

ANALYSIS OF THE USE OF ACRYLIC WASTE AS A PARTIAL SUBSTITUTION OF COARSE AGGREGATE FOR CONCRETE COMPRESSIVE STRENGTH

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ABSTRACT

Acrylic, or polymethyl methacrylate, is a synthetic polymer that has superior properties compared to glass, such as flexibility, light weight, easy to process (cut, drill, polish), and can be formed into various complex shapes through thermal processes. This material has advantages in resistance to impact and weather conditions, and is environmentally friendly because it can be recycled. Acrylic is widely used in industries, including advertising, automotive, and interior design, due to its ease of processing and aesthetics. However, the production of acrylic products is still considered inefficient and expensive, triggering the need for new tools for the bending process to increase the efficiency of making acrylic-based products. Based on the results of the average concrete compressive strength test for normal concrete at the age of 28 days is 11.94 Mpa, the compressive strength results are less than the planned concrete quality of 25 Mpa; Based on the research results, it was found that concrete using acrylic waste as a partial replacement for coarse aggregate at the age of 28 days at a variation of 3% was 13.94 MPa, a variation of 5% was 24.87 MPa and a variation of 7% was 7.97 MPa, so it can be concluded that the more acrylic waste mixture for the compressive strength of concrete, the results will decrease.

Keywords: Acrylic, Quality, Concrete

INTRODUCTION

Acrylic, or polymethyl methacrylate, is a synthetic polymer that has superior properties compared to glass, such as flexibility, light weight, easy to process (cut, drill, polish), and can be formed into various complex shapes through thermal processes. This material has advantages in resistance to impact and weather conditions, and is environmentally friendly because it can be recycled. Acrylic is widely used in industries, including advertising, automotive, and interior design, due to its ease of processing and aesthetics. However, the production of acrylic products is still considered inefficient and expensive, triggering the need for new tools for the bending process to increase the efficiency of making acrylic-based products.

METHODS

This study uses an experimental method to explore the causal relationship between the compressive strength of normal concrete (dependent variable) and concrete with Acrylic waste (independent variable).



Figure 1. Research Flowchart

Concrete compressive strength testing involves several important stages. Initially, concrete is tested for resistance to loads at the ages of 7, 14, and 28 days, by measuring the weight, diameter, and cleaning the test specimens from contaminants before being tested in the laboratory using a compression machine. The test specimens are placed in a parallel position in the machine, and the loading is monitored until they reach the maximum load, where the maximum compressive strength is recorded when the sample is damaged. For the manufacture of test specimens, the steps include measuring the aggregate and mixture materials, mixing evenly in the mixer, and measuring the slump to ensure the consistency of the concrete. Concrete that meets the standards is cast in a three-layer cylinder, with each layer coated with sulfur mortar, tested on the machine with a constant load addition, and monitored until the sample fails while recording the crack condition and maximum load.

RESULTS AND DISCUSSION

The purpose of designing this concrete mixture, based on SNI 03-2834-2000, is to determine the composition of materials for the concrete mixture. Testing was carried out at the ages of 7, 14, and 28 days for one test cylinder measuring 15 cm x 30 cm. For the use of substitute materials using acrylic of 3%, 5% and 7% with an acrylic specific gravity of 3.379.

Table 1. Calculation of Acrylic Requirements

Variasi	Berat Jenis	Berat Pasir	Volume Silinder	Kebutuhan Akrilik (kg)
3%	3,379	633,808	0.0053	0,18
5%	3,379	633,808	0.0053	0,30
7%	3,379	633,808	0.0053	0,42

The results of the concrete compressive strength test were carried out on test objects aged 7 days, 14 days, and 28 days. The test was carried out using a concrete compressive tester, which uses readings on the tool with kN units and a digital display.

Table 2. Recapitulation of Normal Concrete Compressive Strength Test Results

No	Kode Benda Uji	Umur	Slump	Berat Benda Uji	Beban (KN)	Kuat Tekan Beton (Mpa)	Rata - rata kuat tekan beton (Mpa)
1	Fe'25	7 hari	12	11,12	16,7	0.94	0.93
2	Fe'25		12	11,20	17,2	0.97	
3	Fe'25		12	11,05	15,4	0.87	
4	Fe'25	14 hari	12	11,22	168	9.5	8.56
5	Fe'25		12	11,15	149	8.43	
6	Fe'25		12	11,09	137	7.75	
7	Fe'25	28 hari	12	11,38	211	11.94	11.94
8	Fe'25		12	11,27	194	10.98	
9	Fe'25		12	11,19	184	10,41	

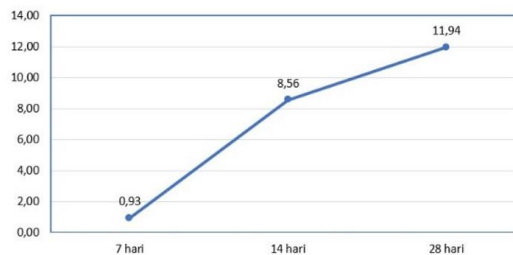


Figure 2. Normal Concrete Compressive Strength Graph

Table 3. Recapitulation of Concrete Compressive Strength Test Results Variation 3%

No	Kode Benda Uji	Umur	Slump	Berat Benda Uji (kg)	Beban (KN)	Kuat Tekan Beton (Mpa)	Rata - rata kuat tekan beton (Mpa)
1	Fe'25	7 hari	11	11,50	65	3.67	4.22
2	Fe'25		11	11,65	74	4.18	
3	Fe'25		11	11,94	85	4.81	
4	Fe'25	14 hari	11	11,84	135	7.6	7.73
5	Fe'25		11	11,88	137	7.7	
6	Fe'25		11	11,94	140	7.9	
7	Fe'25	28 hari	11	12	236.2	13.37	13.94
8	Fe'25		11	12	241.5	13.66	
9	Fe'25		11	12,5	262.3	14.8	

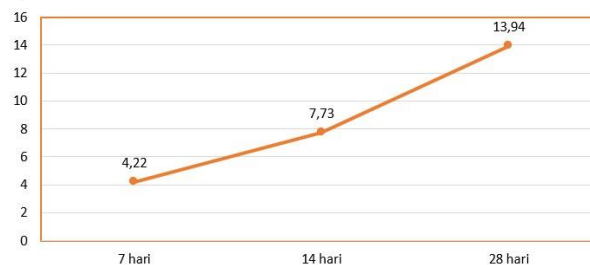


Figure 3. Concrete Compressive Strength Graph Variation 3%

Table 4. Recapitulation of Concrete Compressive Strength Test Results Variation 5%

No	Kode Benda Uji	Umur	Slump	Berat Benda Uji (kg)	Beban (KN)	Kuat Tekan Beton (Mpa)	Rata - rata kuat tekan beton (Mpa)
1	Fe'25	7 hari	12	12,13	318,8	18.04	14.99
2	Fe'25		12	12, 7	253,5	14.34	
3	Fe'25		12	12,2	222,7	12.6	
4	Fe'25	14 hari	12	12,29	391,6	22.16	20.07
5	Fe'25		12	12,23	349,1	19.75	
6	Fe'25		12	12,19	323,4	18.3	
7	Fe'25	28 hari	12	12,30	432	24.4	24.87
8	Fe'25		12	12,38	439	24.8	
9	Fe'25		12	12,45	449	25.4	



Figure 4. Concrete Compressive Strength Graph Variation 5%

Table 5. Recapitulation of Concrete Compressive Strength Test Results Variation 7%

No	Kode Benda Uji	Umur	Slump	Berat Benda Uji	Beban (KN)	Kuat Tekan Beton (Mpa)	Rata - rata kuat tekan beton (Mpa)
1	Fe'25	7 hari	12	10,87	85	4.8	5.17
2	Fe'25		12	10,90	92	5.2	
3	Fe'25		12	10,94	98	5.5	
4	Fe'25	14 hari	12	11,46	110	6.2	7.37
5	Fe'25		12	11,68	128	7.2	
6	Fe'25		12	11,70	155	8.7	
7	Fe'25	28 hari	12	11,50	137	7.7	7.97
8	Fe'25		12	11,72	138	7.8	
9	Fe'25		12	11,98	149	8.4	

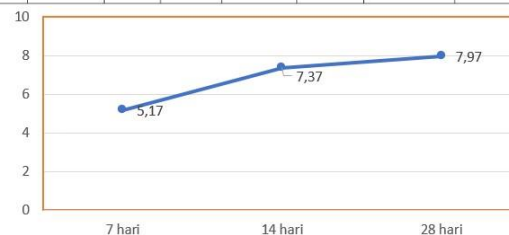
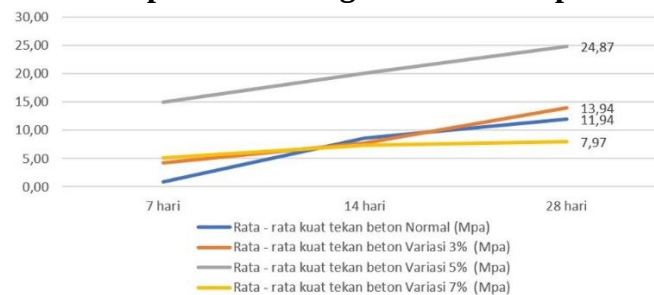


Figure 5. Concrete Compressive Strength Graph Variation 7%

Table 6. Concrete Compressive Strength Results Graph Based on Test Age



CONCLUSIONS

Based on research conducted at the Laboratory of the Faculty of Civil Engineering, Krisnadwipayana University, as well as the discussion in the previous chapter on how the use of Acrylic as a substitute for coarse aggregate in concrete affects the compressive strength of concrete, it can be concluded that:

- 1) Based on the results of the average concrete compressive strength test for normal concrete at the age of 28 days is 11.94 Mpa, the compressive strength results are less than the planned concrete quality of 25 Mpa;
- 2) Based on the results of the study, it was found that concrete using acrylic waste as a partial substitute for coarse aggregate at the age of 28 days at a variation of 3% was 13.94 MPa, a variation of 5% was 24.87 MPa and a variation of 7% was 7.97 MPa, it can be concluded that the more acrylic waste mixture for the compressive strength of concrete the results decreased.

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