Jurnal Mekintek,12 (1) (2021) pp. 23-29

Published by: IHSA Institute

Jurnal Mekintek: Jurnal Mekanikal, Energi, Industri, Dan Teknologi

Journal homepage: www.ejournal.isha.or.id/index.php/Mekintek

The Effect Of Adding Latex And Hair Fiber On Concrete

Hendrik

Department Of Electrical Engineering, University Of North Sumatra, Jl. Dr. Mansur No. 9 Padang Bulan, Kec. Medan Baru, Kota Medan 20222

ARTICLE INFO

Article history:

Received Feb 05, 2021
Revised Mar 12, 2021
Accepted Apr 30, 2021

Keywords:

Latex
Hair Fiber
Compressive Strength
Split Tensile Strength
Flexural Strength

ABSTRACT

Along with the development of the construction world, the need for concrete is increasing and the scale of development shows that there will also be more and more concrete needs in the future, thus affecting the development of concrete technology which will demand new innovations regarding the concrete itself. In the construction of high-rise buildings required concrete with high compressive strength. However, to get good quality concrete, high costs are also required. So in this study, an economical additional material will be used which will be added to the concrete in the form of latex and hair fiber. Testing of materials and test objects is carried out in accordance with the applicable Indonesian National Standard (SNI). The latex used is liquid latex. First, the hair fiber is washed in order to clean the dirt and debris attached and then dried in the sun for 2 days, then cut to a size of ± 30 mm. By adding latex with variations of 0.25%, 0.5% and 0.75% it is expected to achieve a concrete quality of 20 MPa and by adding 2% hair fiber and latex with variations of 0.25%, 0.5% and 0.75% is expected to achieve a concrete quality of 20 MPa. The research object used a cylinder with a diameter of 15 cm and a height of 30 cm with the addition of 48 pieces of latex which were tested at the age of 28 days, cylinder with a diameter of 15 cm and a height of 30 cm with the addition of latex and hair fiber as many as 18 pieces were tested at the age of 7 days, and a beam without reinforcement with a length of 60 cm, width 15 cm and height of 15 cm with the addition of latex and hair fiber as much as 3 pieces The Water Cement Factor (FAS) in this study was locked at 0.5. This study was intended to obtain the value of compressive strength, split tensile strength, concrete absorption, slump value in cylinders and flexural strength values in unreinforced beams. From the test results, it was found that the slump value decreased due to the addition of the latex additive and increased due to the addition of the latex and hair fiber additives and then increased along with the increase in the additional variation. The absorption of concrete also decreased with the addition of the latex additive and increased with the addition of the latex additive and hair fiber. The most optimum compressive strength results were obtained in concrete with the addition of 0.75% latex variation, an increase of 13.226% from normal concrete while the most optimum compressive strength results were obtained in concrete with the addition of 0.75% latex variation and 2% hair fiber reduced by 0.94% from normal concrete.

Corresponding Author:

Hendrik ,
Department Of Electrical Engineering,

University Of North Sumatra,
Jl. Dr. Mansur No. 9 Padang Bulan, Kec. Medan Baru, Kota Medan 20222.
Email : hendrik0012@gmail.com

1. INTRODUCTION

Concrete is formed from a mixture of fine aggregate, coarse aggregate, cement and water in a certain ratio. Concrete is a construction material that is widely used in building structural work in Indonesia because of the many advantages it provides, including the constituent materials that are easy to obtain, easy to shape, and carry heavy loads, are resistant to high temperatures, and low pet costs.

To understand and study the entire behavior of the combined elements forming concrete, knowledge of the characteristics of each component forming concrete is required, namely cement, fine aggregate, coarse aggregate and water. The strength of concrete at a certain age depends on the ratio of the weight of water to the weight of cement in the concrete mixture.

In addition to strength, the specific gravity of concrete also affects a construction. If the specific gravity is large, the dimensions of the structural elements will also be large so that it greatly affects the overall building load. This weight will be smaller / lighter if the dimensions are small. This will only be achieved if the concrete has a high strength / high load. But high-quality concrete is more brittle. Therefore, it is necessary to conduct research to obtain high-quality but ductile concrete.

With a special design, the compressive strength and tensile strength of this concrete can be increased so that it can withstand pressure and tensile stress without cracking. One way is by adding materials such as chemicals or fibers to the concrete mix so that the cracks that may occur in the concrete can be blocked by these additional fibers.

Various types of additives for the strength of concrete used to improve the properties of concrete are fly ash, palm shells, steel fibers, plastic fibers, and others. In Indonesia, the concept of using steel fiber in concrete mixes for civil engineering building structures is not widely known and has not been used in practice. One of the reasons is the unavailability of steel fiber in Indonesia and the high price.

2. RESEARCH METHOD

The method used in this research is an experimental study. This research was conducted at the Engineering Materials Laboratory, Department of Civil Engineering, Faculty of Engineering, University of North Sumatra. In general, the sequence of research stages carried out are:

a. Selection and supply of concrete building materials
b. Latex selection and hair fiber cleaning
c. Inspection of concrete constituents
d. Planning the proportion of concrete mix (mix design)
e. Weighing of concrete constituents
f. Mold making
g. Casting
h. slump test
i. Manufacture of cylindrical test specimens
j. Cylindrical test object maintenance
k. Concrete absorption test
l. Testing the compressive strength and tensile strength of concrete
m. Manufacture of beam specimens with a size of 60 cm x 15 cm x 15 cm.
n. Treatment of the beam test object with a size of 60 cm x 15 cm x 15 cm.
o. Testing the flexural strength of concrete.

3. RESULTS AND DISCUSSIONS

3.1 Slump Value

To determine the level of viscosity of the concrete mix, a slump test is carried out, which can describe the workability of the concrete. The results of the slump test can be seen in table 1.

Table 1. Slump . Value Measurement Results

No	Concrete Type	Slump Value (cm)
1	Normal	10
2	L 0.25%	7
3	L 0.5%	8
4	L 0.75%	9
5	L 0.25% ; SR 2%	12
6	L 0.5% ; SR 2%	11
7	L 0.75% ; SR 2%	9

From the table it can be seen that the slump value increases with the addition of latex alone because it is influenced by these materials caused by the material acting like an admixture material in SCC (self compacting concrete) concrete because the nature of the latex is superplasticizer and the slump value decreases with the addition of latex and hair only. This shows that the more latex in the concrete mixture, the higher the workability of the concrete and vice versa if latex and hair fiber are mixed into the concrete, it will reduce the workability of the concrete.

3.2 Concrete Unit Weight

The unit weight inspection is carried out when the concrete is 28 days old. The unit weight test results can be seen in table 2.

Table 2. Concrete Unit Weight Test Results

Concrete Type	Concrete Unit Weight (kg/m3)
Normal	2381.32
L 0.25%	2435.83
L 0.5%	2395.53
L 0.75%	2414.94
L 0.25% ; SR 2%	2290.10
L 0.5% ; SR 2%	2277.27
L 0.75% ; SR 2%	2282.39

Source: Research Results

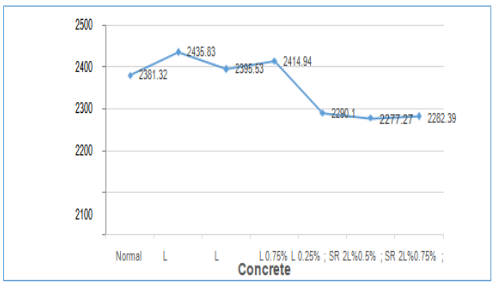

Figure 1. Graph of Relationship Between Unit Weight of Concrete and Type of Concrete

From table 2 and figure 1 it can be seen that the greater the addition of latex to the concrete mixture, the unit weight of the concrete will decrease and the slump value will increase. Meanwhile, the greater the addition of latex and hair fiber to the concrete mixture, the unit weight and slump value decreases.

3.3 Compressive Strength of Concrete

The compressive strength test of concrete is carried out when the concrete is 28 days old. The results of the calculation of the compressive strength and the comparison to normal concrete can be seen in table 4.3.

Table 3. Calculation Result of Concrete Compressive Strength (MPa)

No	Variation	P(KN)	A(cm2)	Fc' (MPa)
1	Normal	424,667	176,625	24.043
2	L 0.25%	442,333	176,625	25,044
3	L 0.5%	462.5	176,625	26.185
4	L 0.75%	480,833	176,625	27,223
5	L 0.25%; SR 2%	274.833	176,625	22,229
6	L 0.5%; SR 2%	288,833	176,625	23,361

Source: Research Results

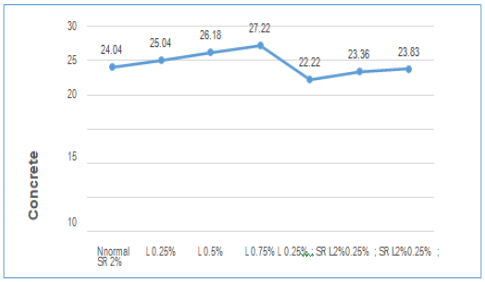

Figure 2. Graph of Relationship Between Compressive Strength of Concrete and Type of Concrete

From table 3 and figure 2, it can be seen that the compressive strength of concrete with 0.25% latex variation increased by 4.16% from normal concrete compressive strength which was 24.043 and 0.5% latex variation increased 8.9% from normal concrete compressive strength and 0.75% latex variation increased by 13,226 % of the compressive strength of normal concrete while the compressive strength of concrete with variations of latex 0.25% and hair fiber 2% decreased by 7.57% from the compressive strength of normal concrete and the compressive strength of concrete with variations of latex 0.5% and hair fiber 2% decreased by 2.9% from the compressive strength normal concrete and the compressive strength of concrete with variations of latex 0.75% and 2% hair fiber decreased by 0.94% from the compressive strength of normal concrete. On the addition of latex with a variation of 0.25%; 0.5% and 0. 75% with 2% hair fiber obtained a compressive strength that still meets the requirements of medium quality concrete with a compressive strength of between 20 MPa but still below the normal compressive strength of concrete. So the variation used on the beam test object with a size of 60x15x15 cm is 0.75% latex and 2% hair fiber.

3.4 Concrete Absorption

The concrete absorption test was carried out on cylindrical specimens that were 28 days old which were intended to obtain the water resistance/rate of absorption in various variations of the mixture and compared with normal concrete. The test results can be seen in table 4.

Table 4. Concrete Absorption of Each Variation

No	Variation	Average dry weight (kg)	Average wet weight (kg)	Absorption (gr)	Average absorption (%)
1	Normal	12,705	12,750	44,417	0.3496
2	L 0.25%	12.897	12,949	52	0.4036
3	L 0.5%	12.675	12,704	29,083	0.2296
4	L 0.75%	12.798	12.832	33,833	0.2642
5	L 0.25%; SR 2%	12,151	12.193	42,167	0.3473
6	L 0.5%; SR 2%	12,043	12.090	46,333	0.3853

3.5 Split Tensile Strength of Concrete

Split tensile strength test is based on SNI 03-2491-2002. Testing the split tensile strength of concrete using 28 days old concrete. The value of the flexural tensile stress with

Table 5. Calculation Result of Split Tensile Strength of Concrete (MPa)

No	Variation	P(KN)	A(cm2)	Fc′ (MPa)
1	Normal	184.333	176,625	8.1926
2	L 0.25%	232.5	176,625	10.333
3	L 0.5%	229.167	176,625	10.185
4	L 0.75%	244.833	176,625	10,881

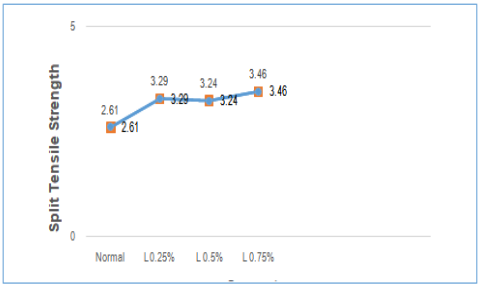

Figure 3. Graph of Relationship Between Split Tensile Strength of Concrete and Type of Concrete

From table 5 and Figure 3, it can be seen that the split tensile strength with 0.25% latex variation is 10,333 MPa or an increase of 26.13% from the normal split tensile strength of 8,1926 MPa and the split tensile strength with 0.5% latex variation is 10,185 MPa or an increase of 10,185 MPa. 24.31% of the split tensile strength of normal concrete is 8.1926 MPa and the split tensile strength with 0.75% latex variation is 10.881 MPa or an increase of 32.81% from the split tensile strength of normal concrete which is 8.1926 MPa. On the addition of latex with a variation of 0.25%; 0.5% and 0.75% obtained split tensile strength which exceeds the split tensile strength of normal concrete.

3.6 Bending Strength of Concrete

The flexural strength test of concrete was carried out when the concrete was 28 days old. The test object tested was a beam measuring 60cm x 15cm x 15cm and with a variation of 0.75% latex and 2% hair fiber (taken from the results of the most optimum compressive strength test among all variations of concrete). The flexural strength test of this concrete is based on SNI 03-4431-2011. The results of this study can be seen in table 6.

Table 6. Bending Strength Test Results of Beams

No	Object Test	Variation	L (cm)	b(cm)	h(cm)	P(kN)	fr' (MPa)	fr' (MPa)	Standard deviation (kg/cm2)
1	1					38	6,755	6.103	0.718
2	2	L 0.75% ; SR 1.5%	60	15	15	30	5,333		
3	3					35	6.222		

Source: Research Results

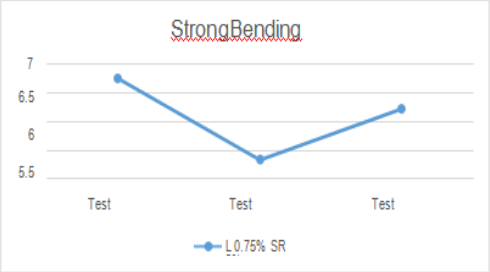

Figure 4. Graph of Bending Strength of Concrete with Variation of Latex 0.75% and Hair Fiber 2%

From table 6 and figure 3 it can be seen that the value of the test results for the flexural strength of the beam with a variation of latex 0.75% and hair fiber 2% is 6.755 MPa; 5.333 MPa ; 6,222 MPa with an average of 6,103 MPa.

4. CONCLUSION

The compressive strength values with the addition of latex 0%, 0.25%, 0.5%, and 0.75% on average at the age of 28 days in a row were 24.04 MPa, 25.04 Mpa, 26.19 MPa, and 27.22 MPa and the compressive strength values with the addition of latex 0.25%, 0.5%, and 0.75% and hair fiber 2% at the age of 7 days in a row were 22.22 MPa, 23.36 MPa, and 23.83 MPa.

The split tensile strength values with the addition of latex 0%, 0.25%, 0.5%, and 0.75% on average at the age of 28 days were 8.193 MPa, 10.333 MPa, 10.185 MPa, and 10.881 MPa.

The greater the addition of latex, the lower the absorption value. This is because latex cannot absorb water, while the greater the addition of latex and hair fiber, the higher the absorption value. This is because hair can absorb water.

The value of the flexural strength of the beam with the addition of 0.75% latex and 2% hair fiber at the age of 28 consecutive days was 6.103 MPa.

REFERENCES

Ghorpade, Dr. Vaishali. G dkk. 2013 . *Effect of Natural Rubber Latex on Strength and Workability of Fibre Reinforced High-Performance-Concrete with Metakaolin admixture.* International Journal of Engineering Research and Applications (IJERA). ISSN: 2248-9622 Vol. 3, Issue 3 PP 827-831. Head of Civil Engineering Dept., JNTUA College of Engineering, Anantapur-515002.

K, Vinaya L dkk. 2014 . *Effect of Natural Rubber Latex on Normal and High Strength Concrete.* International Journal of Advance Research in Science and Engineering. IJARSE, Vol. No. 3, Issue No.9, ISSN-2319-8354(E). Civil Engineering, Adichunchanagiri Institute of Technology Chikmagalore, Visvesvaraya Technological University-Belgaum, Karnataka (India).

M, Nila V dkk. 2015 . *Hair Fibre Reinforced Concrete.* International Journal of Research in Advent Technology. E-ISSN: 2321-9637. Department of Civil Engineering, Sahrdaya College of Engineering and Technology, Kodakara, Thrissur, Kerala.

Antoni dan Paul Nugraha. 2007. *Teknologi Beton*. Yogyakarta: Andi Publishing.

Mulyono, Tri, Ir. 2004. *Teknologi Beton*. Yogyakarta: Andi Publishing.

Mulyono, Tri. 2003, Teknologi Beton, Penerbit ANDI Yogyakarta.
Tjokrodimuljo, K., 1992, Bahan Bangunan, Jurusan Teknik Sipil, Fakultas Teknik Universitas Gadjah Mada, Yogyakarta.
Tjokrodimuljo, K., 1996, Teknologi Beton, Jurusan Teknik Sipil, Fakultas Teknik Universitas Gadjah Mada, Yogyakarta.
Tjokrodimuljo, Kardiyono. 2007. *Teknologi Beton*. Biro Penerbit Jurusan Teknik
ASTM Standards, 2004, ASTM C 150 150 – 04 Standards Specification For Portland Cement, ASTM International, West Conshohocken, PA