The behavior of self-compacting concrete (SCC)

Hanafiah, Saloma and Putri Nurul Kusuma Whardani

AIP Conference Proceedings **1903**, 050005 (2017); https://doi.org/10.1063/1.5011544

The effect of polypropylene fiber on mechanical properties of reactive powder concrete

Saloma, Hanafiah, and Fungki Nopreal Putra

Citation: AIP Conference Proceedings **1885**, 020093 (2017); doi: 10.1063/1.5002287
View online: http://dx.doi.org/10.1063/1.5002287
View Table of Contents: http://aip.scitation.org/toc/apc/1885/1
Published by the American Institute of Physics

The Effect of Polypropylene Fiber on Mechanical Properties of Reactive Powder Concrete

Saloma[1,a)], Hanafiah[1,b)] and Fungki Nopreal Putra[1)]

[1]*Civil Engineering Department, Faculty of Engineering, Sriwijaya University, Jl. Raya Palembang-Prabumulih Km.32 Indralaya, OI, Sumatera Selatan 30662, Indonesia*

Corresponding author: [a)]saloma_571@yahoo.co.id
[b)]hanafiah_dr@yahoo.com.sg

Abstract. Reactive Powder Concrete (RPC) was known as concrete with very dense in microstructure and having high value in compressive strength due to the utilization of very fine materials. One of the weakness of RPC is very brittle. To improve the ductility could used polypropylene fiber. In this research, the various weight of the polypropylene fiber used were 0.4 kg, 0.6 kg, and 0.8 kg per cubic metre of concrete. From this study, RPC mixture with 0.8 kg polypropylene fiber yielded maximum value, e.g the compressive strength was 103.253 MPa, modulus of elasticity was 45.252 MPa, splitting tensile strength was 5.91 MPa, and flexural strength was 9.56 MPa.

INTRODUCTION

Reactive Powder Concrete (RPC) is one of an advance solution in concrete technology. RPC has compact microstructure and high compressive strength ranging 150-250 MPa and low permeability [1-2]. Materials using for RPC is very fine in particle size as in submicroscopic range. Cement in the size of 0.1-0.6 μm and sand in the size of 0.125-0.500 mm. RPC also use microsilica in the size of 0.08-0.125 μm and quartz flour in the size of 0.1-0.6 μm [3-6]. One of the weakness of RPC is very brittle. For improving the ductility of RPC can use polypropylene fiber. The purpose of the research is to investigate the effect of using polypropylene fiber in various weight on RPC mechanical properties, e.g. compressive strength, modulus of elasticity, splitting tensile strength, flexural strength.

MATERIAL AND EXPERIMENTAL STUDY

The Materials used in this research were type 1 cement, silica fume, water, quartz sand in the size of 150-650 μm, quartz flour in the size 0.3-25 μm, polypropylene fiber in the diameter of 18 μm and 1.2 mm in length, and superplasticizer. The composition of RPC used can be seen in Table 1.

Materials mixing process used horizontal mixer. The first step, mixed all material e.g cement, quartz sand, quartz flour, and silica fume in dry condition for five minutes as can be seen Figure 1.a. The second step, added 85% of water and 50% of superplasticizer from the total needed at seventh minute, poured polypropylene fiber into the mixed. Then, added all the rest water and superplasticizer in the 10^{th} minute. The mixture was stirred until homogeneous until the 20^{th} minute as can be shown in Figure 1.b. The next step, carried out slump flow test according to ASTM C1611 as can be seen in Figure 2. Before conducting compressive strength test, modulus of elasticity test, split tensile strength test, and flexural strength test, the cylinder specimens with the size of 150 mm x 300 mm were covered using damp cloth for curing process till the day of performing the each test.

3rd Electronic and Green Materials International Conference 2017 (EGM 2017)
AIP Conf. Proc. 1885, 020093-1–020093-6; doi: 10.1063/1.5002287
Published by AIP Publishing. 978-0-7354-1565-2/$30.00

TABLE 1. The composition of RPC

Materials	Composition (kg/m^3)			
	PVA 0	PVA 0.4	PVA 0.6	PVA 0.8
Cement	750.00	750.00	750.00	750.00
Silica fume	221.29	221.29	221.29	221.29
Quartz sand	859.98	859.98	859.98	859.98
Quartz flour	201.05	201.05	201.05	201.05
Superplasticizer	25.42	25.42	25.42	25.42
water	152.00	152.00	152.00	152.00
Polypropylene	0.00	0.40	0.60	0.80
w/c	0.28	0.28	0.28	0.28

(a) The initial stage of mixing (b) The final stages of mixing

FIGURE 1. The mixing process

FIGURE 2. Slump flow test

RESULTS AND DISCUSSION

Slump Flow

The result of slump flow tests were shown in Figure 3. The diameter of slump flow for mixture without polypropylene fiber was 64.9 cm. And the diameter of slump flow for mixture with polypropylene addition of 0.4 kg/m^3, 0.6 kg/m^3, and 0.8 kg/m^3 were 64.15 cm, 62.65 cm, and 58.75 cm, respectively. The more the addition of polypropylene fiber, the smaller the diameter of slump flow. But for mixture will 0.8 kg/m^3 polypropylene addition showed significant decreasing of slump flow diameter.

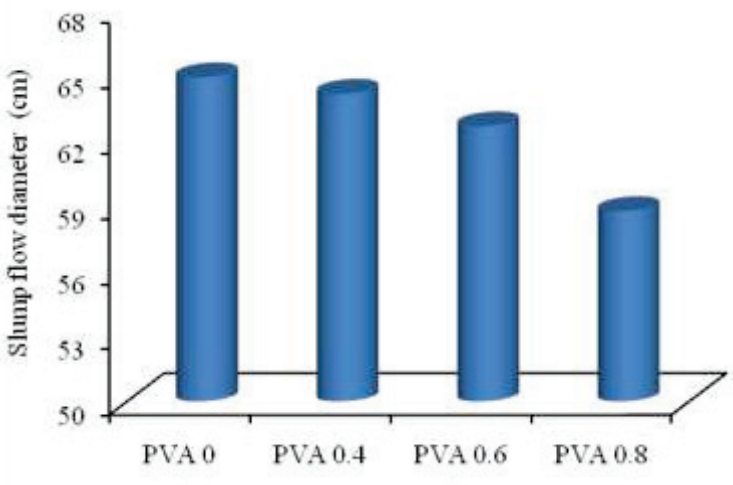

FIGURE 3. The results of slump flow test

Setting Time

The data of setting time test can be seen in Figure 4. From this figure can be explained that both initial setting time and final setting time not differ significantly from each other mixture with addition of polypropylene fiber. Its initial setting time was ranging from 150 to 158 minutes and final setting time was rangging from 240 to 248 minutes. Both initial and final setting time for each mixture were not differ significantly.

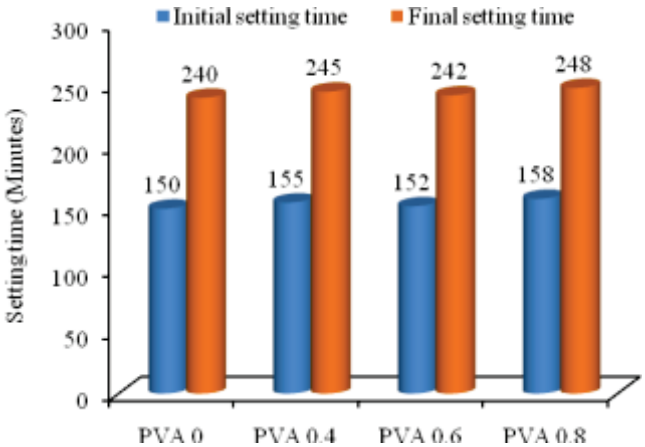

FIGURE 4. The result of setting time test

Compressive Strength

Figure 5 showed the graph of compressive strength for various of RPC mixtures for 3, 7, 14, 21, and 28 days. From this graph, can be explained that the more the addition of polypropylene fiber, the higher the compressive strength as the increasing of testing age. The highest value of compressive strength was 103.254 MP was yielded by 0.8 kg/m^3 of polypropylene fiber RPC mixture, and for RPC mixture without polypropylene fiber reached the lowest value as low as 84.939 MPa. Then the increasing percentage of compressive strength with addition 0.4 kg/m^3, 0.6 kg/m^3, and 0.8 kg/m^3 of polypropylene fiber were 10.488%, 14.347%, and 17.737%, respecticely. The increasing of compressive strength can be due to the effect of each other crossing of polypropylene fiber which acted as cross tie.

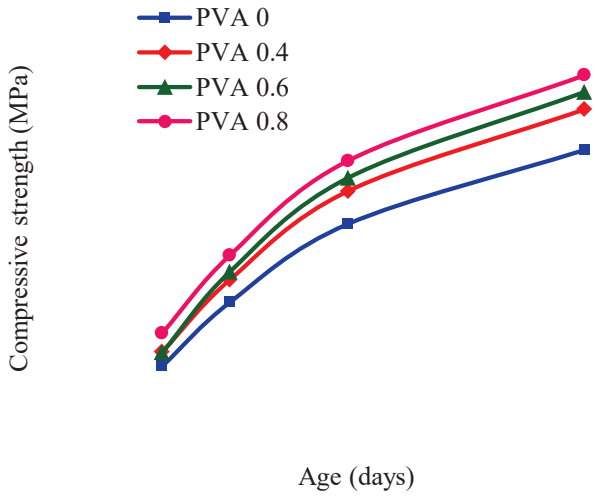

FIGURE 5. Compressive strength

Modulus of Elasticity

Figure 6 showed the modulus of elasticity values of each mixture for 28 days. It can be seen that the modulus of elasticity value would increassed due to the increasing of addition of polypropylene fiber. The highest value of modulus of elasticity was 45.252 MPa given by RPC with 0.8 kg/m^3 of polypropylene fiber and the lowest value was 32.053 MPa for RPC without polypropylene fiber. Based on the value of modulus elasticity of RPC without polypropylene fiber, the percentage increasing of modulus of elasticity for each addition of polypropylene fiber e.g 0.4 kg/m^3, 0.6 kg/m^3, and 0.8 kg/m^3 were 10.183%, 14.334%, and 24.154%, respectively.

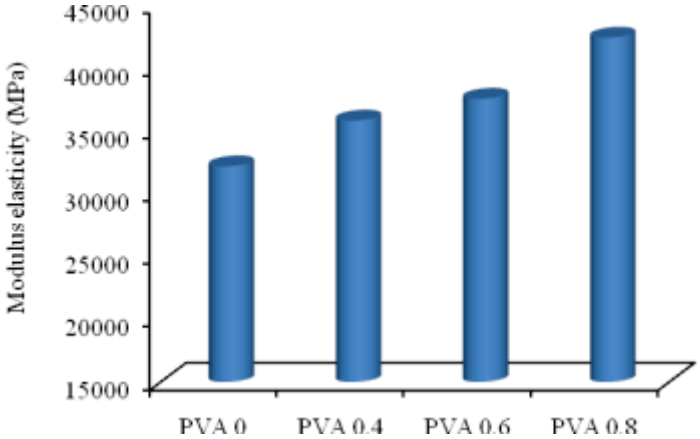

FIGURE 6. Modulus of elasticity

Splitting Tensile Strength

Figure 7 showed the results of splitting tensile strength test of each mixture for 28 days. From this figure, it can be explained that the splitting tensile strenght of RPC would increasing with the increasing of polypropylene fiber addition. The value is 5.01 MPa, 5.45 MPa, and 5.91 MPa for each addition of polypropylene fiber e.g 0.4 kg/m^3, 0.6 kg/m^3, and 0.8 kg/m^3, respectively.

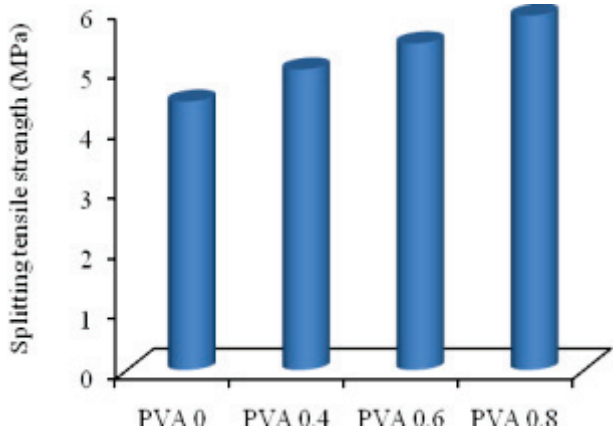

FIGURE 7. Splitting tensile strength

Flexure Strength

The result of flexure strength test for 28 days was shown in Figure 8. The more the addition of polypropylene fiber in the mixture, the greater the flexural strength were yielded. The values of flexural strength for various addition of polypropylene fiber e.g 0.4 kg/m^3, 0.6 kg/m^3, and 0.8 kg/m^3 were 8.51 MPa, 8.96 MPa, and 9.56 MPa, respectively

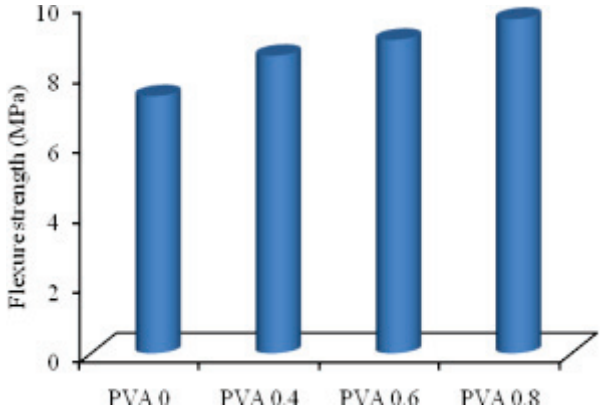

FIGURE 8. Flexure strength

CONCLUSIONS

From this study, can be concluded as follow:

1. The smallest slump flow diameter was yielded from mixture with 0.8 kg/m^3 of polypropylene fiber.
2. The initial and final setting time of each mixture were not differ significantly.
3. All the mechanical properties e.g compressive strength, modulus of elasticity, splitting tensile strength, and flexural strength increased simultaneously with the increasing addition of polypropylene fiber in the mixture.
4. The highest values were yielded from mixture with 0.8 kg/m3 of polypropylene fiber.
5. The highest values of compressive strength, modulus of elasticity, splitting tensile strength, and flexural strength were 103.253 MPa, 45.252 MPa, 5.91 MPa, and 9.56 MPa, respectively.

ACKNOWLEDGMENTS

The research presented in this paper was supported by grant from Unggulan Kompetitif Universitas Sriwijaya, 2015.

REFERENCES

1. B.A. Graybeal, "Material Property Characterization of Ultra-High Performance Concrete" Report No. FHWA-HRT-06-103.
2. K. Ramujee, International Journal of Innovative Research in Science, Engineering and Technology 2, 3409-3413 (2013).
3. H.K.S. Eldin, H. A. Mohamed, M. Khater, S. Ahmed, International Journal of Engineering and Innovative Technology 4, 4-10 (2014).
4. T.C. Madhavi, L.S. Raju, D. Mathur, International Journal of Emerging Technology and Advanced Engineering 4, 114-119 (2014).
5. M.V. Mohod, IOSR Journal of Mechanical and Civil Engineering 12, 28-36 (2015).
6. V.M. Sounthararajan, A. Jain, A. K.Singh, S. Thirumurugan, A. Sivakumar, International Journal of Engineering and Technology 5, 1817-1828 (2013).

KEMENTERIAN RISET, TEKNOLGI, DAN PENDIDIKAN TINGGI
UNIT PENELITIAN DAN PENGABDIAN
PADA MASYARAKAT DAN KERJASAMA
FAKULTAS TEKNIK UNIVERSITAS SRIWIJAYA
Jln. Raya Prabumulih KM. 32 Inderalaya (306620) Telp. (0711) 580739-580741 Fax (0711) 580062
e-mail : ftunsri@plasa.com

REGISTRASI PROCEEDINGS OF THE 3rd INTERNATIONAL CONFERENCE ON CONSTRUCTION AND BUILDING ENGINEERING (ICONBUILD)

Sesuai dengan data yang ada pada kami, maka tulisan dengan judul :

- The Behavior of self –compacting Concrete (SCC) with bagasse ash

Penulis : **Dr. Ir. Hanafiah, MS**

Telah teregistrasi dengan No.

NOMOR REGISTRASI

0 3	0 1	0 8	0 2	1 7	0 1	0 1	1 5 3 5
Kode Fakultas	Kode PS/Jurusan	Kode Publikasi	Kode Penulis	Tahun Publikasi	Kode Sumber Tulisan	Sumber Dana	Nomor urut Publikasi dan Fakultas

Inderalaya, 27 Juli 2018
Ketua
Unit PPMK FT. UNSRI

Ir. H. Abdullah Saleh MS. M.Eng
NIP. 195304261984031001