

# Utilization of Disposable Diaper Waste with Added Naphthalene Formaldehyde Sulfonate into Paving Blocks in an Effort to Minimize Waste to Reduce Environmental Pollution

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## Abstract

This research aims to determine the best classification and composition of paving blocks mixed with baby diaper waste in terms of compressive strength and water absorption of paving blocks based on SNI 03-0691-1996, the effect of variations in baby diaper waste on compressive strength and water absorption tests and to determine the quality comparison. paving blocks mixed with baby diaper waste and commercial paving blocks. The method used in this research is an experimental method, using a quantitative approach. The materials used to produce paving blocks are cement, sand, water, a mixture of baby diaper waste and the added ingredient sikacim concrete additive. The samples were tested to determine the relationship between physical characteristics and mechanical properties with material composition in accordance with the quality of Paving Blocks produced based on SNI 03-0691-1996. In this research, it was determined based on the planning ratio between cement and sand, namely 3:7. Baby diaper waste added to the paving blocks was 0 grams, 5 grams, 10 grams, 15 grams and 20 grams. The best classification and composition for adding baby diaper waste to paving blocks if viewed from the compressive strength of paving blocks is by adding 10 grams of baby diaper waste with a compressive strength of 36.76 Mpa which meets the SNI 03-0691-1996 quality classification A, where this paving block can be used for roads, container terminal land pavement at ports, non-structural and structural needs with other heavy loads. Meanwhile, if we look at the water absorption capacity of the paving blocks, the best classification and composition of adding 5 grams of baby diaper waste with the lowest water absorption capacity of 1.41% meets the SNI 03-0691-1996 quality classification standard A.

**Keywords:** *Paving Blocks, Diaper Waste, Compressive Strength, Water Absorption.*

## A. INTRODUCTION

Indonesia is the fourth country in the world after China, India and the United States with the highest population of more than 200 million people. The increase in population and the pace of the economy and development apart from having a positive impact also has a negative impact, one of which is problems related to the environment. Especially in waste management, which can be seen from the increasing volume of waste produced. Waste is leftover from human activities, the types of waste composition produced by households are increasingly diverse, one of which is disposable diapers, this type of waste requires great attention in management. disposable diaper waste. Disposable diaper waste contains human waste which can have a negative impact on the environment. Disposable diapers (diapers) are the largest waste in developed countries, so they require great and special attention in their processing, where awareness among urban communities is still lacking

regarding the existence of disposable diaper waste. Baby diapers are a primary need in caring for babies aged 0-3 years according to 71% of mothers in Indonesia. Baby diapers are often used on babies or toddlers. The diapers that are often used are disposable diapers. Because they are disposable, they are thrown away after use and result in a lot of baby diaper waste. The higher the birth rate, the higher the number of baby diapers used, the higher the diapers used, the higher the waste produced. The percentage of baby diaper use in Indonesia is around 97.1%. The time used to decompose baby diaper waste is very long, namely 250-500 years to decompose completely. Using baby diaper waste as an additional material for making paving blocks serves as an effort to reduce landfills. Thus, the author is encouraged to use baby diaper waste as an additional material for making paving blocks so that the use of baby diaper waste has a very high use value and at the same time increases the quality of the paving blocks.

## B. METHOD

The type of method used in this research is an experimental method, using a quantitative approach. The materials used to produce paving blocks are cement, sand, water, a mixture of baby diaper waste and the added ingredient Naphthalene Formaldehyde Sulfonate. The samples were tested to determine the relationship between physical and mechanical properties and material composition according to the quality of the Paving Blocks produced based on SNI 03-0691-1996.

In this research, the materials used in making paving blocks were cement, sand, water and baby diaper waste. The type of baby diaper waste used in this research is used as an aggregate substitute for sand. As materials other than water, aggregate and hydraulic cement that are mixed into concrete before or after mixing. Therefore, the composition of the mixture of materials making up paving blocks for baby diaper waste in this study was determined based on the planned ratio of cement to sand, namely 3:7. Water composition is calculated based on the Water Cement Factor (FAS) value. The FAS value generally used for paving block mixtures is 0.5. The FAS value shows that if 100 grams of cement is used, the water required is  $0.5 \times 100 \text{ grams} = 0.5 \text{ ml}$ .

**Table 1. Composition of Paving Block Mix Per Pcs**

Sample Code	Cement (Grams)	Sand (Grams)	Baby Diaper Waste (Grams)	Sikacim Concrete Additive	Water (ML)
A	1,134	1,512	0	6.8 ml	560.2
B	1,134	1,507	5	6.8 ml	560.2
C	1,134	1,502	10	6.8 ml	560.2
D	1,134	1,497	15	6.8 ml	560.2
E	1,134	1,492	20	6.8 ml	560.2

**Table 2. Overall Composition of Paving Block Mixture**

Sample Code	Cement (Grams)	Sand (Grams)	Baby Diaper Waste (Grams)	Sikacim Concrete Additive	Water (ML)	Number of Test Objects
A	4,536	4,608	0	27.2 ml	2,240.8	4
B	4,536	4,608	20	27.2 ml	2,240.8	4
C	4,536	4,608	40	27.2 ml	2,240.8	4
D	4,536	4,608	60	27.2 ml	2,240.8	4
E	4,536	4,608	80	27.2 ml	2,240.8	4

In this study, the cement and sand composition ratio was calculated based on the volume of paving block sizes with a cement and sand composition ratio of 3:7. Where the cement weight is around 25% of the volume, namely 1,134 grams for one paving block. Meanwhile, the volume of sand is around 75% of the volume, namely 1,512 grams, adjusting for variations in the composition of the amount of additional baby diaper waste. In this study, adding 0 grams of baby diaper waste required the addition of 1,512 grams of sand, adding 5 grams of baby diaper waste required 1,507 grams of sand, adding 10 grams of baby diaper waste required 1,502 grams of sand, adding 15 grams of baby diaper waste required sand. as much as 1,497 and to add 20 grams of baby diaper waste requires 1,492 grams of sand. Paving blocks that have been treated for 29 days will then be tested in the laboratory. The paving block test parameters are compressive strength and water absorption testing.

## C. RESULTS AND DISCUSSION

### 1. Paving Block Compressive Strength Testing

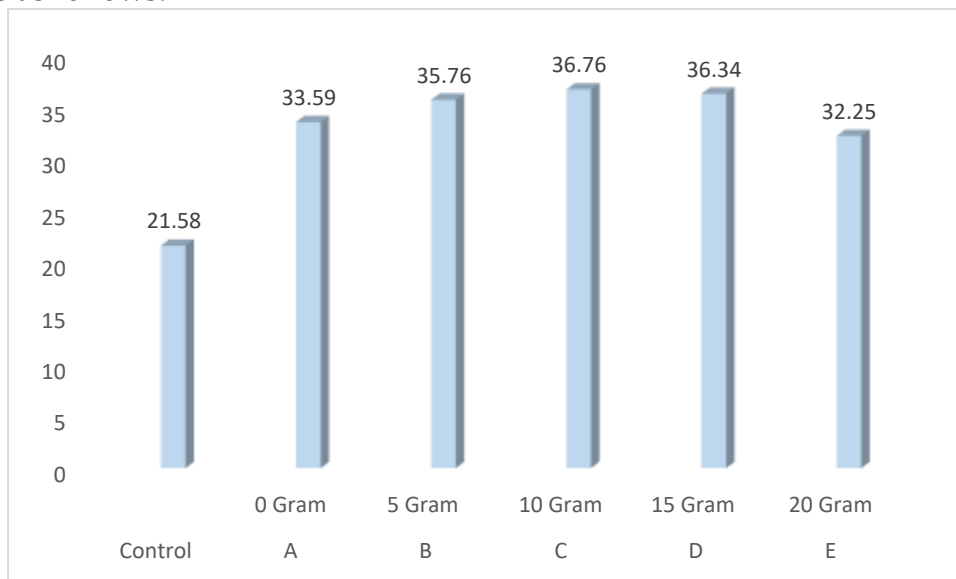
The compressive strength test of paving blocks was carried out on paving block samples that had been treated for 29 days. This was done because at 29 days, the strength of the concrete had reached 100%. From the results of the compressive strength test, the results are obtained in the form of force exerted on the paving block in kilonewton units. To convert the force into kilograms, the results must be multiplied by 101.97. The cross-sectional area of the paving block is  $20 \times 10 = 200 \text{ cm}^2$ . Results obtained from compressive strength tests using a Compression Machine. From the results of the calculation analysis carried out, below is the classification of paving blocks based on their compressive strength.

**Table 3. Paving Block Compressive Strength Test Results**

Sample code	Addition of Baby Diaper Waste (grams)	Compressive Strength Test Analysis Results (Mpa)	SNI Paving Block Standard SNI 03-0691-1996. (Mpa)	Paving Block Classification SNI 03-0691-1996
Controls	-	21.58	10-40	Quality B
A	0	33.59	10-40	Quality B
B	5	35.76	10-40	Quality A
C	10	36.76	10-40	Quality A
D	15	36.34	10-40	Quality A
E	20	32.25	10-40	Quality B

Based on the table above, we tested the compressive strength of paving blocks in the laboratory and carried out calculations and obtained the results shown in table 4.3. We can see that the use of baby diaper waste as an additional material for making paving blocks can still be done because the additional amount of baby diaper waste is 5 grams, 10 grams, 15 gram and 20 grams compressive strength of paving blocks still meet SNI 03-0691-1996 standards. Paving blocks with variations in the addition of 5 grams of baby diaper waste show a compressive strength of 35.76 Mpa, a concentration of 10 grams of added baby diaper waste shows a compressive strength of 36.76 Mpa, and variations in the concentration of the addition of baby diaper waste of 15 grams show a compressive strength value of 36.34 Mpa which can be included in quality classification A which can be used for roads. And the variation in concentration of adding 20 grams of baby diaper waste shows a compressive strength of 32.25 Mpa which can be included in quality classification B which can be used for parking lots. Compared with control paving blocks, the compressive strength values of paving block compositions of 5 grams, 10 grams, 15 grams and 20 grams meet the compressive strength values in accordance with SNI 03-0691-1996. Compared with the existing control paving blocks, the compressive strength values of the 5 gram, 10, 15 gram and 20 grams composition paving blocks exceed the compressive strength of the control paving blocks.

If depicted in diagram form, the effect of adding baby diaper waste to paving blocks is as follows:



**Figure 1. Diagram of the Effect of Adding Baby Diaper Waste on the Compressive Strength of Paving Blocks**

From the explanation above, it can be concluded that the best classification and composition for adding waste baby diapers to paving blocks when viewed from the compressive strength of paving blocks is by adding 10 grams of waste baby diapers with a compressive strength of 36.76 Mpa which meets the compressive strength value in accordance with SNI 03-0691-1996 quality classification A.

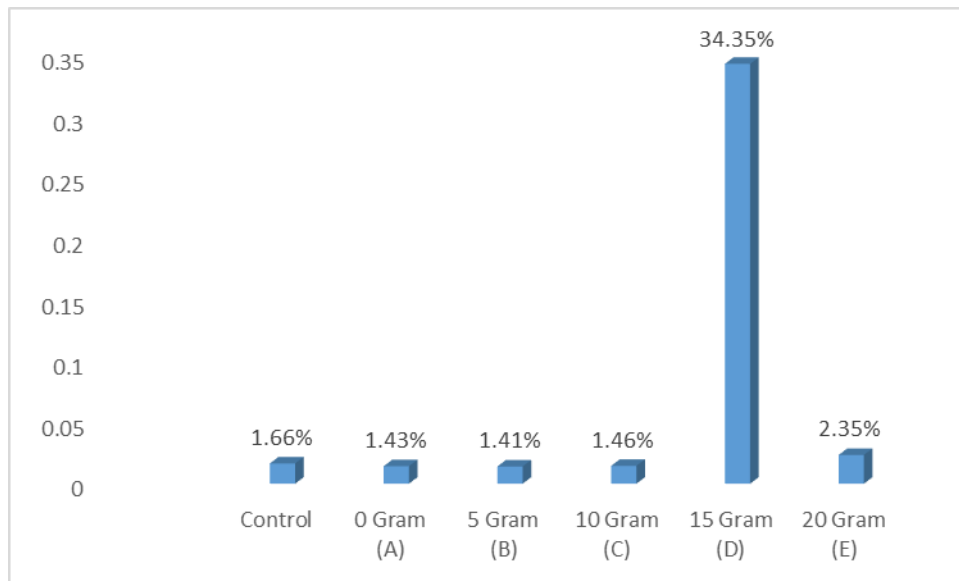
## 2. Paving Block Water Absorption Capacity

Water absorption testing is carried out to determine how much water absorption a paving block has. This water absorption test was carried out when the paving block was 29 days old. This test is carried out by soaking the paving blocks in a soaking tub for  $\pm 24$  hours, after soaking the test object is removed and the wet or water saturated test object is weighed. After weighing the test objects, they were dried by drying them in the sun for  $\pm 24$  hours and the test objects were weighed after drying. Based on the analysis of water absorption capacity parameters, below are the results of weighing dry paving blocks and wet paving blocks:

**Table 4. Water Absorption Analysis Results**

Code Sample	Addition Diaper (Grams)	Results Analysis Absorption Water (%)	SNI <i>Paving Block Standard</i> SNI 03-0691-1996. (%)	SNI <i>Paving Block Standard Classification</i> SNI 03-0691-1996.
Controls	-	1.66%	3-10	Quality A
A	0	1.43%	3-10	Quality A
B	5	1.41%	3-10	Quality A
C	10	1.46%	3-10	Quality A
D	15	34.85%	3-10	Does not meet the requirements of SNI 03-0691-1996.
E	20	2.35%	3-10	Quality A

From the table above we can see that paving blocks that do not have baby diaper waste added, paving blocks that are sold on the market and those that have baby diaper waste added with variations of 5 grams, 10 grams and 20 grams, all meet paving block standards based on SNI 03-0691- 1996 with paving block qualifications of quality A. If you look at the water absorption value, paving blocks that are added with baby diaper waste with a variation of 15 grams tend to have a higher water absorption value. This can be caused by the cement not binding properly and pores forming which will allow liquid substances to enter the paving block. With the results of this research, if we look at the water absorption capacity, it shows that paving blocks that do not add baby diaper waste, paving blocks that are sold on the market, and paving blocks that add baby diaper waste with variations of 5 grams, 10 grams, 20 grams meet the standard value. water absorption capacity in accordance with SNI 03-0691-1996. If depicted in diagram form, the effect of adding baby diaper waste on the water absorption capacity of paving blocks is as follows:



**Figure 2. Diagram of the Effect of Adding Baby Diaper Waste on the Water Absorption Capacity of Paving Blocks**

From the diagram above, it can be concluded that the more baby diaper waste added to the paving block mixture, the higher the water absorption value. This is because the more baby diaper waste that is added, the more pores there will be in the paving blocks because the paving block mixture does not bind with baby diaper waste. So, the best classification and composition of adding waste baby diapers to paving blocks if viewed from the water absorption capacity of paving blocks is by adding 5 grams of waste baby diapers with the resulting water absorption capacity of 1.41% meeting paving block standards based on SNI 03-0691-1996 with qualifications A quality paving block.

**Table 5. Classification and Best Composition for Adding Baby Diaper Waste to Paving Blocks**

Code Sample	Addition Diaper (Grams)	Results StrongPress (Mpa)	Classification of <i>paving blocks</i> (SNI 03-0691-1996)
C	10 Grams	36.76 Mpa	Quality A
Code Sample	Addition Diaper (Grams)	Results Water Absorption Capacity (%)	Classification of <i>paving blocks</i> (SNI 03-0691-1996)
B	5 Grams	1.41%	Quality A

### 3. Comparison of the Quality of Paving Blocks Mixed with Baby Diaper Waste and Commercial Paving Blocks

**Table 6. Analysis Results of Compressive Strength and Water Absorption Capacity of Commercial Paving Blocks**

Code Sample	Results StrongPress (Mpa)	SNI Standard 03-0691-1996 (Mpa)	Analysis results Power Absorb Water (%)	SNI Standard 03-0691-1996
Controls	21.58 Mpa	10-40 Mpa	1.66%	3-10%

Referring to SNI 03-0691-1996, the analysis results of commercial paving blocks all meet the standards, both in terms of compressive strength parameters and water absorption parameters. In terms of compressive strength parameters, this paving block is included in quality class B which can be used for parking lots. And in terms of water absorption parameters, this paving block meets quality class A. The results show that commercial paving blocks are suitable for use. The higher the compressive strength value of the paving block, the better the quality of the paving block, but the higher the water absorption value of the paving block, the worse the quality of the paving block.

**Table 7. Comparison of the Quality of Mixed Baby Diaper Waste Paving Blocks with Commercial Paving Blocks**

Code Sample	Results Strong Press (Mpa)	Code Sample	Results Analysis Absorption Water (%)	<i>Paving block classification SNI Standard 03-0691-1996</i>
C 10 Grams	36.76 Mpa	B 5 Grams	1.41%	Quality A for compressive strength and water absorption parameters
Code Sample	Results Strong Press (Mpa)	Results Analysis Absorption Water (%)	<i>Paving block classification SNI Standard 03-0691-1996</i>	
Commercial paving blocks	21.58 Mpa	1.66%	Quality B is for compressive strength parameters, and Quality A is for water absorption capacity	

Based on the results of the analysis above, for the compressive strength parameters of paving blocks, paving blocks added with baby diaper waste have a greater compressive strength compared to commercial paving blocks. Where the paving block with 10 grams of baby diaper waste added is the highest compressive strength value of the variations in the addition of baby diapers made. Then for the water absorption test parameters, commercial paving blocks have a higher water absorption value compared to paving blocks that add 5 grams of baby diaper waste, which is the smallest water absorption value of the variations in the addition of baby diaper waste made. Furthermore, the classification of paving blocks is based on the compressive strength of the paving blocks. Commercial paving blocks are included in quality classification B where these paving blocks can be used for parking lots. Meanwhile, paving blocks with the addition of 10 grams of baby diaper waste are included in quality classification A, where these paving blocks can be used for roads, pavement for container terminals at ports, non-structural and structural needs with other heavy loads. From the explanation above, we can conclude that the quality of paving blocks with the addition of baby diaper waste is better than commercial paving blocks.

#### D. CONCLUSION

The best classification and composition for adding baby diaper waste to paving blocks if viewed from the compressive strength of paving blocks is by adding 10 grams of baby diaper waste with a compressive strength of 36.76 Mpa which meets the SNI 03-0691-1996 quality classification A, where this paving block can be used for

roads, container terminal land pavement at ports, non-structural and structural needs with other heavy loads. Meanwhile, if we look at the water absorption capacity of the paving blocks, the best classification and composition of adding 5 grams of baby diaper waste with the lowest water absorption results of 1.41% meets the SNI 03-0691-1996 standard, quality classification A. The highest compressive strength value of the paving blocks added 10 grams of baby diaper waste with a compressive strength test result of 36.76 Mpa and for the lowest water absorption results the paving block added to baby diaper waste was the addition of 5 grams of baby diapers with a water absorption capacity of 1.4.1%. This value can meet SNI -03-0691-1996 quality classification A. Based on these results, the quality of paving blocks added to baby diaper waste is better than the quality of commercial paving blocks.

## REFERENCES

1. Akinyele, J. O., Igba, U. T., Ayorinde, T. O., & Jimoh, P. O. (2020). Structural Efficiency of Burnt Clay Bricks Containing Waste Crushed Glass and Polypropylene Granules. *Case Studies in Construction Materials*, 13. <https://doi.org/10.1016/j.cscm.2020.E00404>
2. Alyousef, R., Abbass, W., Aslam, F., & Shah, M. I. (2023). Potential Of Waste Woven Polypropylene Fiber and Textile Mesh for Production of Gypsum-Based Composite. *Case Studies in Construction Materials*, 18. <https://doi.org/10.1016/j.cscm.2023.E02099>
3. Aprilianti, A. (2019). *Pemanfaatan Biji Plastik Jenis Pp (Polypropylene) Sebagai Substitusi Agregat Pada Bata Beton (Paving Block)*.
4. Aziz, A. (2022). *Pemanfaatan Abu Ampas Tebu Dalam Pembuatan Paving Block*.
5. Bachra, Y., Grouli, A., Damiri, F., Bennamara, A., & Berrada, M. (2020). A New Approach for Assessing the Absorption of Disposable Baby Diapers and Superabsorbent Polymers: A Comparative Study. *Materials*, 8. <https://doi.org/10.1016/j.rinma.2020.100156>
6. Berbudi, M. G. (2020). *Analisa Komposit Polimer Polypropylene High Impact (PPHI) Berpenguat Fraksi Volume 10% Serat Nanas Dengan Menggunakan Metode Hand Lay-Up*.
7. Damayanti, Z., & Yushardi, S. (2023). *Analisis Karakteristik Fuel Pirolisis Sampah Plastik Berdasarkan Jenis Plastik Yang Digunakan*.
8. Faruqi, A. A. (2018). *Studi Pengaruh Variasi Komposisi Binder Sampah Plastik Polypropylene (PP) dan High-Density Polyethylene (HDPE) Terhadap Sifat Fisis dan Sifat Mekanik Komposit Berpenguat Serbuk Ampas Tebu Untuk Aplikasi Papan Partikel*.
9. Febriana, M. A., Nisumanti, S., & Minaka, S. U. (N.D.). *Pengaruh Penambahan Abu Serabut Kelapa Dan Sikacim Concrete Additive Terhadap Kuat Tekan Beton*. *Jurnal Gradasi Teknik Sipil Politeknik Negeri Banjarmasin*.
10. Ferdinand, P. (2022). *Analisis Kuat Tekan dan Serapan Air Material Paving Block Akibat Variasi Komposisi Fly Ash*.
11. Ferga Prasetyo, T., Susandi, D., & Yunus, M. (2022). *Prototipe Smart Waste Solving Organic and Inorganic Waste*.

12. Firmansyah, T., Alfiah, T., Caroline, J., Lingkungan, T., & Sipil, T. (2021). *Kualitas Paving Block Dengan Campuran Limbah Popok Bayi Sebagai Alternatif Pemanfaatan Limbah Padat*.
13. Gutama, H. (2022). *Analisis Kualitas Minyak Hasil Pirolisis Sampah Popok*.
14. Hermansyah, & Marselina, S. (2022). Pemanfaatan Cacahan Limbah Plastik Dalam Pembuatan Campuran Paving Blok. *Jurnal Keilmuan Teknik Sipil*, 5, 1–9.
15. Islam, M. J., & Shahjalal, M. (2021). Effect of Polypropylene Plastic on Concrete Properties as a Partial Replacement of Stone and Brick Aggregate. *Case Studies in Construction Materials*, 15. <https://doi.org/10.1016/j.cscm.2021.E00627>
16. Kulkarni, P., Ravekar, V., Rama Rao, P., Waigokar, S., & Hingankar, S. (2022). Recycling Of Waste Hdpe and Pp Plastic in Preparation of Plastic Brick and Its Mechanical Properties. *Cleaner Materials*, 5. <https://doi.org/10.1016/j.clema.2022.100113>
17. Kurniati, D., Saputro, T., Yogyakarta, U. T., Saint, P., & Sorong, P. (2023). *Utilitas Limbah Merang Sebagai Pengganti Agregat pada Paving Block*. Retrieved from: <https://digitalpress.gaes-edu.com/index.php/gaespace/index>
18. Kurniwanto. (2020). *Pengaruh Penggunaan Kapur Padam Sebagai Bahan Pengganti Sebagian Semen Terhadap Kuat Tekan Batako Pada Jenis Pasir Yang Berbeda*.