Use of recycled aggregates from different sources in the production of SCC Part I: Mix design and fresh properties

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Abstract

The purpose of this research is to investigate the effect of recycled gravel on the rheological properties of self-compacting concrete (SCC). In this experimental study, five types of gravel were used to prepare nine SCC mixtures with a Water/Binder ratio (W/B) of 0.4 and a binder dosage of 475 kg/m^3. The control SCC is made entirely of regular crushed gravel, whereas the other mixes use recycled gravel to replace the regular crushed gravel to varying degrees. Slump flow by Abrams cone, V-Funnel test, J-Ring test, L-Box test, and sieve stability segregation test were used to investigate the properties of the fresh SCC mixtures. The results show that all SCC mixtures have good deformability and resistance to segregation, with the exception of mixtures made from bituminous mixtures gravel and crushed brick. SCCs of binary mixtures containing two types of gravel (regular crushed gravel and recycled gravel) produce acceptable results that meet the AFGC and EFNARC recommended criteria.

Keywords: recycled concrete aggregates, brick, marble, bituminous aggregates, SCC fresh properties
Kulcsszavak: újrahasznosított beton adalékanyagok, tégla, márvány, bitumenes adalékanyagok, SCC friss tulajdonságai

1. Introduction

The concept of producing fluid concretes that spread in the formwork without the use of vibrating effort is an intriguing solution that allows for uniform structures and the avoidance of possible errors in the placement of the concrete, particularly elements of very complex shape. This is how the concept of self-compacting concrete (SCC) came to be [1]. These very fluid concretes were also very stable and had a high resistance to segregation and bleeding. The technique of concrete poured under water was used to meet the usually contradictory conditions (deformability and resistance to segregation); in fact, the first generation of self-compacting concretes is formulated in the same way as the concretes intended for submerged structures, but with a lower viscosity and thus a higher workability. In order to resist the segregation of large aggregates and the bleeding phenomenon, these concretes frequently contain viscosity agents or colloidal agents. This type of concrete is of particular interest in Algeria, where the imperatives of improved work quality and formwork complexity have become increasingly apparent in recent years. Recycled aggregates are aggregates that have been obtained by recycling concrete from demolition. Indeed, these aggregates have a variety of applications in civil engineering, most notably in road construction and the preparation of concrete for various buildings. Furthermore, current environmental policy encourages their use in order to reduce raw material consumption and comply with environmental regulations. In this context, several studies have been conducted in Algeria and other countries over the last ten years in order to use waste as recycled aggregates in ordinary concrete and SCC. These investigations include the study of the influence of crushed sand by Benabed [2, 3] and the recovery of construction and demolition waste (particularly brick and concrete) by Azzouz et al. [4], Douara [5] and Nezergui [6].

This study focuses on the effect of gravel type characteristics (coarse aggregates) on the properties of SCC in the fresh state. The study aims to evaluate the behavior of SCC based on the physical characteristics of coarse aggregates and the properties of self-compacting mortar in the fresh state. The influence of the type of gravel (ordinary or recycled) and the shape of the gravel grains (flattened or elongated) on the rheological properties of SCC was investigated.

2. Materials and experiments

2.1 Identification and characterization of materials

In this study, Ordinary Portland cement (CEM I 42.5) was used in the preparation of the various SCC mixtures, which were manufactured in accordance to standard NT 47.01 with densities and specific surface areas of 3.15 and 3700 cm^2/g, respectively. The chemical properties of cement and MP are given in *Table 1*. In order to avoid using high cement content and to develop an SCC at a lower cost while also contributing to environmental preservation, a prudent solution consists in using a binary mixture containing the marble powder (MP) as mineral addition [2] with a degree of substitution of 10%, because it gave a fluid and homogeneous mixture. This powder has a density of 2.70 and a fineness of 3600 cm^2/g (*Table 1*). Throughout this study, a single type of third-generation high water-reducing superplasticizer was employed. It is based on polycarboxylates, which significantly improve the fluidity of fresh concrete.

Binder	SiO_2	CaO	MgO	Al_2O_3	Fe_2O_3	SO_3	K_2O	TiO_2	Na_2O	P_2O_5	Loss ignition
Cement	18.83	61.54	1.27	4.20	5.31	1.96	0.49	0.20	0.21	0.29	5.70
MP	0.42	56.01	0.12	0.13	0.06	0.01	0.01	0.01	0.43	0.03	42.78

Table 1 Chemical composition of cement and marble powder MP
1. táblázat A cement és a márvány (MP) kémiai összetétele

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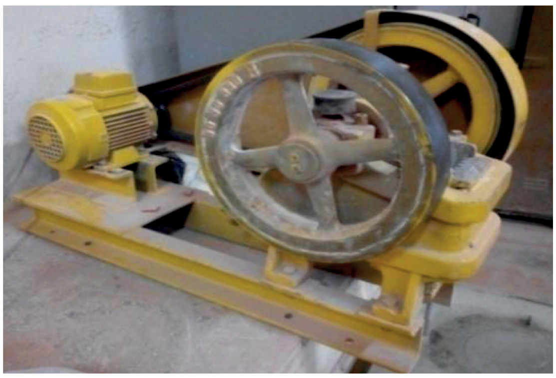

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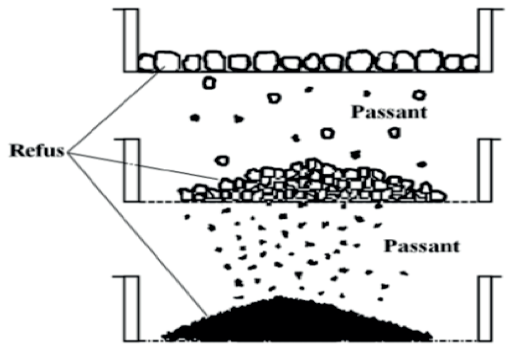

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Fig. 1 Stages of elaboration and preparation of recycled gravel: 1/- Breaking up the blocks of material used with a hammer. and breaking up the material fragments to dimensions suitable for the opening of the crusher, 2/- Crushing of fragments using a two-jaw crusher, 3/- Screening procedure (separation of the different granular classes 3/8 and 8/16)
1. ábra Az újrahasznosított kavics feldolgozásának és előkészítésének szakaszai: 1/- A felhasznált anyagtömbök törése kalapáccsal és az anyagdarabok aprítása a törőgép nyílására alkalmas méretűre, 2/- A darabok aprítása kétpofás törőgéppel, 3/- Szitálás (a különböző szemcseméretű - 3/8 és 8/16 - frakciók szétválasztása)

Fig. 2 Different types of aggregate used
2. ábra Az alkalmazott aggregátumok

Properties	OCG		WMG		RBG		DCG		BMG	
Size (mm)	(3/8)	(8/16)	(3/8)	(8/16)	(3/8)	(8/16)	(3/8)	(8/16)	(3/8)	(8/16)
Absolute density	2.691	2.673	2.71	2.695	2.216	2.227	2.568	2.592	2.286	2.292
Apparent density	1.365	1.395	1.368	1.392	0.946	0.949	1.127	1.18	1.128	1.048
Compactness (%)	50.72	52.19	50.48	51.65	42.69	42.61	43.89	45.52	49.34	45.72
Porosity (%)	49.28	47.81	49.52	48.35	57.31	57.39	56.11	54.48	50.66	54.28
Water absorption (%)	2.31	1.46	0.44	0.28	10.91	9.67	8.23	5.90	1.11	1.60
Surface cleanliness (%)	0.29	0.19	0.81	0.18	0.78	0.26	1.79	1.27	0.28	0.39
Elongation coefficient	0.33	0.57	0.30	0.48	0.34	0.37	0.39	0.64	0.42	0.62
Kurtosis coefficient	0.33	0.45	0.38	0.39	0.33	0.48	0.33	0.43	0.33	0.47
Los-Angeles (%)	25.1	21.1	32.7	28.3	42.8	46.3	34.5	26.4	23.8	25.6
Micro-Deval (%)	8.2	5.2	8.1	15.6	16.1	36.8	12.9	11.2	8.4	11.9

Table 2 Properties of the aggregates used
2. táblázat A felhasznált adalékanyagok tulajdonságai

A river sand SA (0/5) of siliceous nature was used with density of 2.65 for the preparation of SCC mixes. An ordinary crushed gravel (OCG) of limestone nature, and four types of recycled gravel produced in the laboratory *(Fig. 1);* recycled gravel (WMG) made from crushed white marble waste, recycled gravel (RBG) made from crushed red brick waste, recycled gravel (DCG) made from crushed demolition concrete, and recycled gravel (BMG) made from milling and recycling bituminous mixtures. They are divided into two granular classes of each type (3/8 and 8/16) as shown in *Fig. 2*. The different properties of the aggregates used are summarized in *Table 2*. The particle size analysis was performed in accordance with standard NF EN 933-1 [7], and the particle size curves of the various aggregates are shown in *Fig. 3*.

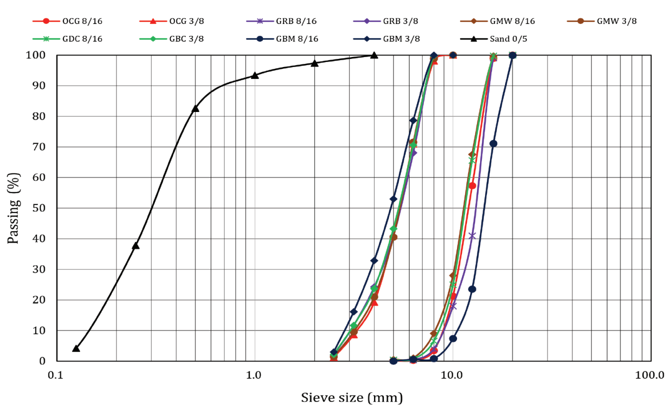

Fig. 3 Particle size curves of the different aggregates studied
3. ábra A vizsgált aggregátumok szemcseméreteloszlása

2.2 Mix-design of SCC

The self-compacting mortar (SCM) phase is critical in the mix-design of SCC, because it provides lubrication between the coarse aggregate particles, viscosity, mobility and overall SCC stability. SCM's properties are similar to those of SCC, namely a low shear threshold to ensure flow under gravity alone and sufficient plastic viscosity to ensure non-segregation concrete during flow. Simpler alternative tests for assessing the fluidity of SCM are proposed, such as the mini-slump test and the mini-funnel test (V-funnel) [8]. The Okamura method was used to formulate the SCM, with improvements in the sand content (S/M) and the water/binder ratio (W/B). The slump test, in which the diameter (D) obtained must be between (270 mm D 330) [9], and the V-funnel test, in which the flow time obtained must be between 2-10 s [8], are used to adjust the superplasticizer/binder ratio (Sp/B).

According to Jin and Domone [8], mortar tests are performed because SCC has a smaller bulk aggregate volume than ordinary concrete and thus the mortar's properties are dominant. Because the evaluation of the properties of the mortar is an integral part of the formulation of the SCC, knowing of the properties of the mortar is useful. As a result, testing mortar is far more convenient and straightforward than testing concrete (*Fig. 4*).

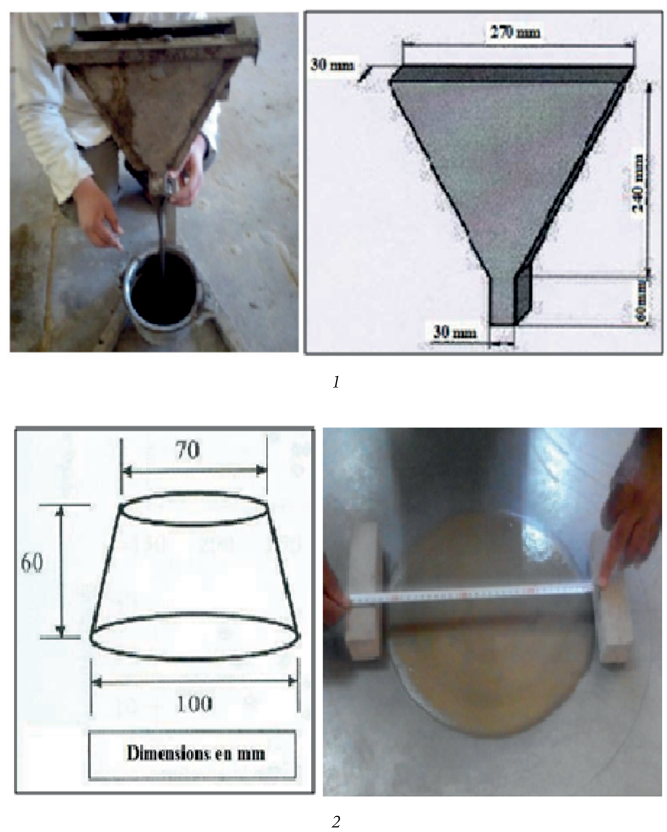

Fig. 4 Self-compacting mortar (SCM) tests: 1/ Mini slump cone test 2/ Mini V-funnel
4. ábra Öntömörödő habarcs (SCM) vizsgálatok

S/M = 0.5 W/B = 0.4 Constituents		Family A SCC 1 100% OCG	SCC 2 100% WMG	SCC 3 100% BMG	SCC 4 100% DCG	SCC 5 100% RBG	Family B SCC6 (50%OCG +50%WMG)	SCC7 (50%OCG +50%BMG)	SCC8 (50%OCG +50%DCG)	SCC9 (50%OCG +50%RBG)
Cement (kg/m³)		433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7	433.7
Marble powder (kg/m³)		41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3	41.3
Sand (kg/m³)		901.5	872.3	916.6	937.7	960.5	883.1	901.9	914.7	920.7
Ordinary gravel (kg/m³)	(8/16)	546.0	—	—	—	—	281.7	246.9	254.6	231.8
	(3/8)	270.8	—	—	—	—	139.6	122.4	126.2	114.9
Recycled gravel (kg/m³)	(8/16)	—	588.3	444	451.9	350.2	285.0	247.8	243.2	212.5
	(3/8)	—	293.7	220.9	221	172.7	142.3	123.3	118.9	104.8
Water (kg/m³)		197.0	182.9	205.6	252.8	273	193.0	202.7	228.4	240.3
Superplasticizer	Sp (%)	1.00	1	1	0.9	0.9	1	1	1	1
	Sp (kg/m³)	4.8	4.8	4.8	4.3	4.3	4.8	4.8	4.8	4.8

Table 3 Mix-proportions of the different SCC
3. táblázat Az öntömörödő betonok (SCC-k) keverékarányai

The results of slump and flow time tests on SCC enabled the following conclusions to be drawn:

- The slumps and flow times obtained are between 303 mm and 324 mm and 2.69 and 3.46 s, respectively, and are consistent with the values proposed by Domone and Jin [8].
- The ratios S/M = 0.5 and W/B = 0.4 will be used for all mortars in the following work because they produce fluid and homogeneous mortars.
- Sp/B ratio = 1.0% will be used in the rest of the work because it produced a fluid and homogeneous mixture that met the three SCM criteria.
- MP with content of 10% will be used in the following work for all SCC mixtures because it produces fluid and homogeneous mortars.

In the laboratory, nine different SCC mixtures were prepared. These mixtures contain coarse aggregates with a maximum diameter of 16 mm, and recycled gravel was used as a replacement for ordinary gravel at substitution rates by volume of 0, 50, and 100%. All of the compositions have a powder content of 475 kg/m³, W/B ratio of 0.4 and S/M ratio of 0.5. Mix-proportions of the different types of SCC are given in *Table 3*.

3. Experimental results

3.1 Slump flow test

3.1.1 Slump

According to EFNARC [10], a concrete with a diameter of 650-800 mm in the slump flow test is considered a BAP. According to *Fig. 5*, it should be noted that all SCC mixtures have slump values between 682-765 mm, which falls within the previously mentioned range. As a result, most of mixtures are within the range of BAP class SF2 (660 to 750 mm) according to AFGC [11], with the exception of the BAP3 mixture (based on BMG), which is within the range of class SF3 (760 to 850 mm). As a result of the AFGC [11] recommendations, all SCC mixtures are characterized by good deformability. SCC5 made with crushed brick gravel (RBG) has a minimum slump of 682 mm. This is because coarse aggregates have a flat and elongated shape. The latter absorb more water and thus have a higher demand for it. As a result, the workability of the concrete is reduced. Aarre and Domone [12] recommend a slump of 650 mm to 700 mm for good SCC.

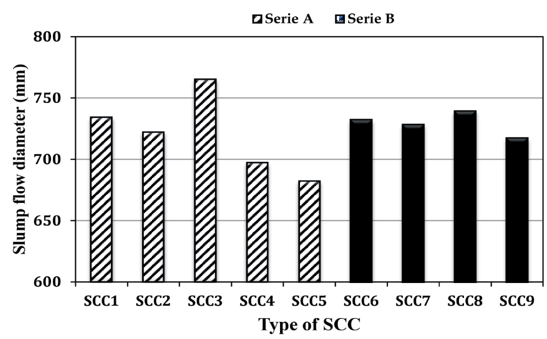

Fig. 5 Slump flow results of the different types of SCC
5. ábra Az öntömörödő betonok (SCC-k) zsugorodási eredményei

3.1.2 Slump flow time T500

The time required to reach a diameter of 50 cm is the second parameter entered into the Abrams cone slump test. *Fig. 6* depicts the results of the flow time T500. It should be noted that, the flow time T500 results of all SCC are lower than those proposed by Domone et al. [9]. This is most likely explained by the mixtures' high viscosity. The lowest flow time is found in the mixture of SCC3 of family A made with gravel of bituminous mixtures (GBM), as shown in *Fig. 6*, and this can be justified by its large high slump (765 mm) and the value of the minimum T500 equal to 0.95 s.

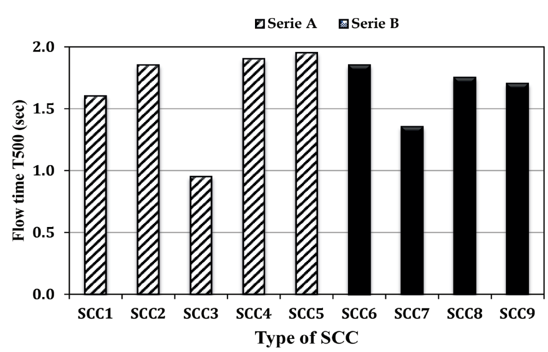

Fig. 6 T500 results of the different types SCC
6. ábra A különböző típusú öntömörödő betonok (SCC-k) T500 eredményei

3.2 J-ring test

The J-ring test is simple to perform and provides an accurate measurement of workability loss in the presence of obstacles. Daczko [13] suggests comparing slump measurements without and with the J-ring present for this purpose.

3.2.1 J-ring slump flow (SJ)

Fig. 7 depicts histograms of the J-ring slump results. It can be seen the clear difference in the slump values of the mixtures when the J-ring is absent versus present for all of the mixtures with the same rate. This distinction is interpreted by the blocking caused by the J-obstacles ring. It is also observed the increase in the slump of the J-ring of SCC3 of family A made with recycled gravel (BMG), which has a significant value and provides the best value (728 mm). In comparison to SCC4 and SCC5 (100% recycled gravel) mixtures of the family A, SCC8 and SCC9 of the family B (50% OCG + 50% recycled gravel) exhibit a large slump of J-Ring.

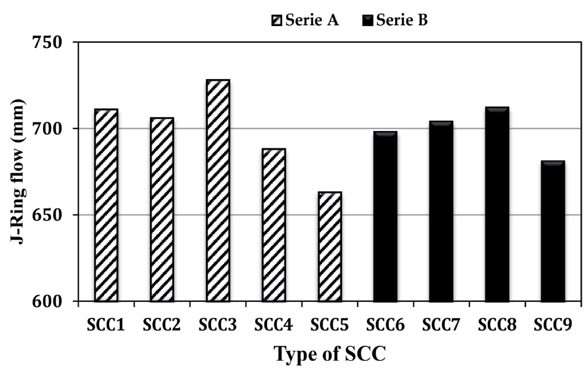

Fig. 7 J-Ring flow results of the different types of SCC
7. ábra J-gyűrűs áramlási eredmények a különböző öntömörödő betonoknál (SCC)

Table 4 shows the flow of SCC as a function of the flow difference without and with J-ring [14]. Based on these findings, it is possible to conclude that, the mixtures (SCC1, SCC2, SCC4, SCC5, and SCC7) have an adequate passage capacity and resistance to segregation in heavily reinforced areas.

Mix.	Slump – Slump (J-Ring) (mm)		Evaluation of flow
SCC1 (100%OCG)	23	(0 - 25)	Good flow
SCC2 (100%WMG)	16		
SCC4 (100%DCG)	9		
SCC5 (100%RBG)	19		
SCC7 (50%OCG+50%BMG)	24		
SCC3 (100%BMG)	37	(> 25 - 50)	Partially blocked flow
SCC6 (50%OCG+50% WMG)	34		
SCC8 (50%OCG+50%DCG)	27		
SCC9 (50%OCG+50%RBG)	36		

Table 4 Flow of different types of SCC according to the difference in slump without and with the ring
4. táblázat A különböző típusú öntömörödő betonok (SCC-k) folyása a gyűrű nélküli és a gyűrűvel való süllyedés különbsége alapján

3.2.2 J-ring slump flow time T500J

The J-ring test determines the capacity of passage to fill all voids. The flow time T500J results for the various SCC mixtures are translated into histograms in *Fig. 8*. The flow time T500 (1.25 s–2.40 s) in the presence of the J-Ring is acceptable when compared to the absence of the J-Ring for all types of SCC. As a result, the SCC passage capacity is suitable for all compositions. The delay is significant for SCC2 mixtures made with marble waste gravel (WMG) and SCC5 mixtures made with crushed brick gravel (RBG). This is because gravel grains are flat and elongated.

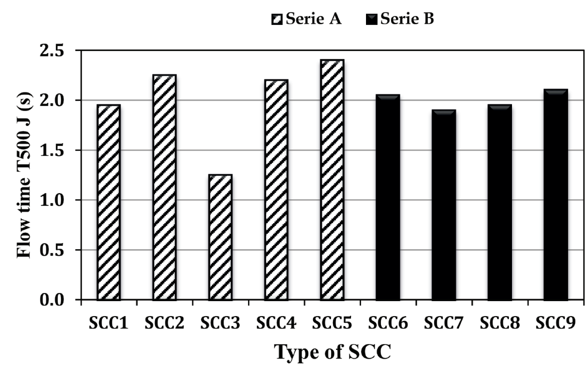

Fig. 8 T500 J-Ring result of the different types of SCC
8. ábra Az öntömörödő betonok (SCC) T500 J-gyűrű eredményei

3.2.3 Height of J-ring slump flow (Difference in height: Bj)

It is widely accepted that in order to mitigate the risk of non-blocking, the difference in height (Bj = Hint – Hext) must be less than 20 mm. According to some authors [15], the risk of non-blocking is only satisfied if Hint - Hext ≤ 15 mm. *Fig. 9* depicts the height of flow (Bj) results obtained from J-ring tests. It should be noted that the risk of mixtures blocking is low for the majority of the mixtures. SCC5 and SCC9 mixtures containing flat and elongated gravel grains, but low for SCC2.

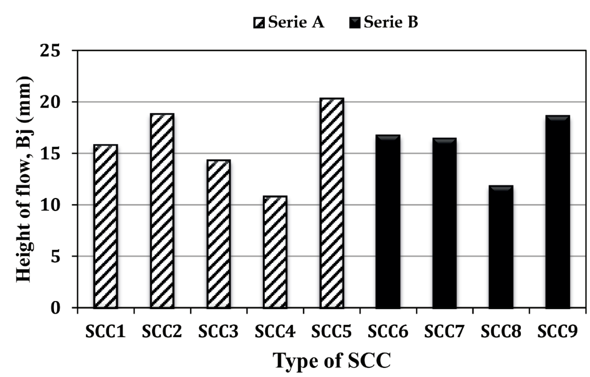

Fig. 9 Difference in height BJ-Ring of the different types of SCC
9. ábra Az öntömörödő betonok (SCC) BJ-gyűrű magasságkülönbségei

3.3 V-funnel flow time test

One method for determining the viscosity and resistance to segregation of SCC is to test the flow through the V-funnel. According to Domone and Jin [8], the flow time values range between 2-10 s. Based on the obtained results, it can be concluded that, all SCC mixtures produce good results with flow time ranging between 5.3-7.35 s. SCC3 of family A made from bituminous mixtures gravel yields the lowest flow time value (BMG).

Sonebi and Bartos [16] achieved a T500 time of less than 2 seconds with SCC mixture containing approximately 40% more paste than ordinary concrete. SCC4 of family A achieves the highest value (7.35 s) using crushed concrete gravel (GDC). This is explained by an increase in the mixture's compactness, and thus an increase in viscosity [17].

Safawi et al. [18] demonstrated that the V-Funnel flow time is an appropriate tool for describing the tendency of segregation. As a result, the tendency for concrete to segregate is very high for very short flow times (less than 2 s). This implies that low viscosity mixtures segregate easily. If there is too much aggregate, for example, the inverted cone shape will obstruct the flow of concrete. On the other hand, a high flow time can be associated with low deformability due to high paste viscosity and/or high intergranular friction [19]. SCC4 and SCC5 mixtures have a higher viscosity than the others, resulting in V-funnel blocking. This is due to type of gravel's, grain water consumption as well as the grain settling effect.

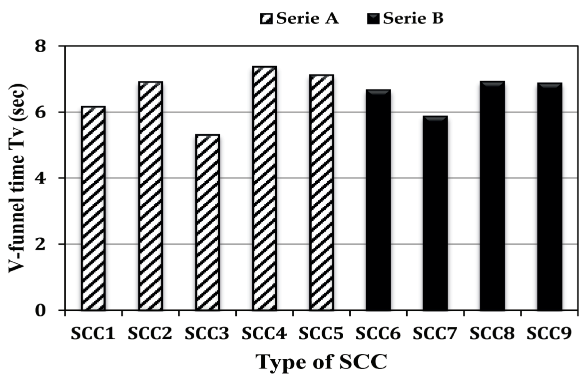

Fig. 10 Flow time results of the different types of SCC
10. ábra Az öntömörödő betonok (SCC-k) folyási idő eredményei

3.4 Sieve stability segregation test

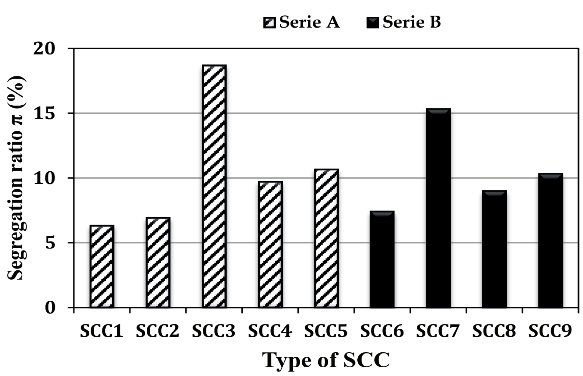

Fig. 11 Resistance to segregation π (%) of the different types of SCC
11. ábra Az öntömörödő betonok (SCC-k) π szegregációval szembeni ellenállása (%)

According to AFGC recommendations [11], the optimum percentages of cement grout passing through the sieve are between 0% and 15%. By using recommended values, it is clear that, the majority of SCC mixtures have good resistance to segregation and bleeding, except for mixtures of bituminous mixtures gravel SCC3 (100% BMG) and SCC7 (50% BMG), which have higher percentages (>15%) than other SCC mixtures due to low viscosity. As a result, these SCC are less viscous and unstable. On the one hand, the large amount of mortar (sand + cement) contained in SCC, the nature of the addition and the type of gravel used, ensure good resistance to segregation. According to Corinaldesi and Moriconi [20], mixtures of SCC with 100% crushed concrete gravel and stone powder as mineral additions may have improved flowability and segregation resistance.

3.5 L-Box test

The L-Box test is notable for providing an accurate assessment of three capacities: filling, passage, and resistance to segregation. *Fig. 12* depicts the results of varying the H_2/H_1 ratio based on the type of gravel. The gravel substitution had no effect on the SCCs' filling capacity. The H_2/H_1 ratio varies between 80.42% and 93.7% for all SCC (except SCC5). As a result, this ratio exceeds 80% as required by EFNARC recommendations [10].

The H_2/H_1 ratio of SCC5 made from gravel (RBG) remains below the EFNARC limit. This may be explained by the flattened and elongated shape of the coarse aggregates. This latter causes a decrease in the H_2/H_1 ratio and increases the risk of gravel blocking behind the steel bars of the L-Box [21]. The results show that when ordinary crushed gravel (OCG) is completely or partially replaced by crushed concrete gravel (DCG), the L-box filling capacity improves for the SCC4 and SCC8 mixtures.

Three parameters influence the H_2/H_1 ratio, according to Sonebi et al. [21]: the amount of water, the amount of coarse aggregates in the mixture and the amount of superplasticizer. The first two parameters increase the H_2/H_1 ratio but increasing the dosage of aggregates decreases the H_2/H_1 ratio and increases the risk of blocking of the coarse aggregates behind the steel bars of the L-Box.

3.6 Visual examination of SCC static segregation

The vertical (static) segregation control test of SCC mixtures is a very simple test and consists of sawing the hardened concrete specimen in the direction of the pour and directly observing the aggregate distribution over the height of the concrete. *Fig. 13* clearly shows that the nine SCC mixtures presented here are not subjected to static segregation. In fact, the aggregates are evenly distributed across the entire height of the sawn samples. This observation was made in all cases and resulted in the same conclusion.

The results demonstrated that limiting sieve stability to 15% is slightly severe, as concretes with sieve values greater than 15% (SCC3 and SCC7) did not exhibit static segregation. The L-box test simulates concrete flow in reinforced formwork. This test allows you to determine whether or not there is concrete blockage at the reinforcing bar level. The sieve stability test results can be used to make a judgment about vertical segregation.

Vertical segregation is not a significant risk in an SCC with a viscous and cohesive paste. However, this method remains an indirect appreciation of static segregation. Given the high fluidity of SCC, the risk of vertical (static) segregation is not insignificant. As a result, it is critical to inspect the uniformity of the granular skeleton in the concrete mass. Bensebti et al. [22] demonstrated that this type of segregation is not visible and can only be observed using very advanced techniques.

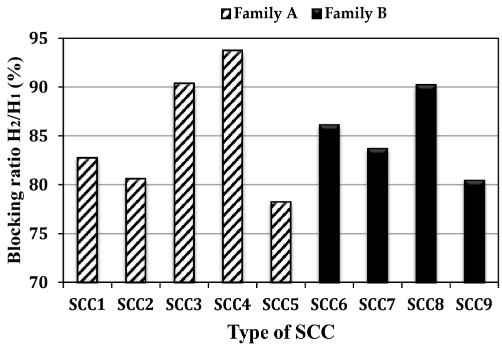

Fig. 12 L-Box test results of the different types of SCC
12. ábra Az öntömörödő betonok (SCC-k) L-Box vizsgálati eredményei

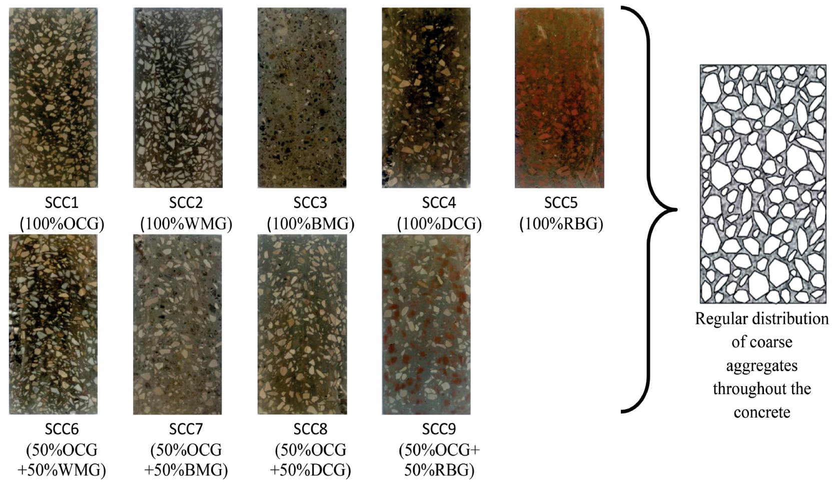

Fig. 13 Visual examination of static segregation of the different types of SCC
13 ábra Az öntömörödő betonok statikus szegregációjának vizuális vizsgálata

4. Conclusions

Based on the findings of this study, a number of conclusions can be made including the following:

- Ordinary crushed gravel (OCG) SCC is found to meet the wet state properties required by EFNARC and AFGC recommendations;
- Crushed marble waste gravel (WMG) has fairly similar wet characteristics, but use of this type of gravel (WMG) is ineffective, because it is very expensive;
- Crushed brick gravel (RBG) significantly reduces SCC slump, due to the flat and elongated shape of gravel (RBG) as well as the high water absorption.
- Incorporating of Bituminous mixtures (BMG) in SCC appears to improve deformability but exhibits poor resistance to segregation and bleeding.
- The risk of mix blockage is low for most SCC mixes, but high for mixtures of marble waste gravel (WMG) and crushed brick gravel (RBG) containing coarse aggregate grains of flat and elongated shape.
- The minimum value of the V-funnel flow time is obtained for SCC3 made from bituminous gravel (BMG). SCC4 crushed concrete gravel (DCG) and SCC5 crushed brick gravel (RBG) mixtures have higher viscosity than the other mixtures, resulting in V-funnel blocking. This is due to each type of gravel's grain water consumption as well as the grain settling effect.
- To improve SCC's static stability and resistance to segregation, the coarse aggregate content is reduced while the fines content is increased.

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Welcome notes to XVIII ECERS

The XVIII^th^ Conference of the European Ceramic Society will take place in Lyon, on 2-6 July 2023.

Lyon, where the Rhőne and the Saőne rivers meet, has always been a city of exchanges and industrial development, with major historic landmarks. 'Lugdunum' was founded in 43BC by the Romans and served as the capital of Gaul. It was also famous, as the world capital of silk, during the French Renaissance. Lyon's cuisine is famous all over the world, the cinema was invented by the Lumiére brothers in this City of Lights, surrounded by prestigious wine areas where you can taste Beaujolais, Burgundy and Cőtes-du-Rhőne, not far from the Alps and of course Mont Blanc. Lyon is also the city of cutting edge industry and engineering, especially in the fields of chemistry and materials, bio-technology and medicine, mobility systems, with numerous schools and faculties created to answer technological and societal needs.

Thus, it is a great pleasure to welcome ceramists in the City of Lights, to share the latest discoveries in ceramic science and technology, reconnect with colleagues from around the world, in a convivial conference atmosphere. The conference, hosting ceramic experts from industry and academia, offering a unique opportunity to participate in an international event covering the development and applications of ceramic-based systems.

In addition to the now traditional symposia dealing with innovative processing, thermo-mechanical properties, modelling and ceramics for different high-tech applications, emphasis will also be given to advanced characterization techniques, silicate-based ceramics and materials for building applications, as well as the place of ceramics in necessary sustainable development. Lyon has been growing and evolving for 2,000 years: it is today a leading sustainable destination. Therefore, intent on reducing our environmental impact, we will make this XVIII^th^ ECerS conference a truly "think green" event.

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