

THE EFFECT OF USING RUBBER SEED WASTE ON K-300 COMPRESSIVE STRENGTH TEST (f'_c 25 MPa)

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ABSTRACT

Modern construction technology has evolved with the principle of environmental concern through various innovations that support environmentally friendly construction. This includes the use of natural materials, procedures that minimize the use of hazardous resources, and techniques that produce minimal waste. The industry is also faced with the challenge of increasing demand for building materials due to population growth, which is addressed by utilizing local resources and waste, such as rubber seed shells as an alternative to conventional materials. The history of rubber use in Indonesia began with the introduction of seeds by Henry A. Wickham in 1876, with further development in the late 19th century. Based on the results of the research that has been conducted and the discussion in the previous chapter regarding the variation of the use of rubber seed shell waste of 0%, 5%, and 10%, the following conclusions can be drawn: The results of the ordinary concrete compressive strength test at the age of 28 days reached 440 kN (f'_c 24.91 Mpa), while variation 1 of 5% rubber seed waste reached 317 kN (f'_c 17.95 Mpa), and variation 2 of 10% rubber seed waste reached 274 kN (f'_c 15.51 Mpa).

Keywords: Shell, Rubber seeds, Quality, Concrete.

INTRODUCTION

Modern construction technology has evolved with the principle of environmental concern through various innovations that support environmentally friendly construction. This includes the use of natural materials, procedures that minimize the use of hazardous resources, and techniques that produce minimal waste. The industry is also faced with the challenge of increasing demand for building materials due to population growth, which is addressed by utilizing local resources and waste, such as rubber seed shells as an alternative to conventional materials. The history of rubber use in Indonesia began with the introduction of seeds by Henry A. Wickham in 1876, with further development in the late 19th century.

METHODS

This study applies an experimental approach to examine the causal relationship between the compressive strength of ordinary concrete (dependent variable) and concrete containing rubber seed waste (independent variable).



Figure 1. Research Flowchart

In Indonesia, rubber seeds are used in various forms that provide economic benefits. These seeds are rich in nutrients, with a protein content of 27%, fat 32.3%, carbohydrates 15.9%, water 9.1%, and ash 3.96%. The high crude protein allows the seeds to be processed into flour which is used as a protein concentrate in animal feed for poultry and ruminants, as well as fish pellets. In addition, rubber seeds are also used as organic fertilizer thanks to the presence of probiotic local microorganisms (MOL) which accelerate the fermentation and decomposition of organic waste. Rubber seeds also have the potential as a source of biodiesel, especially because of the high and abundant carbohydrate content in Indonesia, which can reduce diesel imports. The process of processing biodiesel from rubber seeds uses a non-catalyst method with fermentation and squeezing oil from fresh seeds. In addition, rubber seeds can also be processed into snacks such as chips and tempeh with processing that removes cyanide content, and the seed shells can be used as biobriquettes because of their high cellulose, hemicellulose, and lignin content.

RESULTS AND DISCUSSION

Table 1. Results of Normal Concrete Mix Design in 1 Cylindrical Test Specimen

No.	Material	Volume	Satuan
1	Semen	2,07	Kg
2	Agregat Kasar (split)	5,97	Kg
3	Agregat Halus (pasir)	3,36	Kg
4	Air	0,98	Kg

Table 2. Results of Mix Design of Concrete Variation 1 in 1 Cylindrical Test Object

No.	Material	Volume	Satuan
1	Semen	2,07	Kg
2	Agregat Kasar (split)	5,67	Kg
3	Agregat Halus (pasir)	3,36	Kg
4	Limbah Cangkang Biji Karet 5%	0,30	Kg
5	Air	0,98	Kg

Table 3. Results of Mix Design of 2-in-1 Variation Concrete Cylindrical Test Objects

No.	Material	Volume	Satuan
1	Semen	2,07	Kg
2	Agregat Kasar (split)	5,37	Kg
3	Agregat Halus (pasir)	3,36	Kg
4	Limbah Cangkang Biji Karet 10%	0,60	Kg
5	Air	0,98	Kg

Abram's Cone with a top diameter of 10 cm, a bottom diameter of 20 cm, and a height of 30 cm is used for slump testing on fresh concrete, in accordance with SNI 1972-2008. This tool is equipped with a handle to lift the cone and release the concrete, as well as a 16 mm diameter tamping rod that can be extended up to 60 cm. The purpose of this test is to assess the workability of the fresh concrete mixture. The lower the slump value, the greater the difficulty in mixing, casting, transporting, and working the concrete. The average slump value for this concrete is 10 cm, which is included in the initial slump design range of 60-180 mm. A compression testing machine is used to evaluate the compressive strength of concrete on specimens aged 7, 14, and 28 days. The results are displayed in Kilo Newton (kN) in digital number format.

Table 4. Results of Concrete Compressive Strength Test f'_c 25 MPa for 7-Day Test Specimen Age

No	Benda Uji	Tanggal Pembuatan	Tanggal Pengujian	Umur Benda Uji (hari)	Berat Benda Uji (kg)	Aktual Kuat Tekan kN	Rata-rata Kuat Tekan kN	Rata-rata Kuat Tekan kN
1	fc'25	27 Mei 2024	3 Juni 2024	7	11,85	265		
2	fc'25	27 Mei 2024	3 Juni 2024	7	12,1	274	266	60,18%
3	fc'25	27 Mei 2024	3 Juni 2024	7	11,7	260		
1	5% CBK	6 Juni 2024	13 Juni 2024	7	11,7	194		
2	5% CBK	6 Juni 2024	13 Juni 2024	7	11,65	220	197	44,57%
3	5% CBK	6 Juni 2024	13 Juni 2024	7	11,65	176		
1	10% BK	13 Juni 2024	20 Juni 2024	7	11,7	210		
2	10% BK	13 Juni 2024	20 Juni 2024	7	11,65	228	205	46,38%
3	10% BK	13 Juni 2024	20 Juni 2024	7	11,65	177		

Table 5. Results of Concrete Compressive Strength Test f'_c 25 MPa for Test Specimen Age 14 Days

No	Benda Uji	Tanggal Pembuatan	Tanggal Pengujian	Umur Benda Uji (hari)	Berat Benda Uji (kg)	Aktual Kuat Tekan kN	Rata-rata Kuat Tekan kN	Rata-rata Kuat Tekan kN
1	fc'25	27 Mei 2024	10 Juni 2024	14	11,95	367		
2	fc'25	27 Mei 2024	10 Juni 2024	14	12,16	372	372	84,16%
3	fc'25	27 Mei 2024	10 Juni 2024	14	11,9	377		
1	5% CBK	6 Juni 2024	20 Juni 2024	14	11,62	264		
2	5% CBK	6 Juni 2024	20 Juni 2024	14	11,84	267	270	61,09%
3	5% CBK	6 Juni 2024	20 Juni 2024	14	11,91	278		
1	10% CBK	13 Juni 2024	27 Juni 2024	14	11,73	229		
2	10% CBK	13 Juni 2024	27 Juni 2024	14	11,64	216	226	51,13%
3	10% CBK	13 Juni 2024	27 Juni 2024	14	11,82	233		

Table 6. Results of Concrete Compressive Strength Test f'_c 25 MPa for Test Specimen Age 28 Days

No	Benda Uji	Tanggal Pembuatan	Tanggal Pengujian	Umur Benda Uji (hari)	Berat Benda Uji (kg)	Aktual Kuat Tekan kN	Rata-rata Kuat Tekan kN	Rata-rata Kuat Tekan kN
1	fc'25	27 Mei 2024	24 Juni 2024	28	11,85	445	440	99,55%
2	fc'25	27 Mei 2024	24 Juni 2024	28	12,1	439		
3	fc'25	27 Mei 2024	24 Juni 2024	28	11,7	436		
1	5% CBK	6 Juni 2024	4 Juli 2024	28	11,6	292	317	71,72%
2	5% CBK	6 Juni 2024	4 Juli 2024	28	11,8	312		
3	5% CBK	6 Juni 2024	4 Juli 2024	28	11,7	347		
1	10% CBK	13 Juni 2024	13 Juli 2024	28	11,6	257	274	61,99%
2	10% CBK	13 Juni 2024	13 Juli 2024	28	11,7	273		
3	10% CBK	13 Juni 2024	13 Juli 2024	28	11,8	293		

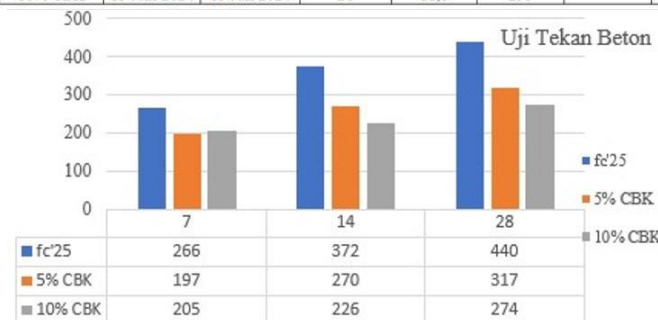


Figure 2. Concrete Cylinder Compression Test Diagram

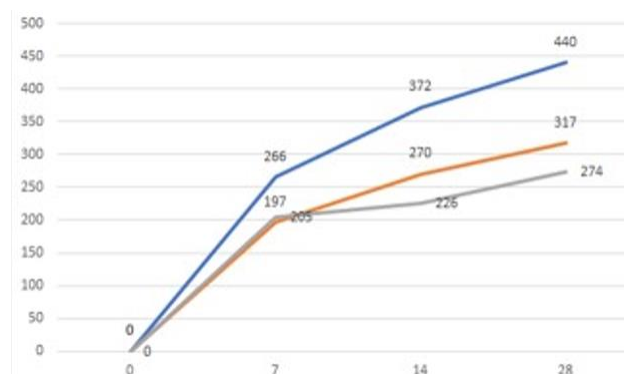


Figure 3. Concrete Cylinder Compression Test Graph

CONCLUSIONS

Based on the results of the research that has been conducted and the discussion in the previous chapter regarding the variation of the use of rubber seed shell waste of 0%, 5%, and 10%, the following conclusions can be drawn: The results of the ordinary concrete compressive strength test at the age of 28 days reached 440 kN (f'_c 24.91 Mpa), while variation 1 of 5% rubber seed waste reached 317 kN (f'_c 17.95 Mpa), and variation 2 of 10% rubber seed waste reached 274 kN (f'_c 15.51 Mpa).

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