

Performance of self-compacting repair mortar including metakaolin and glass fibers

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Abstract:

Introduction: Self compacting mortar is known as a highly fluid mortar that can flow and fill all spaces under its own weight without vibration or compaction. This experimental work aims to produce a self-compacting mortar (SCM) that can be used to repair damaged structural concrete by replacing a proportion of ordinary Portland cement with metakaolin (MK) and adding glass fibers (GF).

Methods: Mixtures including various percentages of MK and GF were prepared and tested. All mixtures were tested in the fresh state to assess fluidity and viscosity through mini-slump flow and mini V-funnel flow time

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tests, respectively. Physical and mechanical properties of all mixtures were measured, such as compressive strength, flexural strength and water absorption. In order to check the performance of prepared SCM in structural repair two experiments were conducted on damaged reinforced concrete beam and cylindrical specimens.

Results: The results showed that the addition of GF and MK needs an increase in SP dosage to reduce their negative effect on the fluidity and the viscosity of SCM mixtures. The use of MK up to 10% of cement as replacement resulted in a compressive strength gain of 11 MPa at 28 days and 13 MPa at 56 days. Similar behavior was observed in the mixture containing 0.4% of GF and 10% of MK. Adding GF with 0.2, 0.4, and 0.6% led to flexural strength gains of 4, 6, and 15%, respectively. Water absorption was reduced by 29% when 15% of MK was incorporated. Using MK improves the bond between the repair mortar and the concrete substrate.

Conclusion: Following a rigorous analysis of the obtained results, it can be concluded that MK and GF can be used to improve mechanical properties and reduce water absorption of SCM mixtures. The mixture including 0.4% of GF and 10% of MK exhibited the best performance and was considered more suitable for repairing damaged SCC beams.

Key words: self-compacting mortar, metakaolin, glass fibers, strength, absorption, reparation.

Introduction

The service life of concrete building can be affected by numerous actions from physical, mechanical, and chemical origins. Under such conditions, concrete structures exhibit many typical types of damage, such as cracks, spalling, and reduction of flexural stiffness and bearing capacity. To ensure adequate behavior in service of concrete structures, damaged concrete structures should be repaired. The choice of repair materials is very difficult, it is affected by many factors such as cost, damaged element and parent material, method of repair and density of reinforcement bars. In concrete structural applications, repair materials should have similar characteristics to the parent concrete in terms of dimensional stability, chemical and transport properties (Hassan et al., 2001). In general, repair material should have good workability with higher dimensional stability and low permeability. Self-compacting mortar is a highly fluid mortar that can flow and put in place without vibration. This material is very useful for overhead repairs, especially to facilitate the placement of mortar in congested zones such as thin repairs with closely spaced reinforcing bars (Lacombe et al., 1999). SCM including mineral additions and fibers can

develop superior performance. The use of mineral additions was confirmed to be very useful in improving the workability, stability, mechanical, and durability characteristics of SCC and SCM (Boukhelkhal & Kenai, 2022; Barluenga et al., 2015; Hammat et al., 2021; Sharma & Khan, 2021; Boukhelkhal et al., 2022, Benguit et al., 2024). MK is a calcined clay that has been thermically treated to obtain a highly reactive pozzolanic material. Adding MK to mortars and concretes offers many technical and environmental advantages. It was reported that the partial substitution of cement by MK reduces the carbon dioxide emitted into the atmosphere, the unit cost of concrete, and the energy required for its production (Kavitha et al., 2015, 2016). The same authors reported that the use of 10% of MK was more suitable to produce SCC with good fresh and hardened properties. According to Siddique et al. (2026), the incorporation of MK in high strength concrete significantly improves its mechanical and durability performance, particularly at the cement replacement level of 10–15 %. Kavitha et al. (2016) stated that inclusion of MK decreases the permeability and ingress of chloride ions into the concrete due to the refined pore structure of the concrete. Ouldkhaoua et al. (2023) reported that the use of calcined kaolinite clay (CK) consumed a significant part of the SP dosage and decreased SCM fluidity. The mixture made with 15% CK exhibited lower fluidity, with a reduction of 3%.

The introduction of fibers in the concrete matrix opens new possibilities in civil and structural engineering. Numerous authors stated that adding fibers improves the tensile strength, flexural strength, dynamic properties, crack resistance, and ductility of concrete (Mohammadi et al., 2008; Manoharan and Anandan, 2014). Many types of fibers are available, including steel, polymer, rubber, glass, polypropylene and vegetable fibers. Vedhasakthi and Chithra (2023) studied the incorporation of basalt fibers (BF) in a volume range of 0.1% to 0.5% to improve SCC properties such as compressive, split-tensile, flexural, residual, and impact strength properties. The research findings revealed that compressive strength and split-tensile strength increased at 0.3% volume fraction of BF, whereas the flexural strength, residual strength, and impact strength increased at 0.4% volume fraction of BF. Güneyisi et al. (2019) conducted an experimental laboratory study to investigate the fresh and rheological characteristics of glass fiber reinforced self-compacting concrete containing nanosilica. They observed that an elevation of the nanosilica (NS) content from 0% to 4% and the glass fiber (GF) volume fraction from 0% to 1.5% resulted in a rise in both the slump flow and V-funnel flow times. The Herschel-Bulkley model was used to characterize the rheological behavior of fresh glass fiber reinforced mortar. The results showed that the shear-thickening

intensity increased with the increase of glass fiber volume fraction for the cement-fly while the addition of glass fiber resulted in the rheological behavior of cement-silica fume binary mortar changing from shear-thickening to shear-thinning response (Jiao et al. 2019). Rosas et al. (2025) have concluded that mineral wool (MW) has primarily been studied as a supplementary cementitious material (SCM) due to its pozzolanic activity and capacity to densify the microstructure, while glass fiber (GF) has been used as reinforcement to enhance tensile and flexural strength. It is recommended to limit the proportion of fibers in concrete to prevent mixing difficulties, which cause poor compaction, non-uniform repartition of fibers, and an increase in voids volume (Sukontasukkul et al., 2018; Wan & Takahashi, 2016). Zhang et al. (a 2024) have demonstrated that incorporating waste glass fiber improves its axial compressive strength, with an improvement of 2.2~15.3 %. Scanning electron microscopy (SEM) techniques were applied to explore the influence mechanism of waste glass fibers on glass fiber-reinforced self-compacting recycled concrete (RGF-SCRC). The results showed that after adding an appropriate content of waste glass fiber, the porosity and the number of large pores decreased. It was also noticed that specimens with the 7.5 kg/m³ alkali-resistant glass fiber content showed the best mechanical properties (Zhang et al., b 2024).

This study aims to produce a repair mortar with high fluidity, which includes mineral additions and fibers, that can be successfully used to repair damaged structural concrete elements. To achieve this goal, MK was incorporated as a partial replacement of cement at substitution ratios of 5, 10, and 15%, while glass fibers were added with different percentages (0.2, 0.4 and 0.6%). The objective of this research was to determine the mixtures that achieve self-compacting requirements and offer acceptable physical and mechanical properties.

Materials and experimental program

Materials

The cement used in this work was CEMI 42.5. Metakaolin was used as a partial replacement of cement. It was obtained by thermal treatment of kaolin clay for 3 hours at 850 °C (Said-Mansour et al., 2011). Table 1 presents the physical characteristics and chemical composition of cement and metakaolin. The results of this table indicate that MK consists predominantly of alumina (33%) and silica (49.3%). The results of laser distribution analysis (Figure 1) on cement and metakaolin showed that MK is finer than cement. It was noted that the proportion of particles of a finer

size is higher in MK, with about 50% of particles finer than 4 μm , while 50% of cement particles are finer than 13.7 μm . The curve of particle size destruction of sand was also plotted in Figure 1. It can be clearly seen that sand has continuous particle size destruction.

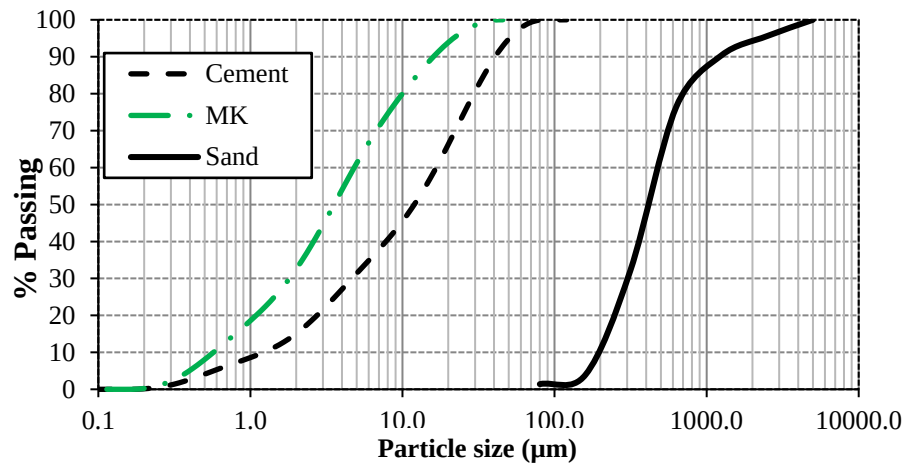


Figure 1 - Particle size distribution of sand, ordinary cement and metakaolin

Table 1 - Chemical and physical properties of cement and metakaolin

Element		OPC	MK
SiO ₂ (%)		18.83	49.30
CaO (%)		61.54	0.08
MgO (%)		1.27	0.40
Al ₂ O ₃ (%)		4.20	33.00
Fe ₂ O ₃ (%)		5.31	2.37
SO ₃ (%)		1.96	-
K ₂ O (%)		0.49	2.93
TiO ₂ (%)		0.20	0.24
Na ₂ O (%)		0.21	0.09
P ₂ O ₅ (%)		0.29	-
Loss on ignition (%) (%)		5.70	10.5
Specific density		3.11	2.45
Blaine fineness (cm ² /g)		3300	8500
Fineness characteristics	d ₁₀ (μm)	1.4	0.7
	d ₅₀ (μm)	13.7	4
	d ₉₀ (μm)	46.7	18.3

Figure 2 shows the results of SEM analysis of cement and MK. As can be observed, metakaolin has finer and less angular particles shape compared to those of cement. This confirmed the results of Figure 1. A kind of locally commercial glass fiber with a density of 0.91 g/cm^3 and a length of $1.50 \pm 0.25 \text{ cm}$ (Figure 3) was used in this study.

River sand was used as fine aggregates in all self-compacting mortar mixes. It has 5 mm maximum aggregate size, specific gravity of 2.47 and absorption coefficient of 1.16%. Superplasticizer (SP) type polycarboxylates based High-Range Water Reducers (HRWR) was employed to reach desired fluidity. The superplasticizer's density, pH and solid particle concentration are 1.07 g/cm^3 , 8 and 30%, respectively. Potable water was used for mixing of mixtures constituents and curing of the specimens.

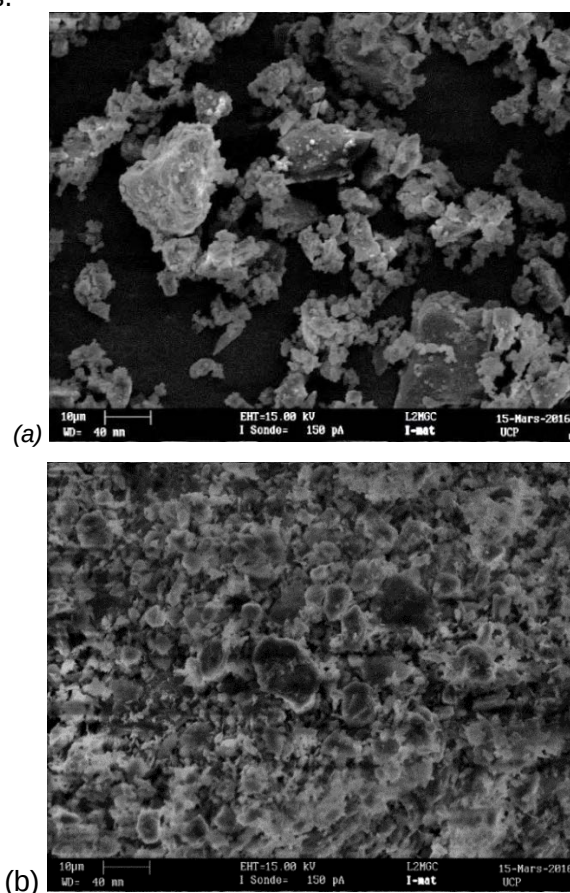


Figure 2 - Particle shape of: (a) ordinary cement and (b) metakaolin



Figure 3 - Glass fibers with a length of 1.50 ± 0.25 cm

Mix proportion design

A total of eight mixtures were prepared and tested. One was a control mix, three contained different ratios of metakaolin (5, 10, and 15%), three others including glass fibers at 0.2, 0.4, and 0.6%, and one mixture contained a combination of metakaolin (10%) and glass fibers (0.4%). The composition of the SCM reference mix is determined based on Okamura and Ozawa (1995) mix design method, in which the sand/mortar ratio (S/M), total content of binder, and water-binder ratio (w/b) were kept constant at 0.5, 693 kg/m³ and 0.4, respectively. To provide the desired fluidity, SP was used with a dosage of 1.1% of the binder in the control mix, while in mixtures incorporating MK and GF, the dosage of SP was varied to satisfy the required fluidity (slump flow diameter ranged between 27.5 and 33.5 cm, and flow time between 2 and 10 s). The proportions of the SCM mixtures are given in Table 2.

Table 2 - Mix proportions of SCM mixes for 1 m³

Mixes	w/b	Constituents						
		Cement (kg)	Metakaolin (kg)	Glass fibers (kg)	Sand (kg)	Water (kg)	SP (%)	SP (kg)
100C	0.4	692.6	-	0	1300	278.8	1.10	7.59
5MK		658.0	34.6	0			1.15	7.94
10MK		623.4	69.2	0			1.30	8.98
15MK		588.7	103.9	0			1.45	10.01
0.2GF		692.6	-	1.38			1.15	7.94
0.4GF		692.6	-	2.76			1.35	9.32
0.6GF		692.6	-	4.14			1.60	11.05
10MK+0.4GF		623.4	69.2	2.76			1.60	11.05

Note: 5MK → 5% of metakaolin and 95% of ordinary Portland cement

Test procedure

Fresh mortar tests

According to the EFNARC standard (EFNARC, 2002), mini slump flow and mini v-funnel tests are two main tests that allow the assessment of the fluidity, filling ability, and stability of fresh self-compacting mortar. In the first test, the final slump flow diameter of the mortar was determined. Slump flow diameters ranging from 27.5 and 33.5 cm are recommended to obtain slump flow values in the range of 55-85 cm for SCC (Safiuddin, 2008; Jin & Domone, 2002). In the second test, the mini v-funnel was filled completely with mortar and the bottom outlet was opened, allowing to the mortar to flow out (Figure 4.b). The v-funnel flow time T_v was measured. During these tests, it is possible to assess the risk of segregation or bleeding through visual control.

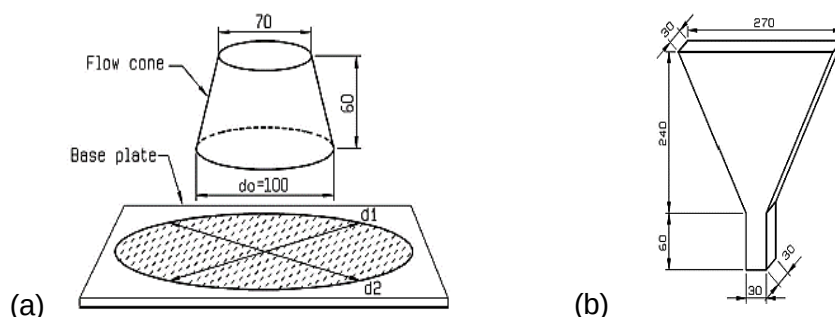


Figure 4 - Schematization of SCM tests, (a) mini-slump flow test, (b) mini v-funnel test (Jooste, 2006)

Hardened mortar tests

From each mortar mixture, prismatic specimens with dimensions of $40 \times 40 \times 160 \text{ mm}^3$ in size were prepared and stored in water until the age of testing. According to the European Standard EN 196-1 (EN 196-1, 2016), three specimens from each mixture were used to evaluate flexural strength at 28 days and compressive strength at 28 and 56 days. Water absorption was measured at 28 days. The microstructures of each mixture's specimens were examined by scanning electron microscopy (SEM).

In order to check the performance of the designed mortars as repair materials, two experiments were conducted. In the first test, small beams of reinforced SCC were made ($50 \times 10 \times 10 \text{ cm}$), and then deformed in the tension part. After 28 days, repair mortars that included GF and MK were added, as it can be seen in Figure 5. For the second test (slant shear test), cylindrical samples with a diameter of 10 cm and a height of 20 cm of SCC were prepared with an inclined surface (Figure 6). After a water-curing period of 28 days, the repair mortars that included only MK were applied without any compaction. This test, which puts the bond interface into a combined state of compression and shear, is adopted in BS6319: Part 4 (British Standard Institute, 1984). The mix-design of repair mortars is already given in Table 2. All specimens were cured in conditioning chamber ($T=20^\circ\text{C}$, $RH > 90\%$) and then tested at 28 days after repair.

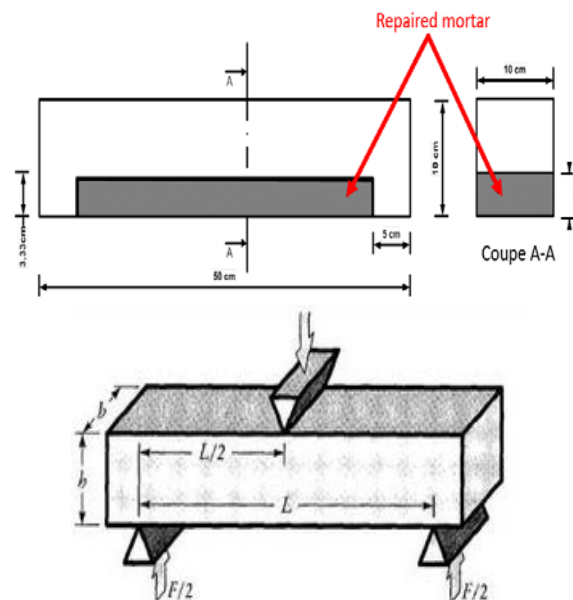


Figure 5 - Preparation of beam specimens for the 3P flexural strength test

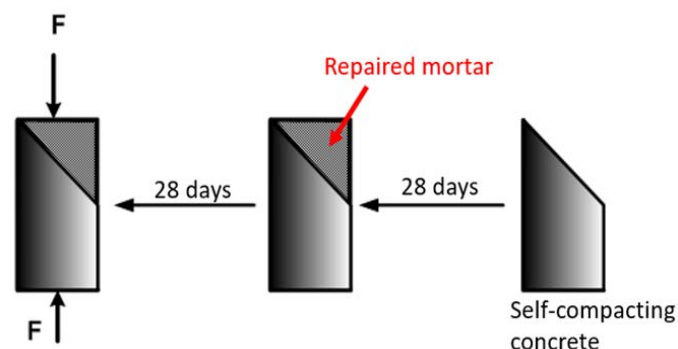


Figure 6 - Preparation of cylindrical specimens for the slant shear strength test

Results and discussion

Properties of fresh mortar

The effect of MK as a partial cement replacement and GF at different percentages on the workability of self-compacting mortar was investigated based on two fresh mortar tests, namely, slump flow and V-funnel. Figures 7 and 8 present the obtained results. It is important to note that for equitable comparison, differences between the slump flow values and between the flow time values were minimized using varied dosages of superplasticizer, as shown in Table 2. The values are within the recommended values of EFNARC of 27–33 cm for slump flow and 2–10 s for flow time, except for the 0.6GF mixture. From Figure 7, it can be observed that the slump flow values decreased as the MK and GF content increased. This decrease varied between 0.25 cm and 1.25 cm between the reference mortar and mortars with 5 and 15% MK, respectively. It can be seen from Figure 8 that the flow time increased with the increase of MK replacement rates. For example, when the %MK increased from 5% to 15%, the flow time increased from about 37 to 49%. The decrease in slump flow in mortar including GF was more pronounced. Increasing GF content from 0.2 to 0.6 decreased the slump flow by 2.5 cm to 4 cm. The results of Figure 8 indicated a significant increase in the V-funnel flow time with the addition of GF. Adding GF resulted in an important increase in the V-funnel flow time (40 to 98%). It should be observed that mixtures named 0.4GF and 10MK+0.4GF reached values superior to 10 s. V-funnel flow time is a good indicator of viscosity, so its increase means an increase in viscosity and vice versa. Visual control showed that all designed SCM mixtures have good homogeneity and stability (Figure 9).

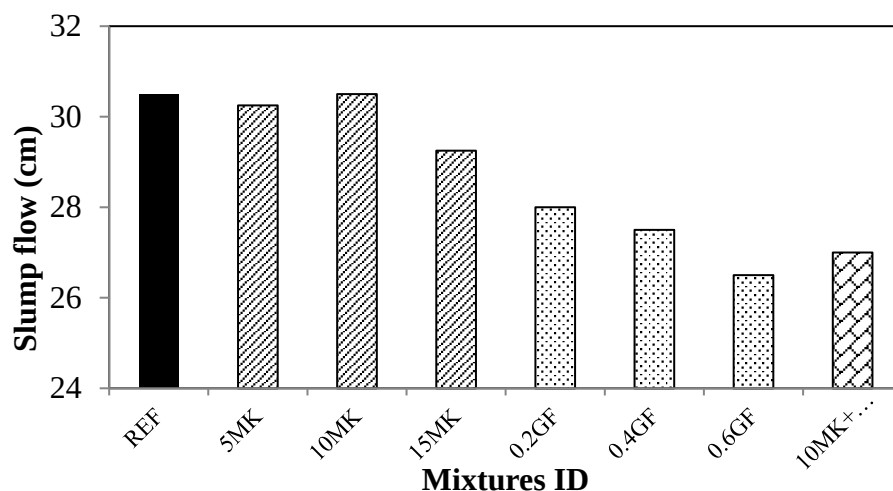


Figure 7 - Variation of slump flow for different SCM mixtures

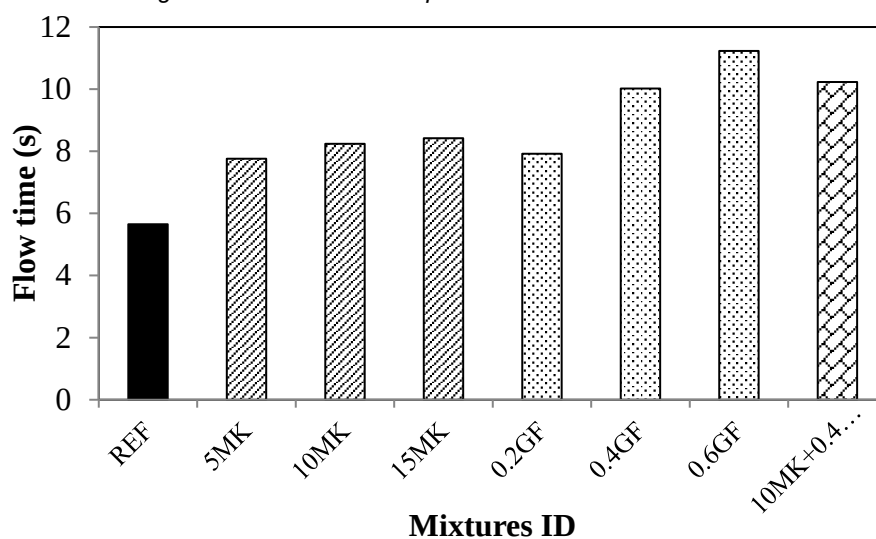


Figure 8 - Variation of flow time for different SCM mixtures

Similar results for the impacts of MK and GF on the fresh properties of mortars and concretes were reported in the literature (Yu et al., 2022; Güneyisi et al., 2019; Zhang et al., 2024). Some authors pointed out that the fine MK powder with higher specific area adsorbed more water, and therefore, it significantly reduced the fluidity and systematically increased the viscosity of concrete at the mixing stage when the ratios of water to cementing material kept constant (Qin et al., 2019; Hammat et al., 2021).

The decrease in V-funnel flow time with the addition of GF is attributed to the following two reasons: on the one hand, a layer of slurry will be wrapped around the surface of the glass fibers, resulting in less slurry wrapping around the aggregates and reducing the lubrication effect of the slurry on the aggregates; on the other hand, the accumulation of glass fiber forms a framework in concrete, which increases the internal friction force that the cement slurry needs to overcome and limits the movement of aggregates (Zhang et al., b 2024).

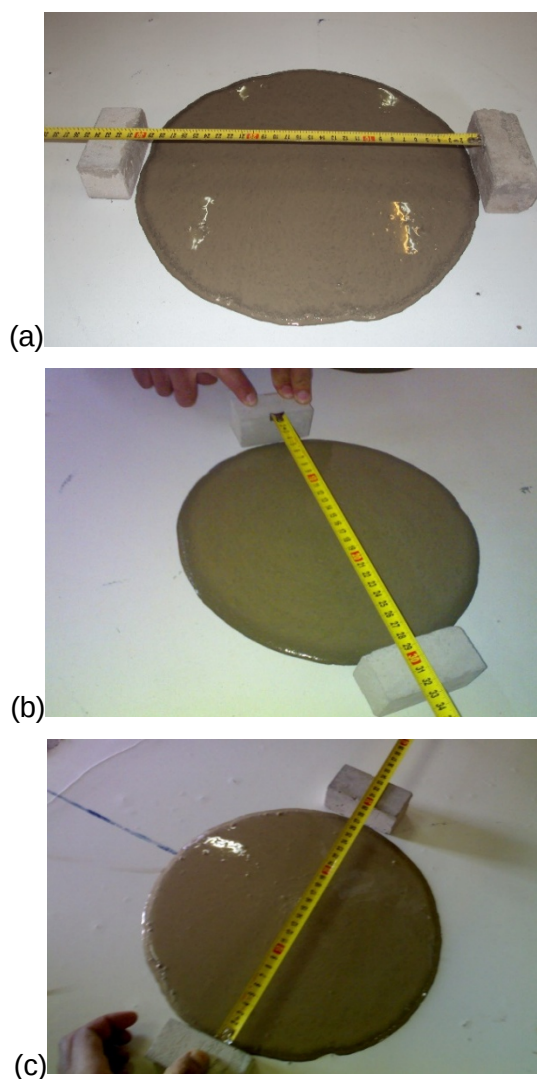


Figure 9 - Slump flow of the SCM mixtures: (a) 100C, (b) 15MK, (c) 0.2GF

Properties of hardened mortar

Compressive strength

Figure 10 shows the evolution of compressive strength of the developed SCM mixtures at 28 and 56 days. The reported values of compressive strength are the average of three specimens prepared for each mixture. The values of 28-day compressive strength varied between 24.6 and 35.4 MPa. The introduction of MK in SCM mixtures significantly increased the compressive strength, with an optimum at 10%. The mixture including 10MK and 0.4GF showed also superior 28-day compressive strength in comparison to the control mix. It was observed that adding GF had no effect on compressive strength. Similar results were observed for 56-day compressive strength. It was noted that the 28-day compressive strength for mixtures made with MK is 22-39% more than that of the corresponding plain cement mixture. At 56 days, this reached 32-49%. This may be attributed to the pozzolanic reaction of MK which occurred after 28 days. In fact, MK is an ultra-fine pozzolana and its superior performance could be attributed to the filling effect, where the MK particles fill the space between cement particles and also to the pozzolanic reaction between silica from MK and portlandite (calcium hydroxide C-H) from hydrated cement, which generates secondary calcium silica hydrate (C-S-H). This resulted in a more refined pore structure and denser cement matrix.

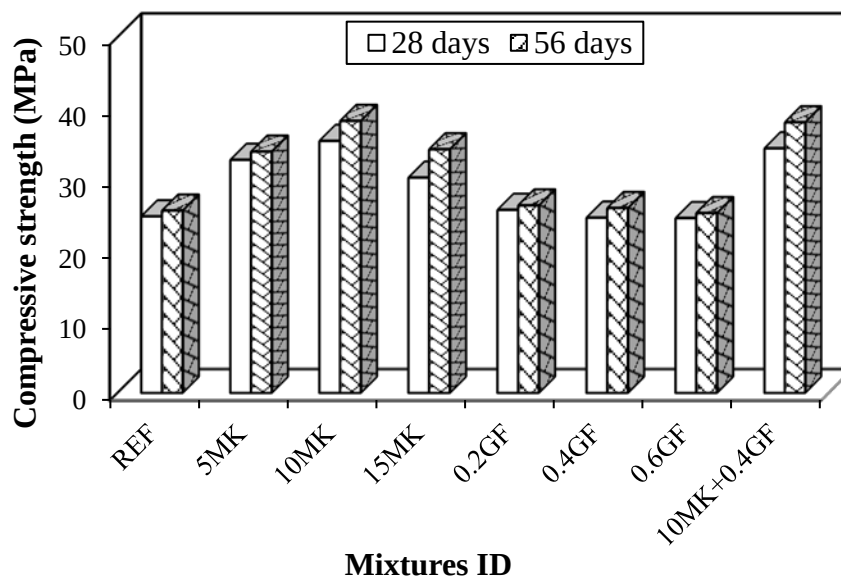


Figure 10 - Effects of MK and GF on compressive strength of SCM mixtures

Flexural strength

Figure 11 shows the evolution of the 28-day flexural strength of the developed SCM mixtures. Compared to the mixture with plain cement, it appears that the introduction of MK and GF increased the flexural strength and as the amount of GF increased, the flexural strength increased. For example, the use of 0.2, 0.4 and 0.6% of GF led to flexural strength superior to that of the mixture without fibers by 4, 6 and 15%, respectively. For MK mixtures, similar trends were observed to those of compressive strength with an optimum of 10%. The combined use of MK and GF (10MK+0.4GF) showed the highest flexural strength. The introduction of fine powder reduces the interconnectivity of the pore system and enhances the interfacial transition zone and, consequently, the flexural strength increased. The improvement of flexural strength when GF was added may be due to the bridging effect of GF between cracks during the loading process. A higher fiber content forms a denser fiber network, thereby increasing the possibility of effective bridging and improving the bearing capacity of SCM mixtures. However, excessive fiber content leads to fiber conglomeration, which reduces flexural performance (Zhang et al., b 2024).

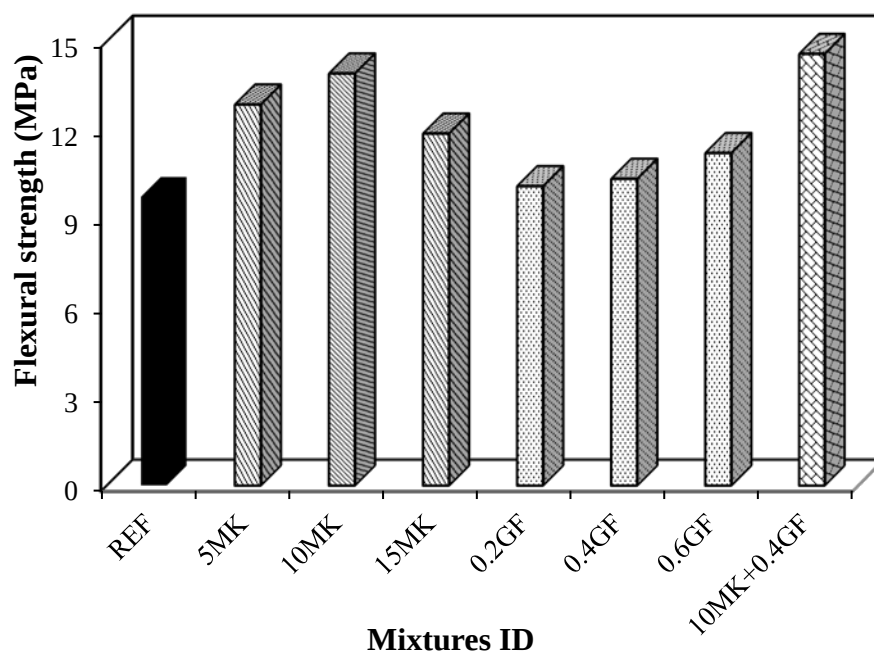


Figure 11 - Effects of MK and GF on 28 days- flexural strength of SCM mixtures

Water absorption

The water absorption of the developed SCM mixtures was evaluated by measuring the water absorbed after complete immersion for 72 h (Figure 12). A lower durability is expected for a concrete material with a higher water absorption. The water absorption values of GF mortars were slightly lower than those of the corresponding reference mix. For MK mixtures, water absorption decreased by 2, 14 and 29% for substitution levels of 5, 10 and 15%, respectively. The mixture including both MK and GF (10MK+0.4GF) showed a water absorption value of 5%, which is lower than that of the plain cement mortar by about 13%. The reduction in water absorption with increasing MK content may be due to the formation of supplementary calcium silicate hydrates (C-S-H), which contributes to clogging the pore system, and results in a decrease in total porosity and hence leads to the concrete with a denser cement microstructure. According to Figure 1, MK has finer particle size than cement. This improves the grading curve of the binder's particles and makes the cement matrix denser.

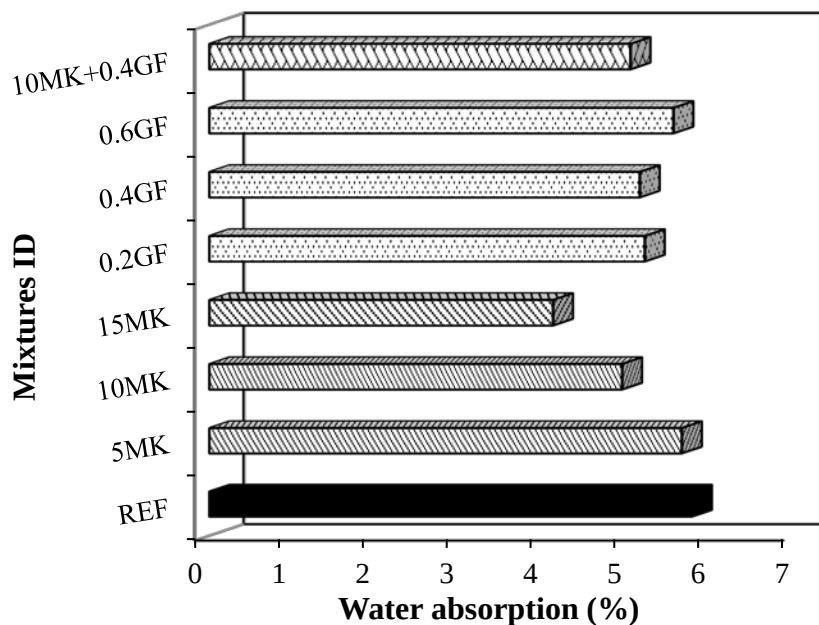


Figure 12 - Effects of MK and GF on the water absorption of SCM mixtures

Microstructure examination:

SEM images for some selected SCM specimens are depicted in Figure 13. The mixture without MK and GF showed some voids and micropores in the sample (Figure13a). There is also the absence of dense C-S-H and a bond between particles. The introduction of MK resulted in a more uniform and refined structure (Figure13b) as compared to the mixture with only cement (Figure13a). Figure 13c shows better cohesion and a bond between GF and the blended cement matrix. With the addition of MK, the particle size of the binder is improved and the SCM structure becomes more homogeneous and dense.

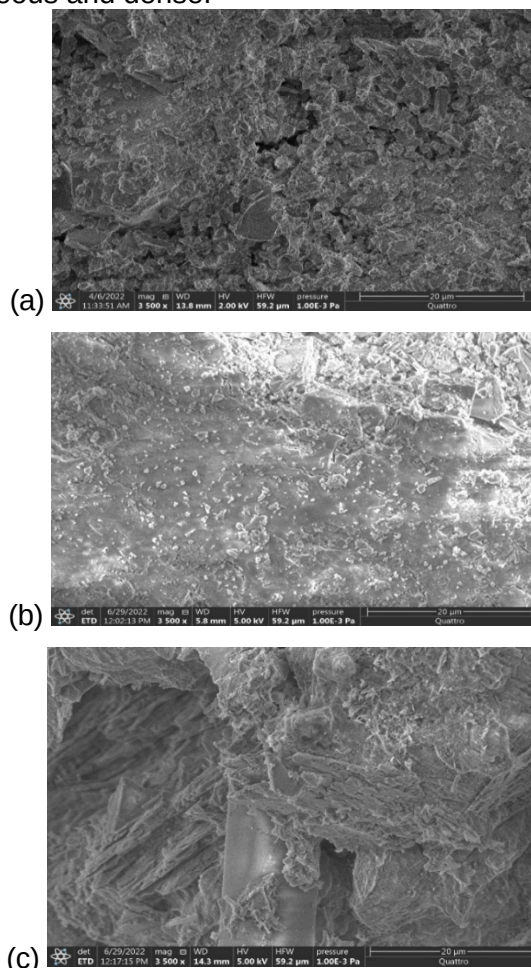


Figure 13 - SEM images of (a) plain cement SCM, (b) MK cement SCM and (c) SCM with GF and MK

Slant shear strength

Figure 14 depicts the variation in the slant shear strength of concrete repaired by mortars including cement and MK. Slant shear strength values varied from 25 to 31 MPa. Mixtures with MK replacements of 5%, 10% and 15% developed slant shear strengths of 25.66, 28.73 and 31.43 MPa, these values are higher by about 4%, 16% and 27% in comparison to the control mixture, respectively. These results showed beneficial effects of MK on improving the bond between repair mortar and the SCC substrate. In fact, the presence of MK in SCM resulted in enhancing cement matrix microstructure, which may be due to the physical effect, providing therefore a filling of pores and micropores. The advantage effect of MK may also attributed to the pozzolanic reaction (chemical effect) which is effective in reducing the average size of pores and segmenting large pores.

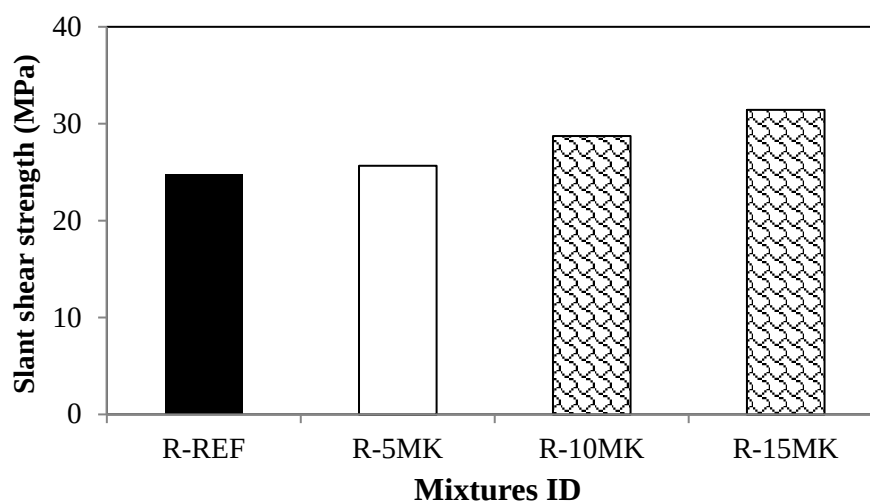


Figure 14 - Evolution of slant shear strength for the SCC cylindrical specimens repaired by different mortar compositions

Figure 15 presents the failure modes of some SCM specimens under slant shear force. The failure mode can reflect the bond performance. According to Feng et al. (2024), the substrate failure mode indicates excellent bond performance, indicating that the interfacial bond strength exceeds the concrete substrate strength, and the interface failure indicates a weak bond performance that the interfacial bond strength is weaker than that of the concrete substrate. Cracks appeared in concrete substrates and repair materials. The failure modes of repair specimens are a combination



of failure in the SCC substrate and repair mortars, which indicates relatively better interfacial bond properties.



Figure 15 - Evolution of flexural strength for the beam repaired by different mortar compositions

Flexural strength

Figure 16 illustrates the flexural strength of SCC beams repaired by mortars including various proportions of GF and MK. Flexural strength values ranged from 10.54 to 11.62 MPa. It was observed that increasing GF content increased the flexural strength. The increase in flexural strength is 3, 4 and 10% for GF content of 0.2, 0.4 and 0.6%, respectively. The combined use of MK and GF (10MK+0.4GF) showed approximately similar performance to that of the mixture including 0.6% of GF. Jasiczak and Mikołajczak (2003) stated that the presence of fibers in the internal structure of the concrete bridges cracks and allows the concrete elements to deform plastically. Moreover, the use of fibers contributes to the reduction of stress concentration at the crack's end, which, if the fibers

were absent, would accelerate the propagation of the cracks and reduce the flexural strength. MK contributes to improving flexural strength. This may be explained by (i): the physical effect, in which MK particles fill the gaps between cement particles and (ii) the physico-chemical effect, in which pozzolanic reaction takes place between silicon dioxide from MK with calcium hydroxide and water to form new calcium silicate hydrate. This results in a more refined pore structure and a denser cement matrix (Al-Akhras 2006; Boukhelkhal et al., 2019).

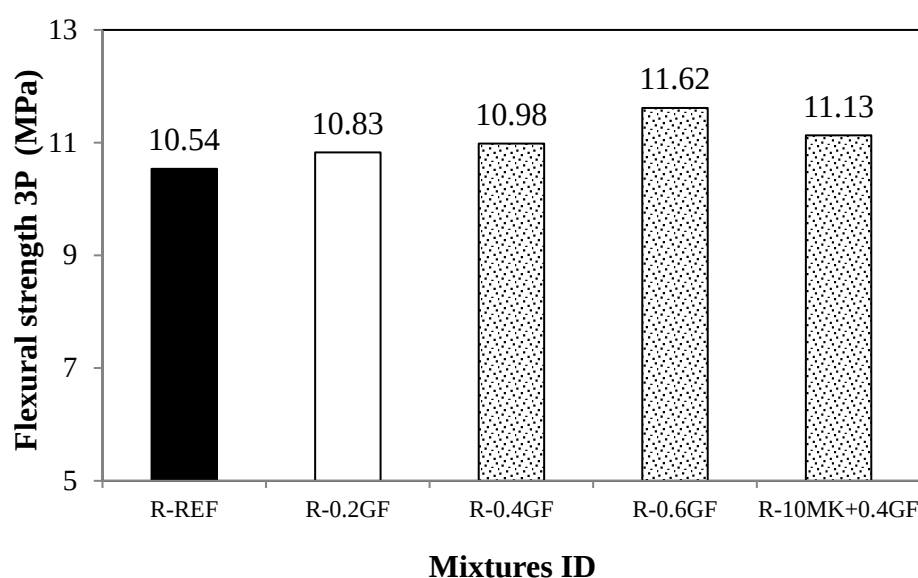


Figure 16 - Evolution of flexural strength for the beam repaired by different mortar compositions

Conclusion

The elaboration of self-compacting repair mortar incorporating metakaolin and glass fibers offers a promising solution for addressing environmental concerns in the construction industry. By utilizing industrial new powder and enhancing the properties of repair mortar, this approach enhances construction practices and the long-term durability of structures. Based on the findings, the following conclusions could be drawn:

- The use of metakaolin requires a higher dosage of superplasticizer in order to achieve self-compatibility of all mortars.
- Adding glass fibers significantly affected the fluidity and viscosity of the mortar, so it should not exceed a percentage of 0.6%.

- Replacing proportions of cement with metakaolin resulted in improved compressive and flexural strengths and reduced water absorption with an optimum of 10%.
- Flexural strength slightly increased with increasing GF content.
- When the amount of MK is increased from 5 to 15%, the slant shear strength increased by 26 to 31%, respectively. This means that MK had beneficial effects in improving the bond between repair mortars and concrete substrate.
- Specimens' beam repaired by GF and MK showed superior performance to those repaired by cement mortar alone.

Regarding all conducted tests, it can be stated that the mixture including the combination of 0.4% of GF and 10% of MK is the best since it has acceptable fresh properties combined with superior mechanical properties as compared to the other mixtures.

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Performanse samozbijajućeg maltera za reparaciju sa metakaolinom i staklenim vlaknima

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Sažetak:

Uvod/cilj: Samozbijajući malter je poznat kao malter visoke fluidnosti koji može da teče i popuni sve prostore pod sopstvenom težinom, bez vibriranja ili zbijanja. Cilj ovog eksperimentalnog istraživanja je razvoj samozbijajućeg maltera koji se može koristiti za sanaciju oštećenog konstrukcijskog betona zamenom određenog udela običnog portland cementa metakaolinom i dodatkom staklenih vlakana.

Metode: Pripremljene su i ispitane mešavine sa različitim procentima metakaolina i staklenih vlakana. Sve mešavine su ispitane u svežem stanju radi procene fluidnosti i viskoznosti ispitivanjem rasprostiranja testom mini-slump i vremena proticanja kroz mini V-levak. Izmerena su fizička i mehanička svojstva svih mešavina, kao što su čvrstoća pri pritisku, čvrstoća pri savijanju i upijanje vode. Kako bi se proverile performanse pripremljenog samougrađujućeg maltera u konstrukcijskoj sanaciji, sprovedena su dva eksperimenta na oštećenoj armiranobetonskoj gredi i cilindričnim uzorcima.

Rezultati: Rezultati su pokazali da dodatak staklenih vlakana i metakaolina zahteva povećanje doze superplastifikatora kako bi se smanjio njihov negativan uticaj na fluidnost i viskoznost mešavina. Upotreba metakaolina do 10% kao zamene za cement povećala je čvrstoću pri pritisku od 11 MPa nakon 28 dana i 13 MPa nakon 56 dana. Slično ponašanje uočeno je kod mešavine koja je sadržala 0,4% staklenih vlakana i 10% metakaolina. Dodavanje staklenih vlakana u količinama od 0,2, 0,4 i 0,6% dovelo je do povećanja čvrstoće pri savijanju od 4, 6 i 15%. Upijanje vode smanjeno je za 29% kada je ugrađeno 15% metakaolina. Upotreba metakaolina poboljšava vezu između reparaturnog maltera i betonske podloge.

Zaključak: Na osnovu detaljne analize dobijenih rezultata, može se zaključiti da se metakaolin i staklena vlakna mogu koristiti za poboljšanje mehaničkih svojstava i smanjenje upijanja vode mešavina samougrađujućeg maltera. Mešavina koja je sadržala 0,4% staklenih vlakana i 10% metakaolina

pokazala je najbolje performanse i ocenjena je kao pogodnija za sanaciju oštećenih greda od samozbijajućeg betona.

Ključne reči: samozbijajući malter, metakaolin, staklena vlakna, čvrstoća, upijanje, reparacija.

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