RESEARCH ON THE HARMFUL EFFECTS OF ASBESTOS IN CONSTRUCTION

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ABSTRACT: Asbestos, a group of fibrous silicate minerals, was widely used in the construction industry from the 19th century until its ban, due to its exceptional fire resistance, thermal and acoustic insulation, and durability properties. However, recognition of its catastrophic effects on human health led to the banning of its use in most developed countries. This research article assesses the impact of the historical use of asbestos in construction, focusing on the risks to public and occupational health, the current regulatory framework of the European Union and Romania, and the challenges associated with managing the "asbestos legacy" in the context of the EU's "Renovation Wave" initiative. Statistical data on the prevalence of asbestos in existing buildings and the incidence of associated occupational diseases, as well as modern alternative solutions, are presented.

KEY-WORDS: exposure to asbestos fibers, asbestos-associated pathologies, alternative solutions.

1. INTRODUCTION

Asbestos, composed of minerals such as chrysotile, amosite, and crocidolite, has long been considered a "wonder material" in construction, being incorporated into over 3,000 products[1], [2], including asbestos-cement sheets (eternit), thermal and acoustic insulation, pipes, paints, adhesives, and sealants. Approximately 80% of asbestos used globally was destined for the construction materials sector.

Intensive use, especially in the post-war period and up to the 1980s and 1990s, led to widespread contamination of the built environment. Although a total ban was implemented in the European Union since 2005 (Directive 1999/77/EC, transposed in Romania by GD 124/2003) [3], it is estimated that over 220 million buildings or structures in the EU were built before the ban and may contain asbestos. Exposure to asbestos fibres is associated with pleural mesothelioma, lung cancer, asbestosis and other respiratory pathologies; the risk is duration and intensity dependent, with long latency periods (decades). The EU recommends efforts to eliminate asbestos-related risks through inventory, management, controlled removal and public information [4].

The main objective of this paper is to synthesize current knowledge on the physical, economic and public health effects of asbestos in the construction sector and to propose clear directions for action, based on scientific data and consolidated regulations.
The study presents: a synthesis of health effects; exposure assessment at building/city level; symptomatic and provisional analysis of available data in Romania on mesothelioma deaths and local distribution; policy recommendations and technical measures to reduce risk [5]. The conclusion highlights the need for a national inventory, elimination policies and awareness campaigns

2. THE HARMFUL EFFECTS OF ASBESTOS ON PUBLIC AND OCCUPATIONAL HEALTH

Exposure to asbestos fibers, which are released into the air when materials containing them are damaged, cut, or handled, poses a major health risk. Pathological effects manifest after an average latency period of 30-40 years.

2.1. Asbestos-Association Pathologies

Exposure to asbestos fibers has serious and long-lasting consequences on human health, with the effects usually manifesting after a latency period of between 20 and 50 years. Due to their microscopic size and needle-like shape, asbestos fibers can penetrate deep into the pulmonary alveoli, where they remain blocked for long periods. The human body is unable to eliminate them effectively, and their presence causes chronic inflammatory reactions, oxidative stress and irreversible tissue damage. These biological processes, cumulative over time, lead to the appearance of serious pathologies, the most important of which are mesothelioma, lung cancer, asbestosis and pleural plaques.

Mesothelioma is the most severe and distinctive asbestos-related disease. It is a rare but extremely aggressive form of cancer that affects *the mesothelium* – the membrane that lines the lungs (pleura), the heart (pericardium) or the abdominal cavity (peritoneum). In most cases, pleural mesothelioma is directly related to occupational exposure to asbestos fibers, even at low concentrations [6]. The disease has a rapid progression and a poor prognosis, with a five-year survival rate of less than 10%. Symptoms appear late, in the form of dyspnea, chest pain and pleural fluid accumulation, which makes early diagnosis difficult.

lung cancer is another major consequence of exposure. Asbestos acts as *a co-carcinogen* , amplifying the effects of other factors, especially smoking. Epidemiological studies show that asbestos-exposed workers who are also smokers have a risk of lung cancer up to 50 times higher than unexposed and non-smoking individuals[8]. Asbestos fibers can cause genetic mutations and cellular abnormalities in the bronchial epithelium, leading to the development of malignant tumors. Unlike mesothelioma, lung cancer can be detected early by imaging methods and may respond to surgical or chemotherapy treatments, but the prognosis remains reserved.

Asbestosis is a chronic lung disease characterized by the development of progressive fibrosis of the lung tissue. It occurs after prolonged inhalation of asbestos fibers, which causes persistent inflammation and scarring of the alveoli. The lungs gradually lose their elasticity, which leads to respiratory difficulties, chronic cough, fatigue and hypoxia. Asbestosis is an irreversible condition, and its evolution can be worsened by continuous exposures or concomitant respiratory infections. In advanced stages, the disease can progress to respiratory failure or secondary lung cancer.

Pleural plaques and thickenings are structural changes in the membrane that covers the lungs and chest cavity. Although they are not considered malignant in themselves, they are biological markers of asbestos exposure and may indicate an increased risk for developing other lung diseases. These plaques, formed by fibrous deposits, reduce the elasticity of the pleura and can cause chest pain or limitation of breathing capacity. In many cases, they are discovered incidentally during imaging examinations for other conditions.

Overall, asbestos-related pathologies reflect the insidious nature of exposure: the effects do not appear immediately, but accumulate over decades[9]. The lack of a curative treatment for most of these diseases highlights the importance of prevention , continuous monitoring of exposed workers, and the elimination of sources of contamination in the built environment[10], [11]. In the absence of these measures, the impact on public health remains major and lasting.

2.2. Current statistics

It is estimated that between 4.1 and 7.3 million workers in the EU are currently exposed to asbestos, the majority of whom are employed in the construction and renovation sector.

Asbestos is responsible for 78% of recognized occupational cancers in the EU, causing over 90,000 deaths annually in Europe.

In Romania, although there are no complete and centralized published statistical data on the exact number of buildings affected, it is known that a high asbestos consumption was recorded in the 1990s and early 2000s, indicating a persistent "legacy" problem in buildings built in those decades. The decommissioning and renovation activities of buildings from the communist period, especially those covered with asbestos-cement (eternit) boards, represent major sources of uncontrolled exposure (fig. 1).

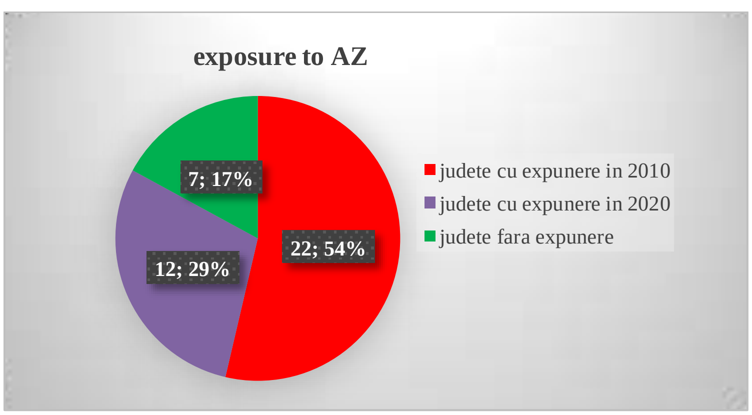

Figure 1. Exposure to asbestos in the counties of Romania.

Figure 2 shows that the number of cases of mesothelioma and asbestosis is significant, but underdiagnosis and underreporting are real problems, the official data of health institutions seem to be much lower than estimates based on independent investigations. INSP statistics indicate a number of 1723 deaths from mesothelioma[11] at the national level in the period 2000–2023.

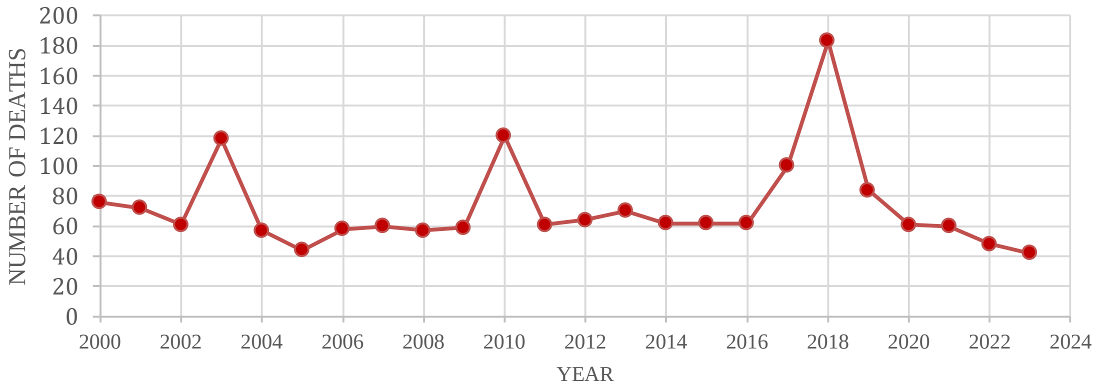

Figure2. Deaths from mesothelioma at national level (2000 – 2023) (source: INSP)

There is no central public database that annually and exhaustively reports "asbestos release accidents" at the level of rehabilitation/demolition works - incident reports appear rather in specific project documents (impact studies, APM reports for construction sites), not in an accessible national register.

3. RISKS IN THE FIELD OF CONSTRUCTION

The issue of asbestos in existing buildings represents one of the most complex public health and environmental challenges in contemporary Europe [12]. In Romania, the risks generated by asbestos are at the intersection of outdated infrastructure, the lack of a coherent institutional framework and the intensification of energy renovation works. Asbestos, although prohibited by law, continues to persist in the physical structures of buildings, walls, roofs, ventilation systems or pipes, becoming an "invisible legacy" that is reactivated whenever these buildings are renovated, modernized or demolished.

Currently, the major risk does not come from the use of new products, but from the degradation of historical materials and uncontrolled interventions on them . According to estimates by the European Commission, over 35% of public buildings in Europe contain asbestos-based materials, and Romania is among the high-risk countries, given that almost the entire urban housing and industrial stock was built before 2000.

The risk of fiber release is closely related to the friability of the material , i.e. its ability to crumble or pulverize under conditions of mechanical handling or natural wear.

Friable materials , such as sprayed insulation or thermal insulation layers applied to pipes, pose the highest hazard. The fibers easily break off, and vibration, mechanical cutting, or air blasting are sufficient to release dangerous concentrations of fibers into the air you breathe[13].

Non-friable materials , such as asbestos cement sheets, floor tiles or corrugated roof tiles, are relatively stable in their intact state. However, once they are broken, drilled, cut or exposed to the elements, they become equally dangerous.

In the Romanian urban environment, asbestos cement is omnipresent in the roofs and fences of yards, in the structure of garages and industrial halls, and their damage through corrosion or unauthorized handling produces a slow but constant dispersion of the fibers[15].

3.1. Risks related to rehabilitation and demolition works

The implementation of the European policy "Renovation Wave", aimed at increasing the energy efficiency of buildings, has brought to the fore a strategic dilemma: how can thermal rehabilitation be promoted without increasing exposure to asbestos? In Romania, thousands of apartment blocks and public buildings are included in renovation programs, but asbestos detection before works is not mandatory by law . This legislative gap makes workers, designers and even beneficiaries unaware of the real risks.

Documented cases of accidental exposure are rarely officially reported. However, there is indirect evidence, especially in reports by Environmental Protection Agencies and health authorities, which mention incidents of air and soil contamination during the demolition of industrial buildings in the Brașov, Hunedoara, Călărași and Galați areas. In some localities, the work was carried out by companies without authorization to handle asbestos-containing materials, and personal protective equipment was insufficient or non-existent.

These deficiencies are exacerbated by the lack of accredited staff for asbestos detection and risk assessment . Currently, Romania has a very small number of laboratories and inspectors certified for sampling and analysis, which makes prior identification of suspect materials the exception, not the rule. In the absence of technical checks, numerous renovation works of schools, hospitals or public institutions can generate undiagnosed exposures, with effects on workers and local communities.

3.2. The challenge of the "renovation wave"

The EU's goal of increasing the rate of building renovation (Renovation Wave) directly conflicts with the need for safe asbestos management. Without prior detection and removal, energy renovation works can accidentally disturb asbestos in panels, partitions, roofs and pipes, exposing millions of workers and, indirectly, the public (Table 1).

Table 1. Common Locations of Asbestos in Buildings and Associated Risk

Location in Buildings	Material Type	Period of Use	Friability/Risk
Roofs/Facades	Asbestos cement sheets (tile, corrugated)	1960 - 2000	Non-friable (Risk of damage)
Pipe/Boiler Insulation	Powdered materials/preformed shells	1940 - 1980	Friable (Very high risk)
Coatings	Vinyl Tiles/Adhesive Mastic	1950 - 1980	Non-friable (Risk of mechanical removal)
False Ceilings	Fireproof boards	1960 - 1980	Frizz-resistant/Semi-frizz-resistant

3.3. Hazardous Waste Storage and Management

Another significant vulnerability concerns the disposal of waste containing asbestos . This must be handled, packaged and transported in accordance with European rules (Regulation (EC) No. 1357/2014 and Decision 2000/532/EC on the classification of hazardous waste). However, the safe storage infrastructure is insufficiently developed in Romania. In 2025, there were only a few authorized landfills (e.g. in Turda, Slobozia and Brazi), and the transport and storage costs are high, sometimes leading to the abandonment or illegal burial of waste.

The lack of a national asbestos waste traceability system amplifies the risks of secondary contamination. In many cases, waste resulting from renovations ends up in unauthorized landfills, being covered with soil, which causes soil and groundwater contamination [16]. From an ecological point of view, the risk becomes cumulative and persistent, as the fibers do not degrade over time and can be reintroduced into the air circuit by wind or erosion.

The industrially-tradition regions of Hunedoara, Galați, Ploiești, Brașov, Bucharest and Călărași represent "hot spots" of the asbestos legacy. The largest asbestos-based product factories were located here, and the materials from them were distributed nationwide. Consequently, risk maps can be constructed starting from these production centers and the surrounding urban areas. The "risk chain" associated with asbestos can be schematically represented by four interdependent stages:

1. Production and use – material manufacture and widespread use in construction (1950–2000).
2. Wear and tear – the gradual release of fibers from old structures.
3. Uncontrolled interventions – renovation works, cutting, drilling, demolition without protection.
4. Improper storage – secondary environmental contamination.

This chain highlights the systemic nature of the risk: even though production has ceased, the industrial legacy continues to generate negative public health, economic and environmental effects.

Effective management of the "asbestos legacy" involves moving from reactive approaches to proactive strategies , based on:

- creating a national geocoded inventory of buildings containing asbestos ,
- training and certification of specialists for inspection and removal,
- updating the legislative framework on renovations, so that asbestos detection becomes mandatory before any work ,
- and the development of storage and neutralization infrastructure.

Only through a combination of technical, educational and legislative measures can the vicious circle of risk be broken, transforming a latent public health problem into a concrete objective of safety and sustainability of the built environment.

4. ALTERNATIVE SOLUTIONS AND REMOVAL TECHNIQUES

With the ban on asbestos, the construction industry has developed a wide range of environmentally friendly and high-performance materials, designed to replace its key properties, fire resistance, thermal and sound insulation, durability and low cost.

- *Insulation* : Mineral wool (glass or rock wool), cellulose fiber, polyurethane foam. These materials provide excellent thermal protection, are non-hazardous to health and have a lifespan comparable to asbestos-based products.
- *Roof and facade panels* : Fiberglass, asbestos-free fiber cement boards (using cellulose or synthetic fibers), galvanized sheet metal. These alternatives are already widely used in modern construction and have the advantage of recyclability.
- *Fireproof materials* : Vermiculite, perlite, silicate-based compounds. They provide fire protection in industrial buildings, hospitals or schools, completely replacing the asbestos-based sprayed insulation used in the past.

These modern solutions contribute to the transition to sustainable construction , in line with the objectives of *the Green Deal* and the European *Renovation Wave initiative. However, material substitution is not enough; for already contaminated buildings, a rigorous process of* removal and safe disposal of existing waste is required[18],[20] .

4.1. Disposal and management of waste containing asbestos

The biggest challenge today is the management of waste containing asbestos (*Waste Asbestos Containing Materials – WACM*). According to European and national legislation, this waste is classified as *hazardous waste* , which requires compliance with strict standards for collection, packaging, transport and final disposal[19].

- *Specialized removal* : work must be carried out exclusively by authorized companies, under the control of environmental authorities and territorial labor inspectorates. The personnel involved must be trained and equipped with appropriate personal protective equipment (PPE)

: tight overalls, P3 filter masks, gloves, safety shoes and negative pressure ventilation systems to prevent the dispersion of fibers.

- *Packaging and labeling* : the collected materials are placed in double, airtight bags or containers, clearly marked with the "biological hazard" symbol and the statement *Contains asbestos - risk of cancer by inhalation* .
- *Transportation and storage* : carried out only by authorized transporters, to specially designed warehouses for hazardous waste.

Reducing the impact of asbestos exposure requires a complex, coordinated and multisectoral approach, combining technical control measures, effective organizational mechanisms and coherent public policies. Since the health effects are long-lasting and often irreversible, prevention becomes the central instrument of any national protection strategy.

A first essential step is to create a national geocoded inventory of asbestos-containing materials (ACM). This would allow for the precise location of contaminated buildings and the prioritization of interventions according to the degree of risk. The inventory should be built on the basis of standardized inspections, carried out by accredited specialists, and integrated into a GIS database with controlled access for authorities, public health institutions and technical experts. Such a platform would also facilitate rapid public information, allowing for the safe planning of renovation and demolition works.

Once the presence of asbestos is identified, it is necessary to prioritize buildings for intervention, especially those with critical social functions - schools, hospitals, kindergartens, public institutions and collective housing. For these categories, removal works must be carried out under strict supervision, through controlled removal procedures, in compliance with all occupational safety and environmental protection regulations.

In parallel, strict rules are needed for demolitions and renovations. Any work involving the possible presence of asbestos must be authorized in advance, based on a technical risk assessment report. The companies involved must be certified for handling hazardous materials, and construction sites must be equipped with air monitoring systems. The resulting waste must be collected, transported and stored exclusively in authorized hazardous waste depots, to prevent environmental contamination.

In terms of public awareness, information campaigns play a crucial role. It is necessary to develop practical guides for owners, managers and local authorities, explaining the risks, legal procedures and steps to follow in case of identification of suspicious materials. It is also recommended to create a regional telephone line or an online platform for rapid advice to citizens and reporting of risk cases.

On the public health component, medical screening programs should be implemented for exposed professional groups (construction, maintenance, demolition, sanitation workers). These programs would include exposure registries, periodic monitoring through imaging investigations (radiographs, chest CT) and rapid access to oncological care services for diagnosed individuals. Thus, pulmonary changes can be identified early and mortality can be reduced through early detection of occupational diseases.

In legislative and social terms, it is imperative to establish measures to compensate and recognize occupational diseases caused by asbestos. Simplifying the procedure for recognizing these diseases, providing compensation and support for patients and their families are measures of social justice and health equity. At the same time, these policies stimulate correct reporting of cases and hold employers accountable.

In conclusion, reducing the risks of disease caused by asbestos depends on an integrated chain of actions: identification, control, prevention, information and medical monitoring. Only through close cooperation between state institutions, the scientific environment and local communities can the goal of a safe Romania be achieved, in which the asbestos legacy is managed responsibly and sustainably.

5. CONCLUSIONS

The effects of asbestos use in construction represent a long-standing public health and environmental problem. Although its use has been banned and asbestos is no longer produced or used in modern construction, the risk of exposure continues to exist, particularly during renovation, maintenance and demolition work . Millions of square metres of asbestos-cement boards, thermal insulation and fireproofing materials remain embedded in residential and industrial buildings, and their slow deterioration or improper handling releases microscopic fibres with high carcinogenic potential.

Exposure-related diseases, mesothelioma, lung cancer, asbestosis and pleural plaques have long latency periods. European estimates show that approximately 90,000 people die annually in Europe from asbestos-related causes , and between 4 and 7 million workers are still occupationally exposed. In Romania, the real number of cases is probably underreported, due to the lack of a centralized register of occupational diseases and the difficulties of diagnosis. These data highlight that the risk has not disappeared, but has transformed: from an industrial risk, specific to production, to an occupational and community risk, associated with rehabilitation works and maintenance of old buildings. Therefore, prevention and correct management of exposure become a major public health obligation.

One of the main challenges identified is the absence of a centralized national database on the presence of asbestos-containing materials. The lack of clear records slows down prevention efforts, increases rehabilitation costs and exposes workers and the population to unnecessary risks. In the absence of this map, local authorities and construction companies often operate without reliable information, which leads to demolitions or renovations carried out without adequate protection.

The development of a national geocoded inventory of buildings at risk of containing asbestos is a strategic urgency[18]. This tool, carried out through standardized inspections and managed in GIS format, would allow for permanent monitoring, prioritization of interventions and transparent communication with the public. In parallel, an update of the legislative framework is necessary to impose the obligation of prior asbestos testing before any renovation, thermal rehabilitation or demolition work.

Inter-institutional coordination is another essential condition. The Ministry of Health, the Ministry of Environment, the Ministry of Development, local authorities and inspection institutions must act synergistically, based on a single national plan, with clearly defined objectives, deadlines and performance indicators [18].

The financial and social burden of occupational diseases caused by asbestos is considerable. The costs of treatment, loss of work capacity and legal compensation amount to billions of euros annually at European level. In Romania, although the data are incomplete, estimates suggest that the economic impact of uncontrolled asbestos far exceeds the costs of implementing an effective preventive system[20].

At the same time, the costs of safely disposing of contaminated materials should be understood as investments in public health and safety, not as expenses. In the absence of proper management, waste can be dispersed into the environment, generating secondary contamination and affecting the quality of soil and groundwater . In this regard, specific funding for the detection, removal and disposal of asbestos must be integrated into energy renovation programs [21].

A key aspect for the future is supporting research and technological innovation in the field of asbestos waste treatment. Modern techniques, such as vitrification, thermolysis or chemical neutralization , have the potential to transform hazardous fibres into inert, recyclable and safe materials. Investments in these areas can reduce the dependence on landfill, create new green jobs and contribute to the European circular economy objectives.

At the same time, research must include the social and medical dimension: the development of screening programs, predictive epidemiological models and digital technologies for monitoring air quality and occupational exposures. A data-driven approach and smart tools can transform asbestos management into an area of public innovation and sustainability.

The conclusions of this research confirm that the asbestos problem is not an exclusively technical one, but a deeply multidisciplinary one . It involves various medical, engineering, legal, social and economic fields that must collaborate for a common goal: protecting the health of the population and ensuring a safe built environment. A coherent national framework is needed that combines:

- strict and clear regulations regarding the handling and disposal of asbestos-containing materials;
- education and awareness programs among the population and local authorities;
- continuous environmental and public health monitoring systems;
- sustainable and transparent financing for inventory and decontamination projects.

By implementing these measures, Romania can transform a historical problem into an example of European good practice. In this regard, the creation of a national asbestos map, the development of safe disposal infrastructure and the integration of research into public policies represent the pillars of an effective long-term strategy.

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