Concrete Brick Production Using a Mixture of Paint Waste by Solidification Process

P Purwanto¹,², S Sudarno¹,³, A D P Citra⁴

¹ Green Technology Research Center, School of Postgraduate Studies, Universitas Diponegoro, Semarang Indonesia
² Department of Chemical Engineering, Faculty of Engineering, Universitas Diponegoro, Semarang Indonesia
³ Department of Environmental Engineering, Faculty of Engineering, Universitas Diponegoro, Semarang Indonesia
⁴ Study Program of Optometry, Universitas Widya Husada Semarang, Semarang Indonesia

*Corresponding author’s email: purwanto@live.undip.ac.id

Abstract. Unutilized hazardous and toxic waste requires management and landfill costs. Hazardous and toxic paint waste can be used as additional raw material to make brick products through solidification. Concrete bricks are made from a mixture of cement (1 part) and sand (14 parts) with the addition of water for mixing purpose. The mixture composition is 0,1,2,4,6, and 8% by using paint waste as the raw material added. Then, the quality of concrete brick products is tested on compressive strength and water permeability. The test results can be used as recommendations for the use of paint waste into products and reduce waste management costs.

Keywords: paint waste, concrete brick, solidification

1. Introduction
The paint coating is used by the industry to improve the surface performance of a product to make it attractive to consumers. The cosmetic container manufacturing industry uses ultraviolet (UV) paint which is superimposed on the surface of the container. Industrial waste is one of the problems for the industry, which harms the environment if it is not appropriately managed. Industrial waste management tends to use a reactive approach by treating waste to meet environmental quality standards and laws and regulations. Waste treatment is costly and does not solve the waste problem. Industrial wastewater which contains pollutants is treated physically, chemically and biologically so that the effluent meets environmental quality standards. Solid byproducts become a further problem, still requiring proper management.

The proactive waste management approach provides financial benefits as well as positive benefits for the environment using waste into products. Raut et al. [1] reviewed various types of industrial and agricultural waste which are added to raw materials in various compositions to become waste-create-brick products with the aim of sustainable construction. A review on the potential for recycling and use of waste to produce construction materials was carried out by Safiudin et al. [2] with direct application to real construction. Recycling of solid waste for sustainable construction is investigated by researchers [3] [4].
Hazardous and toxic solid waste management refers to laws and regulations to prevent adverse environmental impacts. The industry pays the management fee for harmful ultraviolet paint to third parties who get management permits if they cannot manage themselves or cannot use them into products.

Industrial solid waste is used as raw material or a mixture of raw materials for solidification by tying solid waste into the paving block, brick, brick, and ceramic products [5] [6]. Citra et al. [7] use waste paint as a mixture for making paving blocks with a waste composition of up to 10%. Research shows the use of paint waste as a mixture at levels up to 2.5% provides high compressive strength that meets A quality based on the Indonesian National Standard for paving blocks. The compressive strength decreases with the increase in the level of sludge paint waste, and at 10% the compressive strength does not meet the requirements as a paving block. Other researchers have used industrial solid waste as a mixture for brick making [8] [9] [10]. Research on resin waste has been used for concrete making [11], but it has not been used as a mixture for making concrete bricks.

This study uses ultraviolet paint as a mixture of concrete blocks which does not require high compressive strength and is used as a building material coated with sand and cement. The use of concrete blocks as building walls is protected from the effects of weather and rainwater leaching, in contrast to the use of paving blocks. This study aims to determine the compressive strength and permeability of the brick using a mixture of ultraviolet sludge paint waste.

2. Research Method

Equipment. The brick making equipment uses a press made of steel measuring 40 cm x 10 cm x 20 cm, which is done manually to produce blocks of 39 cm x 9 cm x 19 cm.

Materials. The raw materials used consisted of sand, cement and ultraviolet sludge paint waste and production water.

Composition. The ratio of sand to cement is 14: 1, added with sludge paint waste 0,1,2,4,6 and 8% by weight.

Figure 1. Equipment for producing concrete bricks. Figure 2. Paint waste sludge

Procedure. The process of solidification of paint waste into concrete blocks begins by mixing sand, cement, paint waste with the addition of water, stirring is conducted to homogenize the raw material mixture. The homogeneous mixture is put into a press manually to form a wet brick product. Wet brick is dried naturally in an open area protected from the influence of rainwater. The 28-day old dry brick was tested for compressive strength and water permeation, compared to the brick without the addition of paint waste.
3. Result and Discussion

3.1. Characteristic of ultraviolet sludge waste paint

The waste comes from paints with binding and drying using UV light consisting of the main compounds ethyl benzene, propylene glycol methyl ether acetate, n-butyl acetate, 2-propenoic acid 2-ethyl xz, 1-2-3 propanetryiltris xy as much as 45-70 % and other components added up to 100%. Figure 2 shows the paint waste in the form of a reddish sludge. Ultraviolet paint waste is included in category 2 hazardous waste according to Government Regulation No 101 Year 2014 with waste codes A 325-1 and A325-2 [12]. Waste in the form of sludge that can be mixed with sand and cement with the addition of water.

3.2. Effect of paint waste composition on the compressive strength of the brick

The effect of adding waste with levels of 1,2,4,6 and 8% by weight of the brick is shown in Figure 6.
Measurement of the compressive strength of the concrete blocks showed an increase in the addition of paint waste. The increasing content is 1% by weight of the brick. Overall, the addition of paint limited increased the compressive strength of the brick in the experiment. It is by adding levels up to 8% by weight. The highest compressive strength was obtained from the addition of paint waste with a level of 1%. The addition of paint waste to the brick mixture serves to increase the binding of sand with cement. The results obtained are consistent with previous studies that used paint waste as a mixture for making paving blocks [7].

3.3. Effect of paint waste content on the water permeability of concrete brick

Figure 7. shows the results of the water permeation test of brick products at the various composition of paint waste.
Water permeability decreased with the addition of waste paint from 1% to 8% by weight. This decrease indicates an excellent binding function with the addition of paint waste to the brick making. Significantly decreased water permeability on the brick with the addition of paint waste levels of 1, 2 and 4%, respectively 18.6%, 27% and 21%.

3.4. Benefit of solidification processes.

Solid waste processing which is carried out by means of solidification, can be combined with the utilization of waste into mixed raw materials to make useful products. Solidification functions to bind the components of hazardous materials so that they are not easily leaching out to the environment. The Toxicity Characteristic Leaching Procedure (TCLP) test that has been conducted on the use of paint waste as a mixture for making paving blocks shows that the test value is below the environmental quality standard. Brick is generally used as a building material for walls covered with sand and cement so that the use of this paint waste binds the components of hazardous materials to the brick which are not easily leached.

4. Conclusion

The addition of paint waste to the mixture of sand and cement for making concrete brick increases the compressive strength of the product and decreases water permeability. The addition of paint waste serves as a binder for concrete bricks. Utilization of waste as a raw material for a mixture of product manufacturing can be used as a way of managing industrial environments that produce solid waste.

References

[1] S P Raut, R V Ralegaonkar, S A Mandavgane, 2011, Development of sustainable construction material using industrial and agricultural solid waste: A review of waste-create bricks, Construction and Building Materials, Volume 25, Issue 10, October 2011, p. 4037-4042

[2] Md Sufiuddin, M Z Jumaat, M A Salam, M S Islam, R Hashim, 2010, Utilization of solid wastes in construction materials, International Journal Physical Sciences (Int. J. Phys. Sci), Vol.5(13), p. 1952-1963.

[3] D Jevtic, D Zakic, A Savic, 2012, Achieving sustainability of concrete by recycling of solid waste materials, Mechanical Testing and Diagnosis, Volume 1, p. 22-39

[4] R Kamala, B K Rao, Reuse of solid waste from building demolition for the replacement of natural aggregats, 2012, International Journal of Engineering and Advanced Technology, Volume 2, Issue 1, p. 74-76.

[5] A A Arbunowo, P Purwanto, MA Budihardjo, Waste to Product: Bisolum-Bricks, Incorporating of WWTP Sludge of Textile Industry into Bricks for Wall Pairs, 2019, Jurnal Riset Teknologi Pencegahan Pencemaran Industri 10 (2), p. 29-35

[6] P Purwanto, A D P Citra, 2019, Recycling and processing of solid waste into products of the cosmetic packaging industry, Journal of Physics : Conference Series, 1

[7] A D P Citra, P Purwanto, H R Soenoko, Life Cycle Assessment and Quality of Utilization of Paint Waste as a Raw Material of Paving Block, 2020, Journal of Ecological Engineering 21 (2), p. 89-94

[8] T Sekar, N Ganesan, N V N Nampoothiri, Studies on strength characteristics on utilization of waste materials as coarse aggregate in concrete, International Journal of Engineering Science and Technology (IJEST), 2011, Vol. 3 No. 7, p. 5436-5440

[9] N V Boltakova, G R Faseeva, R R Kabirov, R M Nafikov, Yu A Zakharov, 2017, Utilization of inorganic industrial wastes in producing construction ceramics. Review of Russian experience for the years 2000–2015, Waste Management, Volume 60, p. 230-246
[10] M R Sudhir, M Beulah, P S Rai, G Gayathri, 2020, A microstructure exploration and compressive strength determination of red mud bricks prepared using industrial wastes, *Materials Today: Proceedings*

[11] K Ayse, K A R Filiz, 2016, Properties of concrete containing waste expanded polystyrene and natural resin, *Construction and building materials*, Volume 105, p. 572-578

[12] Government Regulation of Republic Indonesia No 101 Year 2014 concerning Hazardous Waste Management.