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The Influence of Polypropylene Fibers on Crushed Glass RC Mixed Using Seawater Curing

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***Abstract*—The purpose of this study is to reduce environmental problems by using wasted material i.e. with crushed glass. 15% crushed glass has substituted with 15% total weight of sand materials then added polypropylene fibers within RC specimens. Specimens treatment added in this case used freshwater and seawater curing. The results are as follows crushed glass effectively to increase compressive strength, Polypropylene fibers provide strengthening force on compressive and split tensile testing, and seawater curing affects protected hydration processing within RC mixing. Even though freshwater more effective to increase that strength.**

Keywords—reinforced concrete, crushed glass, polypropylene fibers, sea water curing

I. Introduction

Industry activities make effects on the environmental problem for example household waste. Reuse wasted materials either of environmental problem-solving. Styrofoam, rubber, and glass already often used as materials on RC study. In another research was done with object research crushed glass within RC mixed given results that crushed glass effectively to escalate compressive strength, this research announced with adding polypropylene fibers within RC about 13.82-18.53% compressive strength [1]. Therefore, we conduct further research by adding research variables in the object of seawater treatment.

II. Literature Riview

Investigation about rheological and tribological behaviors polypropylene fiber (ppf) reinforced concrete [2]. The study aims to evaluate the effect of PPF inclusion on both rheological and tribological properties of ordinary concrete through two phases (without and with the incorporation of superplasticizer), using a fibrillated twist and wave fibers shapes at different dosages (0.12, 0.24, 0.36%) and with various lengths (19, 30 and 54 mm). The results of the test explained superplasticizer can improve concrete workability with high fiber dosage (0.24 and 0.36%) during the test. In another way study about Destructive and non-destructive experimental investigation of polypropylene fiber reinforced concrete subjected to high temperature was investigated [3] and the conclusion is that the deviation of the value of plain concrete strength at elevated temperature is significantly higher in comparison with the deviation of the value of PFRC strength. Research of glass aggregates performed by Mardani-Aghabaglou et al. [4] in this study investigated mechanical and durability performance of concrete, recycled fine aggregates as 0, 15, 30, 45, and 60% by weight. The maximum reduction strength was observed containing 60% recycled aggregate. Another study Recycled waste glass as fine aggregate replacement in cementitious materials based on Portland cement [5] the study to find practical ways to recycle waste glass in building materials, the results of this study i.e. the inclusion of glass sand increased temperature during hydration, bleeding and segregation increased with increasing glass sand content. The next study about the effect of seawater on structural concrete [6] objects of this study covered compressive, tensile, flexural and bond strengths of concrete are investigated. The result shown compressive strength subsequently related strength of concrete early ages up to 14 days, while a definite decrease for ages more than 28 days and up to 90 days.

III. Materials and Specimens

The concrete material component consists of cement, water, sand, and gravel. Before mixing concrete, each material is tested for its physical properties by applicable standards. The quality of each material is following the standards set in the concrete testing process. Specimens are made in the form of concrete cylinders. Additional concrete mixture material is crushed glass.

A. Cement

The cement used is Type 1.

B. Water

The water used consists of freshwater and seawater. Freshwater is clean water that is ready to drink. Freshwater is used for two conditions, namely when mixing concrete and treating concrete. While seawater is used only in curing conditions only. Seawater is taken at Kupang City, Indonesia.

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Seawater has been tested and is free of acidity properties that damage concrete.

C. Aggregates

Aggregates consist of fine aggregate (sand) taken from Takari quarry, Kupang, Indonesia whereas coarse aggregate (gravel) is split stone.

D. Polypropylene Fibre

Polypropylene fibers can increase compressive strength and tensile strength of concrete mixes.

Fig. 1. Polypropylene fibers.

E. Specimens

Test specimens use concrete cylinders. The cylinder has a diameter (d) = 15 cm and height (h) = 30 cm. There are 4 categories of specimens, namely:

- Normal Concrete (BN) treatment of seawater. This concrete is a normal concrete mixture consisting of cement, water, sand, and gravel but for the treatment of concrete using seawater. Concrete specifications can be seen in Table I.

TABLE I. NORMAL CONCRETE OF SEA WATER CURING (BN)

Specimen	Compressive Strength		
	28 days	*56 days*	*90 days*
BN	3	3	3

- 15% Crushed Glass Concrete Seawater Curing (BK15). This category of concrete mix is substituted crushed glass by 15% total weight of sand. Concrete specifications can be seen in Table II.

TABLE II. 15% CRUSHED GLASS CONCRETE SEA WATER CURING (BK15)

Specimen	Compressive Strength		
	28 days	*56 days*	*90 days*
BKP15	3	3	3

- 15% Crushed Glass Concrete with additional polypropylene fiber and seawater curing (BKP15). Concrete specifications can be seen in Table III.

TABLE III. 15% CRUSHED GLASS CONCRETE WITH ADDITIONAL POLYPROPYLENE FIBER AND SEA WATER CURING (BKP15)

Specimen	Compressive Strength		
	28 days	*56 days*	*90 days*
BKP15	3	3	3

- 15% Crushed Glass Concrete Freshwater Curing (BKT15). Concrete specifications can be seen in Table IV.

TABLE IV. 15% CRUSHED GLASS CONCRETE WITH ADDITIONAL POLYPROPYLENE FIBER AND FRESHWATER CURING (BKT15)

Specimen	Compressive Strength		
	28 days	*56 days*	*90 days*
BKT15	3	3	3

- Split Tensile Strength for 15% crushed glass Concrete with the addition of polypropylene fibers with freshwater and seawater curing (BKS15). Concrete specifications can be seen in Table V.

TABLE V. SPLIT TENSILE STRENGTH FOR 15% CRUSHED GLASS CONCRETE WITH THE ADDITION OF POLYPROPYLENE FIBERS WITH FRESH WATER AND SEA WATER CURING (BKS15)

Specimen	Compressive Strength			
	28 days/fresh water	*28 days/sea water*	*90 days/fresh water*	*90 days/sea water*
BKS15	2	2	2	2

IV. METHODOLOGY

A. Curing Water Treatments

Curing treatments used are seawater and freshwater curing. Curing is done 1 day after making the specimen, then the specimen is immersed in water.

B. Glass Blends

Glass mixes are substituted for sand weight. Glass Blends function as aggregates instead of fine aggregates. The glass mixture is equal to 15% of the total weight of the fine aggregate. The use of a glass of 27.4 kg for 36 specimens.

Fig. 2. Glass blends.

C. Polypropylene Fibers

Based on the provisions of the use of polypropylene fibers in 1 m3 of concrete mix of 600 gr. The use of polypropylene fiber for 26 cylinders amounted to 82.6605 gr.

Fig. 3. Polypropylene fibers.

D. Experimental Setting Up

Concrete compressive strength is obtained by carrying out the concrete compressive strength test. Concrete compressive strength test equipment is Universal Testing Machine (UTM) as shown in Fig. 4.

Fig. 4. Universal Testing Machine (UTM).

The test is carried out according to the planned day, which is 28 days, 56 days, and 90 days.

V. Results and Experimental Investigatio

A. Compressive Strength of Seawater Curing

The results of compressive strength of seawater curing consisting of BN, BK15 and BKP15 can be seen in Table VI.

TABLE VI. COMPRESSIVE STRENGTH OF SEAWATER CURING

Concrete Category Class	*Age (days)*	*Specimen*	*Compressive Strength (MPa)*	*Average Compressive Strength (MPa)*
BN	28	1	24.9115	25.478
		2	24.9115	
		3	26.6100	
	56	1	28.025	29.158
		2	31.139	
		3	28.309	
	90	1	30.856	31.234
		2	31.706	
		3	31.139	
BK15	28	1	36.235	30.573
		2	27.176	
		3	28.309	
	56	1	38.783	35.574
		2	31.706	
		3	36.235	
	90	1	37.084	36.141
		2	35.386	
		3	35.952	
BKP15	28	1	29.441	28.309
		2	28.309	
		3	27.176	
	56	1	33.687	35.669
		2	34.820	
		3	38.500	
	90	1	39.066	39.726
		2	39.632	
		3	40.481	

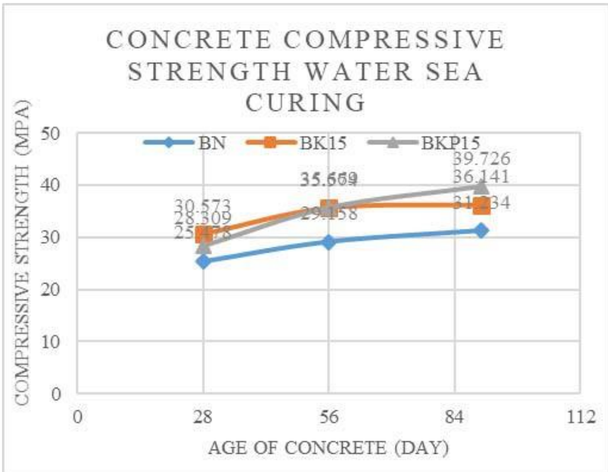

Fig. 5. Concrete compressive strength seawater curing.

At 28 days concrete BN is 19.19% weaker against BK15 and 11.11% against BKP15. At 56 days of age, BN is 22% weaker against BK15 and 22.33% against BKP15. At 90 days concrete BN is 15.71% weaker against BK15 and 27.19% against BKP15.

B. Comparison of Compressive Strength of Freshwater and Sea Water Curing Concrete

TABLE VII. COMPARISON OF COMPRESSIVE STRENGTH OF CURING METHODS

Concrete Category Class	Age (days)	Specimen	Compressive Strength (MPa)	Average Compressive Strength (MPa)	Concrete Category Class
BKP15	Fresh water	28	1	36.235	35.103
			2	33.687	
			3	35.386	
		56	1	31.139	35.291
			2	37.367	
			3	37.367	
		90	1	41.614	41.425
			2	38.217	
			3	44.444	
BKT15	Sea water	28	1	29.441	28.309
			2	28.309	
			3	27.176	
		56	1	33.687	35.669
			2	28.309	
			3	27.176	
		90	1	39.066	39.726
			2	39.632	
			3	40.481	

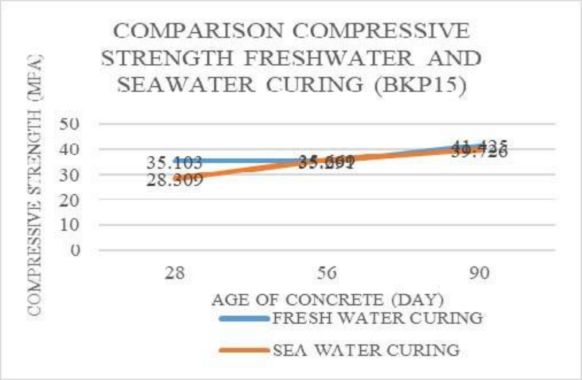

Fig. 6. Comparison compressive strength freshwater and seawater (BKP15).

At the age of 28 days the compressive strength of freshwater curing concrete is 19.35% stronger against seawater curing. At 56 days the compressive strength of freshwater curing concrete is 1.07% weaker than seawater curing. At the age of 90 days, freshwater curing is 4.10% stronger than seawater curing.

C. Comparison of the Tensile Strength of Freshwater and Sea Water Curing

TABLE VIII. COMPARISON OF THE TENSILE STRENGTH OF CURING METHODS

Concrete Category Class	*Age (days)*	*Specimen*	*Compressive Strength (MPa)*	*Average Compressive Strength (MPa)*	Concrete Category Class
BKS15	Fresh water	28	1	3.539	3.468
			2	3.397	
		90	1	4.600	4.423
			2	4.246	
BKS15	Sea water	28	1	2.831	3.149
			2	3.468	
		90	1	4.034	4.140
			2	4.246	

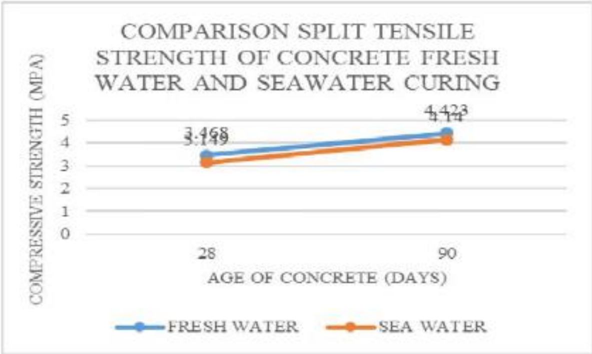

Fig. 7. Comparison split tensile strength of concrete fresh water and sea water.

At the age of 28 days, the strength of the pull fresh curing split freshwater is 9.19% stronger against seawater curing. At the age of 90 days, concrete strength of freshwater split Pulls 6.39% stronger against curing seawater.

VI. CONCLUSION

This paper focused on compressive strength of crushed glass reinforced concrete with addition polypropylene fibers and curing treatment using seawater. The findings experimental indicate the following.

- Crushed glass effectively to increasing RC compressive strength.
- Polypropylene fibers provide strengthening force on compressive and split tensile testing.
- Sea water curing affect protected hydration processing within RC mixing. Even though freshwater more effective.

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