Waste Technology (WasTech)
Journal homepage: http://ejournal.undip.ac.id/index.php/wastech
An International Journal

# Strategies for Paint Waste Minimization in the Packaging Industry

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**Abstract** - *Cosmetic packaging painting using an alkyd resin compound is to make a smooth, glossy surface and attract the attention of consumers. The generated waste is handed over to a third party and has not been utilized as a product, so it requires a high enough cost. This research aims to develop a waste management strategy from its source to its utilization into a product. The research method uses a block diagram of the production process to identify waste generation and opportunities for prevention and reduction. Waste arising from alternative uses is created into a product leading to zero waste. This approach provides economic and environmental benefits for the cosmetics packaging industry.*

***Keywords*** *– paint waste, cosmetic packaging, waste to product, zero waste*

Submission: March 17, 2020 Correction: April 23, 2020 Accepted: April 30, 2020

**Doi**: http://dx.doi.org/10.14710/wastech.8.1.18-21

[How to cite this article: Citra, A.D.P, Purwanto, P. (2020). Strategies for Paint Waste Minimization in the Packaging Industry. *Waste Technology,* 8(1),18-21. doi: http://dx.doi.org/10.14710/wastech.8.1.18-21]

## 1. Introduction

The packaging industry in Indonesia projected to grow by 6 per cent in 2020. One of the packaging users is the cosmetic industry. The cosmetics industry is growing by 9 per cent in 2019, by directing the transformation towards digital technology from production to distribution to consumers. Growth was driven by growing domestic and export market demand, as a trend of people began to pay attention to body care products as their primary needs. [1]

The packaging is one of the supporting elements needed by the cosmetics industry as a container of cosmetic products. It made of plastic-coated with paint to give a good appearance and prevent dirt sticking. The paint material used is an alkyd compound which was developed in the paint industry because it has a suitable adhesive and coating characteristics [2], with suitable organic solvents.

Paint waste arises from damage and expired paint and during the painting process. Proper waste management can prevent and reduce negative impacts on the environment and the health of the workforce. Nevertheless, the management of paint waste still focuses more on processing than prevention and reduction. Alkyol [3], investigate the processes that paint manufacturing wastewater using an electrocoagulation process as a fast and effective method with a COD removal efficiency of 94%. Da Silva et al. [4] investigates the processing of paint manufacturing wastewater by a combination of coagulation / electrochemical methods. The coagulation process can meet the needs of water recycling, while the electrochemical process is used to discharge wastewater to the environment.

Research has also been conducted using microorganisms to treat paint wastewater and paint-containing gas emissions [5] [6] and the combination of biotrickling filtration with photocatalytic oxidation [7]. He et al. found that the results of the main components of waste gas are ethyl acetate, toluene, ethylbenzene, xylene, ethyl toluene and trimethyl benzene. The removal efficiencies of these VOCs ranged from 79.4% to 99.8% even after 90 days of operation.

Incineration of paint waste containing TiO2 was investigated by Massari et al. [8] showed that the combustion gas did not contain TiO2 compound, but found a low release of Ti was measured, less 1 mg/kg, during the leaching test of vitrified ashes

There is various way to prevent paint waste generation from its sources, such as the application of technology and standard operating procedures. Study on improving the quality of paint to reduce failure using neural network techniques in the automotive industry was

investigated by Javad et al. [9]. The painting success depends on the thickness of the paint layer as an input factor of the spray process identified for each layer on a plate [9].

Mc Carty et al. [10] make efforts to utilize paint waste into products that are useful as industrial fuels. The paint sludge from the spray paint booth operation which has been separated by its water content is used as a power plant fuel, so there is no paint waste disposal to the landfill with a cheap and safe process.

Utilization of waste as a raw material for paving block mixture is carried out by several researchers [11] [12] [13]. Gencela et al. [11] conducted a study on the use of marble as a cement substitute aggregate for the manufacture of paving blocks. Marble waste can be used as a substitute for aggregate paving blocks with reduced mechanical strength. Gamalath et al. [12] using rubber waste as a mixing material for paving blocks, used as a replacement of coarse and fine aggregates in paving blocks, however, compressive strength gets reduced with the addition of rubber waste. Citra et al. using paint waste as a raw material for a mixture of paving blocks with a composition of 5% produce compressive strength with paving blocks without the addition of waste [13].

Waste minimization in the paint industry is done by replacing hazardous materials, changing technology, and separating waste streams to facilitate waste recycling. This method can reduce plant operating costs [14].

Purwanto and Citra [15] investigated the recycling of solid waste and turned it into a useful product in the cosmetics industry as part of efficient and profitable waste management. The technical feasibility study aims to increase production to reduce waste generation, followed by a study of environmental and occupational health impacts [16]. This approach provides economic benefits and improves the health of workers.

Previous research emphasizes the treatment of waste, recycling and utilization of waste into products in industries that use the painting process. This research aims to develop a comprehensive waste minimization strategy that can be applied to the paint user industry.

## 2. Methodology

The study was conducted in the paint user industry for the surface coating of packaging containers.

The method used is an evaluation of waste management based on PDCA (Plan-Do-Check-Act) as part of implementation in the industry. The data used comes from SDS (Safety Data Sheets) and material information from suppliers on the website and the industry.

Strategy for waste minimization was developed based on the findings of the implementation of waste minimization.

## 3. Result and Discussion

### 3.1 Paint Materials

The main components of the paint are composed of resins, pigments, additives, and solvents. The resins act as a binder to bind other paint components. It also attaches the pigment content or dye mixture to the surface so that it is firmly attached. Types of resins in paints include acrylic resins, alkyd and polyester resins, amino resins, epoxy resins, and polyurethanes [17]. The solvents used are solvent and water-based. The pigment can come from natural compounds, organic compounds and metal oxides. In the packaging industry, it studied using alkyd resins and organic solvents.

### 3.2 Identification of Sources of Paint Waste

Identification of paint waste generation based on the coating process block diagram on the packaging using paint. The process steps include paint preparation, surface cleaning, spray process, curing and quality control.

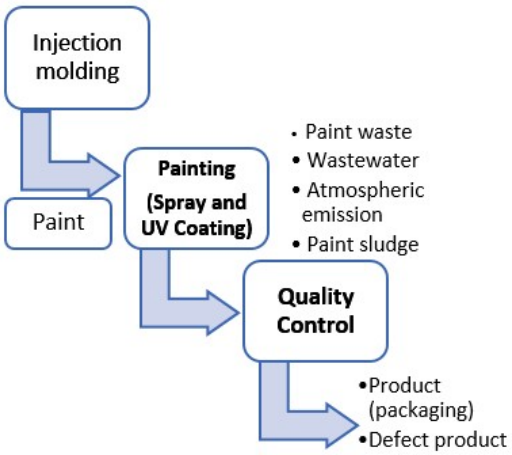


Figure 1. Spray painting process for packaging

The painting process uses a spray gun to spray paint on the surface of UV light-aided plastic packaging for the curing process. Painting is carried out continuously in a part of the package which moves past the spray gun. When the package reaches the starting point, the spray gun will spray paint to the surface until the endpoint passed. Paint waste appears during spraying, captured with air screen to be taken between cat waste and wastewater. Wastewater is treated in the Wastewater Treatment Plant to produce effluent that meets environmental quality standard requirements, while the remaining solids are in the form of sludge containing paint waste. Air emissions containing the remaining paint took from the cyclone which transferred between the remaining liquid droplet with air.

### 3.3 Characteristic of Paint Waste

Paint waste classifies as hazardous and toxic waste (B3) under Government Regulation of the Republic of Indonesia No. 101 of 2014 regarding Management of Hazardous and Toxic Material Waste [18]. It based on flammable, and toxic characteristics, with code A325-1

(Paint and varnish waste containing organic solvents) and A325-2 (Sludge of paints and varnishes containing organic solvents).

### 3.4 Waste Minimization Program

According to Nilsson et al. [19], the paint waste minimization program accomplish through steps as follow; planning, identification of minimum minimization opportunities, technological, economic and environmental feasibility studies, program implementation activities, monitoring performance achievements, and action planning for continuous improvement.

### 3.5 Waste Minimization Technique

Techniques for paint waste minimization using the clean production approach [19] include the exchange of raw materials and support chemicals, modifying the process, modifying the equipment, improved process control, reliability of operation, avoiding accidental spills, separation and extraction of by-products, equalization of wastewater flow, choice of products and product designs.

### 3.6 Waste to Product

Turning waste into products as a whole can be used as a waste minimization strategy. The target of paint waste management with the application of minimization techniques will lead to zero waste conditions [15]. Waste paint consisting of polymeric materials and organic solvents having heating values can be used as fuel in the industry [10]. Drying waste paint after being separated from the solvent can be used as raw material for making concrete bricks (paving blocks) and other brick products [17].

### 3.7 Hazardous Paint Waste Handling

Paint materials and paint waste contain resins, dyes and solvents with flammable and toxic and hazardous characteristics. Hazard control is required when the pressure spraying process keep closed. Workers need to know the potential hazards and risks to health in order to prevent adverse impacts on health during work [20]. The use of personal protective equipment for workers includes respiratory, face and skin protectors as well as gas mask, safety glass (google) and the use of general and standard personal protective equipment.

### 3.8 Strategy for Paint Waste Minimization

The paint waste minimization strategy in the industry uses a hierarchy of waste management ranging from waste prevention, source reduction, recycling, waste to product, waste treatment, and landfilling. The application of waste prevention to waste to product can reduce the generation of waste as small as possible to zero waste.

## 4. Conclusion

The management of paint waste still focused on wastewater treatment and gas emissions, and solid paint waste has not been carried out by the industry. The waste minimization strategy changes the management paradigm with a clean production approach towards zero waste generation.

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