WARSAW UNIVERSITY OF TECHNOLOGY Index 351733
FACULTY OF CIVIL ENGINEERING
COMMITTEE FOR CIVIL AND WATER ENGINEERING
POLISH ACADEMY OF SCIENCES ISSN 1230-2945

DOI: 10.24425/ace.2022.140172

ARCHIVES OF CIVIL ENGINEERING

Vol. LXVIII ISSUE 1 2022

pp. 353 –363

Research paper

Effect of Rice Straw Ash (RSA) as partially replacement of cement toward fire resistance of self-compacting concrete

Rafiza Abd Razak[1], Yi Qin Chin[2], Mohd Mustafa Al Bakri Abdullah[3], Zarina Yahya[4], Mokhzani Khair Ishak[5], Sebastian Garus[6], Marcin Nabiałek[7], Warid Wazien Ahmad Zailani[8], Khairil Azman Masri[9], Andrei Victor Sandu[10], Agata Śliwa[11]

Abstract: Malaysia's construction industry is experiencing rapid growth, translating into increased demand for cement. However, cement production pollutes the air to the detriment of the climate via CO_2 emission, making research into a cementitious replacement in concrete a necessity. This paper

[1]PhD., Eng., Universiti Malaysia Perlis, Faculty of Civil Engineering Technology, 02100 Padang Besar, Perlis, Malaysia; Centre of Excellence Geopolymer and Green Technology (CEGeoGTech), e-mail: rafizarazak@unimap.edu.my, ORCID: 0000-0001-5499-8564
[2]DSc.,Eng. Tech., Universiti Malaysia Perlis, Faculty of Civil Engineering Technology, 02100 Padang Besar, Perlis, Malaysia, e-mail: yiqin4728@gmail.com, ORCID: 0000-0002-2144-1820
[3]Prof, PhD., Eng., Universiti Malaysia Perlis, Faculty of Chemical Engineering, 01000, Kangar, Perlis, Malaysia; Centre of Excellence Geopolymer and Green Technology (CEGeoGTech), e-mail: mustafa_albakri@unimap.edu.my, ORCID: 0000-0002-9779-8586
[4]PhD., Eng., Universiti Malaysia Perlis, Faculty of Civil Engineering Technology, 02100 Padang Besar, Perlis, Malaysia, e-mail: zarinayahya@unimap.edu.my, ORCID: 0000-0003-1144-4945
[5]MSc., Eng., Universiti Malaysia Perlis, Faculty of Civil Engineering Technology, 02100 Padang Besar, Perlis, Malaysia, e-mail: mokhzani@unimap.edu.my, ORCID: 0000-0003-0918-9383
[6]PhD., Faculty of Mechanical Engineering and Computer Science, Częstochowa University of Technology, Częstochowa, Poland, e-mail: sebastian.garus@pcz.pl, ORCID: 0000-0002-6649-5435
[7]Prof., Department of Physics, Częstochowa University of Technology, Częstochowa, Poland, e-mail: nmarcell@wp.pl, ORCID: 0000-0001-6585-3918
[8]PhD., Eng., UniversitiTeknologi MARA, School of Civil Engineering, College of Engineering, 40450Shah Alam, Selangor, Malaysia, e-mail: waridwazien@uitm.edu.my, ORCID: 0000-0002-0619-4948
[9]PhD., Eng., 1 Department of Civil Engineering, College of Engineering, Universiti Malaysia Pahang, 26300 Gambang Kuantan Pahang, e-mail: khairilazman@ump.edu.my, ORCID: 0000-0003-0046-8669
[10]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iasi, 71 D. Man-geron Blv., 700050 Iasi, Romania, e-mail: sav@tuiasi.ro, ORCID: 0000-0002-9292-749X
[11]Division of Materials Processing Technology and Computer Techniques in Materials Science, Silesian University of Technology, 44-100 Gliwice, Poland, e-mail: agata.sliwa@polsl.pl, ORCID: 0000-0001-9459-3895

details an experimental study of self-compacting concrete (SCC) with partial replacement of cement by rice straw ash (RSA), which is expected to result in environmental preservation due to the green materials being used in cement production. The physicomechanical properties of the SCC with RSA replacement were determined via its compressive strength, water absorption, self-workability, and fire resistance (residual strength after exposure to high temperatures). The proportion of RSA replacement used were 0%, 5%, 10%, 15%, 20%, and 25%, and all passed the slump flow test, except the 20% and 25% samples. The SCC samples with 15% of RSA replacement reported the highest compressive strength at 7 and 28 curing days and the highest residual strength post-exposure to high temperatures. The lowest percentage of water absorption was reported by the 15% of RSA replacement, with a density of 2370 kg/m^3

Keywords: self-compacting concrete (SCC), rice straw ash (RSA), fire resistance, high-strength concrete, construction material

1. Introduction

Concrete is one of the main components used in construction due to its high durability and strength, although it is not without a few shortcomings [1]. Su et al. [2] detailed the introduction of self-compacting concrete (SCC) in Japan in 1988, also known as a new type of high-performance concrete (HPC) with excellent deformability and segregation resistance. Moreover, SCC can be integrated into the formwork even amidst numerous reinforcement bars due to its low weight [3]. The production of SCC is always associated with the use of ordinary Portland cement (OPC) as binder. However, cement production is perennially linked to CO_2 emission [4], which is harmful to the environment. One of the methods commonly used to reduce the usage of OPC in concrete while improving the properties of cementitious material is the partial replacement of cement using pozzolanic material.

The particular focus of this research was on the partial use of rice straw ash instead of fully OPC towards SCC. Rice straw can be categorized as agricultural waste material and can be used as a pozzolanic material as it is 60-80% silica [5]. In Malaysia, the production of rice volume is approximately 1.88 million metric tons. Since rice is a staple food in Malaysia, thus the burning of paddy field will also contribute to abundant of rice husk ash (RHA) and rice straw ash (RSA). The wide-ranging research has been carried out on a number of supplementary materials, including rice husk ash, metakaolin ash, sewage sludge ash, and palm shale oil. However, there are little research that focused on the use of RSA. The RSA also meets the minimum requirement of ASTM C150 to be used as a Portland cement replacement. According to El-Sayed & El-Samni, [6] and Agwa et al. [7], materials which have high silica content are suitable to be used as a pozzolanic material to replace ordinary Portland cement (OPC), as it improves the strength and durability of the concrete.

The production of SCC based agricultural product has been widely researched. Recently, study by Jamad et al. [8] indicate that wheat straw ash and bentonite clay additions of up to 10% and 15% of the weight of the cement tend to improve the compressive and split tensile strength of hardened SCC. Rahman et al. [9] have produce normal strength SCC with incorporating up to 40% RHA as supplementary of cementing material. Apart from that, silica fume (SF), ground granulated blast furnace slag (GGBS), and fly ash (FA) are classified as pozzolanic material and are already used as replacements for cement in the production of SCC [10]. Researches report agricultural wastes such as rice husk ash (RHA) replacing the cement content in the SCC to maintain workability, but research on partial replacement of cement by rice straw ash (RSA) on SCC is rarely reported. Studies on RSA's potentials and uses are limited [7]. According to Pandey and Kumar [11], since RSA is cheaper than other mineral admixtures and has high pozzolan characteristics, it is suitable for use as a partial substitution of OPC as it improves the properties of the concrete produced.

On the other side, analysis of fire resistance towards building is crucial. Nguyen et al. [12] stated that one of the significant hazards to buildings is fire. Fire resistance of the concrete structure plays a vital role in keeping the people inside safe. In addition, the properties of the concrete retained after a fire event are essential for recovery after fire damage [13, 14]. Thus, research on heat-damaged RSA–SCC is the aim of this study includes a component analyzing the physicomechanical properties of the RSA–SCC via fire resistance.

2. Methodology

The raw materials used in SCC production are ordinary Portland cement (OPC), water, superplasticizer, rice straw ash (RSA), and aggregate. Rice straw was collected from a paddy field and burned in a furnace at 700°C for two hours, then sieved with a 75 µm siever [7]. The cement ratio to fine aggregate and coarse aggregate was set to 1:1.6:1.6, and the water/cement ratio was set to 0.35% of cement. The size of the coarse aggregate used was 10 mm, while the size of the fine aggregate was 4.75 mm.

All the dry materials such as fine and coarse aggregate, cement, and RSA were mixed in a mixer machine. After that, the superplasticizer (SP) and 60% water were added to the concrete mix, and the mixture was stirred for ~ 3 minutes. The remaining water was then added to the concrete mixer and stirred for ~ 5 minutes. After the concrete was mixed (fresh mixture of concrete), a slump flow test was conducted by measuring the spread diameter, as outlined in ASTM C1611 [15]. After the slump flow test was conducted, the concrete was poured into a mold measuring 100 × 100 × 100 mm for casting. The total of 90 samples have been prepared to cover all test required. Finally, all of the (cube) samples were fully immersed in the water curing tank after being demolded/hardened until the day of the test.

The water absorption test was performed on the concrete cube samples at 28 days per the ASTM C1403 [16]. The density test was also conducted simultaneously on the cured concrete cube samples per ASTM C138 [17]. The compressive strength test was conducted per ASTM C39 [18] using samples cured at 7 and 28 days and a Universal Testing Machine (UTM). The fire resistance test was conducted per the BS 476 standard [19]. The residual strength of SCC after being exposed to high temperatures was measured. All of the concrete cube samples were tested for their residual strength post-exposure at 200°C, 400°C, and 600°C at a rate of 150°C/hr for 2 hours. The results are presented in individual bar graphs of arithmetic mean of three samples.

3. Results and discussion

3.1. Density test

Fig. 1 shows the density result of SCC at various percentage replacements of RSA. The SCC with 25% of RSA replacement has the lowest density value relative to the other samples, which is 2330 kg/m^3, while the SCC with 5% of RSA replacement has the highest density (2390 kg/m^3), per Fig. 1. The SCC with 10% and 15% of RSA replacement have similar densities; 2370 kg/m^3, confirming that the higher the replacement percentage of RSA, the lower the density of the SCC. Therefore, the density of RSA–SCC is 2330÷2390 kg/m^3. The increase of density with 5% replacement of RSA is evident in Fig. 1, confirming that the density of SCC has been refined via the pozzolanic reaction of RSA to form secondary hydration products, resulting in a denser concrete and improved microstructure.

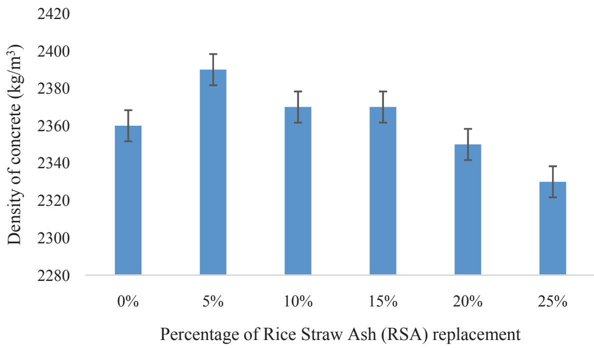

Fig. 1. Density of SCC at different percentages of RSA replacement

3.2. Water absorption

Figure 2 shows the water absorption of SCC at various percentages of RSA in the OPC cement. The SCC with 15% of RSA replacement reported the best performance, where

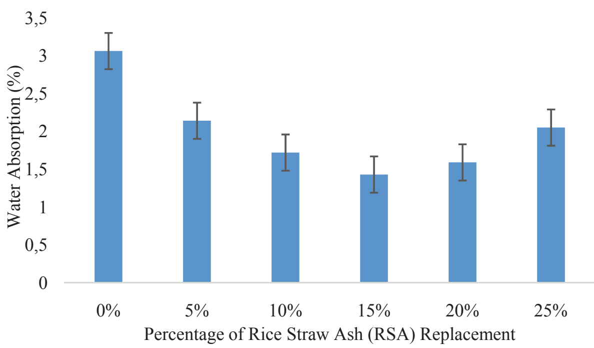

Fig. 2. Percentage of water absorption of SCC with different percentages of RSA replacement

it has the lowest percentage of water absorption at 1.43%, which is a reduction of 53% relative to the control samples. The water absorption of SCC with RSA obtained from this study has a lower percentage of water absorption than the control sample due to the reduction in the preferred arrangement C–S–H crystal from the pozzolanic effect. Also, RSA particles are believed to have filled the pores in the cement matrix, which minimizes the water absorption capability of the samples [11].

3.3. Compressive strength

The compressive strength of SCC with different percentages of RSA replacement of cement at the age of 7 days is shown in Fig. 3. The compressive strength of SCC between 0% and 5% of RSA replacement shows a significant increase (39.7%). The concrete cube samples with 15% of RSA replacement of cement have the highest compressive strength of 68.47 MPa. The compressive strength of SCC at 20% and 25% decreased to 67.93 MPa and 67.6 MPa, respectively, showing that the replacement of cement with RSA performs well in strength development at the highest replacement of 25% for 7 days of curing.

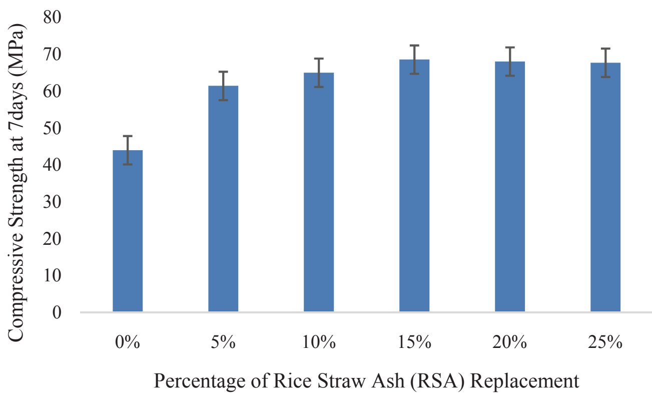

Fig. 3. Compressive strength of SCC with different percentages of RSA replacement of cement at the age of 7 days

Fig. 4 shows the compressive strength of SCC with various percentages of RSA replacement of cement at 28 days of curing. It can be seen that the compressive strength of SCC increases after the replacement of 5% of RSA in cement. The highest compressive strength of SCC is the sample with 15% partial replacement of RSA, which is 73.4 MPa, and it is 42.44% higher relative to that of the control sample. On the other hand, the compressive strength of the concrete cube started to decrease at 20% replacement of RSA, per the trend evident in Fig. 3. According to Elaty [21], the strength of the concrete will reach its maximum at the age of 28 days. This is because the C–S–H gel will form via pozzolanic reaction and hydration, and the RSA replacement in cement matrix-bound both materials due to silica reaction, which directly increases concrete strength. Pandey & Kumar [20] agree with this, as RSA is rich in silica, thus contributing to a highly pozzolanic reaction.

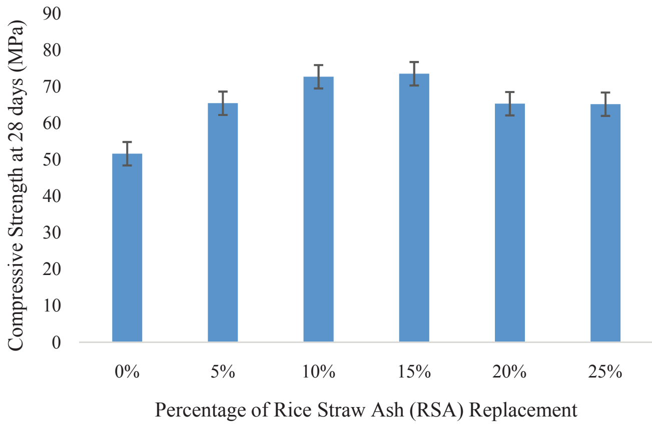

Fig. 4. Compressive Strength of SCC with different percentages of RSA replacement of cement at the age of 28 days

The hydration mechanism of self-compacting concrete (SCC) blended with pozzolanic materials (RSA in this case) resulted in the pozzolanic reaction. The pozzolanic reaction equation or second hydration equation is described by Eqn. 3.1, where the siliceous or siliceous and aluminous material will chemically react with calcium hydroxide ($Ca(OH)_2$) to form calcium silicate hydrated (C–S–H), possessing the cementing properties of SCC. Siliceous material as partial cement replacement will enhance the properties and performance of the SCC.

$$Al_2O_3 \cdot 2SiO_2 + 5Ca(OH)_2 + 19H_2O = CaO \cdot 2SiO_2 \cdot H_2O + Al_2O_3 \cdot 4CaO \cdot 19H_2O \tag{3.1}$$

In this study, the pozzolanic reaction between the siliceous material of RSA and calcium hydroxide with water significantly affects the SCC properties. The extent of the hydration reaction of RSA led to the formation of C–S–H and the development of strength in the concrete. The compressive strength of SCC increased after the replacement of 5% of RSA in cement. RSA contains a high amount of silica, which reacts with calcium hydroxide to form C–S–H. This reaction lowered the formation of $Ca(OH)_2$ relative to the normal hydration reaction of OPC. This resulted in the refinement of the pore microstructure of the concrete, which decreased its water absorption, and increased the durability of SCC containing RSA.

According to previous research, the best proportion for producing SCC by partial replacement of RSA is 10%, resulting in samples with the highest strength at ages 3, 7, and 28 days [7]. However, the results confirmed that a replacement of 15% would further enhance the strength of the concrete produced. Fig. 5 shows examples of concrete cube samples post-compression. The RSA and cement still bind the coarse and fine aggregates at 15% RSA replacement; however, when the RSA percentage was increased to 25%, the coarse and fine aggregates were not bound in the concrete cube sample insufficient cement a substantial proportion. Thus, even though the RSA has the characteristic of pozzolan, meaning it can be used as a binder in concrete, it also requires optimum replacement of RSA in concrete to achieve high strength.

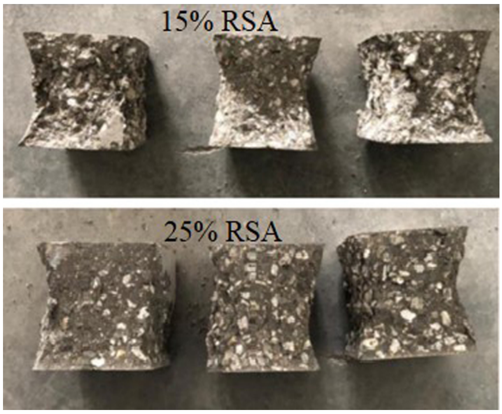

Fig. 5. Crack pattern of concrete cube with 15% and 25% RSA replacement after being compressed

3.4. Residual compressive strength after exposed to high temperature

Figure 6 shows the residual strength of SCC with various percentages of RSA replacement of cement at 200°C, 400°C, and 600°C. It can be seen in Fig. 6 that the strength development decreases when the temperature exposure increases. The SCC with 15% RSA replacement has the highest compressive strength at all temperatures; 73.9 MPa, 62.3 MPa, and 44.6 MPa at 200°C, 400°C, and 600°C, respectively. The residual strength of all samples with or without RSA replacement post-exposure to 200°C is slightly higher than the

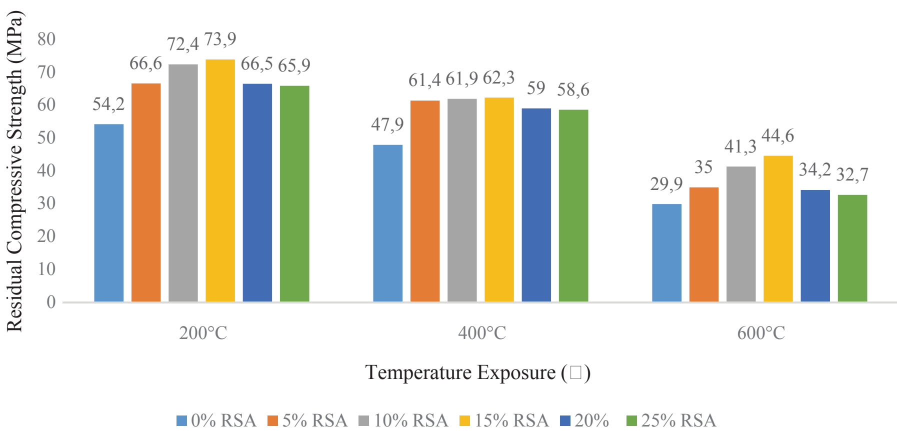

Fig. 6. Residual strength of SCC with different percentages of RSA replacement of cement at different temperatures

concrete cubes not exposed to high temperatures. This could be due to the water content in SCC, which is much greater than the standard mix concrete and high w/c ratio, causing the free water in the SCC to require more time to expand. Suitable temperature exposure will accelerate the hydration process of cement in SCC, which resulted in increased concrete strength [22, 23]. The degradation of C–S–H in concrete decreased its strength when the exposure temperatures were 400°C and 600°C due to the sudden loss of moisture at those temperatures. However, the strength of RSA–SCC still exceeds that of the control sample post-exposure to 600°C. The 25% replacement of RSA reported the lowest strength is (32.7 MPa). Fig. 7 shows the physical view of the concrete cube samples exposed to 200°C, 400°C, and 600°C, and it can be seen that the concrete cube sample is more yellowish and sandier when exposed to higher temperatures.

Fig. 7. Residual concrete cube sample with 25% RSA replacement after exposed to elevated temperature

3.5. Self-compactibility of SCC

The slump flow test for SCC at various percentages of RSA in cement is shown in Fig. 8. Most applications' ideal slump flow diameter is 24–27 in (609–685 mm) [10]. Therefore, all of the proportions with or without RSA replacement of cement were within acceptable ranges. The SCC with 15% of RSA replacement has the highest slump flow diameter, 675 mm, while the SCC with 0% of RSA replacement has the lowest slump flow diameter.

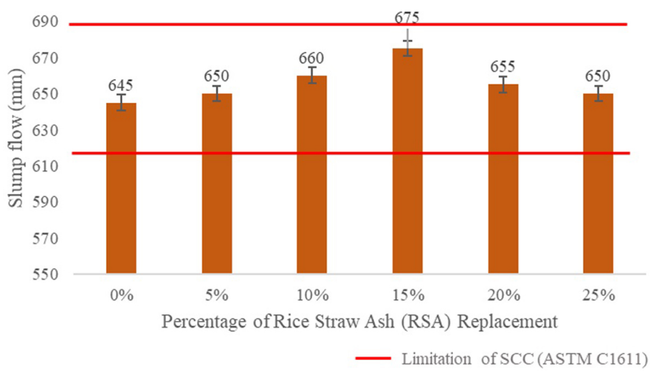

Fig. 8. Slump flow test result of SCC with different percentages of RSA replacement

As shown in Fig. 9, the time taken for SCC to reach the 500 mm diameter in the test T500 is longer when the proportion of RSA replacement increases. The SCC with 0–15% RSA replacement of cement was within the acceptable range of 2–7 s. Simultaneously, the SCC with 20% and 25% RSA replacement reported values of 7.43 s and 7.82 s, which exceeds the acceptable range, but remains under the possible range, which could decrease concrete placement time.

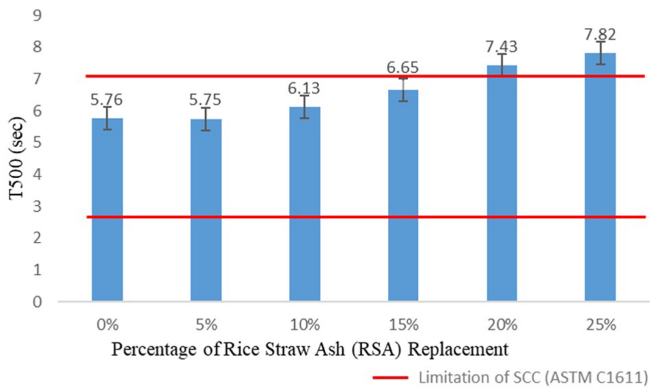

Fig. 9. T500 test result of SCC with different percentages of RSA replacement

The RSA with 15% replacement of cement is the optimum percentage in producing SCC. Agwa et al. [7,24] posited that the optimum percentage of RSA replacement of cement in SCC is 10%, which meets the maximum and minimum requirement in the slump flow test and T500 test based on ERNARC 2002 standard, respectively. Pandey and Kumar [20] reported that the optimum percentage of RSA used to produce Pavement Quality Concrete (PQC) is 10%. There is a significant improvement in this research, where the proportion of RSA replacement has been increased from 10% to 15% for best performance.

4. Conclusion

The objectives of this research to investigate the performance of RSA–SCC towards fire resistance were met. The SCC workability test, such as a slump flow test (T500), water absorption test, density test, compressive strength test, and residual strength of SCC post-exposure to elevated temperature was performed, and the optimum percentage of RSA–SCC replacement was determined.

1. The SCC with 15% of RSA replacement of cement has the highest compressive strength relative to other proportions for 7 and 28 days. The SCC with 15% of RSA can also be regarded as a high-strength concrete since its strength exceeded 50MPa, which is in line with the ACI 363R standard.
2. All the SCC samples reported a slight increase in compressive strength post-exposure to 200°C. The SCC of 15% RSA replacement has the highest residual strength relative to other proportions; 73.9MPa.

3. All of the SCC with or without the replacement of RSA fulfilled the requirement as an SCC, except for SCC with RSAs 20% and 25%. The SCC with 15% RSA replacement was the best proportion of workability in SCC and minimized the proportion of cement used.
4. All of the SCC samples with RSA replacement have a lower percentage of water absorption relative to the control samples. The SCC with 15% of RSA replacement reported the lowest water absorption percentage (1.43%), at an average density of 2370 kg/m^3.

References

[1] M. Nematollahzade, A. Tajadini, I. Afshoon, F. Aslani, "Influence of different curing conditions and water to cement ratio on properties of self-compacting concretes", *Construction and Building Materials*, 2020, vol. 237, DOI: 10.1016/j.conbuildmat.2019.117570.

[2] N. Su, K.C. Hsu, H.W. Chai, "A simple mix design method for self-compacting concrete", *Cement and Concrete Research*, 2001, vol. 31, no. 12, pp. 1799–1807, DOI: 10.1016/S0008-8846(01)00566-X.

[3] M.R. Geiker, "Self-compacting concrete (SCC)", in *Developments in the Formulation and Reinforcement of Concrete*. Elsevier Ltd., 2008, pp. 187–207.

[4] B.S. Thomas, "Green concrete partially comprised of rice husk ash as a supplementary cementitious material – A comprehensive review", *Renewable and Sustainable Energy Reviews*, 2018, vol. 82, pp. 3913–3923, DOI: 10.1016/j.rser.2017.10.081.

[5] S. Munshi, R.P. Sharma, "Utilization of rice straw ash as a mineral admixture in construction work", *Materials Today: Proceedings*, 2019, vol. 11, pp. 637–644, DOI: 10.1016/j.matpr.2019.03.021.

[6] M.A. El-Sayed, T.M. El-Samni, "Physical and Chemical Properties of Rice Straw Ash and Its Effect on the Cement Paste Produced from Different Cement Types", *Journal of King Saud University - Engineering Sciences*, 2006, vol. 19, no. 1, pp. 21–29.

[7] I.S. Agwa, O.M. Omar, B.A. Tayeh, B.A. Abdelsalam, "Effects of using rice straw and cotton stalk ashes on the properties of lightweight self-compacting concrete", *Construction and Building Materials*, 2020, vol. 235, DOI: 10.1016/j.conbuildmat.2019.117541.

[8] J. Ahmad, R.F. Tufail, F. Aslam, A. Mosavi, R. Alyousef, M. Faisal Javed, O. Zaid, M.S. Khan Niazi, "A Step towards Sustainable Self-Compacting Concrete by Using Partial Substitution of Wheat Straw Ash and Bentonite Clay Instead of Cement", *Sustainability*, 2021, vol. 13, no. 2, DOI: 10.3390/su13020824.

[9] M.E. Rahman, A.S. Muntohar, V. Pakrashi, B.H. Nagaratnam, D. Sujan, "Self compacting concrete from uncontrolled burning of rice husk and blended fine aggregate", *Materials and Design*, 2014, vol. 55, pp. 410–415, DOI: 10.1016/j.matdes.2013.10.007.

[10] N.A. Hamirudin, K. Muhamad, N.Z. Zainol, R.A. Razak, M.Z.A. Zahid, "Development of Self Consolidating Concrete (SCC) Using Crushed Waste Clay Brick as Alternative Aggregate", *Journal of Physics: Conference Series*, 2020, vol. 1529, art. ID 042030.

[11] A. Pandey, B. Kumar, "Evaluation of water absorption and chloride ion penetration of rice straw ash and microsilica admixed pavement quality concrete", *Heliyon*, 2019, vol. 5, no. 8, DOI: 10.1016/j.heliyon.2019.e02256.

[12] K.T. Nguyen, Q.D Nguyen, T.A. Le, J. Shin, K. Lee, "Analyzing the compressive strength of green fly ash based geopolymer concrete using experiment and machine learning approaches", *Construction and Building Materials*, 2020, vol. 247, DOI: 10.1016/j.conbuildmat.2020.118581.

[13] O. Arioz, "Effects of elevated temperatures on properties of concrete", *Fire Safety Journal*, 2007, vol. 42, no. 8, pp. 516–522.

[14] M.Z.A. Mohd Zahid, B.H. Abu Bakar, F.M. Nazri, "Behaviour of Post Heated Reinforced Concrete Columns", *IOP Conference Series: Earth and Environmental Science*, 2019, vol. 244, no. 1, DOI: 10.1088/1755-1315/244/1/012006.

[15] ASTM C1611 / C1611M "Standard Test Method for Slump Flow of Self-Consolidating Concrete", 2018.

[16] ASTM C1403 "Standard Test Method for Rate of Water Absorption of Masonry Mortars", 2015.

[17] ASTM C138 / C138M-17a. "Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete", 2017.

[18] ASTM C39 / C39M "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens", 2021.

[19] British Standard 476 "Fire Testson building materials and structures. Non-combustibility test for materials", 1970.

[20] A. Pandey, B. Kumar, "Effects of rice straw ash and micro silica on mechanical properties of pavement quality concrete", *Journal of Building Engineering*, 2019, vol. 26, DOI: 10.1016/j.jobe.2019.100889.

[21] A.M. Elaty, "Compressive strength prediction of Portland cement concrete with age using a new model", *HBRC Journal*, 2014, vol. 10, no. 2, pp. 145–155, DOI: 10.1016/j.hbrcj.2013.09.005.

[22] H.W. Reinhardt, M. Stegmaier, "Influence of heat curing on the pore structure and compressive strength of self-compacting concrete (SCC)", *Cement and Concrete Research*, 2006, vol. 36, no. 5, pp. 879–885.

[23] M. Tufail, K. Shahzada, B. Gencturk, J. Wei, "Effect of Elevated Temperature on Mechanical Properties of Limestone, Quartzite and Granite Concrete", *International Journal of Concrete Structures and Materials*, 2017, vol. 11, no. 1, pp. 17–28.

[24] S.R.C. Madduru, K.S. Shaik, R. Velivela, V.K. Karri, "Hydrophilic and hydrophobic chemicals as self curing agents in self compacting concrete", *Journal of Building Engineering*, 2020, vol. 28, DOI: 10.1016/j.jobe.2019.101008.

Received: 27.05.2021, Revised: 8.08.2021