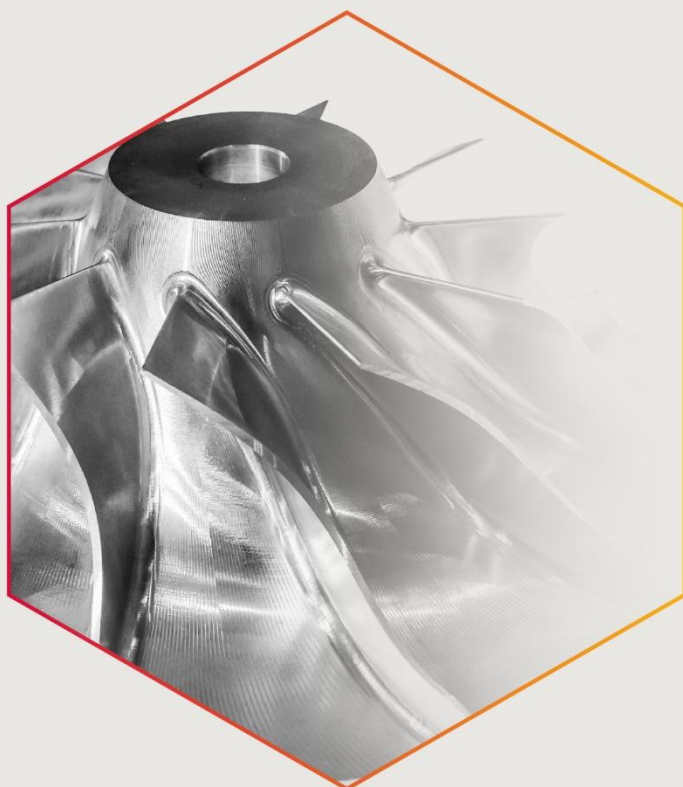




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REPORT no.1 on molding materials

Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

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Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

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1. Introduction

This report shows the results achieved within NetCastPL4.0 project. The project is being realized in cooperation between AGH Faculty of Foundry Engineering (Leader), CNR-ICMATE and Aalto University School of Engineering.

This report is a part of research focused on elaboration of molding materials used for advanced light-weighting castings production and their use in light-weight cast iron castings. Elaboration of molding materials used for advanced light-weighting castings production is also the milestone of the project. The research on elaboration molding materials for thin-walled castings involved:

- ✓ the selection of molding compounds and testing their properties (**output:** SPOLUPRACA 2025 conference abstract (<https://repo.agh.edu.pl/handle/AGH/115005>), REPORT no.1 on molding materials, paper in scientific journal – published (<https://doi.org/10.1007/s40962-025-01638-z>), ICCME 25 conference abstract - submitted, paper in Special Issue 2026 of JCME for NetCastPL4.0 project – under preparation);
- ✓ the design of a mold for the production of thin-walled castings (**output:** ICCME 25 conference abstract - submitted, paper in Special Issue 2026 of JCME for NetCastPL4.0 project – under preparation);
- ✓ the production of classical molds and 3D printed (**output:** REPORT no.2 on molding materials – under preparation, SPOLUPRACA 2025 conference abstract (<https://repo.agh.edu.pl/handle/AGH/115004>), ECIG 2025 Conference abstract (<https://repo.agh.edu.pl/handle/AGH/115006>), paper in scientific journal – accepted for publishing, paper in scientific journal – submitted, paper in Special Issue 2026 of JCME for NetCastPL4.0 project – under preparation);
- ✓ testing the properties of thin-walled castings produced in the designed molds made using the selected compounds (**output:** ICCME 25 conference abstract - submitted, paper in Special Issue 2026 of JCME for NetCastPL4.0 project – under preparation).



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2. Molding materials vs. Green Deal policy

2.1 Molding materials used in the production of cast iron castings

Among the numerous classifications of molding compounds [1-3], the classification proposed by P. Jelinka [4] stands out for its simplicity and substantive justification.

This classification divides compounds into four generations depending on the type of binding material:

- ✓ Generation I – molding sands in which clays are used as binding materials,
- ✓ Generation II – molding sands in which the binding material is a binder,
- ✓ Generation III – molding sands without binding materials, also known as physically bound sands,
- ✓ Generation IV – molding sands bound by biotechnological factors.

Generation II molding compounds, i.e., compounds bound with binders, are most commonly used in casting processes. This is due to their high technological properties, but also to their versatility. They can be used for both molds and cores production.

The latest trends in casting production, which aim to reduce the weight of castings by increasing their dimensional and weight accuracy, involve the use of molds composed of core packs. This trend has led to a significant increase in demand for second-generation core materials.

The binders used in these technologies are mainly organic binders (based on synthetic resins) and inorganic binders, such as hydrated / solid [5-6] sodium silicate.

The essence of the problem, however, is that technologically perfect synthetic resin-based binders have a harmful impact on the environment. On the other hand, ecological inorganic binders are characterized by poor knock-out properties and low mechanical regeneration capacity.



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2.2 Molding materials vs. Green Deal policy

Two important events initiated pro-environmental activities in the EU:

In 1972, the first United Nations Conference on the Human Environment was held in Stockholm, which approved the principles of sound environmental management, including the Stockholm Declaration. In 1992, the Earth Summit was held in Rio de Janeiro. Many important declarations were adopted at the summit, including Agenda 21 and the Rio Declaration.

The above international activities led to the adoption of the following European treaties:

- 1972 - at the European Council meeting in Paris, the need for a Community environmental policy accompanying economic policy was announced.
- 1987 - The Single European Act introduced a new Title VII, “Environment,” which constitutes the first legal basis for a common environmental policy.
- 1993 - The Maastricht Treaty made the environment (Title XVI) an official area of EU policy.
- 1999 - Article 3c of the Treaty of Amsterdam required the integration of environmental protection into all EU sectoral policies.
- 2007 - Under the Treaty of Lisbon, climate change and sustainable development became priorities [7].

The need to comply with high environmental protection requirements is currently a dominant factor in the development of molding and core technologies. Compliance with these requirements is achieved even at the expense of reducing the technological properties of the compounds used in the production of molds and cores.

These trends have meant that molding technologies and materials that have been used successfully in foundry production processes for decades must be replaced with more environmentally friendly solutions.

These include:

- Coal dust

This mainly applies to Generation I molding sands with bentonite, which have been considered completely environmentally friendly until the coal dust occur the necessary additive to them. Considering the high emissions of benzo(a)pyrene (PAH), they are among the main hazards in foundries [8-10].

- Alcohol protective coatings

The alcohol protective coatings are mainly produced on the basis of organic solvents, mainly isopropyl alcohol. However, European Union requirements mandate the elimination of organic solvents in industry, forcing coating manufacturers to develop solutions based on water-based solvents, i.e., water-soluble coatings with low water content [11-12].

- Ethyl silicate molding sands

Due to the ethyl silicate hydrolysis process using organic solvents applied in the preparation of these compounds, precision casting has been forced to search for new binders. The result of this research is the implementation of colloidal silica compounds in production [13].

- Molding sands with furfuryl resins



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On December 1, 2010, Regulation (EC) No. 1272/2008 of the European Parliament and of the Council of December 16, 2008 on classification, labeling, and packaging of substances and mixtures came into force, which classified furfuryl resins with a free furfuryl alcohol content of more than 25% as toxic. The permissible free furfuryl alcohol content has changed over the years and is currently 40% [14-15].

➤ Cold-box process

The cold-box process is the pinnacle of foundry technology in the field of mass production of casting cores. It is an example of technological progress being stimulated by environmental protection requirements. Over the years, the cold-box process has changed significantly in terms of its environmental aspects. In the original solution of this method, high-boiling aromatic hydrocarbons were used as solvents for the two-component binder (resin and activator). However, this technology ensured very good strength properties of the core sand, which predestined it for the production of the most complex cores. In the next generation of technology, the solvents were replaced with acid methyl esters, which reduced the amount of harmful gases generated during the curing and molding processes. Currently, resins for the cold-box process containing ester solvents and silicate esters are produced worldwide [16-17].



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3. Tests of molding sands chosen for light-weighting castings

As part of the development of molding compounds for thin-walled castings, compounds with organic binders and compounds with inorganic binders were tested. Tests were carried out on the tensile and bending strength, permeability, and friability of the compounds. For selected mixes, tests were carried out on their thermophysical properties (hot distortion parameter), gas generation, and thermal degradation.

3.1 Research methodology

Molding sands properties were tested according to the following methodology.

3.1.1 Sand mixture preparation

In each type of molding sands, rotary mixer (drill + mixer) was used, which significantly reduces mixing time. Molding sands were prepared as follows: sand + hardener - 20 s + binder - 20 s. Compaction: LUZ-1 vibratory compactor, compaction time 15 s, vibration amplitude 2 mm.

3.1.2 Tensile strength, bending strength, permeability & friability

A good mold must possess sufficient strength to withstand molten metal pressure, to support its own weight and the weight of the metal being cast. To evaluate this, tensile & bending strength tests were conducted. For tensile tests standard dog bone specimens were prepared and for bending strength tests standard longitudinal specimens of length 172 mm and square cross section of 22.4 mm sides were made. All the tests were done using Morek Multiserw Universal Strength Tester LRu-2e/w. Molding sands were compacted by vibration (LUZ-1 device). Strength tests were conducted after 1, 3 & 24 hours of curing. The results presented for all the different tests are the mean of 3 samples tested.

Permeability was measured using the rapid method (with nozzles) on an LPIR1 electric device. The parameter was tested after 1, 3, and 24 hours of curing of the tested molding sands. The measurement consisted of placing standard cylindrical specimen in the apparatus sleeve and placing it on the apparatus heads. Then, the sleeve with the specimen attached to the head is sealed with a clamping knob. Once the indicator on the measuring scale stabilized, the permeability value is read.

With friability test, the resistance of the mold surface to abrasion was measured. The research was conducted with the usage of an apparatus designed in Poland by the HSW S.A. company. Standard Ø50 mm x 50 mm cylindrical samples were used. The mass of the sample was first measured; then, the sample was rotated along horizontal axis (1 rev/s) and 1750 g of steel shots of 1 mm dia fall onto the cylindrical specimen from a height of 307 mm. The steel shots cause abrasion and wears away some sand. After all the steel shots fell through, the cylindrical specimen was taken out and its mass was measured again. The % change in mass gives a value for the friability of the sample. The lower the friability, the more wear resistant that sample is. Three specimens were measured for each molding sand, and the arithmetic mean is presented. Figure 3 shows the scheme of an apparatus for friability test designed in Poland by the HSW S.A. company [18].



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

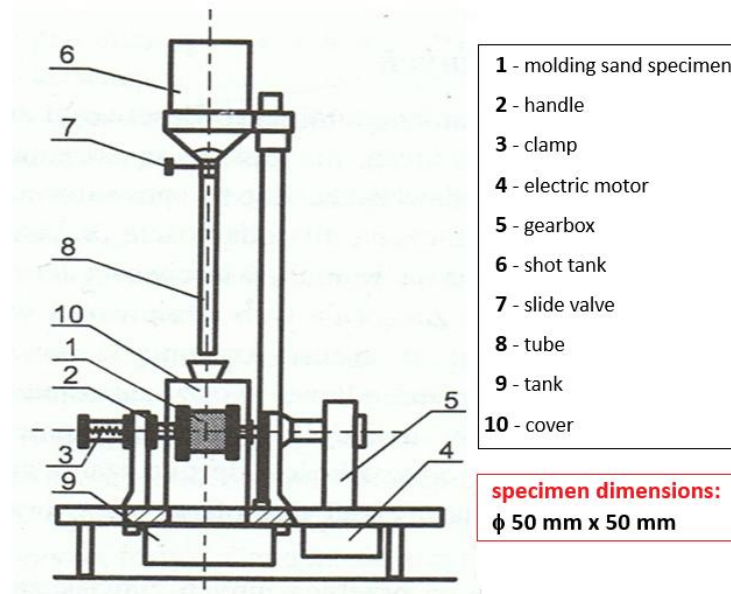


Fig. 1. The scheme of an apparatus for friability test designed in Poland by the HSW S.A. company [18].

3.1.3 Bench life

The bench life was determined by measuring the change in strength over time after the uncompacted mass was set aside. In each case, 2 kg of molding sand was prepared, the ingredients were dosed in the following order: matrix + hardener, and then, after initial mixing, the binder was added. The setting time of the molding sands was measured from the moment the binder was added. After preparing the molding sands, dog bone specimens were quickly made by compacting a portion of the molding sand poured into a metal mold, using a standard rammer by striking the weight three times. After the last strike of the weight, the time of making the shape was recorded – the time that elapsed from the beginning of the measurement. The portion of the molding sand was selected so that the height of the compacted sand corresponded to the position on the rammer scale. The shapes were made until the molding sand became loose. After complete hardening (24 hours), the strength of the specimen was determined and a graph of the tensile strength versus the setting time of the uncompacted molding sand was prepared.

In the case of linear changes in strength, bench life was determined as the time after which there was a 30% decrease in strength relative to the maximum possible strength. The maximum achievable strength was determined by adding a trend line to the obtained measurement points. This is a theoretical value obtained for a setting time of 0 h, read at the point of intersection of the trend line with the strength axis.

In the case of molding sand “aluminosilicate-2.0/hardener-10%” the bench life was determined as the time after which there was a sharp decrease in strength – a break in the curve of strength changes as a function of the standing time of the uncompacted mass.

For molding sand “phenolic resin-2.0/hardener-2-10%”, two time intervals can be observed. Initially, there are very slight changes in strength, and after exceeding the critical point, there is a sharp drop in strength. Therefore, the results were divided into two series, and the bench life was determined at the point of intersection of the trend lines for these measurement series.



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3.1.4 Hot distortion

The behavior of cores and molds in high temperature shows the real conditions of casting. During pouring, the mirror of liquid metal rises up, and cores and molds are intensively heated. Cores in initial stage are heated onesided. During heating many different phenomena occur such as the thermal deformation (expanding and shrinking), the thermoplasticity and thermal and mechanical destruction. All the phenomena depend on the binder type and determine the final shape of the casting, its dimensional accuracy and finally, the quality of the manufactured castings. Hot distortion parameter allows the observation of the core behavior in conditions simulating the real conditions in the mold, when the core is heated by radiation. [41] Hot distortion(thermal deformation) parameters were investigated using a DMA apparatus by Morek Multiserv. One end of the sample is fixed in the jaws of the device, while a tilt sensor rests on the other end(free) of the sample. Additionally, a temperature sensor is provided for more accurate temperature reading. The sample is then heated in the middle from below, with two halogen lamps with a total power of 500 W. The heating temperature ranges from room temperature to 900 °C. The apparatus provides deformation readings as a function of both time and temperature. Maximum deformation reading was set at 6 mm. Schematic diagram of hot distortion test is shown in Figure 2.

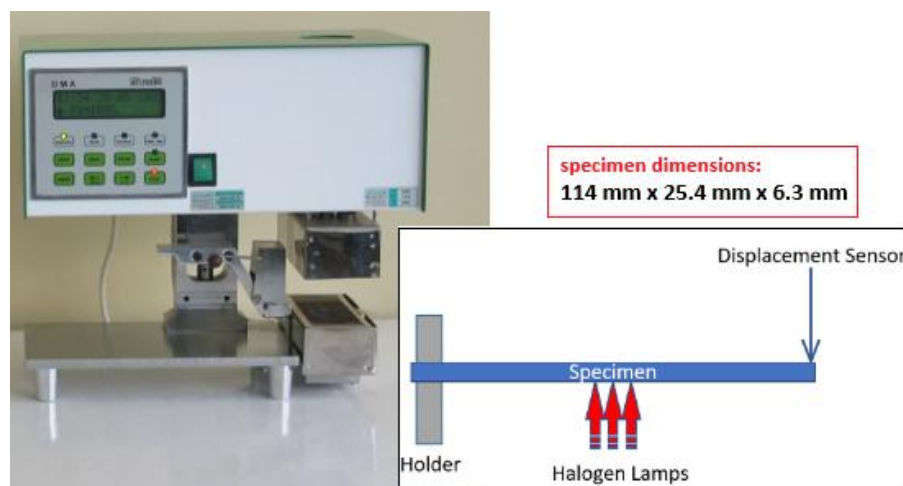


Fig. 2. Prototype device for measuring molding sands deformation at elevated temperatures, type DMA with schematic diagram of the Hot Distortion Test, adapted from [5, 19].

3.1.5 Thermal analysis

Thermal analysis of the tested molding sands was performed using a Jota s.c. derivative thermogravimetric analyzer under the following measurement conditions: heating temperature range 20–1000°C, heating rate 10 deg/min.

3.1.6 Gas emission tests

One of the challenges with organic binders is the large amount of gas release upon pouring. Thermal decomposition at high temperature leads to the emission of VOCs which are harmful for human health.⁴ Apart from that, large amount of gas release could lead to casting defects as well if the gases cannot escape from the mold fast enough. Inorganic binders perform very well in this regard, as they produce very little fumes compared to the organic counterparts. However, some organic additives are used in this study, e.g., glucose and sucrose, and this gas emission test shows if any big emissions are coming from those additives. For this test only, organic phenolic binder was included as well to show the comparative result between organic and inorganic binder. Gas emission test was conducted according to Polish standard BN-76/4024-05. After



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reaching a temperature of 1000 °C, a corundum boat with a weighed sample of 2 g is introduced into the quartz tube. The pipe is closed tightly. The other end of the pipe is connected to a peristaltic pump, which is turned on to create a negative pressure. The measurement is started, and the quartz tube is moved to the position where the sample is in the heating zone. Placing the sample in the heating zone causes the release of gases that are products of the reactions taking place. This increases the pressure in the system. The pump is automatically turned on to remove the generated gases. The recording of the volume of released gases continues until the pressure stabilizes at the initial value.



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3.2 Molding sands with organic binders

Two types of self-hardening molding compounds used for disposable molds and cores in the production of cast iron and non-ferrous metal castings were selected for testing. The most commonly used are compounds with furfuryl alcohol-modified resin and, as an alternative to them, slightly less harmful to the environment, compounds with phenolic resin cured with esters.

SIBELCO quartz sand with the properties shown in Fig. 3 was used as the matrix for the tested molding compounds.

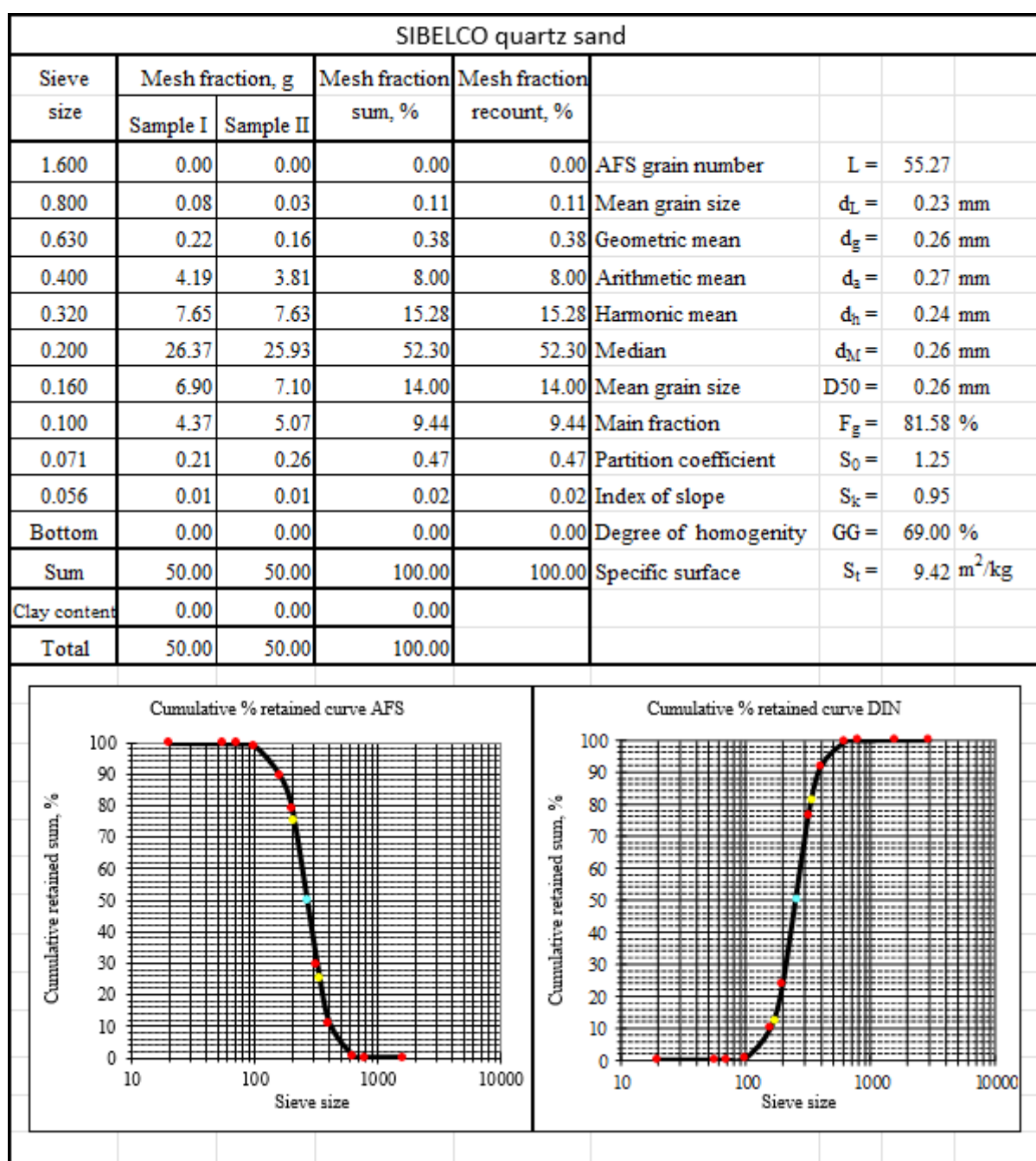


Fig. 3. The Results of sieve analyses of SIBELCO quartz sand used in tests

The compositions of the molding sands are presented in Tables 1-2.



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Table 1. The composition of molding sands with furfuryl resin.

Molding sand symbol	furfuryl resin, p.p.w.	hardener, % to resin content
furfuryl resin-0.7/hardener-50%	0.7	50
furfuryl resin-1.0/hardener-50%	1.0	50
furfuryl resin-1.5/hardener-50%	1.5	50
furfuryl resin-2.0/hardener-50%	2.0	50

Table 2. The composition of molding sands with phenolic resin.

Molding sand symbol	phenolic resin, p.p.w.	hardener1, % to resin content	hardener2, % to resin content
phenolic resin-1.5/hardener1-5%	1.5	5	
phenolic resin-1.5/hardener1-10%	1.5	10	
phenolic resin-1.5/hardener1-25%	1.5	25	
phenolic resin-2.0/hardener1-10%	2.0	10	
phenolic resin-2.0/hardener1-15%	2.0	15	
phenolic resin-2.0/hardener1-25%	2.0	25	
phenolic resin-1.5/hardener2-25%	1.5		25
phenolic resin-2.0/hardener2-10%	2.0		10
phenolic resin-2.0/hardener2-15%	2.0		15
phenolic resin-2.0/hardener2-25%	2.0		25
phenolic resin-2.5/hardener2-25%	2.5		25

The results of the achieved results are presented in Figures 4-30.

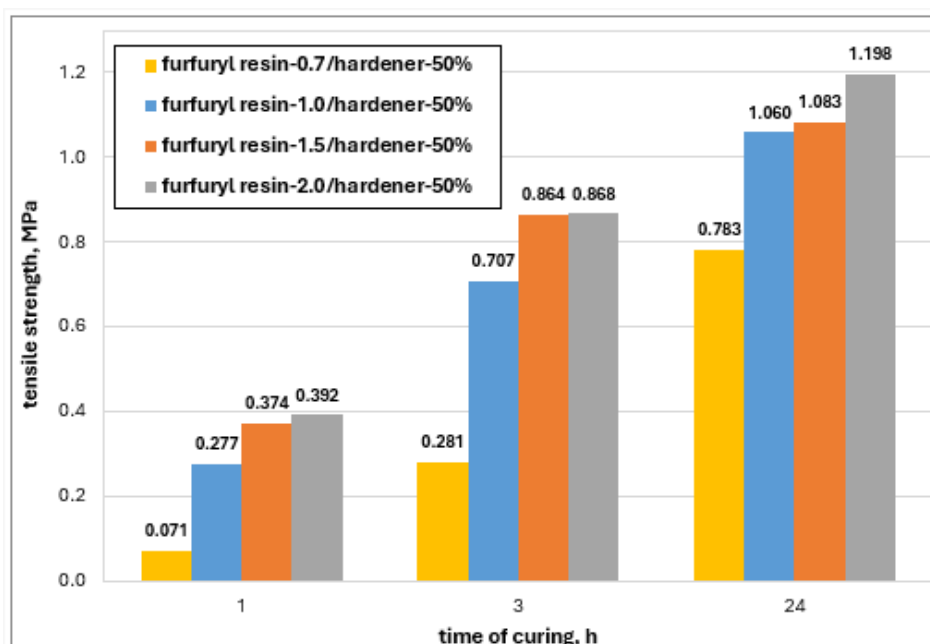
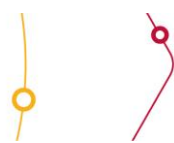


Fig. 4. The influence of molding sands' with furfuryl resin compositions on their tensile strength.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

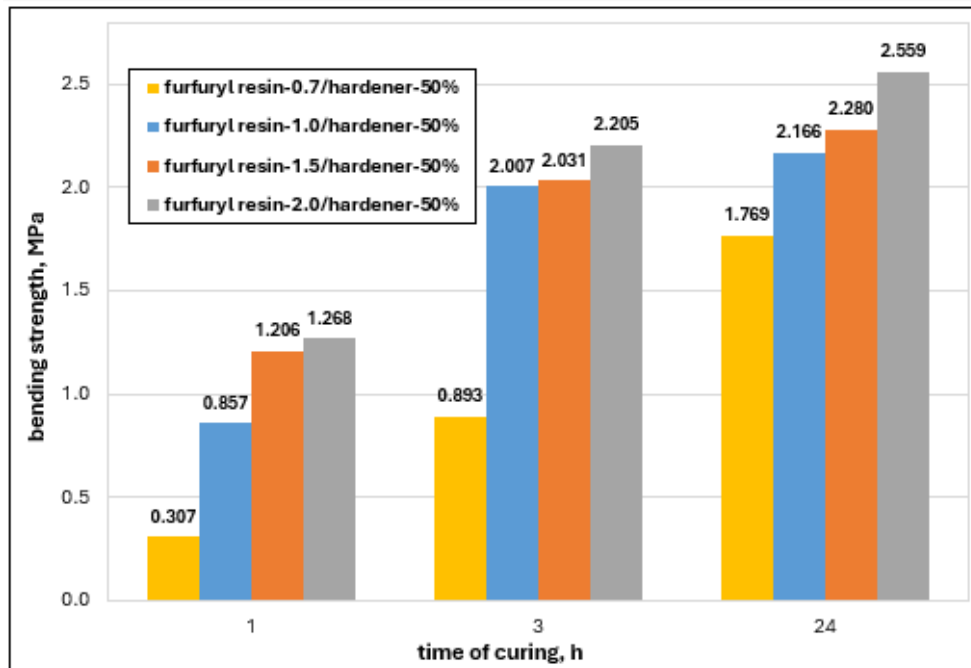


Fig. 5. The influence of molding sands' with furfuryl resin compositions on their bending strength.

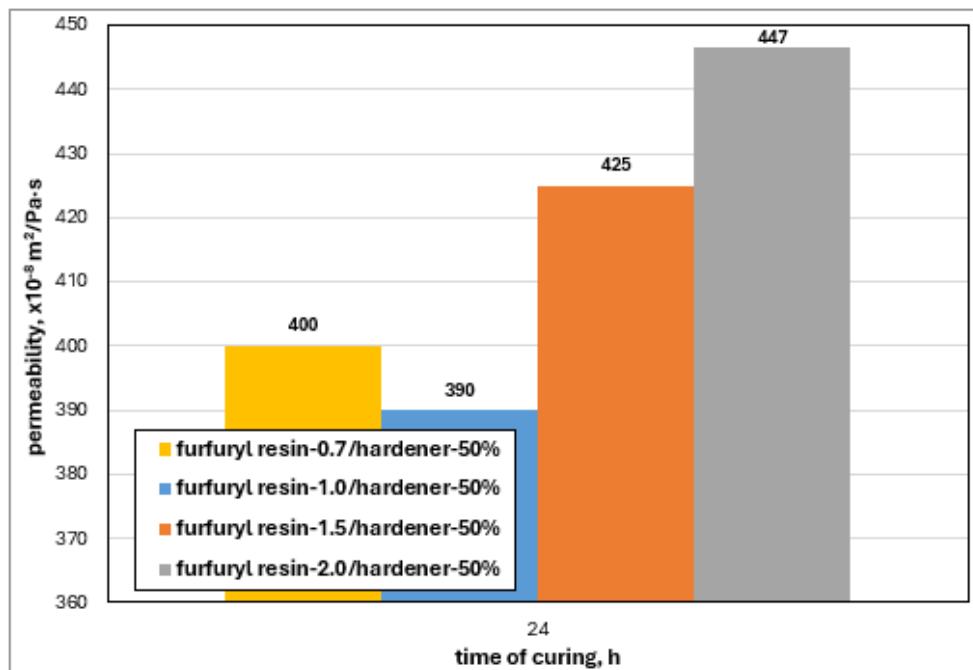
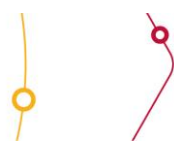


Fig. 6. The influence of molding sands' with furfuryl resin compositions on their permeability.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

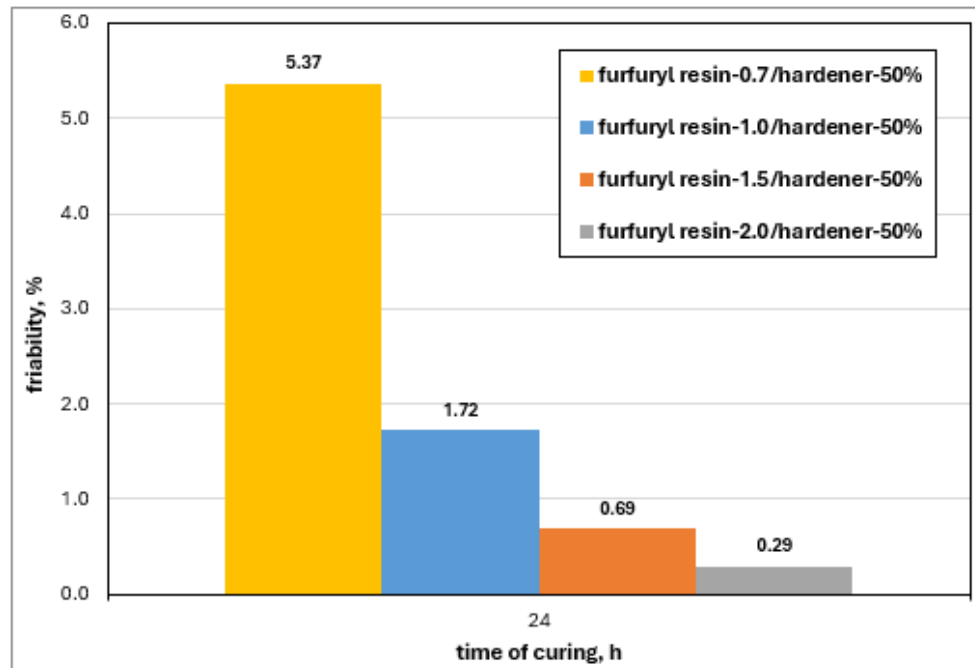
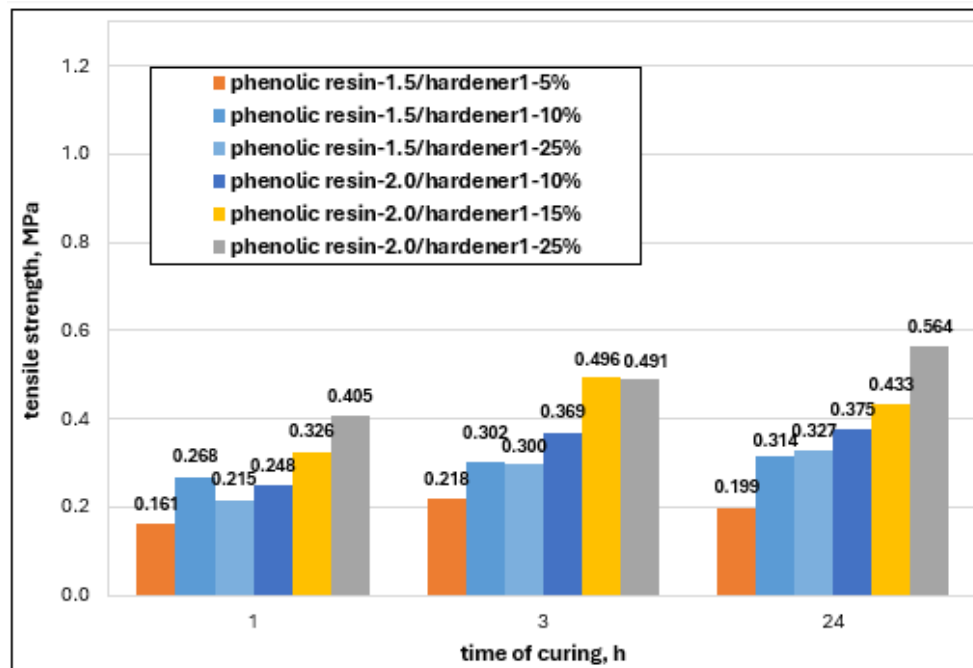
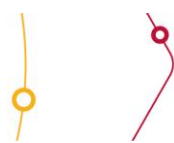


Fig. 7. The influence of molding sands' with furfuryl resin compositions on their friability.





Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

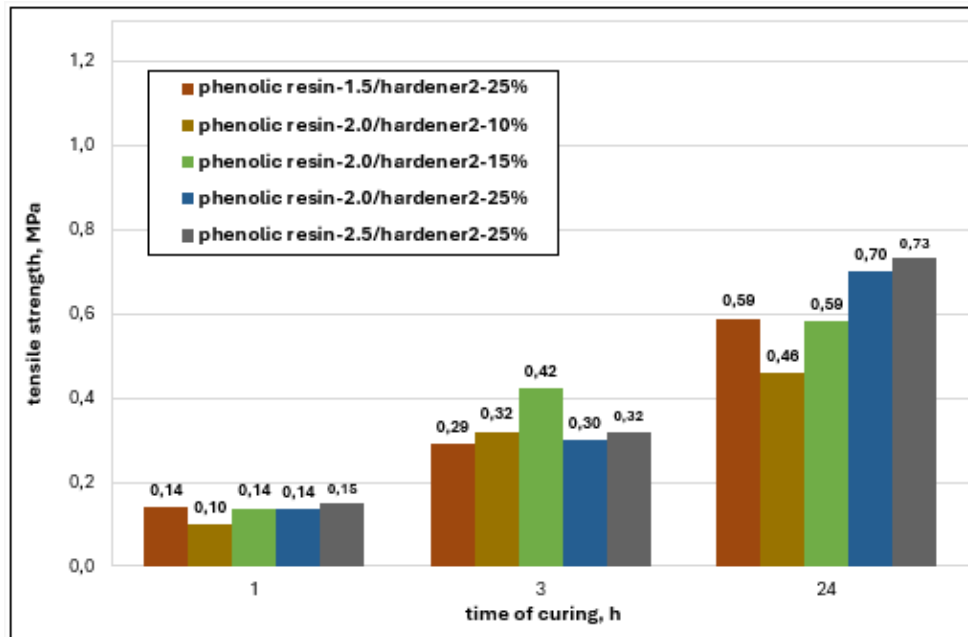
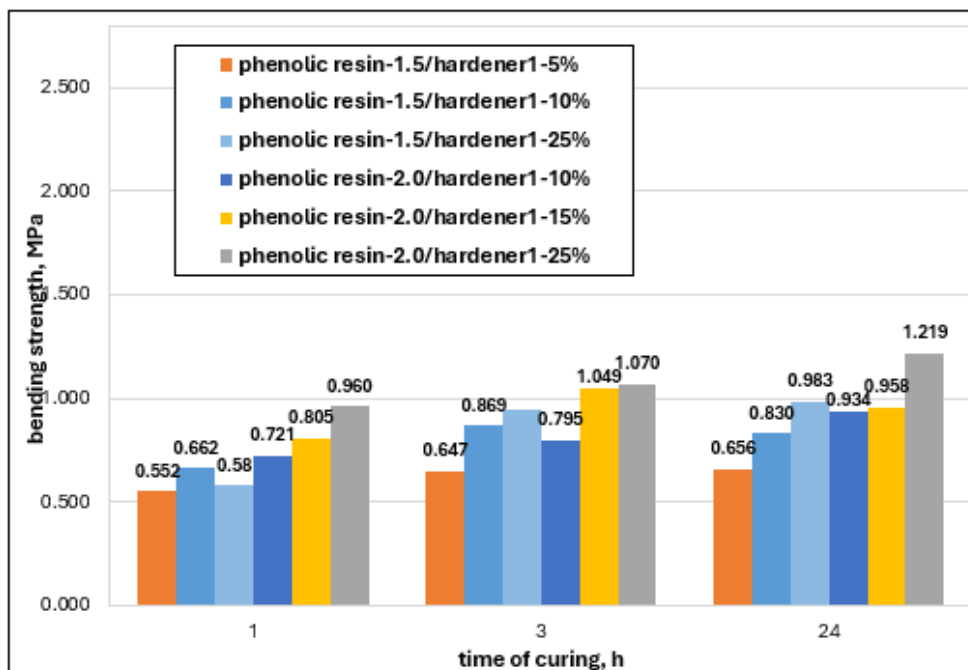
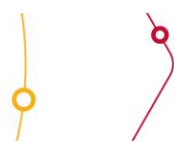


Fig. 8. The influence of molding sands' with phenolic resin and different hardeners compositions on their tensile strength.





Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

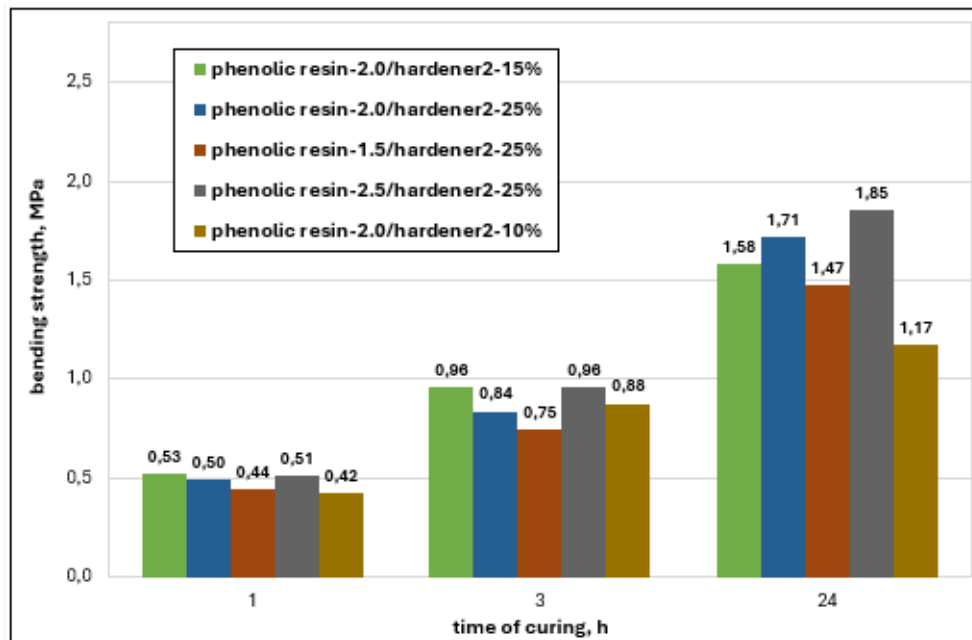


Fig. 9. The influence of molding sands' with phenolic resin and different hardeners compositions on their bending strength.

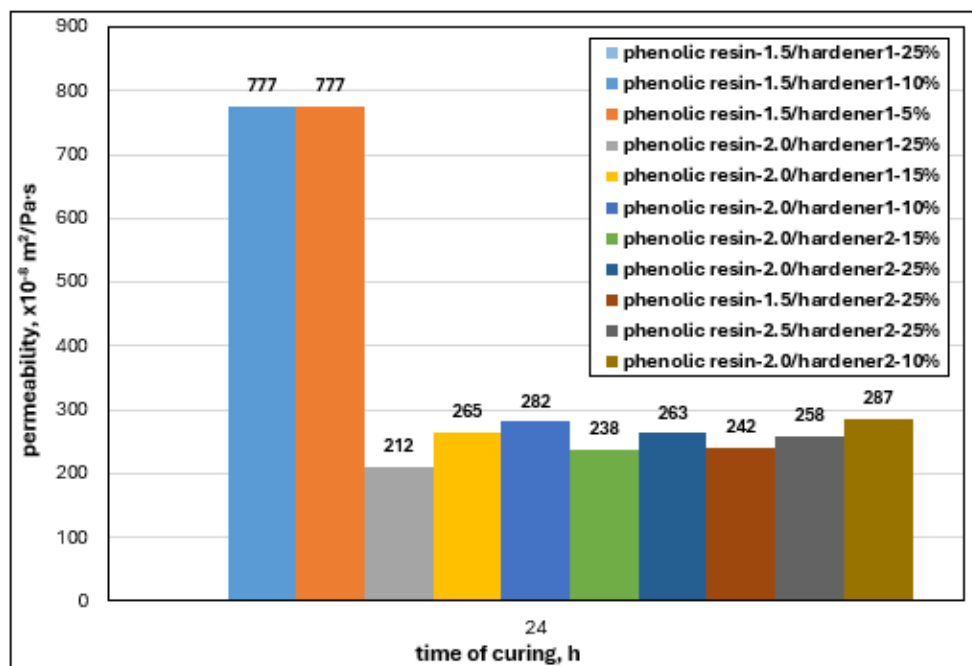


Fig. 10. The influence of molding sands' with phenolic resin and different hardeners compositions on their permeability.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

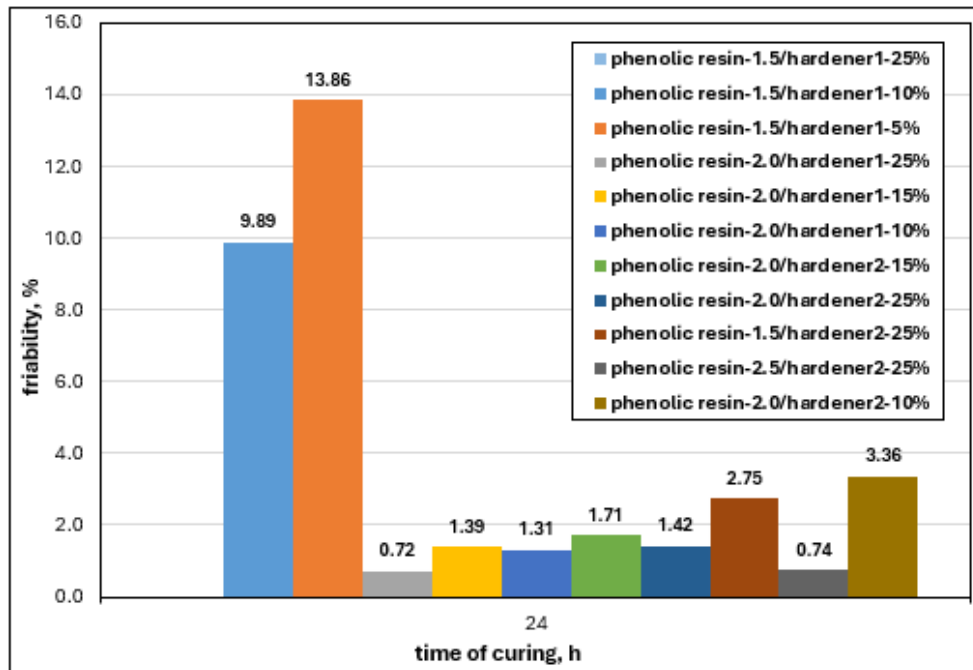


Fig. 11. The influence of molding sands' with phenolic resin and different hardeners compositions on their friability.

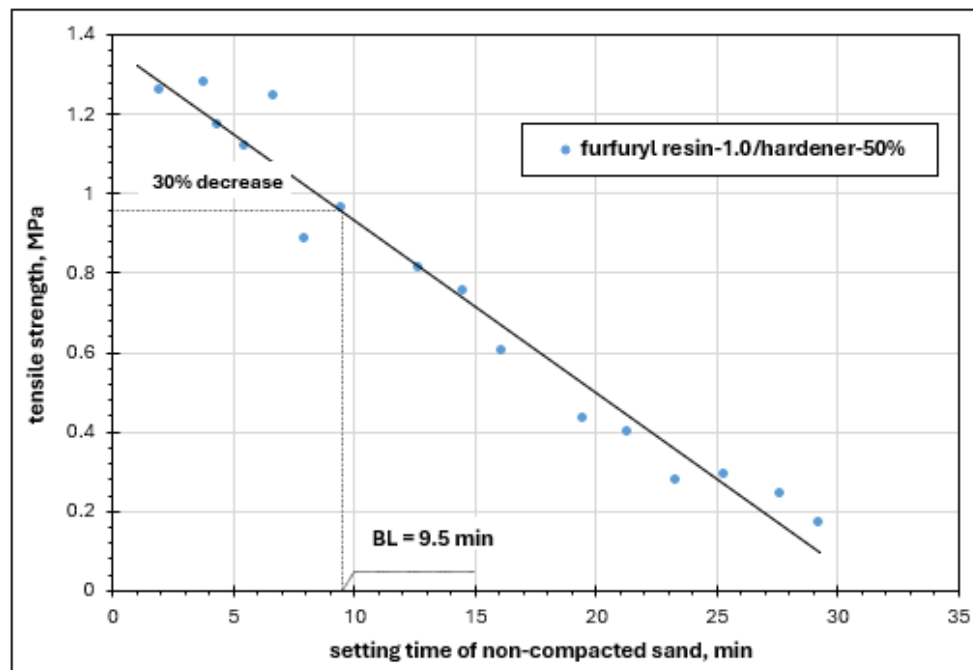
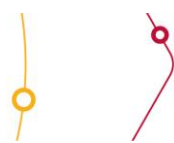


Fig. 12 The bench life of chosen molding sand with furfuryl resin.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

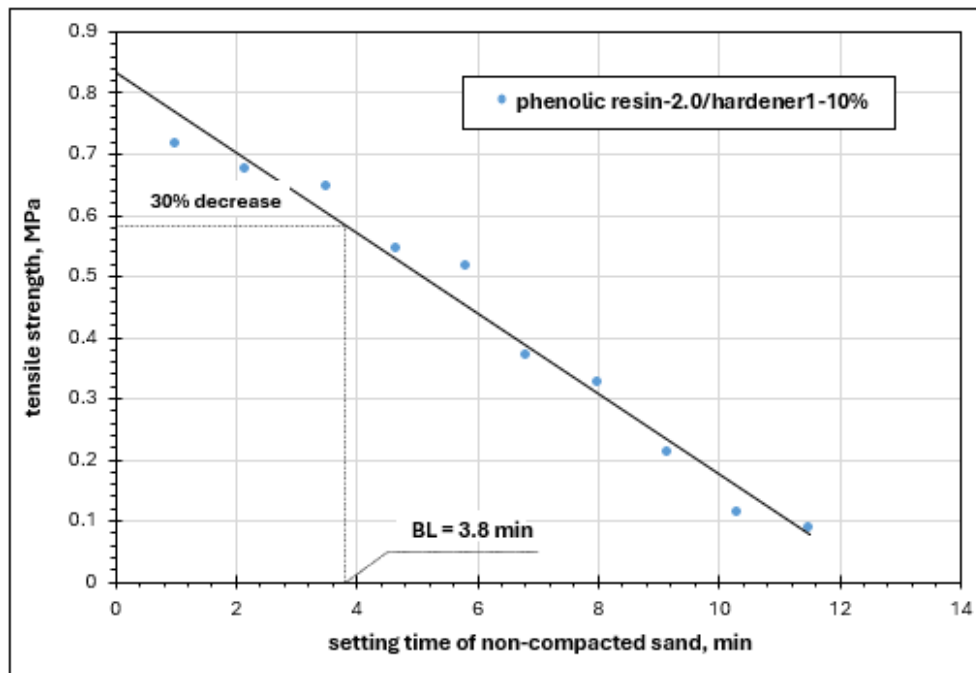


Fig. 13 The bench life of molding sand with 2.0 p.p.w. of phenolic resin hardened with 10% (to resin's content) of hardener 1.

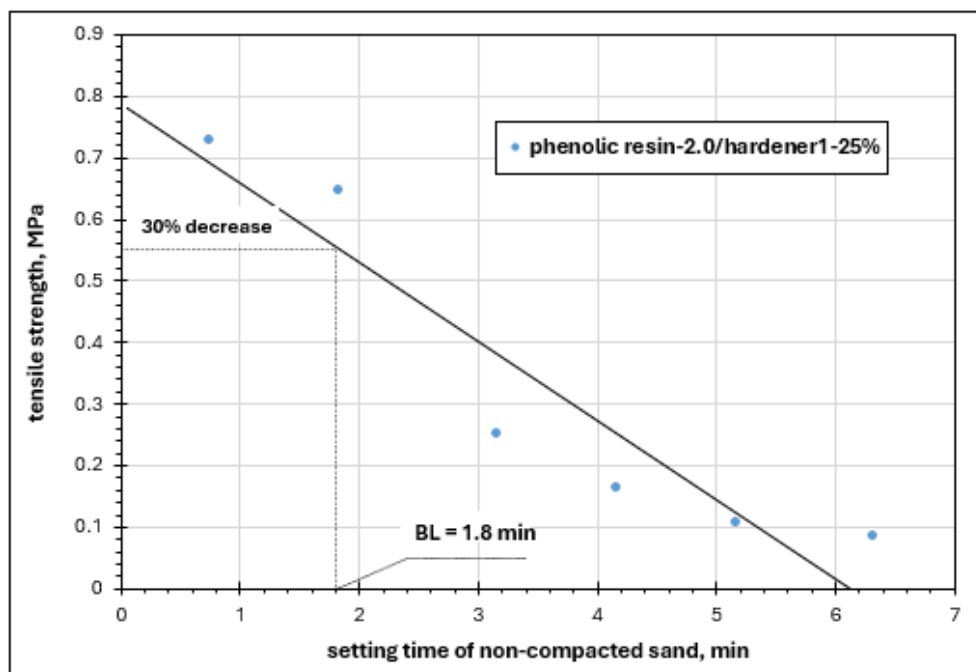
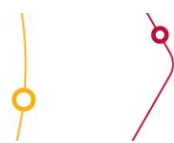


Fig. 14 The bench life of molding sand with 2.0 p.p.w. of phenolic resin hardened with 25% (to resin's content) of hardener 1.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

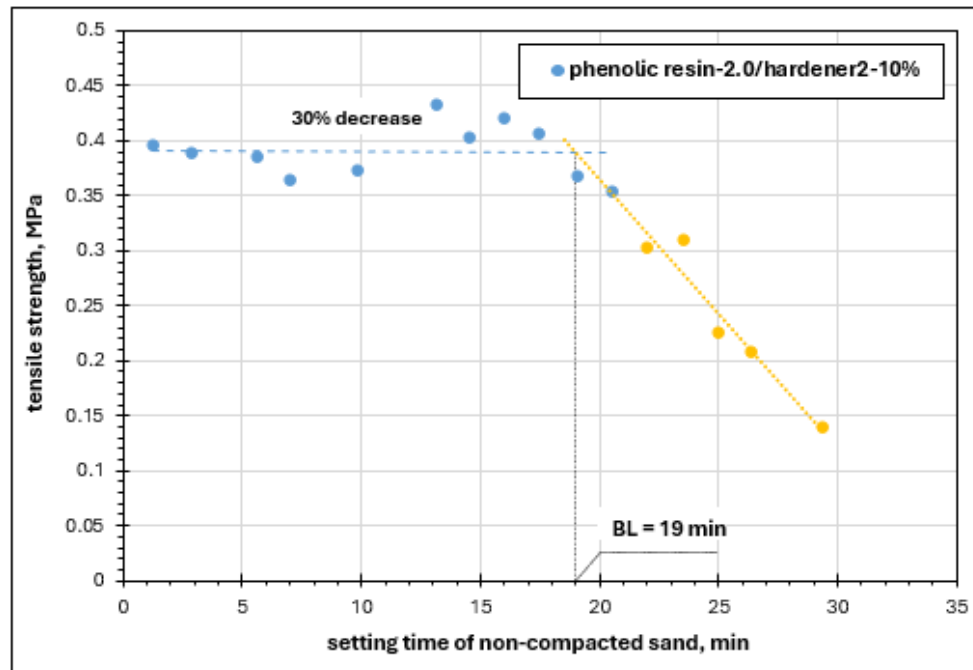


Fig. 15 The bench life of molding sand with 2.0 p.p.w. of phenolic resin hardened with 10% (to resin's content) of hardener 2.

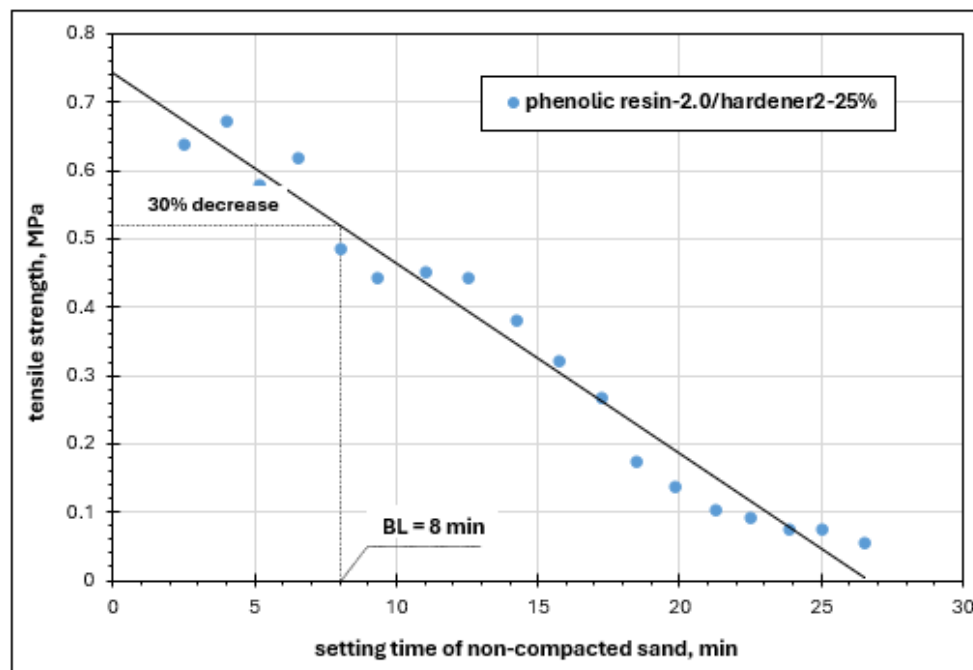


Fig. 16 The bench life of molding sand with 2.0 p.p.w. of phenolic resin hardened with 25% (to resin's content) of hardener 2.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

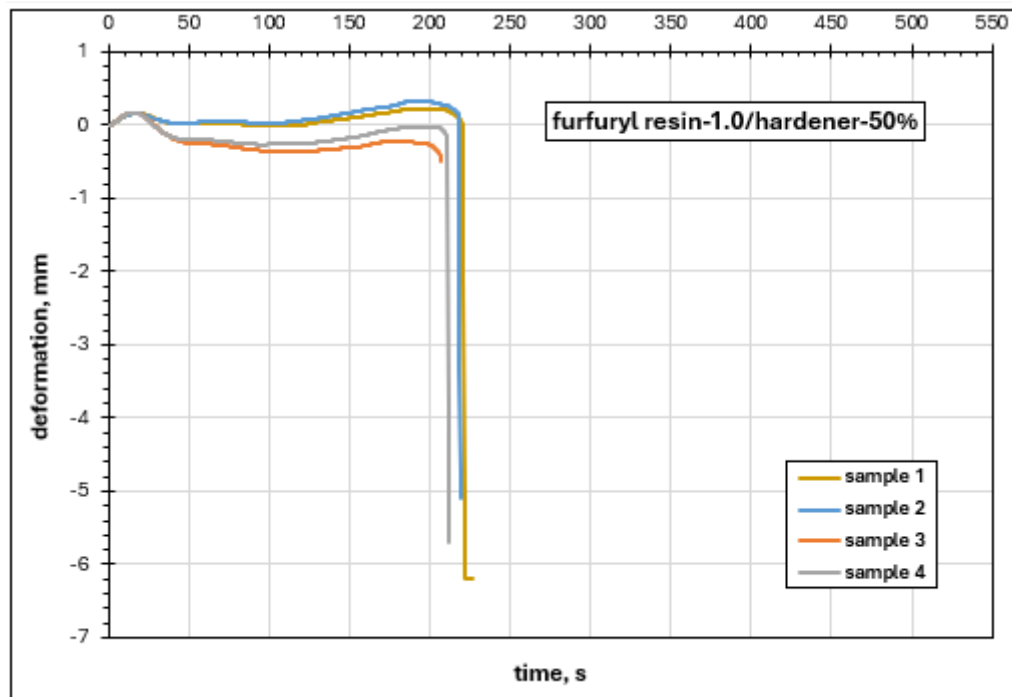


Fig. 17 The thermal deformation (hot-distortion) of molding sand with 1.0 p.p.w. of furfuryl resin.

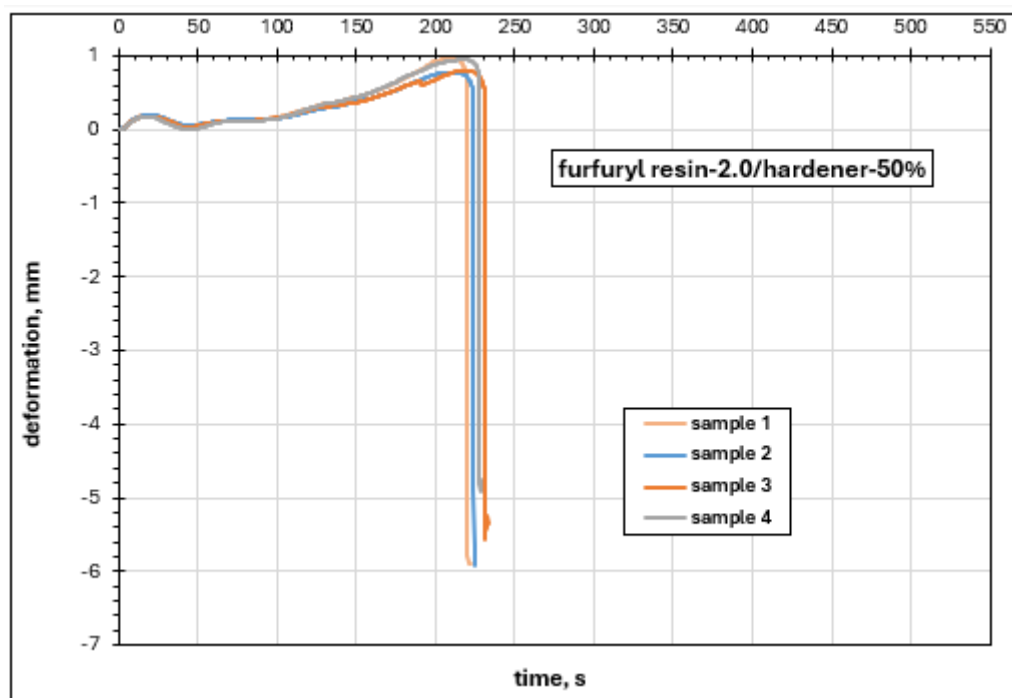
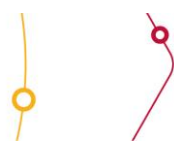


Fig. 18 The thermal deformation (hot-distortion) of molding sand with 2.0 p.p.w. of furfuryl resin.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

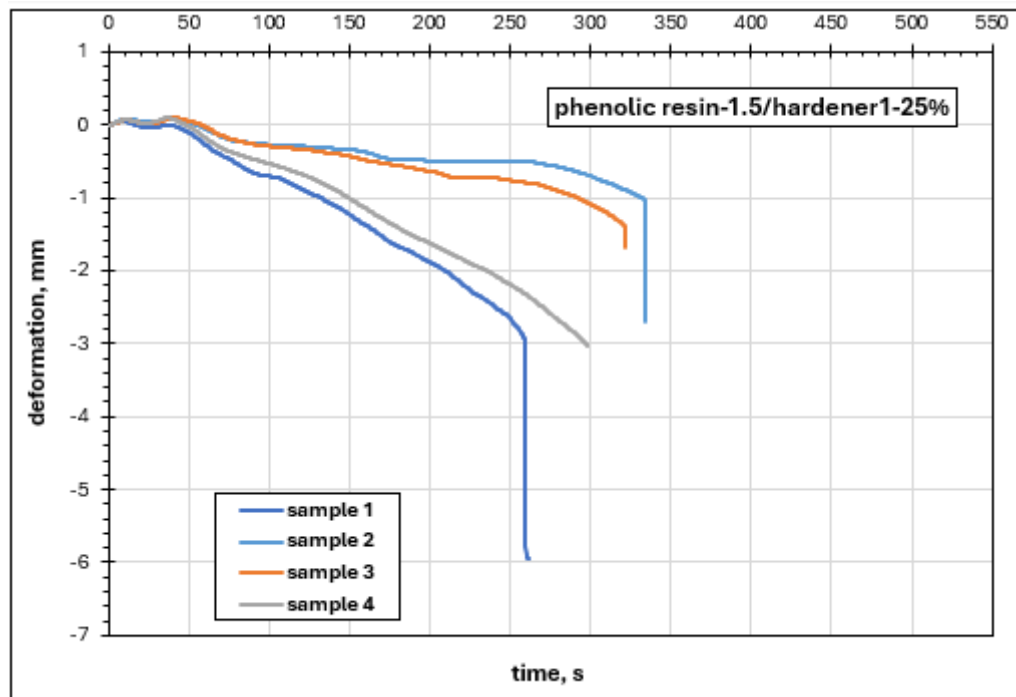


Fig. 19 The thermal deformation (hot-distortion) of molding sand with 1.5 p.p.w. of phenolic resin & hardener1.

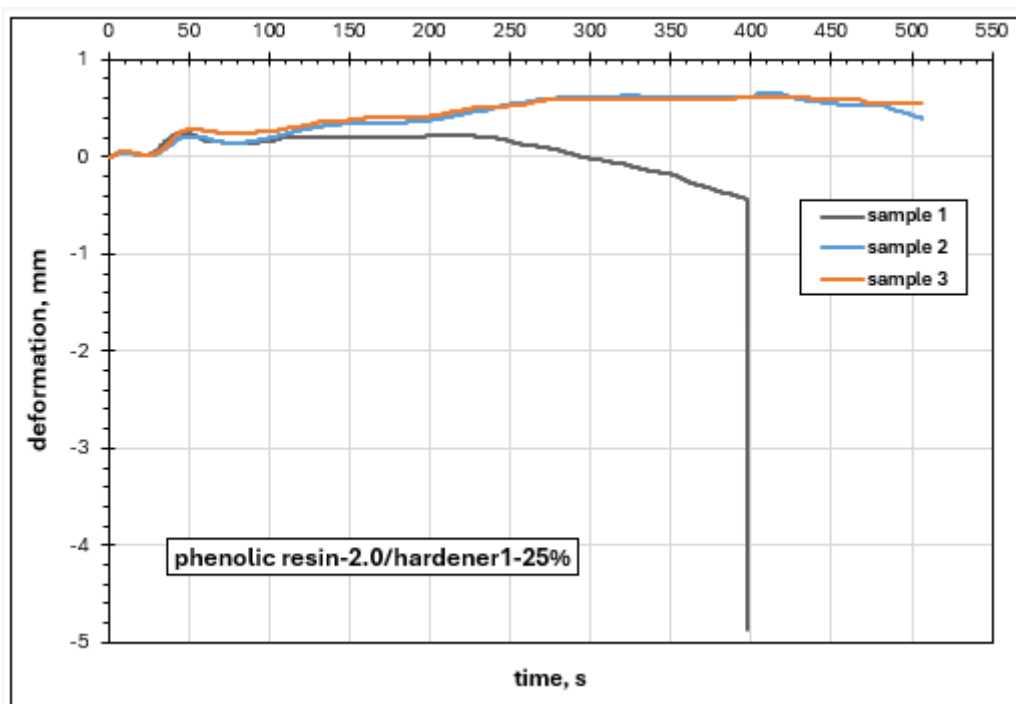
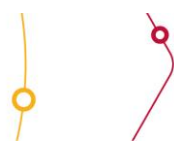


Fig. 20 The thermal deformation (hot-distortion) of molding sand with 2.0 p.p.w. of phenolic resin & hardener1.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

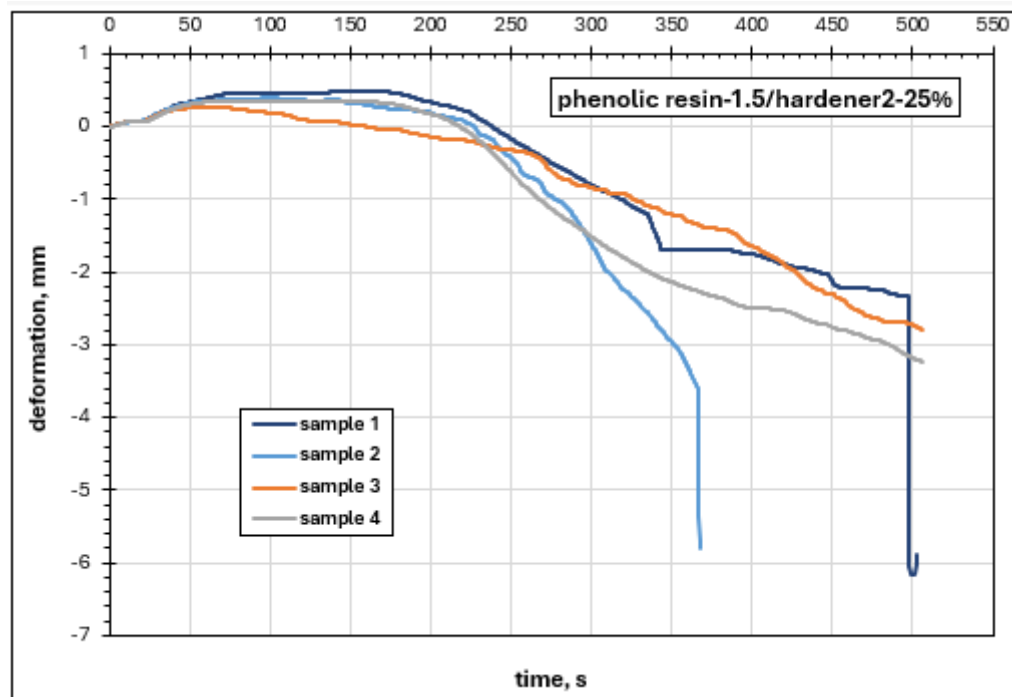
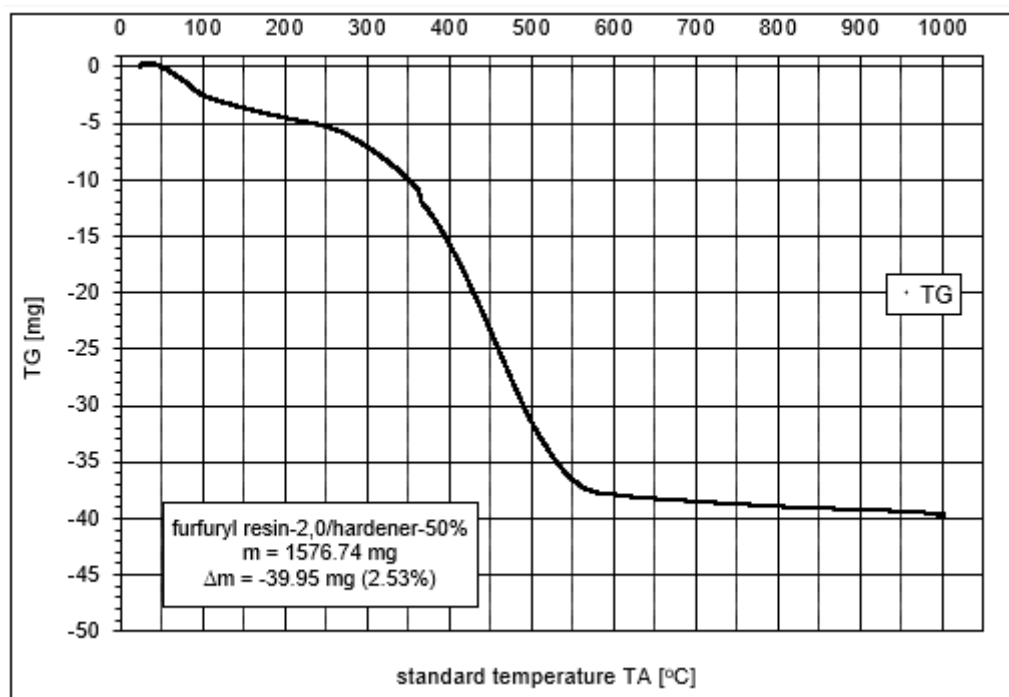


Fig. 21 The thermal deformation (hot-distortion) of molding sand with 1.5 p.p.w. of phenolic resin & hardener2.





Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

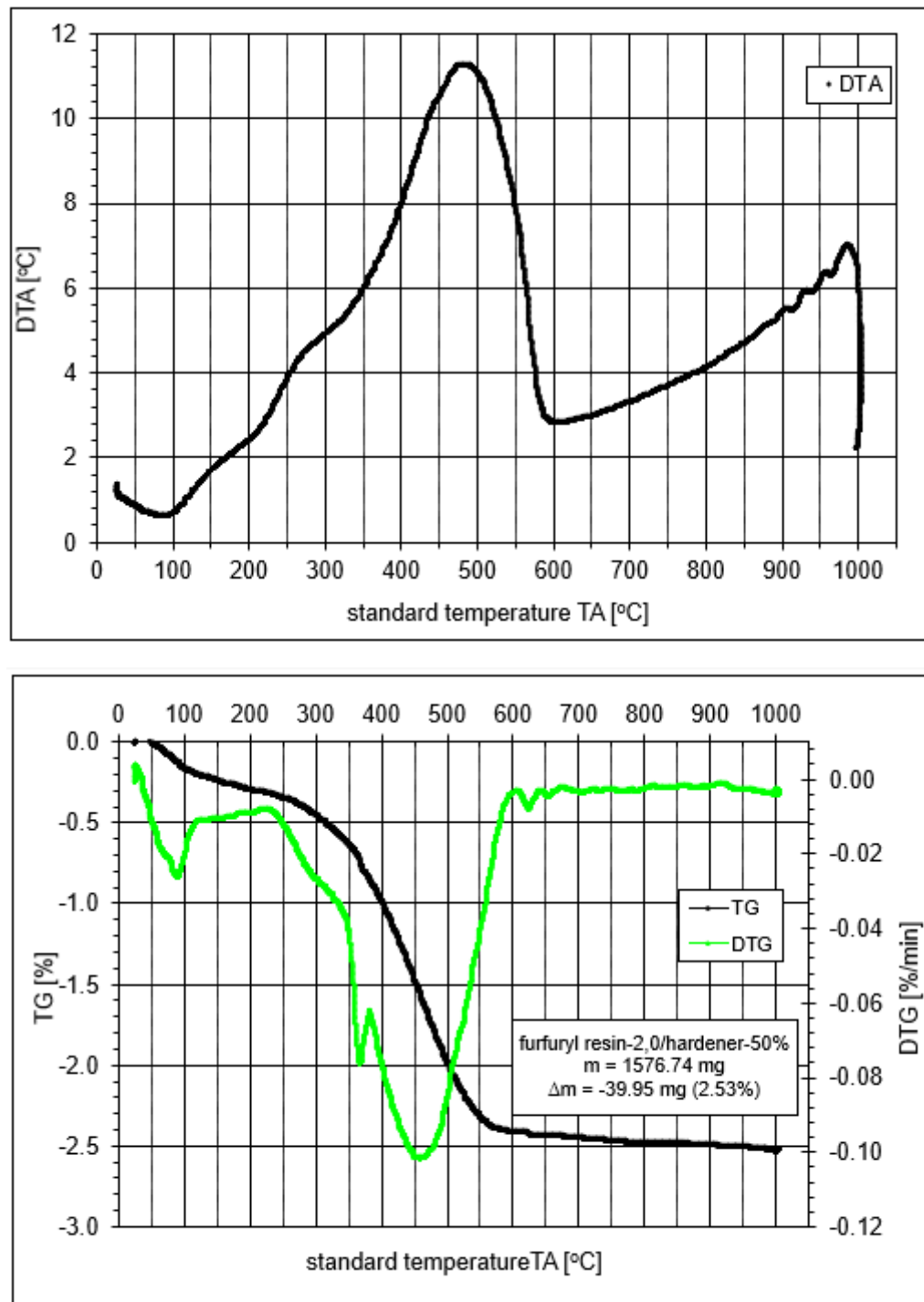
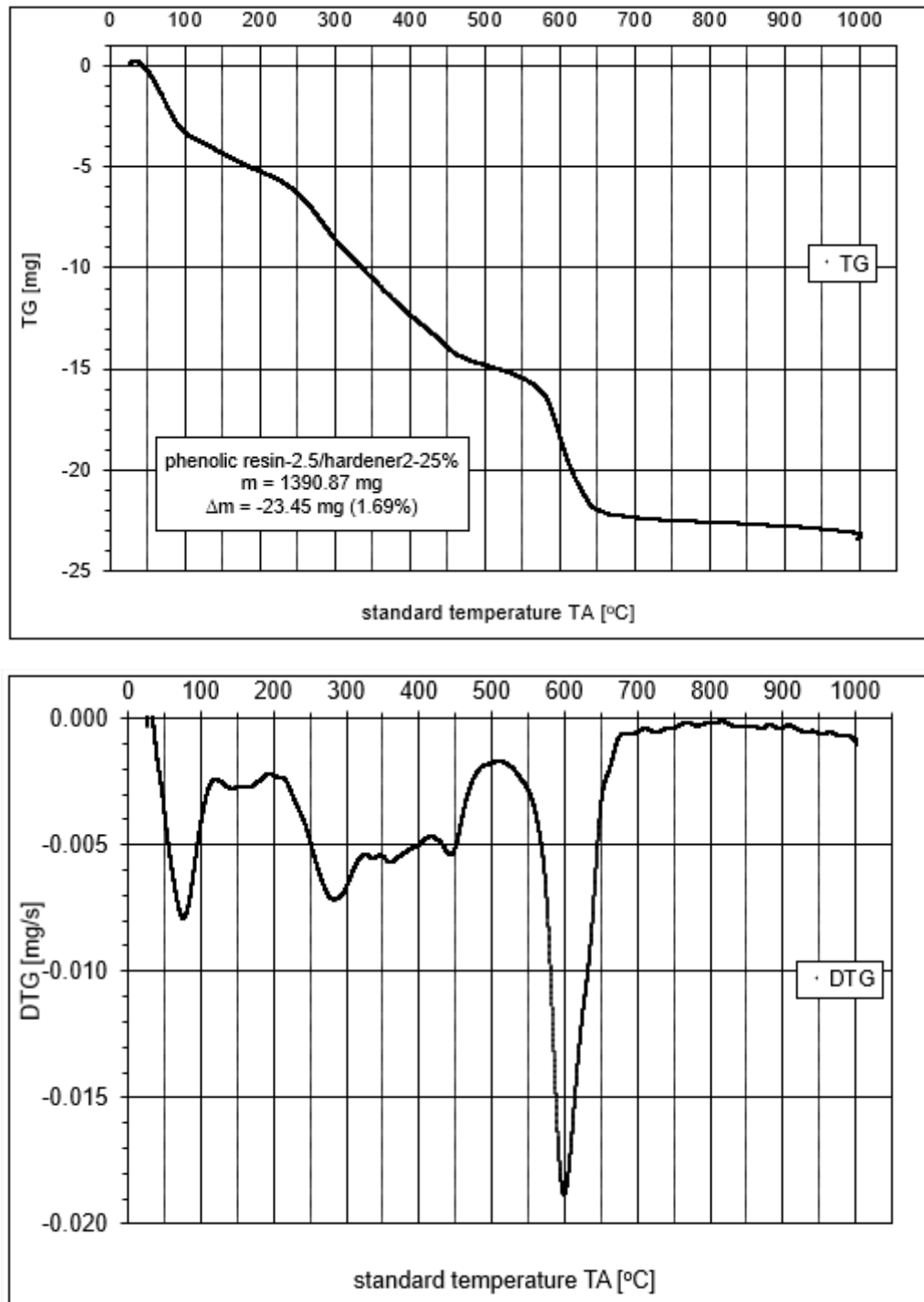
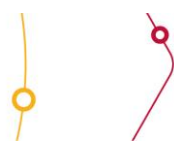


Fig. 22 Thermal degradation (thermogravimetric) tests of chosen molding sand with furfuryl resin.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties





Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

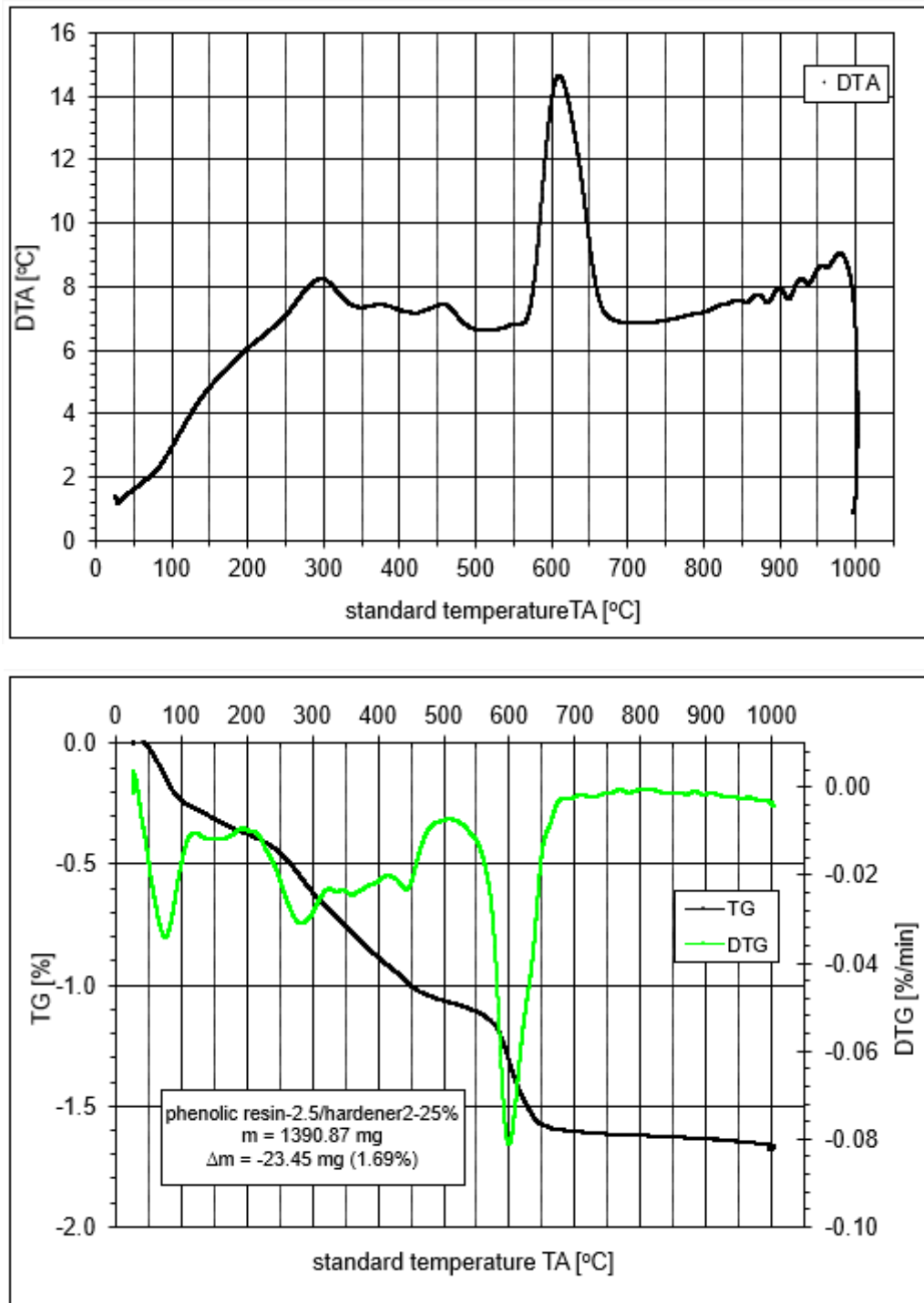
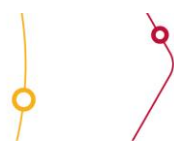


Fig. 23 Thermal degradation (thermogravimetric) tests of chosen molding sand with phenolic resin.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

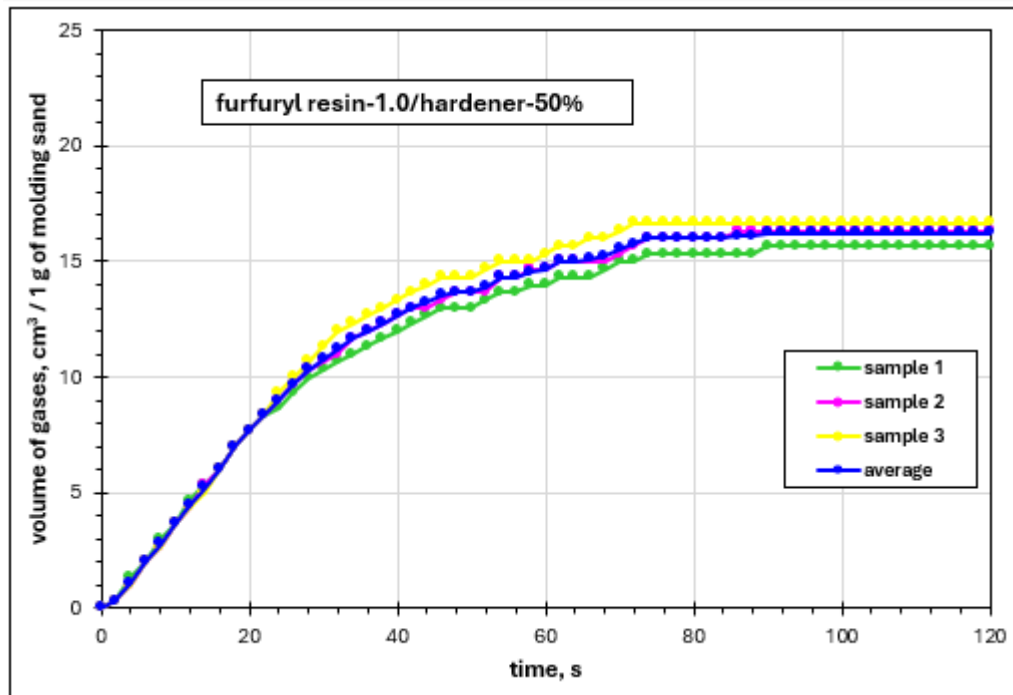


Fig. 24 Gas emission results for molding sand with 1.0 p.p.w. of furfuryl resin.

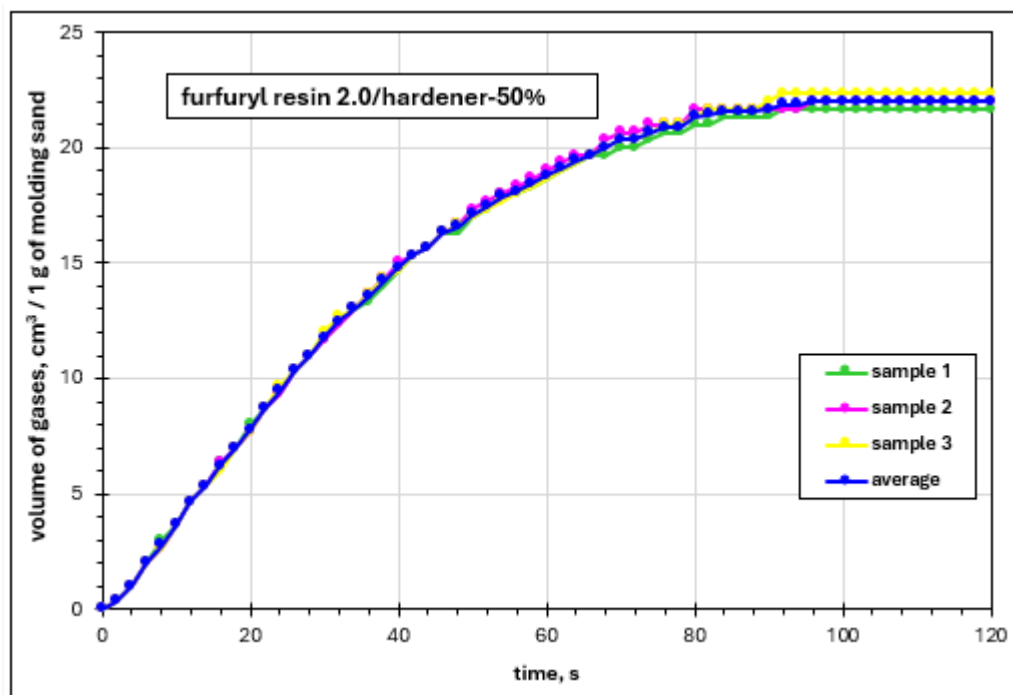


Fig. 25 Gas emission results for molding sand with 2.0 p.p.w. of furfuryl resin.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

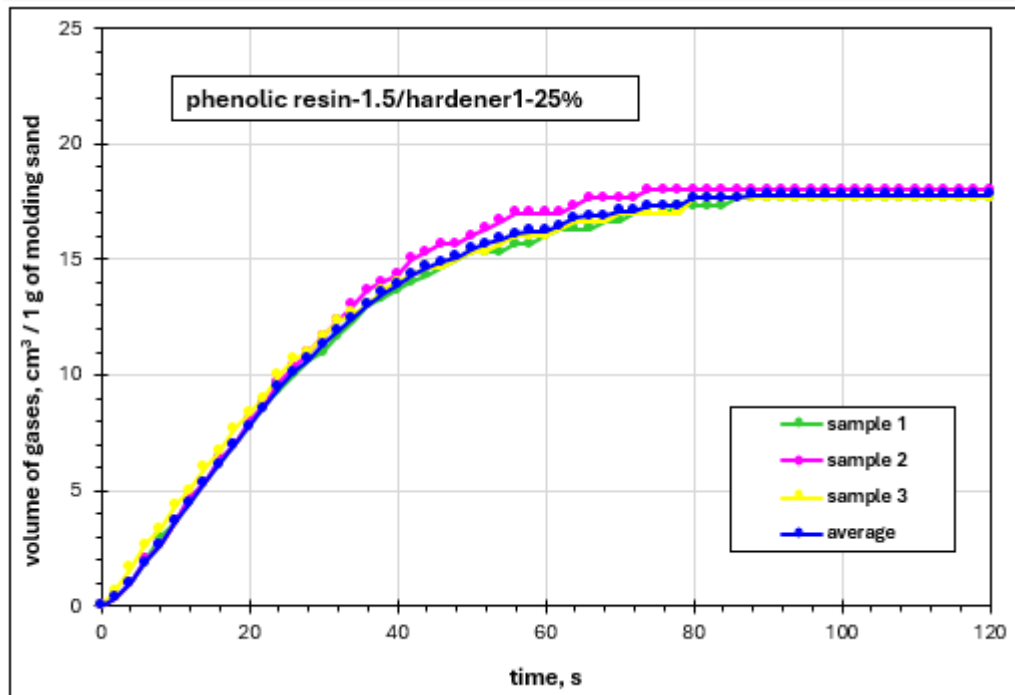


Fig. 26 Gas emission results for molding sand with 1.5 p.p.w. of phenolic resin and hardener 1.

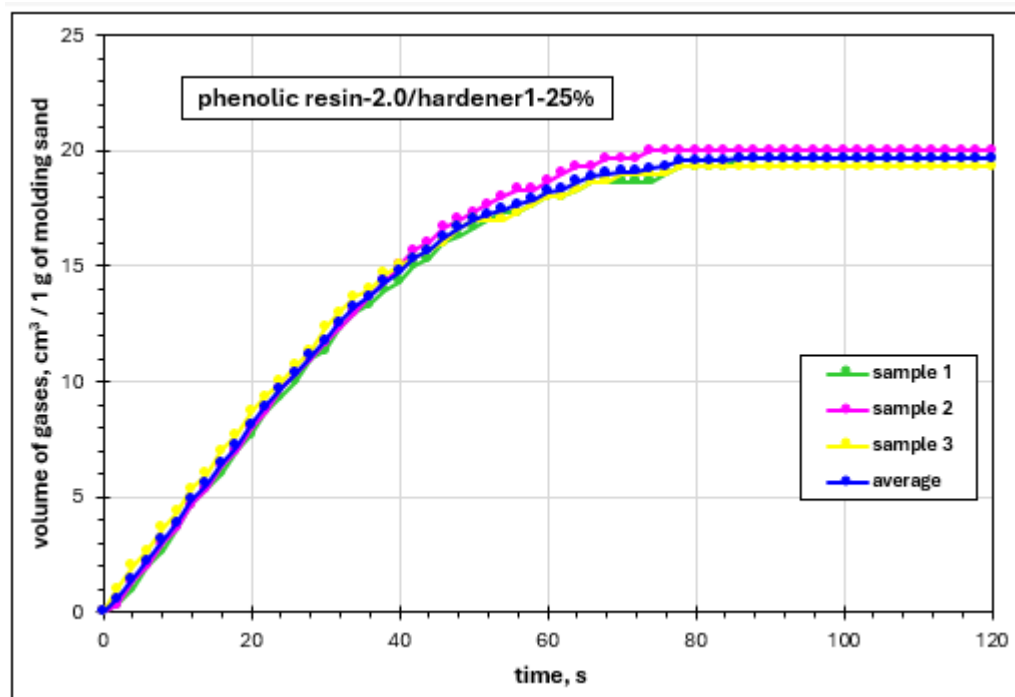


Fig. 27 Gas emission results for molding sand with 2.0 p.p.w. of phenolic resin and hardener 1.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

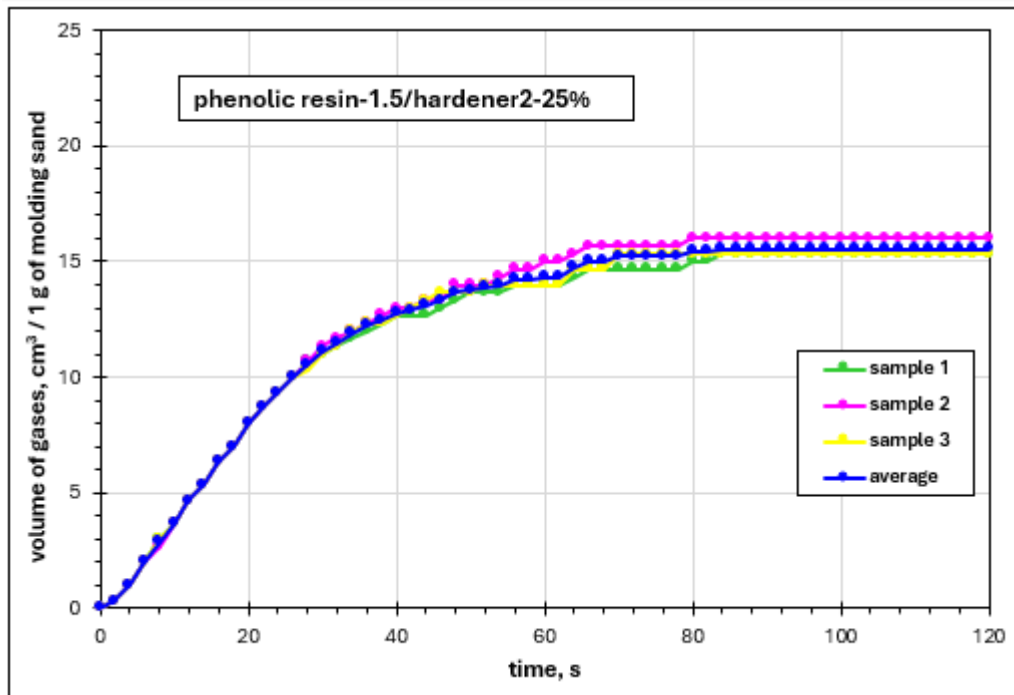


Fig. 28 Gas emission results for molding sand with 1.5 p.p.w. of phenolic resin and hardener 2.

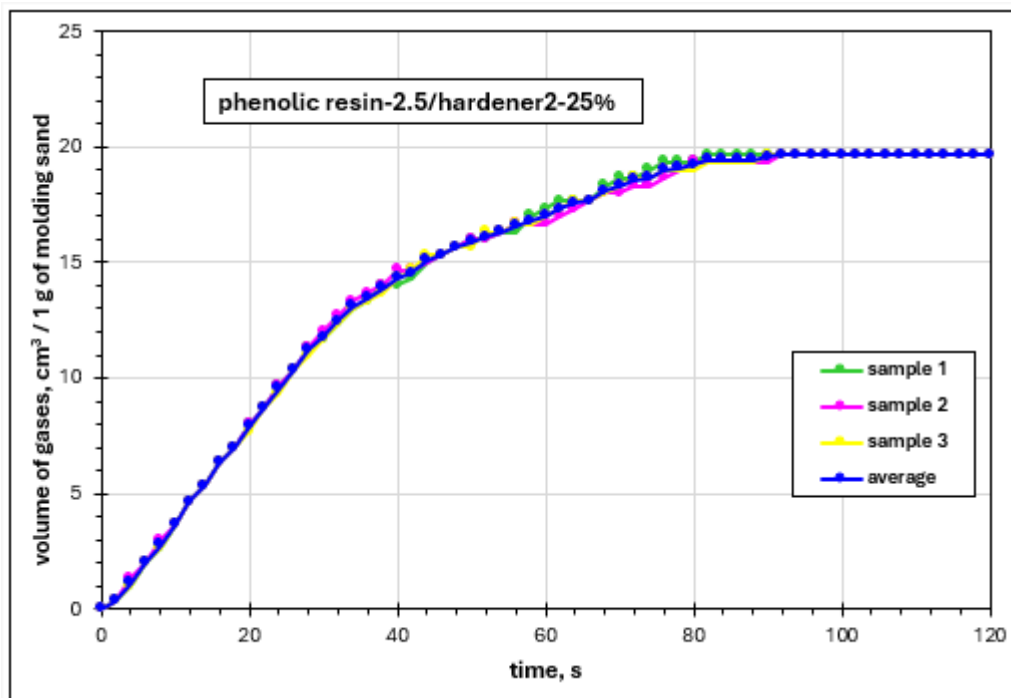


Fig. 29 Gas emission results for molding sand with 2.5 p.p.w. of phenolic resin and hardener 2.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

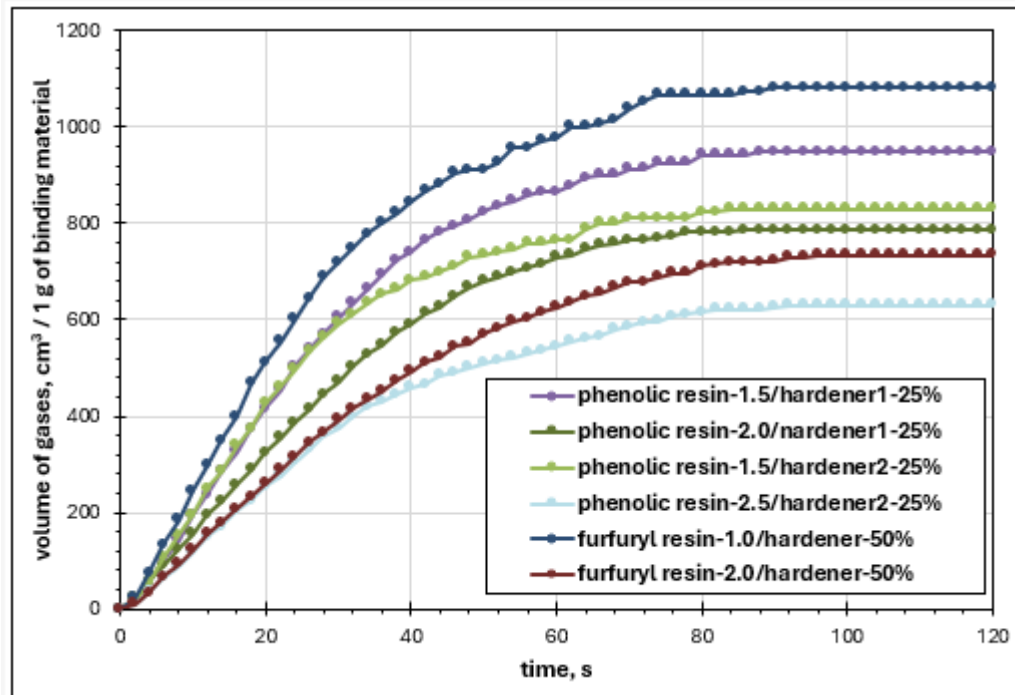


Fig. 30 Gas emission results for volume of gases emitted from 1 g of binding material used in molding sands with organic binders.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

3.3 Molding sands with inorganic binders

Two types of self-hardening molding compounds with inorganic binders used for disposable molds and cores in the production of cast iron castings were selected for testing. The tests were carried out on compounds with R145 water glass hardened with Flodur hardener (Floster technology) and compounds with aluminosilicate binder.

SIBELCO quartz sand with the properties shown in Fig. 3 was used as the matrix for the tested molding compounds.

The compositions of the molding sands are presented in Tables 3-4.

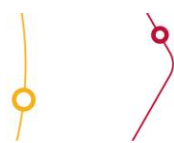
Table 3. The composition of molding sands with water glass R145.

Molding sand symbol	water glass R145, p.p.w.	hardener , % to binder content
water glass R145-2.0/hardener-10%	2.0	10
water glass R145-3.0/hardener-5%	3.0	5
water glass R145-3.0/hardener-10%	3.0	10
water glass R145-3.0/hardener-15%	3.0	15
water glass R145-4.0/hardener-10%	4.0	10

Table 4. The composition of molding sands with aluminosilicate.

Molding sand symbol	aluminosilicate, p.p.w.	hardener , % to binder content
aluminosilicate-2.0/hardener-5%	2.0	5
aluminosilicate-2.0/hardener-10%	2.0	10
aluminosilicate-2.0/hardener-15%	2.0	15
aluminosilicate-2.5/hardener-10%	2.5	10
aluminosilicate-3.0/hardener-10%	3.0	10

The results of the tests conducted on the properties of the molding sands are presented in Fig. 31-51.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

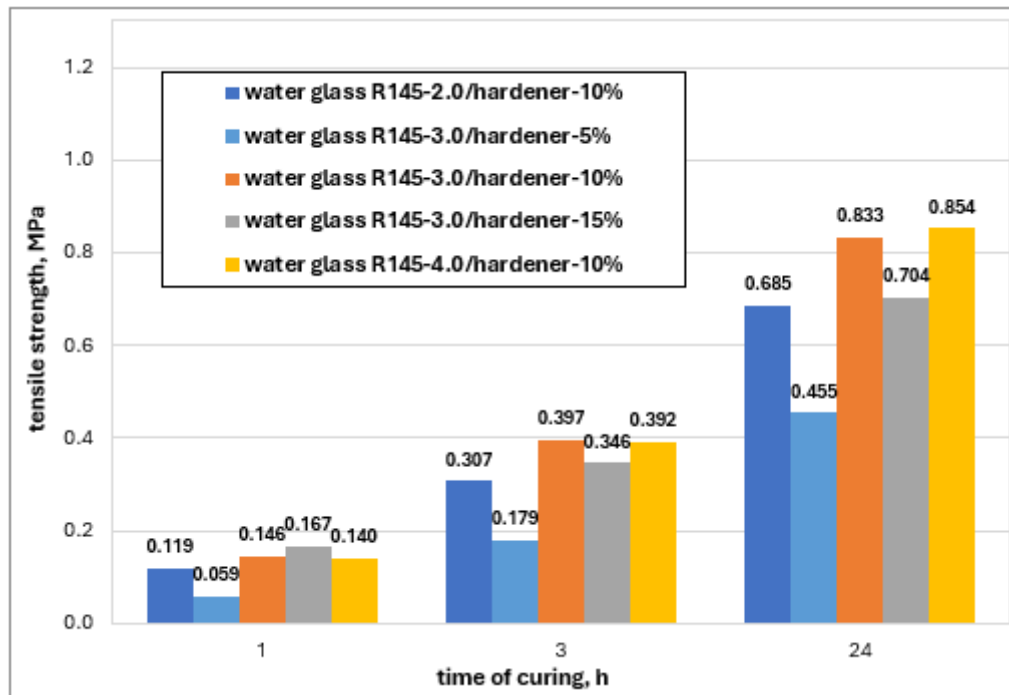


Fig. 31. The influence of molding sands' with water glass R145 compositions on their tensile strength.

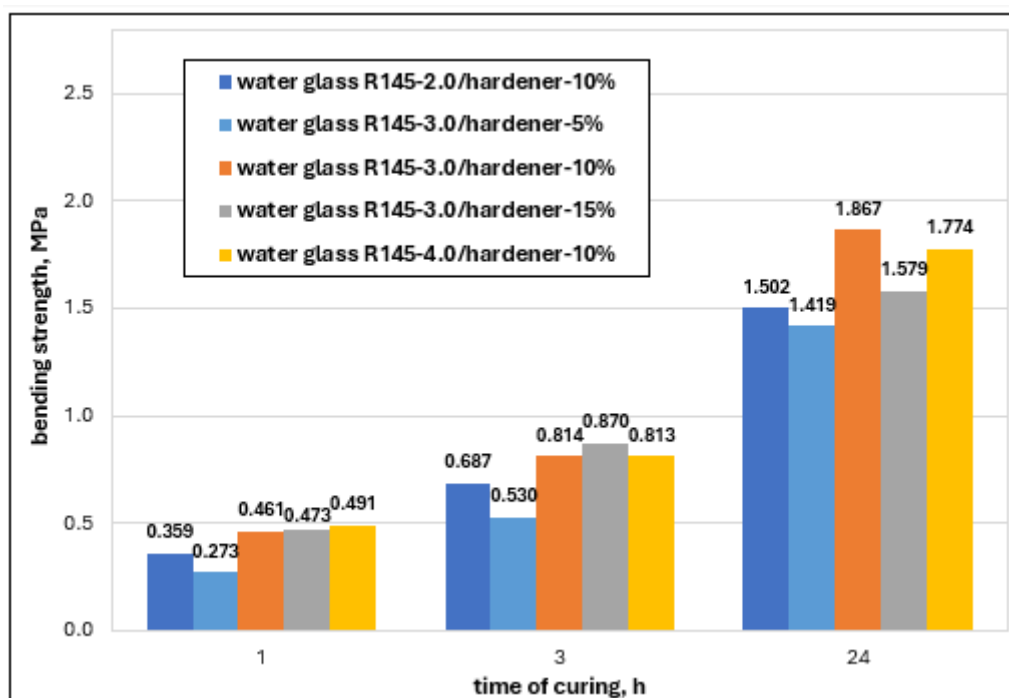
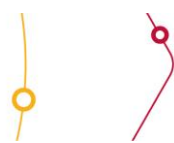


Fig. 32. The influence of molding sands' with water glass R145 compositions on their bending strength.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

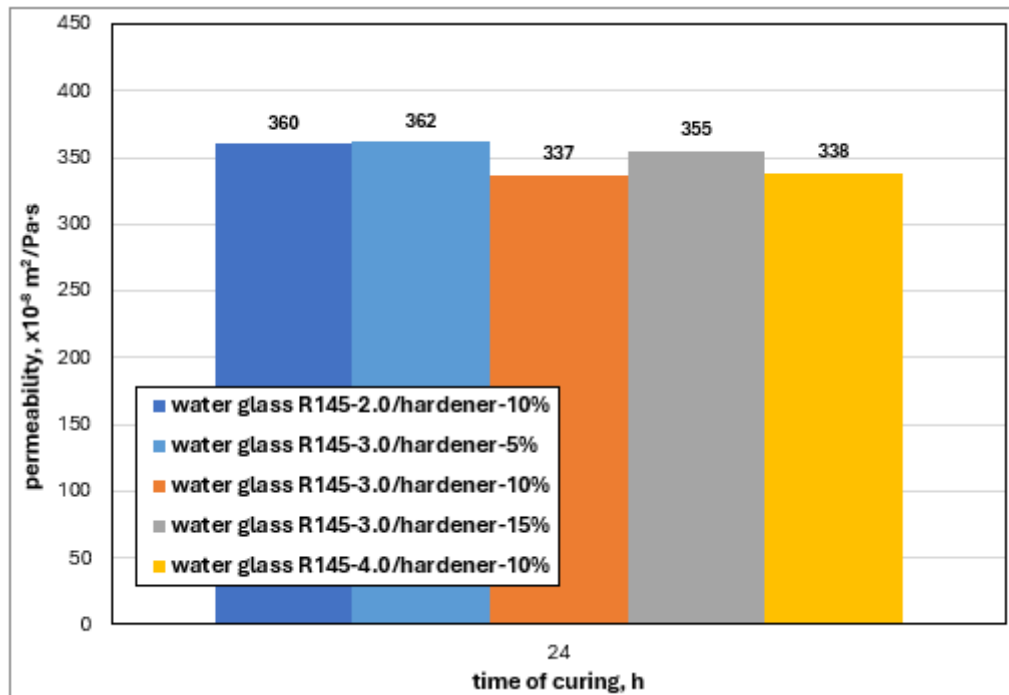


Fig. 33. The influence of molding sands' with water glass R145 compositions on their permeability.

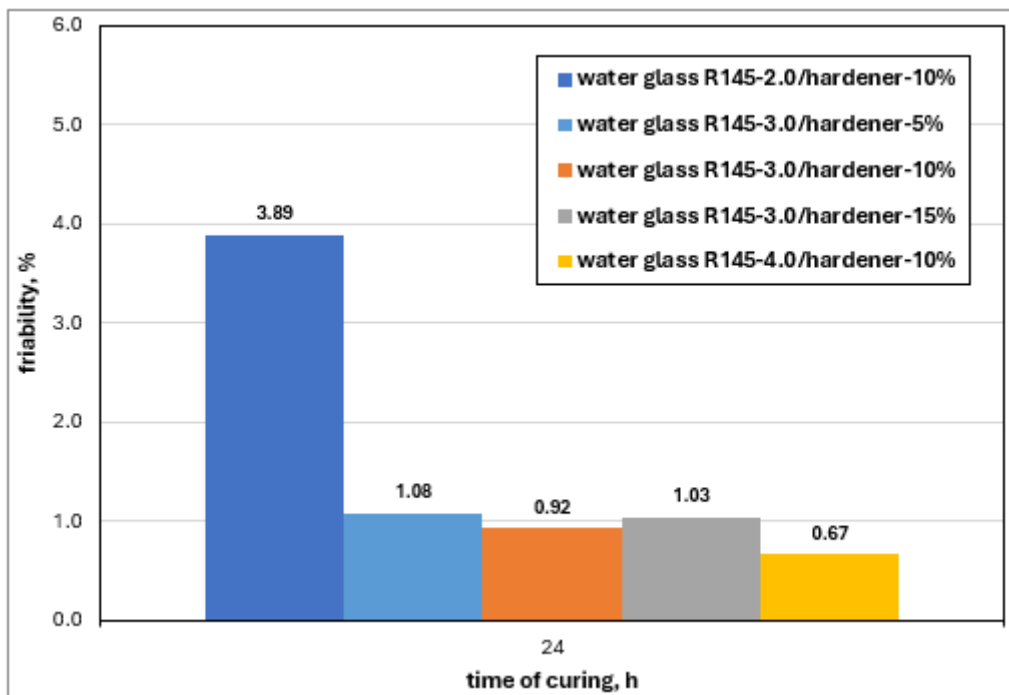


Fig. 34. The influence of molding sands' with water glass R145 compositions on their friability.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

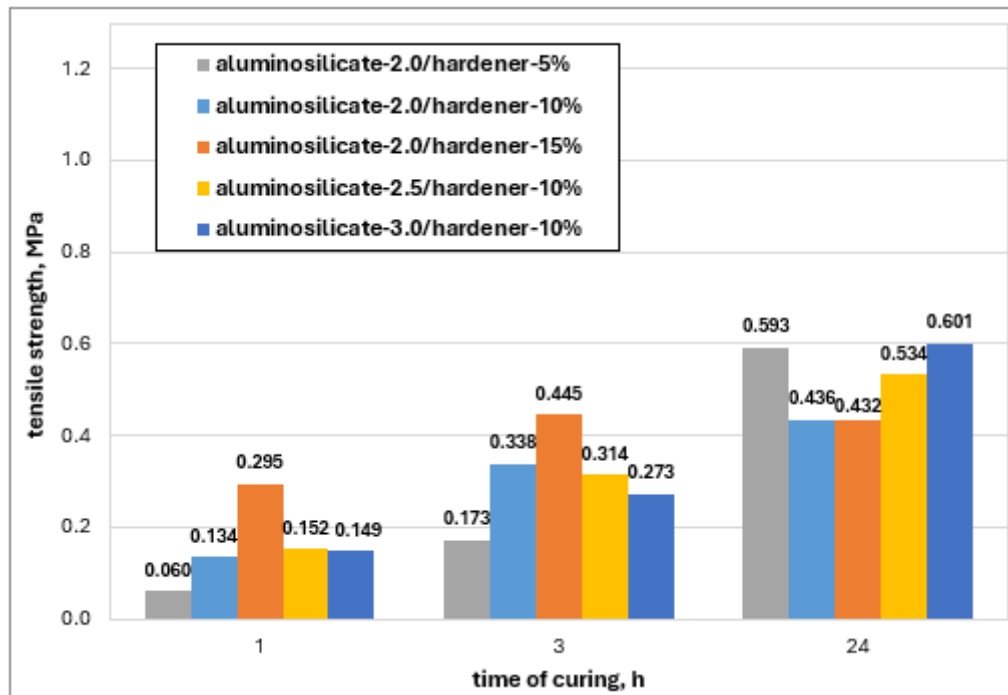


Fig. 35. The influence of molding sands' with aliminosilicate compositions on their tensile strength.

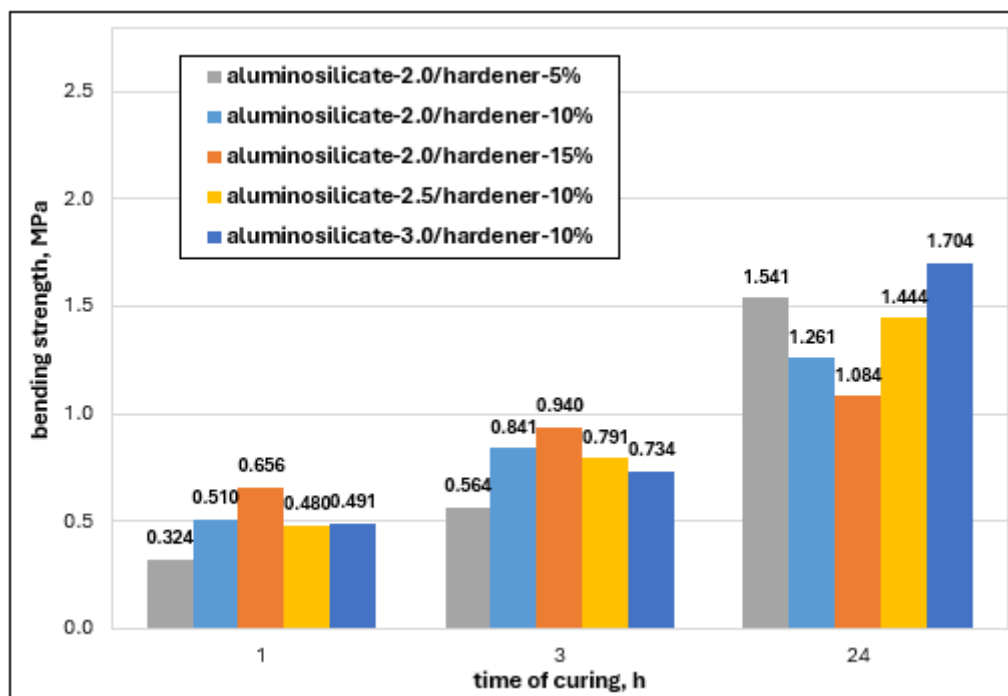
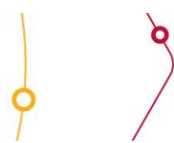


Fig. 36. The influence of molding sands' with aliminosilicate compositions on their bending strength.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

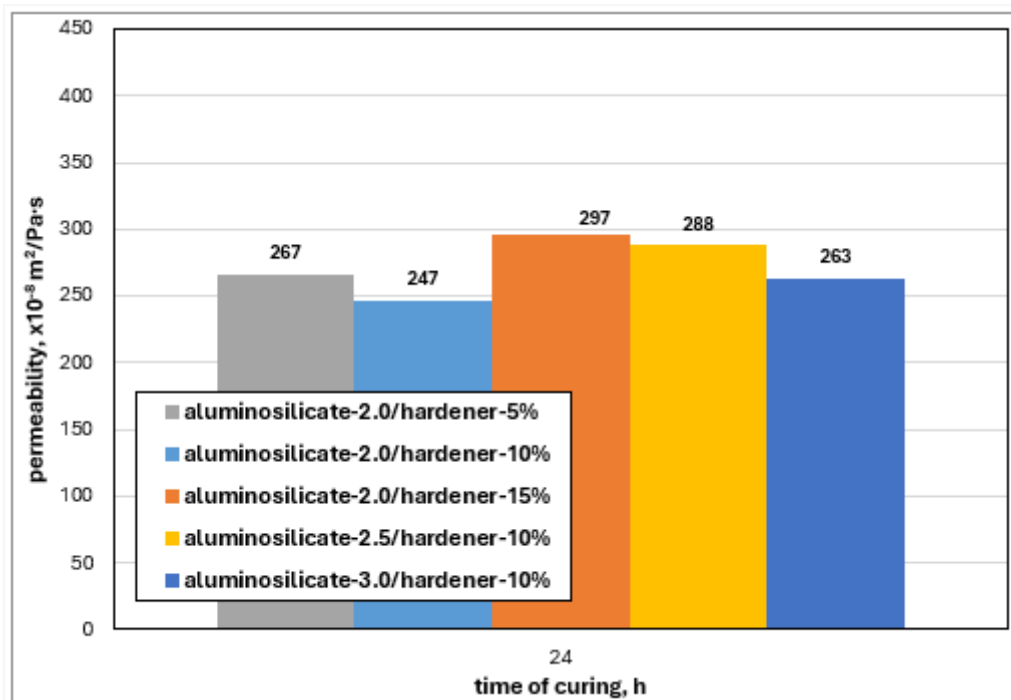


Fig. 37. The influence of molding sands' with aliminosilicate compositions on their permeability.

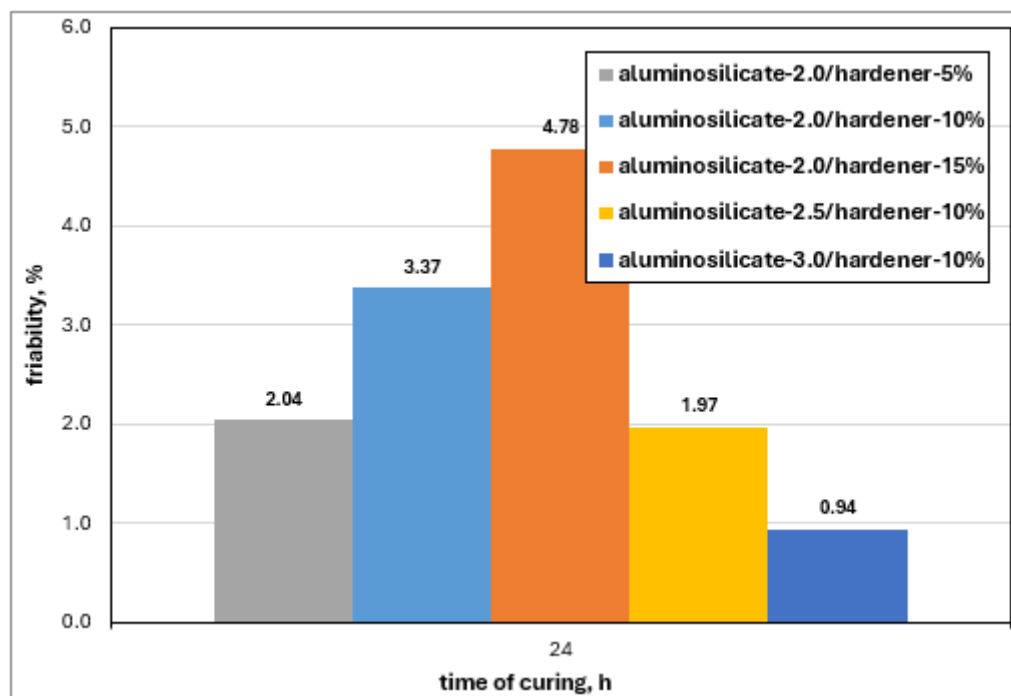


Fig. 38. The influence of molding sands' with aliminosilicate compositions on their friability.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

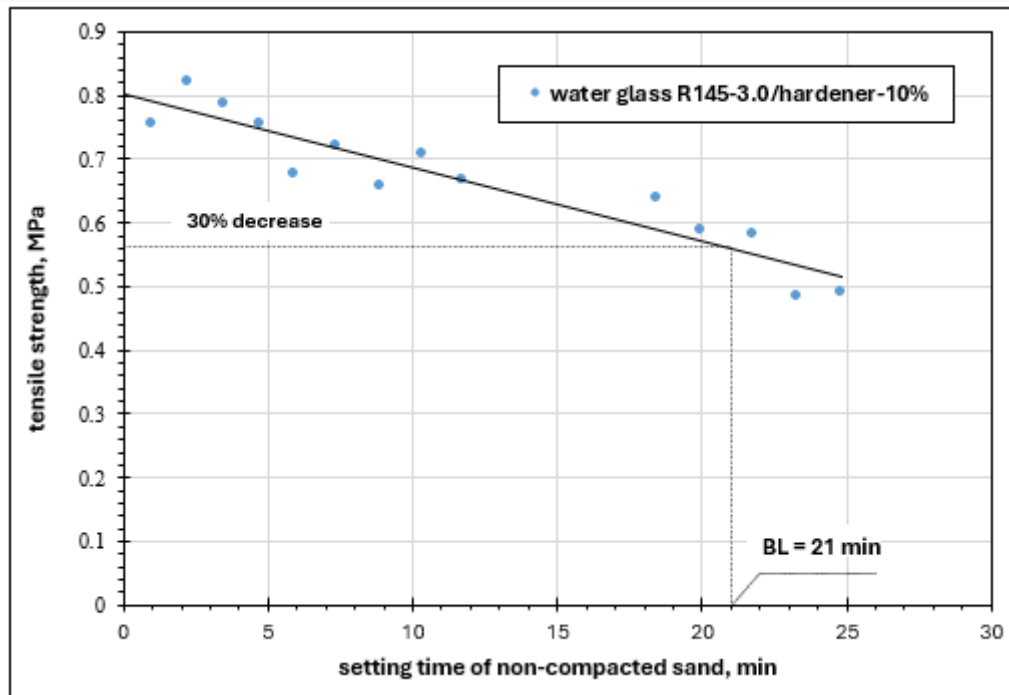


Fig. 39 The bench life of chosen molding sand with water glass 145.

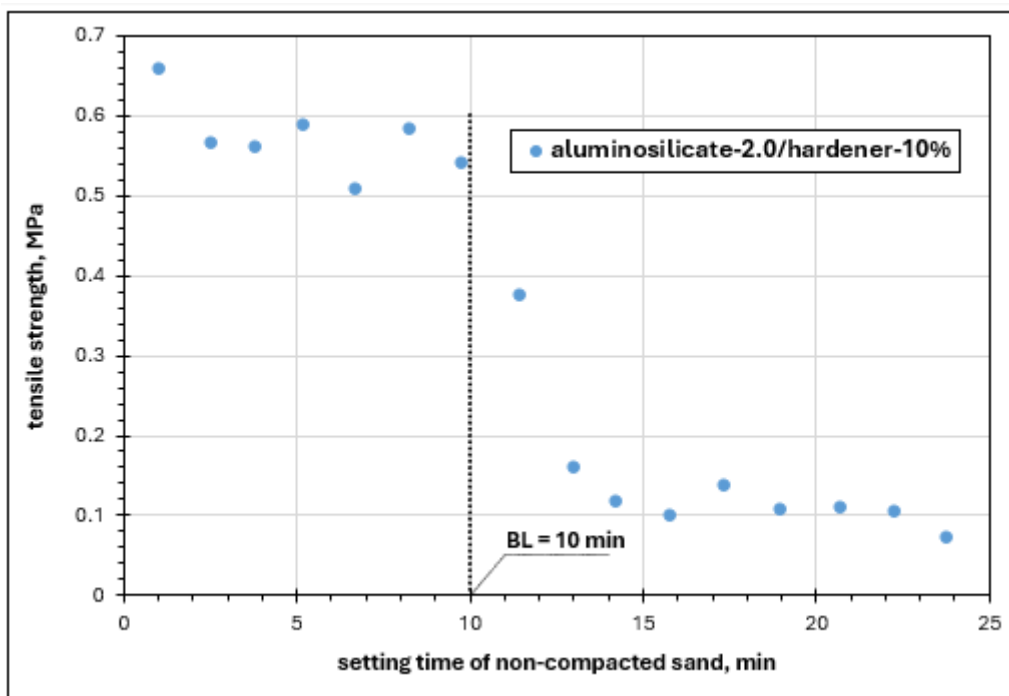


Fig. 40 The bench life of chosen molding sand with aluminosilicate.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

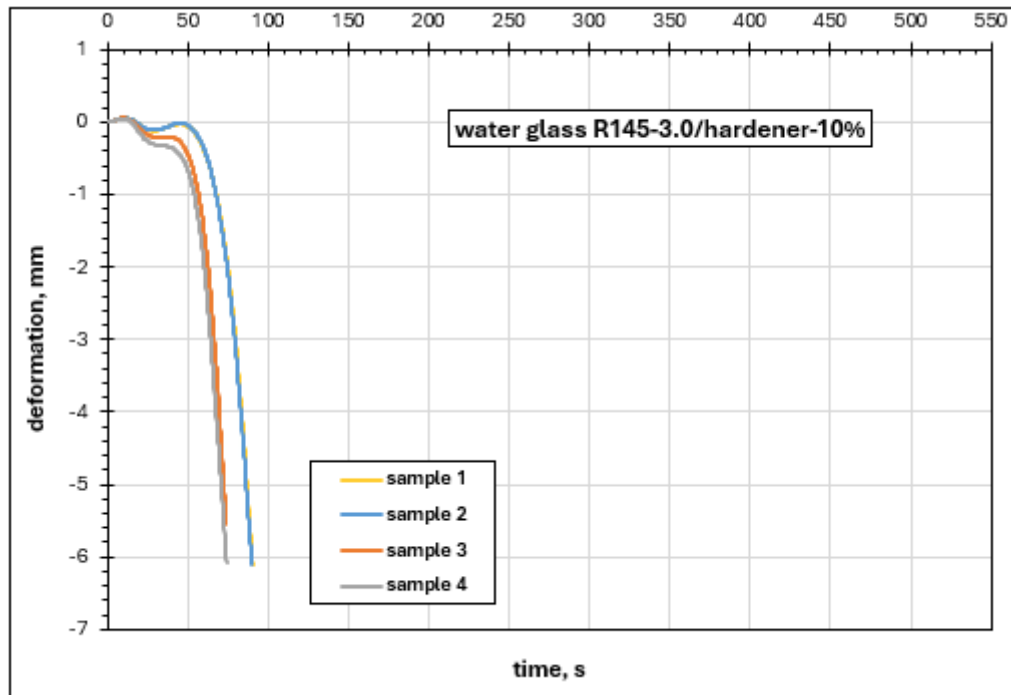


Fig. 41 The thermal deformation (hot-distortion) of molding sand with 3.0 p.p.w. of water glass.

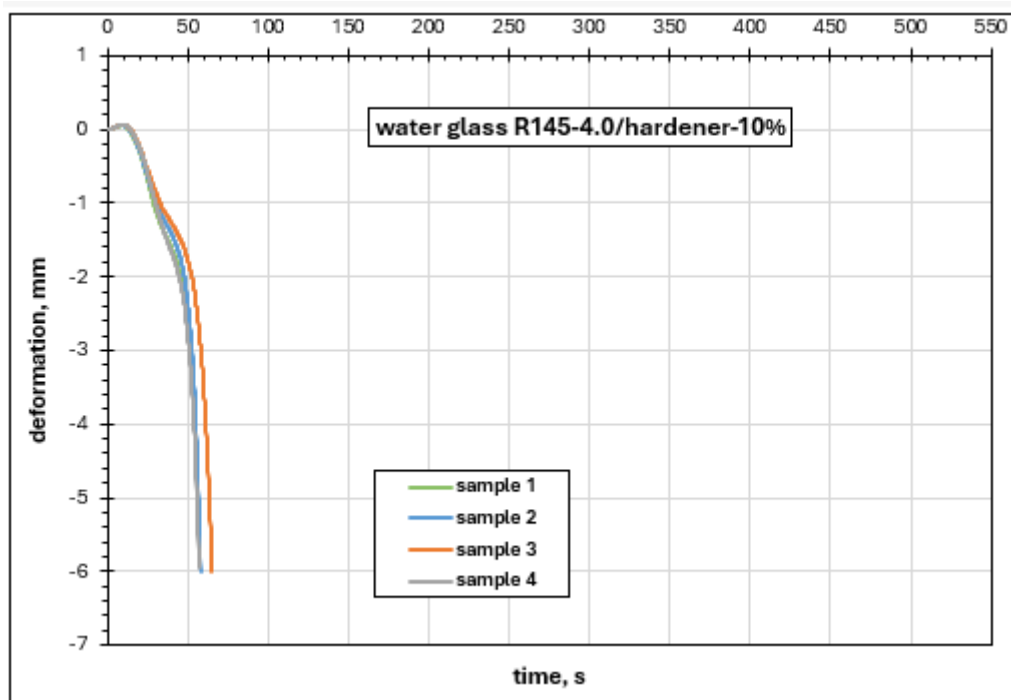


Fig. 42 The thermal deformation (hot-distortion) of molding sand with 4.0 p.p.w. of water glass.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

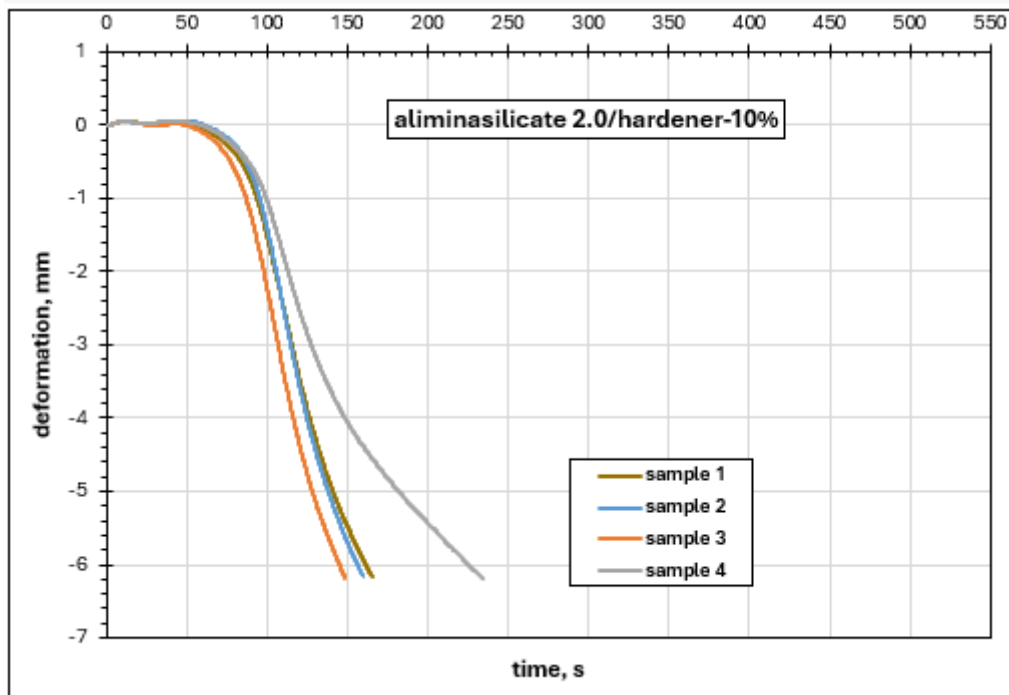


Fig. 43 The thermal deformation (hot-distortion) of molding sand with 2.0 p.p.w. of aluminosilicate.

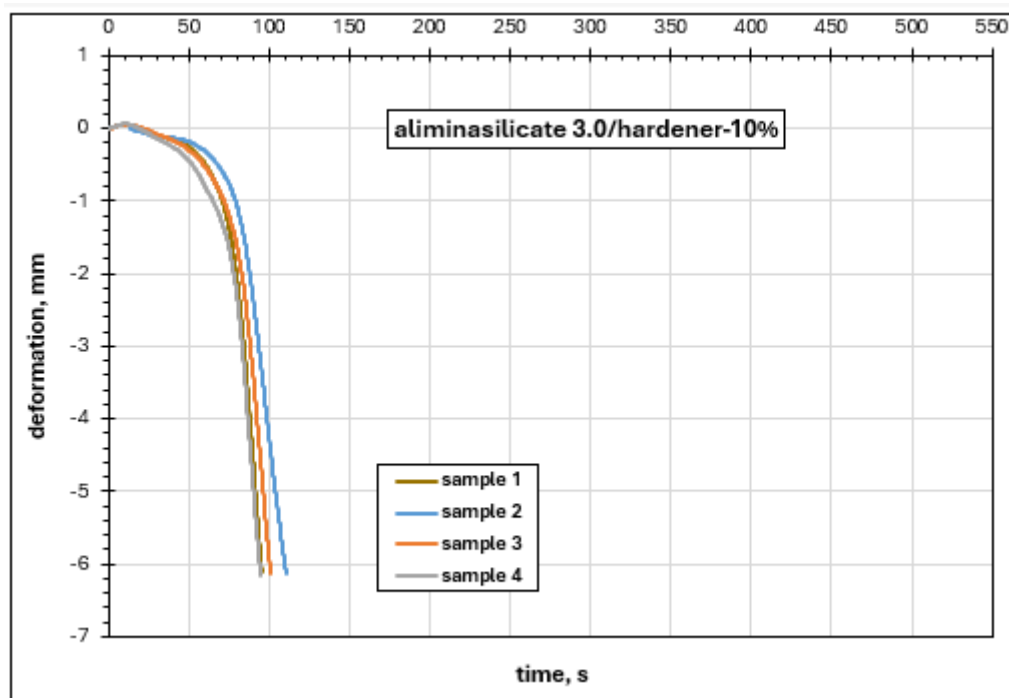
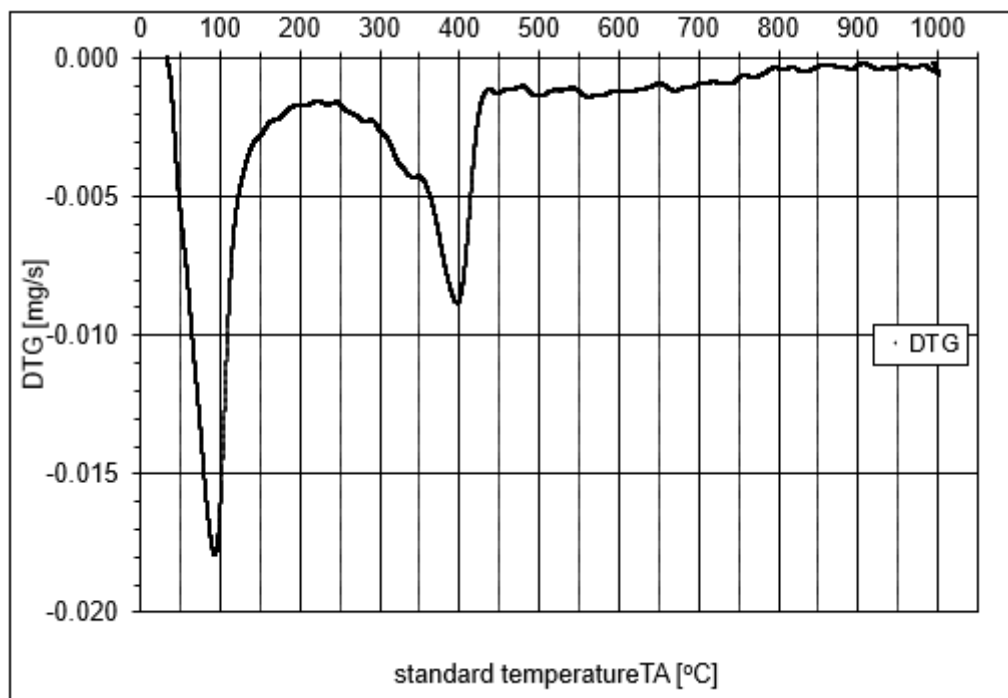
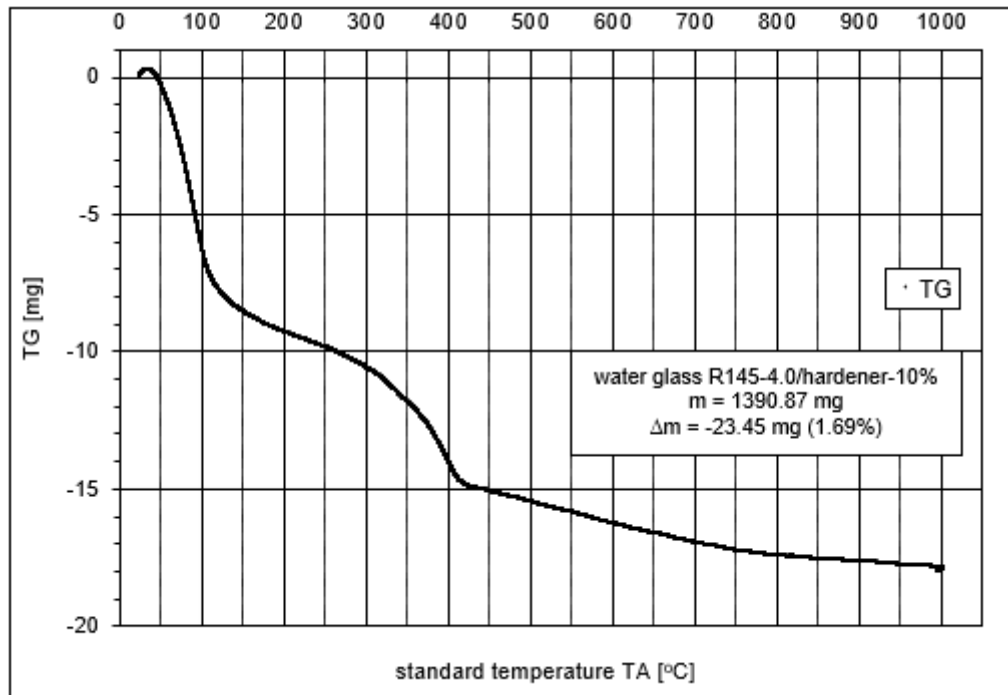
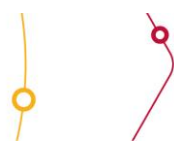


Fig. 44 The thermal deformation (hot-distortion) of molding sand with 3.0 p.p.w. of aluminosilicate.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties





Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

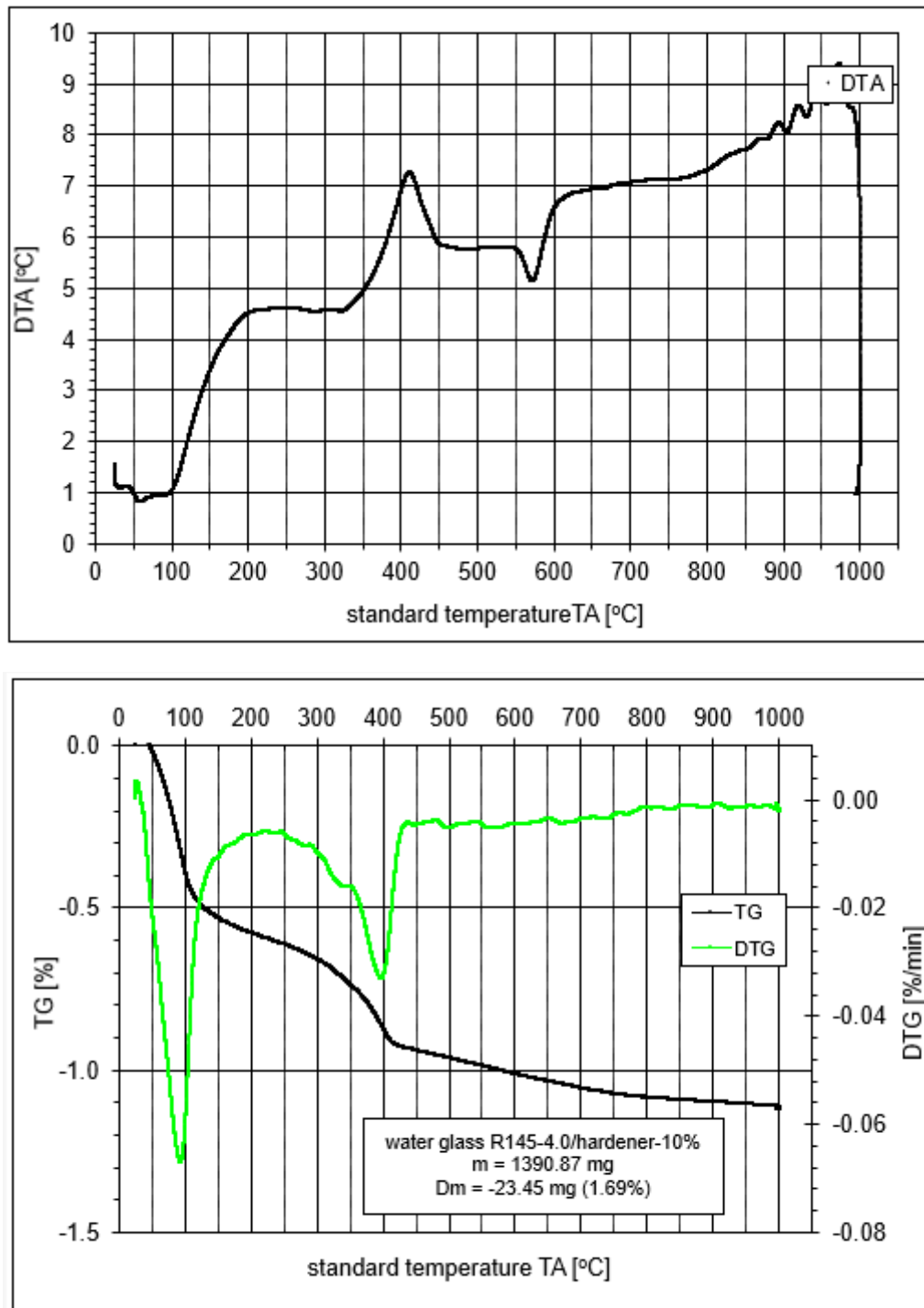
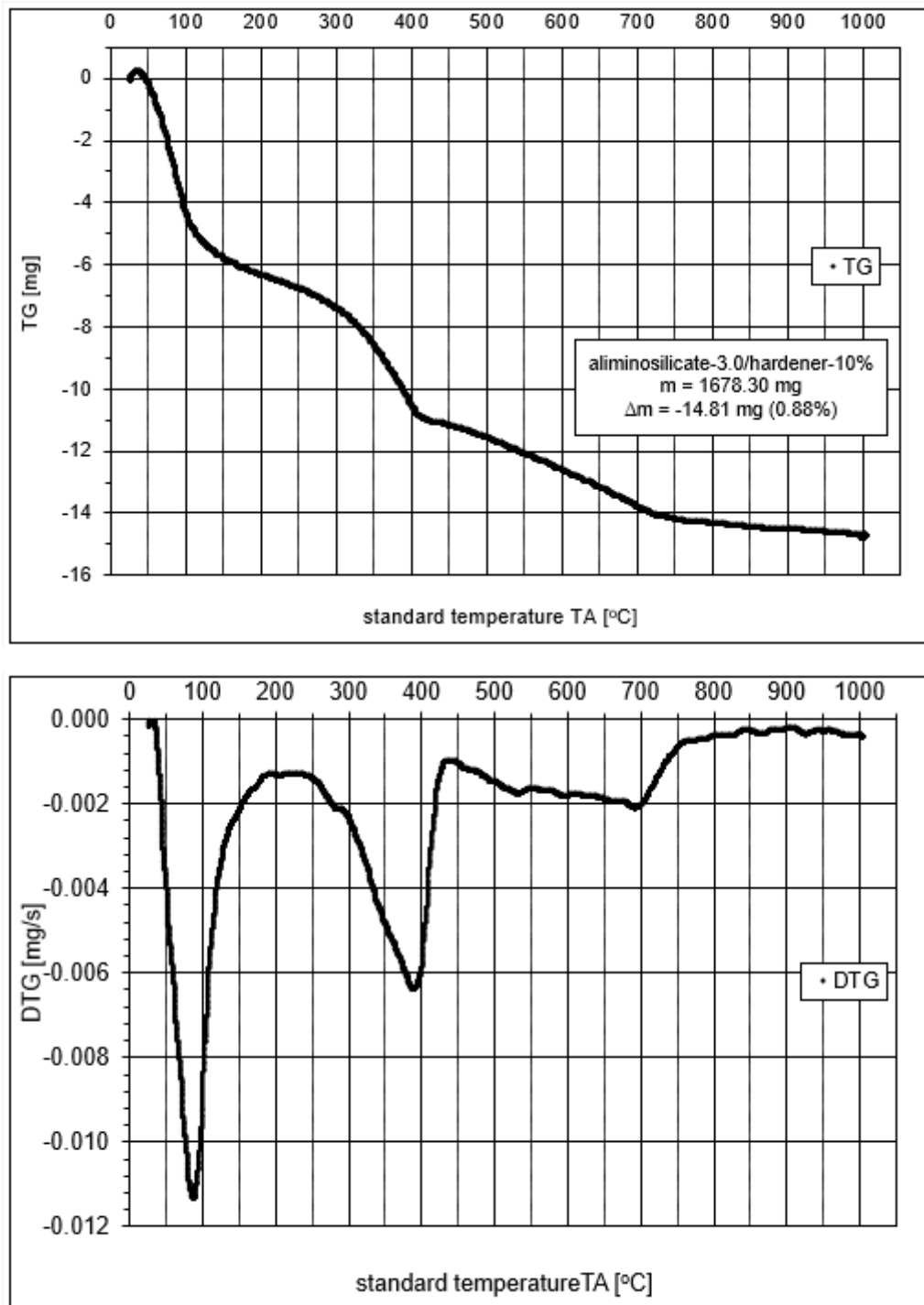
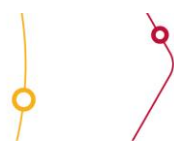


Fig. 45 Thermal degradation (thermogravimetric) tests of chosen molding sand with water glass R145.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties





Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

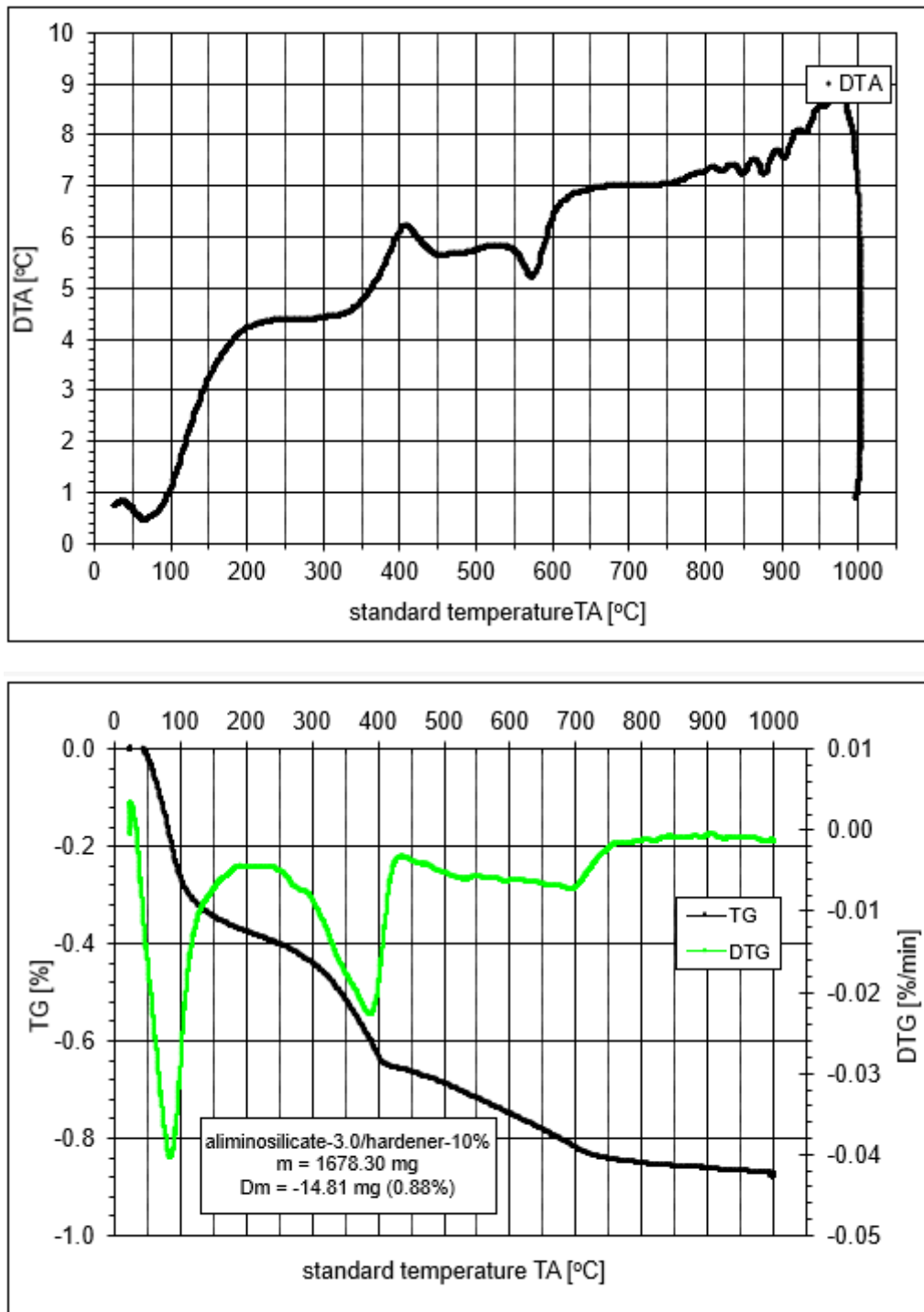
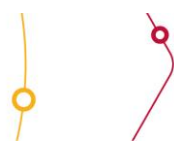


Fig. 46 Thermal degradation (thermogravimetric) tests of chosen molding sand with aluminosilicate.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

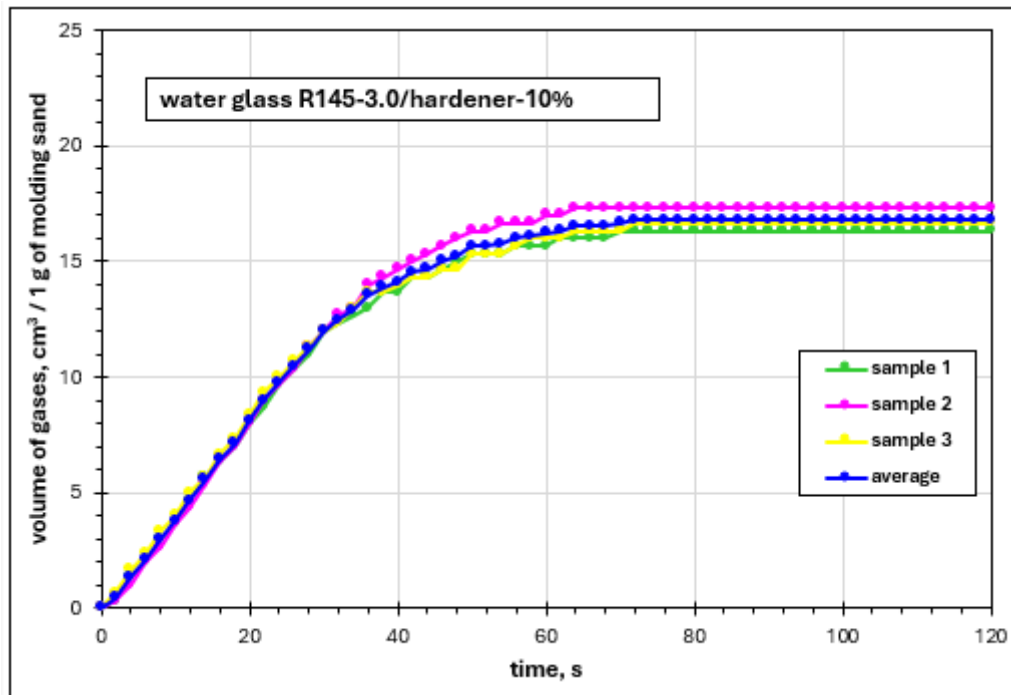


Fig. 47 Gas emission results for molding sand with 3.0 p.p.w. of water glass R145.

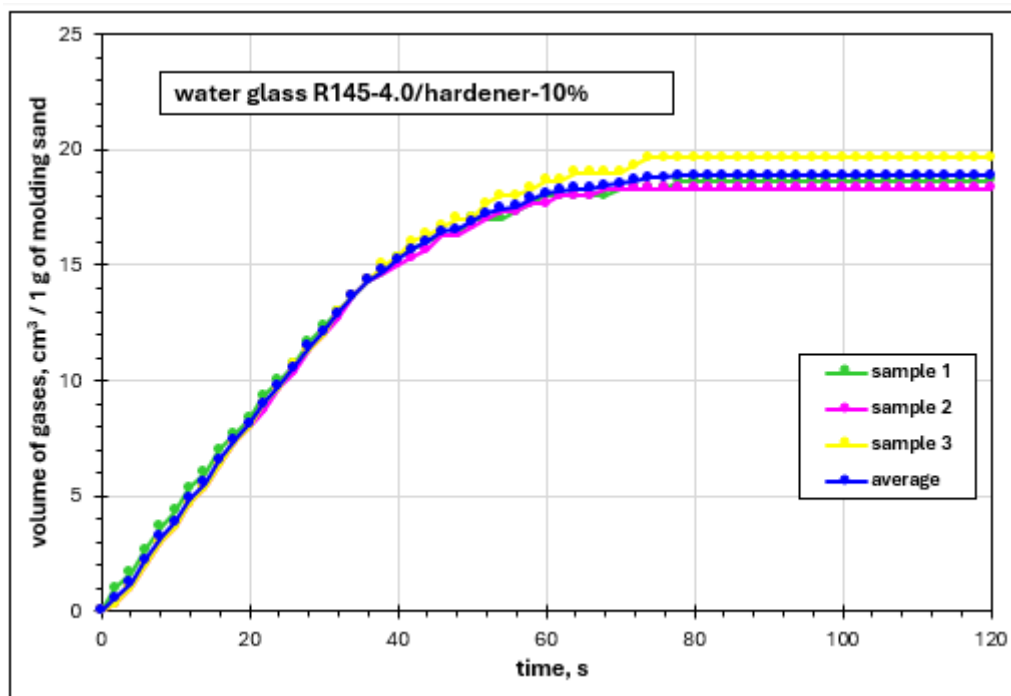
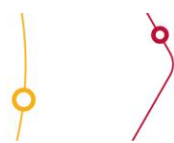


Fig. 48 Gas emission results for molding sand with 4.0 p.p.w. of water glass R145.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

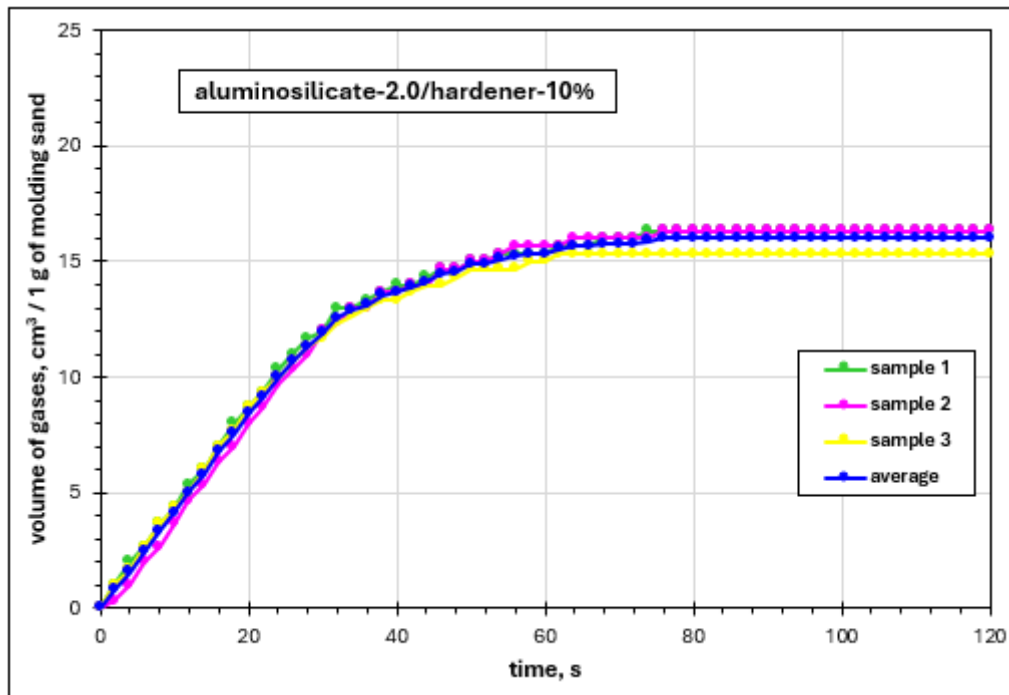


Fig. 49 Gas emission results for molding sand with 2.0 p.p.w. of aluminosilicate.

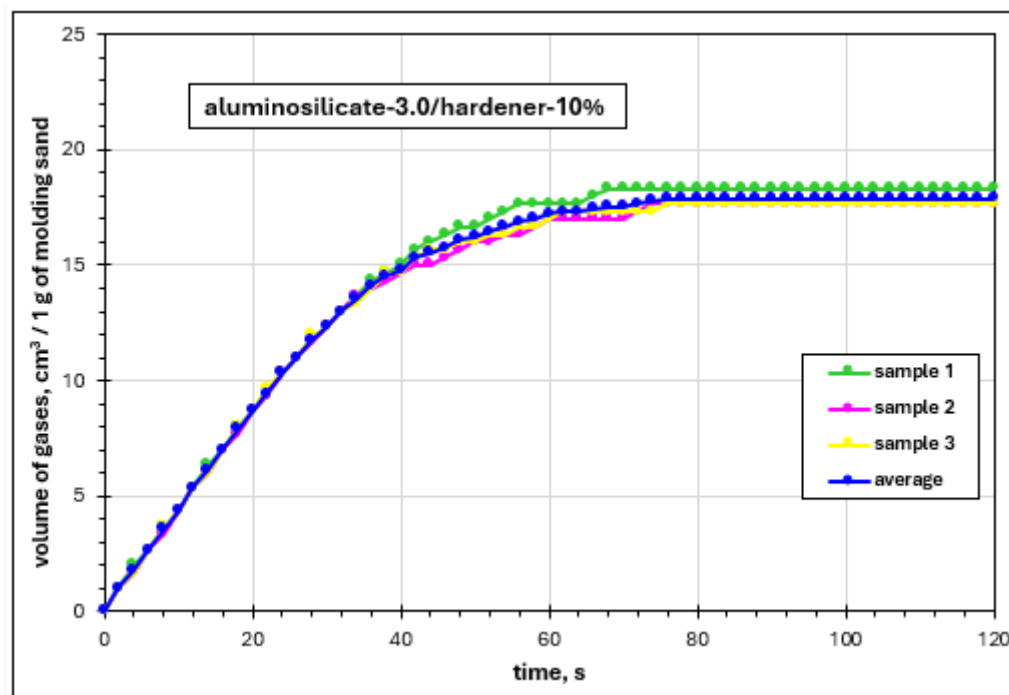


Fig. 50 Gas emission results for molding sand with 3.0 p.p.w. of aluminosilicate.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

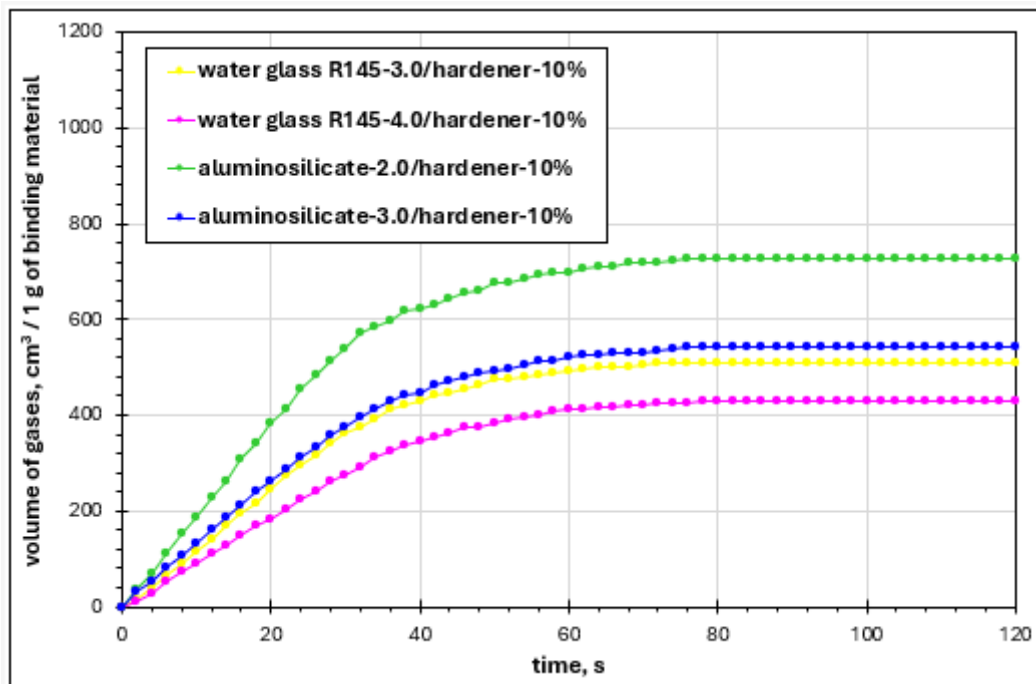


Fig. 51 Gas emission results for volume of gases emitted from 1 g of binding material used in molding sands with inorganic binders.



Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

4. Conclusions

The following conclusions were drawn based on data analysis and own research:

1. All molding sands selected for testing are characterized by sufficient strength, good permeability, and adequate resistance to mechanical damage (abrasion resistance) from a practical point of view.
2. Thermal degradation tests showed mass losses in samples depending on the content and type of binder.
3. Gas emission tests showed lower gas emission per gram of binder material in the case of mixtures with inorganic binders.
4. In the next stage of the work, spheroidal cast iron castings were made from the molding compounds selected for testing. Castings were also made in a similar mold produced using 3D printing technology. The thin-walled castings obtained were subjected to testing.

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Selection of molding sands for thin-walled cast iron castings, including testing of their selected properties

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