

# Plastic in Brick Application



Siti Nabilah Amir and Nur Zulaikha Yusof\*

Department of Civil & Environmental Engineering, Universiti Teknologi, Malaysia

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\*Corresponding author: Nur Zulaikha Yusof, Department of Civil & Environmental Engineering, Universiti Teknologi, Petronas, Seri Iskandar Perak, Malaysia

## Abstract

This paper outlines the utilization of municipal plastic waste (MPW) in construction industries. Both the MPW and the construction industries are increasing rapidly and world's recycling rate of either Municipal Solid Waste (MSW) or MPW specifically is still low. Production of bricks is non-eco-friendly and a waste generating process because of the greenhouse gases released. Utilizing MPW as construction materials especially in production of bricks is one of a promising step towards a sustainable resources and waste management. Plastic waste can substitute either partially or completely one or more of the materials in brick production. Further research based on recent research and a better understanding in utilization of plastic waste in brick is needed to produce a high durability and quality of bricks as well as to achieve the optimum balance in all aspects especially in terms of cost and functionality.

## Introduction

Urbanization caused a vast and rapid growth of construction industries which requires a lot of building materials that utilizes natural resources either in their production plant or as the materials itself. More recently the world concern about the demands for construction materials and the rate production of plastic that increases swiftly every year [1]. In turn, both industries contribute in increasing the MSW. Since the rate of production is projected to double the value in every 10 years, a more sustainable and safer way is needed to be taken into action [2]. Banning or minimizing plastic usage is not practicable to solve the problem as it is nearly impossible for different sectors to run efficiently without plastic. Mining of natural resources on the other hand is an energy waste process as only 900 million tons of raw materials is produced from 6000 million tons of waste generated [3,4]. They may be differ in

constitution of raw materials but possess the same in contributing to various environmental threats. Hence, utilizing plastic waste in brick production can solve both the MPW and demands for construction materials. Previous studies showed the possibility of using plastic waste in bricks application but the bricks produced are still lacking of durability as a safe construction materials. The aim of this paper is to review the application of plastic waste in bricks.

## Review of Research on Application of Plastic Waste in Bricks

The table layout the use of plastic in manufacturing bricks. Plastic waste has been utilized in various extend producing various properties of bricks and the properties of bricks produced has been assessed following standards provided Table 1.

**Table 1:** Application of plastic in brick

No.	Application of Plastic	Process/ Other Materials	Types of Plastic Used	Brick Size (mm)	Optimum Plastic Content (%)	Compressive Strength for Optimum Plastic Content (MPa)	Other Test Conducted	Reference
1	Binder	Glycolysis of PET bottles.	PET	150 x 150 x 150	10	28.5	Flexural strength, pull out test.	[5]
2	Binder	Soil, bitumen.	PET	200 x 100 x 100	70	7.82	Water absorption.	[6]
3	Mold	Pour OPC in PET bottles.	PET	150 x 300 x 75	9 bottles per block	35	Splitting tensile strength.	[7]

4	Mold	Compress PE in PET bottles.	PET, PE	62.5 x 201 x 62.5	+ 220g	40.1	Sound insulation, light transmission test.	[8]
5	Aggregate	Gravel, sand, cement.	PET	150 x 150 x 150	25	42.2	Splitting tensile and flexural strength, elasticity, ultrasonic test.	[9]
6	Aggregate	Cement, sand, crushed stones.	EPS	100 x 100 x 100	15	20.77	-	[10]
7	Aggregate	Clay, cement.	EPS	100 x 100 x 100	15	20.77	-	[11]
8	Aggregate	Fly ash, cement.	PW Powder	150 x 150 x 150	5	57.27	Fracture energy, splitting tensile, net flexural, modulus of elasticity.	[12]
10	Aggregate	Cement, sand.	PET, PC	40 x 40 x 160	10	38	Elastic modulus, flexural test, gas apparent permeability.	[14]
11	Aggregate	Cement, fine aggregate, coarse aggregate.	Plastic aggregates	150 x 150 x 150	15	14.06	Splitting tensile and flexural strength.	[15]
12	Aggregate	Sand, gravel, cement.	PE	70 x 70 x 280	10	24	Flexural strength, ultrasonic pulse velocity test.	[16]
13	Aggregate	Laterite soil, bitumen, .	PET	200 x 100 x 100	70	8.16	Water absorption.	[17]
14	Aggregate, Binder	-	PE, BOPP	220 x 100 x 55	5kg of PE and BOPP	8.91	-	[18]
15	Aggregate	Cement, lime, sand.	PVC	160 x 40 x 40	50	24.53	Flexural strength, water absorption, thermal conductivity, adhesion.	[19]
16	Aggregate	Cement, sand, aluminium powder, fly ash	Melamine	50 x 50 x 50	19	5.32	-	[20]
17	Aggregate	Cement, sand	HIPS	50.8 x 101.6	10	32	Splitting tensile strength, modulus of elasticity, thermal conductivity, water vapour permeability, resistance to freezing and thawing.	[20]

18	Aggregate	Cement, silica fume, superplasticizer, sand, crushed blue granite.	EPS	100 x 100 x100	40	21	Water and chloride permeability, splitting tensile strength, potential corrosion rate.	[20]
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## Discussion

Previous studies showed the possibility of using plastic as binder with the aid of catalyst through depolymerization of PET to replace cement. Extensive studies of PET as aggregate is more common in compared to other plastic waste. From the table, it showed a significant decrease in compressive strength is observed for more than 50% replacement of binder with PET waste. In fact that PET is thermoplastic, poor bond is created between the matrix and the aggregates and over stress may result in debonding of bricks and structural failure [21]. Increasing the amount of PET increases the softening point of the bricks produced. However, if the amount of plastic waste which acts as binder is too low, the residual unfilled voids will increase and in turn, increasing the water absorption as well as decreasing its compressive strength. When plastic waste is used as a mold, it can be clearly seen that it can withstand a high compressive strength in compared to using it as binder. However, lacking of compaction of plastic waste in plastic waste bottle may result in entrapped air that will contribute to a low compressive strength to the structure. A slight amount of entrapped air is enough to disrupt the structure of the bricks. Incorporating plastic waste as an aggregate is more common in compared to other methods. A few other materials are added to increase the durability of the bricks produced. Using an optimum amount of plastic waste as an aggregate generally shows an acceptable compressive strength. Expanded PS has a flexural properties that is important for buildings built on a problematic soils as the incorporation of expanded PS reduces the cracks appearance on building structure. Normal bricks do not possess this properties. In addition, bricks that are incorporated with expanded PS as aggregate are lighter and it can retain its strength due to its less permeable properties that helps to inhibit hydration. When PVC is used as aggregates, a low compressive strength can be observed and cracks were rapidly observed around the PVC particles because of the modulus mismatch as PVC possesses a lower elastic modulus in compared to the cement. The durability of plastic bricks depend on the amount of plastic incorporated in the mixture. An extensive reviews for the study of waste in construction has been highlighted [21,22]. With the right formulation, plastic waste can be a great substitution for raw materials extracted from natural origin.

## Conclusion

A few conclusions can be drawn based on the review of studies on application of plastic in bricks;

a) A variety of plastic waste has been used in many ways in bricks production. The compressive strength of the bricks produced

comply the standard outlined, which is more than the acceptable range outlined.

b) A suitable proportion between plastic waste and other materials used need to be optimized to meet the standard outlined for manufacturing of bricks. Further research and development is needed to improve the quality and durability of plastic bricks.

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