Centrum Rzeczoznawstwa Budowlanego

Inżynieria Bezpieczeństwa Obiektów Antropogenicznych 2 (2024) 9-16
https://inzynieriabezpieczenstwa.com.pl/

Inżynieria Bezpieczeństwa Obiektów Antropogenicznych

Quality of construction products available on the Polish market on 2016-2020

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Abstract

The quality of construction products and compliance with their declared performance is of key importance for the safety and health of users of construction works. In extreme cases, defects in building materials can lead to a construction disaster. In order to assess what is the quality of construction products available on the Polish market over the period 2016-2020, the measurement results available on the website of the General Office of Building Supervision (GUNB) were analyzed. The paper presents 13 groups of construction products divided into two sets. The results of the analysis show that there are still construction products on the market that do not meet the declared requirements. In 2020, 44% of thermal insulation products and 38% of membranes did not meet at least one tested property. The quality of construction adhesives, flooring and flooring products is average (in adopted scale of assessment). Due to too few samples/tests, it is difficult to draw clear conclusions for doors, windows and bonded products and aggregates. In all of these product groups, the number of tests performed annually should be increased.

References: International Conference, SELECTED ISSUES IN BUILDING STRUCTURES DESIGN, Kielce, 14-15 July 2022.

Keywords: construction products, CPR, quality of construction products, declared requirements

1 Introduction

According to the Regulation of the European Parliament and of the Council No. 305/2011 CPR [1], construction objects as a whole and their individual parts must be suitable for their intended use. Over an economically reasonable period of use and with normal maintenance, construction objects must meet the following basic requirements:

- load-bearing capacity and stability;

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https://dx.doi.org/10.37105/iboa.196
Received 20 November 2023
Available online 10 June 2024
ISSN 2450-1859, eISSN 2450-8721
Published by Centrum Rzeczoznawstwa Budowlanego

- fire safety;
- hygiene, health and the environment;
- safety of use and accessibility of the facilities;
- noise protection;
- energy conservation and thermal insulation;
- sustainable use of natural resources.

In the Act of 16 April 2004 on construction products [2] we can find the following provision: "a product may be placed on the market if it is suitable for use in the execution of construction works, to the extent corresponding to its performance and purpose, i.e. it has functional properties enabling properly designed and executed buildings in which it is to be used in a durable manner, meeting the essential requirements''. The quality of construction products and compliance with their declared performance is therefore of key importance for the safety and health of users of construction works.

The environmental impact of construction product is also very important. Each year about 3 billion tons of mineral resources are used in their production, which is 40-50% of the global output. The construction industry uses over 10,000 different types of materials, including those derived from the exploitation of non-renewable resources [3]. There is therefore a need to increase the share of efficient materials, i.e. those that minimise the consumption of non-renewable raw materials through the use of recovery processes and the use of renewable raw materials, as well as those that are reusable at the end of their life cycle. These postulates were reflected in the concept of the circular economy (CE). This model aims to minimize the consumption of raw materials and the generation of waste. The use of high-quality construction products is one of the elements of the implementation of the circular economy concept. The overall durability and safety of constructed structures depends on the durability of the materials from which they are made. The worse the products, the shorter the life of the objects or the more frequent the need for their renovation. Quality also affects the possibilities of reusing products in other facilities after demolition.

In extreme cases, defects in building materials can lead to a construction disaster. One example is the collapse during concreting of the ceiling of a production and office building with a monolithic reinforced concrete structure in a mullion-slab system in Gliwice [4]. The ceiling of the first floor collapsed as a result of damage to the formwork. During the incident, the reinforcement of the plate was deformed. Construction work had to be stopped immediately. There was a rock burst in the nearby area, so it was suspected that this event could have been the cause of the disaster. However, it was excluded due to the too large distance between its epicenter and the crash site. After the research and inspection of the crash site, it was found that the direct cause of the construction disaster was a hidden material defect of the full-wall ceiling formwork girder. This example shows that the quality of construction products can directly affect the safety of use of construction works.

2 Methodology

In order to assess what is the quality of construction products available on the Polish market over the period 2016-2020, the measurement results available on the website of the General Office of Building Supervision – GUNB (https://www.gunb.gov.pl/probki) were analyzed. The research was performed by the Voivodeship Construction Supervision Inspectorate from sixteen provinces and by the Chief Inspector of Construction Supervision. The product groups tested and included in the report are: cement, construction limes and other hydraulic binders; reinforcing and prestressing steel for concrete; products for walls construction; thermal insulation products; power cables, control and communication; construction adhesives; membrane; flooring and flooring products; space heating equipment; concrete and products related to concrete, mortar and grout; complex insulation kits/systems; doors, windows and related articles; aggregates.

The paper presents 13 groups of construction products divided into two sets. The first set includes products for which a higher number of tests was carried out during the analysed years (on average more than 10 per year). The higher the number of tests, the easier it is to formulate general conclusions about the domestic market for construction products. The second set includes products for which the number of tests did not exceed 10. In this case, formulated conclusions may be burdened with much greater error.

For the proper interpretation of the results presented in the article, it is necessary to pay attention to the fact that the tests of samples of construction products are ordered in order to verify the performance of the product declared by the manufacturer. As the Chief Inspector of Building Supervision explains, "samples of construction products are taken both in the course of market control (as a rule, at sellers of construction products) and without inspection. In

this case, only the result of the examination may be the basis for initiating an inspection. In the out-of-control mode, samples of products may be taken, m.in. from products stored on the construction site". The sampling method does not always guarantee the representativeness of the sample.

What is most important, even if several performance properties of a construction product are compliant with the declaration, and one is not, the result of the entire test is assessed as negative, and the product as non-compliant. For easier assessment of this fact, for each of the analyzed groups of construction products collective data has been presented, showing how large percentage of the tested products fails to meet at least one of the declared properties. This approach allows for proper presentation of the share of defective products. The analysis focusing only on individual properties may lead to misleading conclusions, e.g. when the improvement of one property occurs as a consequence of the aggravation of another one.

Based on the results of research published by GUNB, a system for assessing the quality of construction products available on the Polish market in 2016-2020 has been proposed. A five-grade evaluation scale was adopted, based on the annual percentage of tested products failing to meet at least one of the declared properties. It should be remembered that the low number of samples taken for testing and the way of taking them does not always guarantee the representativeness of the sample.

Table 1. *The adopted scale of assessment of the quality of construction products available on the market.*

Rating scale	Percentage of products failing to comply with at least one of the test properties
Very good	< 5%
Good	< 15%
Average	< 30%
Bad	< 50%
Very bad	≥ 50%

3 Results and conclusions

Based on the analysis of the available data, it can be seen that the number of samples of construction products tested was the highest in 2016 and 2017, while the lowest in 2019 and 2020. The most samples were tested in 2017 (443), the least in 2019 (288). In 2020, 305 tests were performed, which is about 30% less than in 2017. At the same time, it has increased the number of product groups covered by the study over the years.

Based on the results obtained, an attempt was made to assess the quality of construction products available on the Polish market in 2016-2020. It should be remembered that the reliability of the assessment is very much influenced by the average number of tests performed annually for a given group of products and the sampling method. The tested sample will not always be representative.

Table 2. *Assessment of the quality of construction products available in the domestic market from 2016 to 2020.*

Product group	Quality assessment and percentage of products failing at least one of the properties tested (total number of samples tested per year)				
	2016	2017	2018	2019	2020
thermal insulation products	61% (127)	48% (131)	51% (104)	53% (70)	44% (61)
membranes	71% (7)	47% (73)	32% (59)	31% (35)	38% (29)
building adhesives	32% (22)	62% (63)	50% (42)	57% (14)	22% (51)
masonry construction products		24% (33)	18% (49)	8% (24)	8% (24)
cement, building limes and other hydraulic binders	46% (35)	33% (33)	11% (19)	21% (19)	7% (27)
reinforcing and prestressing steel for concrete			0% (11)	0% (5)	7% (46)
space heating equipment	40% (5)	50% (16)	56% (18)	35% (20)	6% (16)
flooring products		11% (9)	38% (8)	28% (18)	15% (20)
Annual average number of tests ≤ 10					
complex insulation kits/systems	89% (18)	55% (11)	0% (5)	0% (3)	0% (1)
doors, windows and related products	73% (22)	33% (3)	20% (5)	38% (8)	50% (2)
control and communication power cables					13% (8)
aggregates	100% (2)	33% (3)	0% (1)	100% (2)	33% (9)
concrete and products related to concrete, mortar and grout				50% (2)	0% (1)

It is worth noting that for some products the number of samples tests yearly is very small (Table 1) - 1 or 2 samples, only. Therefore, the proposed assessments could be different in case of large number of tests.

The main groups of construction products to be tested, included in the report and having an impact on energy efficiency include: thermal insulation products; space heating equipment; doors, windows and related articles.

Thermal insulation products

This group includes mainly polystyrene, mineral wool insulation mats, polystyrene boards, mineral wool boards and extruded polystyrene boards. The largest number of samples was taken for testing in 2017 (131) and the smallest in 2020 (61). After 2017, the number of samples taken is reduced. The quality of thermal insulation products is bad or very bad in the analyzed period. In 2016, as many as 61% of the tested samples did not meet at least one property. The situation has slightly improved in the following years, but in 2020 still 44% of the tested thermal insulation products gave a negative result.

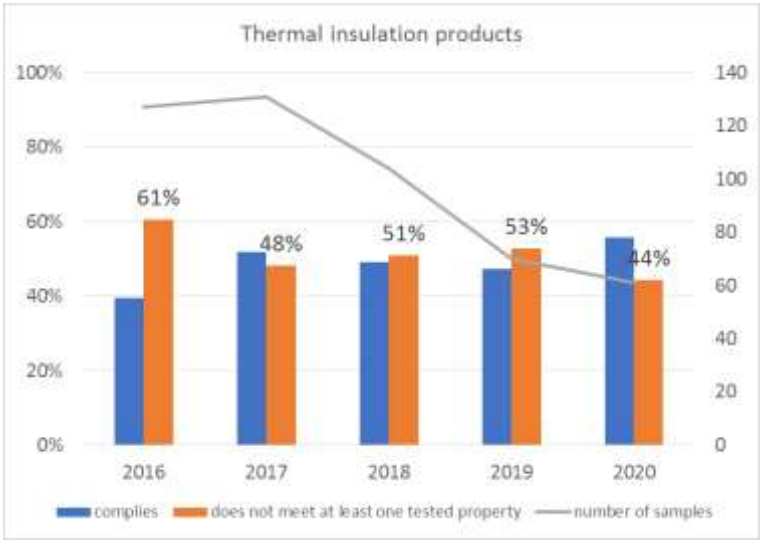

Figure 1 Test results of thermal insulation products in 2016-2020

The parameters to be tested for a given group of construction products are: thermal conductivity coefficient, thermal resistance, tensile strength, bending strength, compressive strength: compressive stresses at 10 % deformation.

The results for the first two, having the greatest impact on the amount of heat loss through partitions, are presented below. Other properties, having a large impact on the durability of thermal insulation, are described in the report.

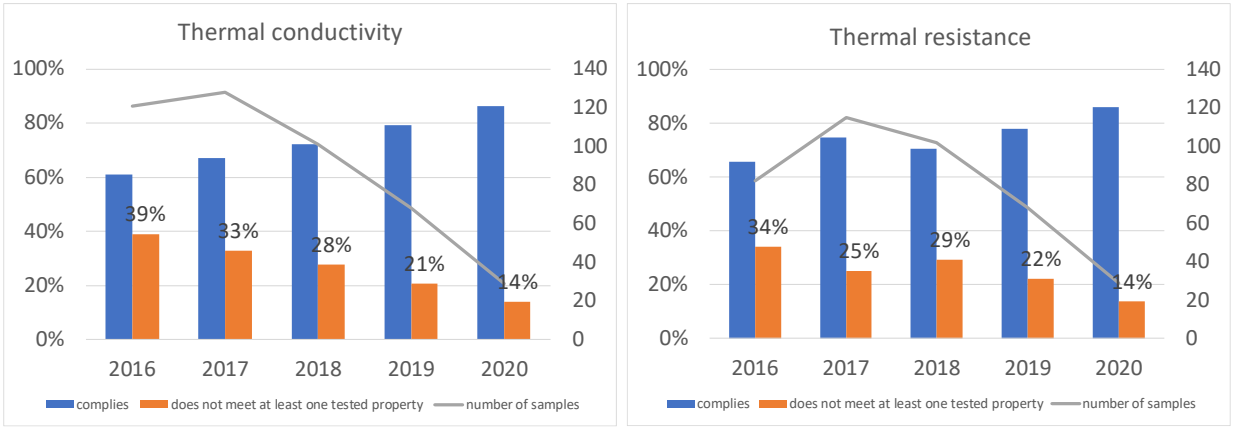

Figure 2 Meeting the requirement for the declared thermal conductivity and thermal resistance coefficient in 2016-2020

It can be seen that the percentage of samples that meet the declared performance properties in terms of thermal conductivity and thermal resistance increases over the following years. In 2020, the highest percentage of samples meeting both requirements was recorded – 84%. The number of samples tested for the declared property has been continuously decreasing since 2017.

Doors, windows and related products

This group includes mainly external and internal doors, vertical and roof windows. The number of tests performed is small and remains at the level of 8-2 per year. The only exception was 2016, when the number of samples was 22. The quality of the tested products is characterized by high variability, although it is difficult to draw unambiguous conclusions for years in which only 2 or 3 tests were performed. In the more reliable 2016, as many as 73% of the tested windows and doors gave a negative result. The remaining years are also characterized by poor or very poor quality of windows and doors, with the only exception being 2018. The most common defects include failure to meet the declared: watertightness; fire resistance; the value of the heat transfer coefficient (most cases) – directly affecting the amount of heat loss by building envelop.

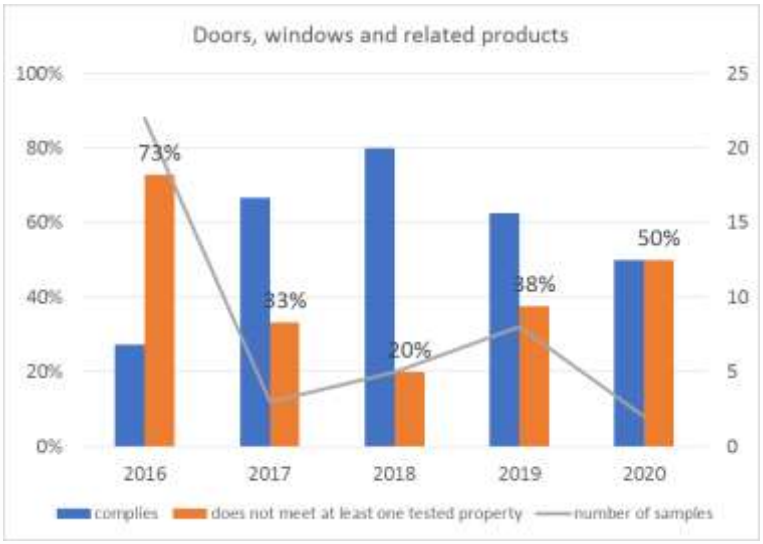

Figure 3 *Test results of doors, windows and related products in 2016-2020*

Space heating equipment

This group includes mainly plate and panel radiators made of steel and aluminum, as well as space heaters and furnaces tested mainly in 2016. The number of studies conducted remains at the level of 16-20 per year. The only exception was the year, 2016, when the number of samples is 5. In the years 2016-2019, the quality of the tested products was bad or very bad. The worst year in this respect turned out to be 2018, when 56% of products did not meet at least one of the tested properties. The most common problems include failure to meet the declared: nominal heat output at a temperature difference of 50K and 30K; tightness under pressure; heat output under various operating conditions (characteristics).

In 2020, the situation improved and only 6% of tests came back negative. Defects that have been revealed may cause that the actual power of the heating system is different than declared and differs to a greater extent from the designed. This affects the efficiency of the entire system, the ability to maintain the designed internal temperatures and the efficiency of regulation.

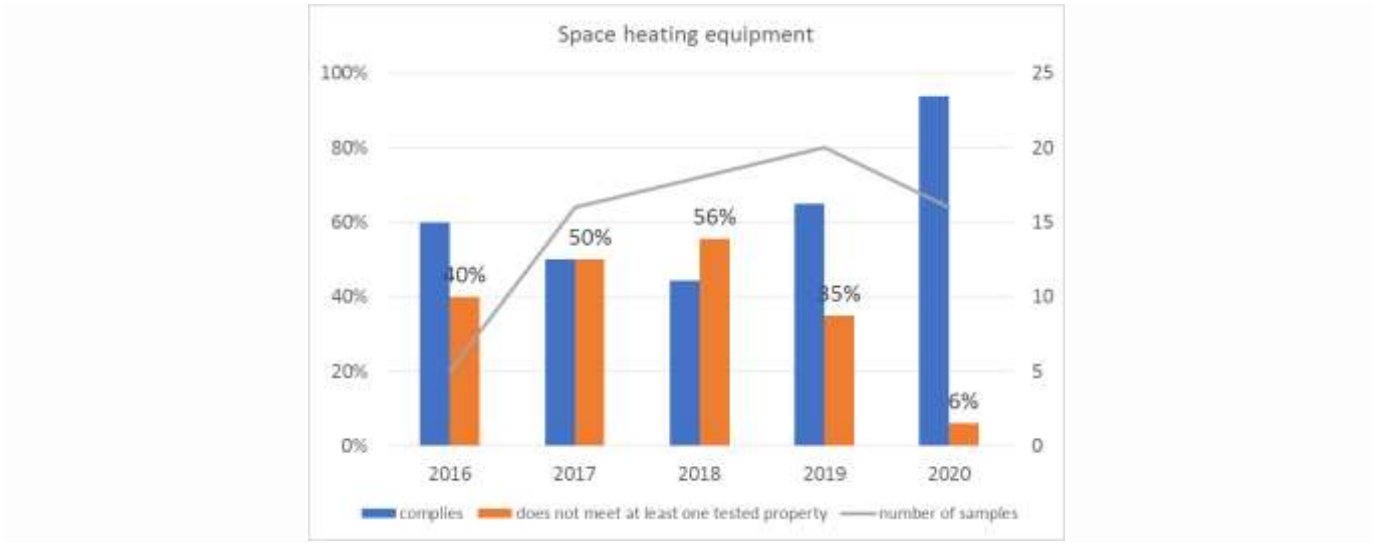

Figure 4 *Research results of space heating equipment in 2016-2020*

5 Conclusions

The results of the analysis show that there are still construction products on the market that do not meet the declared requirements. In 2020, 44% of thermal insulation products and 38% of membranes did not meet at least one tested property. The quality of construction adhesives, flooring and flooring products is average. Due to too few samples/tests, it is difficult to draw clear conclusions for doors, windows and bonded products and aggregates. In all of these product groups, the number of tests performed annually should be increased.

Continuous testing of construction products available on the market, carried out by inspection authorities, contributes to the improvement of their quality. A positive trend is visible in most groups of construction products, with masonry products being a very good example. It is worth increasing the number of tests performed in groups such as: control and communication power cables; concrete and products related to concrete, grout and mortar; complex insulation kits/systems. Increasing the numbers has a positive effect on the representativeness of the sample and better illustrates the quality of the products available on the market. A very good example is the testing of reinforcing and prestressing steel for concrete. With a small number of tests of 5-11 per year, they all gave positive results. After testing 47 samples in 2020, it turned out that 3 of them had already given a negative result.

Based on the obtained results, it can be concluded that the quality of products in the three analyzed groups should be constantly monitored by the supervisory authorities and the number of samples taken should be increased. There are products available on the market that do not meet the declared properties relevant to the energy efficiency of buildings. It is worth introducing solutions that stimulate the improvement of their quality. One of them is to increase the amount of penalties for manufacturers of construction products that do not meet the declared properties and to enforce them effectively. In addition, as part of national or EU programs supporting the improvement of energy efficiency of buildings, e.g. thermo-renovation fund, the Clean Air program, the use of construction products that do not meet the declared properties in accordance with the results of GUNB research should be excluded. The use of defective products leads to lower than expected energy savings. At the same time, the presence on the market of products that do not meet the declared parameters contributes to unnecessary and excessive consumption of natural resources, which is contrary to the concept of the circular economy [5].

The accessibility and readability of the research results published by the GUNB on the website should be improved. The solution may be to use a user-friendly interface and search options for the published database. At the moment, the results of the research reach a very small audience. The aim should be to bring the results closer to consumers. The solution may be to popularize and communicate them to industry and general construction magazines, online construction websites and the use of social networking sites. The results should be presented in an aggregated manner and using information graphics. Such activities are aimed at building consumer awareness. Decisions taken at the construction stage will have an impact on energy consumption over the entire lifetime of buildings.

Bibliography

[1] Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC Text with EEA relevance

[2] Journal of Laws of 2004 No. 92 item 881 ACT of 16 April 2004 on construction products

[3] Firląg S., *Sustainable office buildings*, 2018, Warsaw, Wydawnictwo Naukowe PWN, 404 p., ISBN 978-83-01-19513-7

[4] Major Maciej (ed.): *Practical aspects of the safety of building structures*, Wyd. I, Wydawnictwo Politechniki Częstochowska, 70 p., 2021 ISBN 978-83-7193-849-8

[5] Tomaszewska J., *The Polish construction sector and circular economy*, Materiały Budowlane, 2019, no 12, p. 8-10