were found after the late 1970s.

Conclusion

This inventory presents information on asbestos use in 22 manufacturing sites during the post-war period. Asbestos products were manufactured in eight different industries. 16 municipalities have been pinpointed as locations of occupational exposure in the primary asbestos industry. Out of the identified companies, 13 companies started manufacturing asbestos products before the post-war period. Seven companies continued to use asbestos until the late 1990s.

One of the main limitations of this inventory is the lack in available information on asbestos industries in Belgium. As a result, our findings cannot be considered as an exhaustive list of asbestos companies. Research efforts to optimize the inventory are on-going. Any additional information related to the research objectives would be much appreciated. If readers have any remarks or data, we ask to notify us. New information will be studied and incorporated in the inventory if possible.

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[171] 'Asbestkaart. Producten', http://www.asbestkaart.nl/asbestkaart.html [accessed 12 January 2016].
[172] Agentschap Onroerend Erfgoed, 'Usines Pol Madou En Directeurswoning', *De Inventaris van Het Bouwkundig Erfgoed*, https://inventaris.onroerenderfgoed.be/dibe/relict/18263 [accessed 14 January 2016].
[173] CRISP (1978) 'L'industrie Des Pâtes, Papiers et Cartons En Belgique', *Courrier Hebdomadaire Du CRISP*, 822 - 823 - 824.37, 62 p.

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