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Effect of Acid-Based Level on Storage Acrylic Emulsion Paint

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Abstract— In the present study, a novel methodology was developed for the assessment of acid-based effect levels on the storage acrylic emulsion paints., It was found that the acrylic emulsion paint was clumping and smelled bad on the organoleptic test. Most bacterial growth on the microbiological test. This occurred in the acrylic emulsion paint sample which had a pH level of 7. Microbiological checking found little bacterial growth in the paint which had a level of pH 9, which is relatively safe in the storage process for 30 days and has good results in organoleptic and microbiological tests.

Keywords— Paint; Acrylic emulsion paint; Acid-base level.

1. INTRODUCTION

Paint manufacture is a design work about raw materials mixing technique in such a way to produce paint with quality that meets the requirements and expected colors [1]. Paint has ended up one of the foremost imperative and indispensable materials in our contemporary world for surface protection and decoration of different components. Paints can be widely classified into polyamide epoxies, pigments, primers, resistance coatings, ketosolventents, thinners, and other additives [2].

Acrylic polymer paints (or latex paints) are widely used by artists and are available in a variety of qualities manufactured by various companies. The production of acrylic emulsion polymers by the emulsion polymerization technique produces a binder by mixing the monomers with water, surfactants, and an initiator. The properties and materials of acrylic emulsion paints have been extensively studied for architectural and industrial purposes [3].

Paint is a mixture of binders, fillers, solvents, and small amounts of additives. One of the water-based binders that does not contain heavy metals, especially lead, is acrylic [4]. The materials used in the manufacture of acrylic emulsion paints, are binder using styrene-acrylic (acronal) polymer based material, dye (pigment) for white color using titanium dioxide (TiO_2), filler material using lime ($CaCO_3$) and kaolin, thickener using natrosol, pH regulator using NaOH solution, dispersing agent using disloid, wetting agent using typol, anti-foaming using nofoam, coalesting agent using texanol, co-solvent using ethylene glycol, preservative using ecocide, and water as a solvent [1].

Fungal strains including *Aspergillus flavus*, penicillium, cladaspor, and bacterial strains including bacillus, nitrifying bacteria, and thiobacillus grow on the walls under suitable conditions [5]. The growth of bacteria and fungi on the walls causes allergic reaction and infectious diseases in humans.

In Indonesia, many people use paint as a coating and decoration in their business. The more market interest in the need for paint, the more bulk paint is sold which is more economical than factory paint. The negative impact that may arise by using result of the proliferation of the kilogram paint industry at low prices is the emergence of paint products of varying quality. The Indonesian National Standard (SNI), for wall paint products SNI 3564:2014 "Emulsion Wall Paint", can be used as a reference to protect consumer interests and as a barrier to imported products to protect domestic industries [6].

In the paint industry, referring to the applicable standards to ensure the quality and safety of consumers in using the paint produced, there are several things to be considered in producing paint. One thing to note is the shelf life of the paint itself when it reaches consumers. Ensuring the shelf life of the paint is affected by production materials, temperature, and production processes. From this, several aspects of testing need to be carried out, such as checking pH levels and microbiological tests.

This research aims to make acrylic emulsion paint that is environmentally friendly and has a long shelf life using the acid-base level regulation test method with the addition of NaOH and citric acid as testers to regulate the acid-base levels. After the pH testing process the test continues to the microbiological test

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stage to find out how quickly the microbes will damage the paint so that it affects the shelf life of the paint.

2. EXPERIMENTAL SECTION

2.1. Materials

The materials used in this research were acrylic paint, NaOH 5% (Merck), Citric acid 5% (Merck), and peptone water.

2.2. Procedure

2.2.1. Preparation of acrylic emulsion paint samples

Six storage containers were prepared for archive bottles, then 100 grams of acrylic emulsion paint was weighed in each container. The initial pH of acrylic emulsion paint was tested with a pH meter. Then, 1 mL of NaOH 5% solution was added to two samples of acrylic emulsion paint, then the pH level was checked. One mililiter of NaOH 5% was added to obtain pH 9 data, 1 mL of citric acid 5% solution were added to each of the to two samples of acrylic emulsion paint, then the pH levels obtained were checked. The procedures were repeated to obtain pH 8 and 7.

2.2.2. Storage procedure for acrylic emulsion paint

First the oven was turned on at 50 °C, until the temperature was stable. Then, enter 3 samples of acrylic emulsion paint were added which had been adjusted to the pH level. The acrylic emulsion paint was stored for 30 days at 50 °C oven temperature. Meanwhile, the other 3 samples of acrylic emulsion paint whose pH level had been adjusted were stored for 30 days at room temperature of 27 °C.

2.2.3. *Organoleptic test*

Acrylic emulsion paint samples that had been stored for 30 days were removed and left for 20-30 min. The 6 samples of acrylic emulsion paint were examined, and the condition of each painting was observed. The viscosity stirring, mean, and deformation of each acrylic emulsion paint sample were observed.

2.2.4. Paint samples platting procedure

A sample of acrylic emulsion paint weidghed 1 g in one shot. Nine mililiters of peptone water was added and stirred until homogeneous, henceforth this solution was called peptone water-1. Nine mL of peptone water was taken using a measuring pipette. 1 mL of peptone water-1 solution was added and stirred until homogeneous, hereinafter referred to as peptone water-2 solution. Next two sterile petri dishes were prepared, 1 ml of peptone water-2 solutions was taken and put into the petri dish. The plate count analyte solution was poured into each petri dish, then stirred. Let stand until hardened, and petri dish was put in the incubator for 48 h. The UV light was turned on for 1 h before plating.

2.2.5. Calculation of Total Plate Count (TPC) Procedure

Calculation of Total Plate Count (TPC) in the sample was done by counting the colonies which were round in the egg yolk. The result of TPC calcite Latino won was multiplied by 10^3.

2.2.6. Test of acid-based level based on storage acrylic emulsion paint

Six samples of paint production of each weighed 100 gr. The pH level of the production paint sample was checked. 5 % NaOH solution and 5% citric acid solution were added 5 drops to each sample to reach the predetermined pH level. The production paint sample that had been added was checked plus a pH regulator. The production samples were marked for observation. The production paint samples were stored for 30 days at 27°C and 50°C. Microbiological tests were carried out and observed after 30 days. Data and documentation of the findings were obtained.

3. RESULT AND DISCUSSION

This study aimed to determine the effect of acid-based levels on the storage of acrylic emulsion paint. The research used an active material of 100 g of acrylic emulsion paint for two different samples, with each sample varying in pH 7, 8, and 9 at 27 °C and 50 °C. Variations of pH 7, 8, and 9 are set according to the Indonesian National Standard, SNI), for wall paint products, SNI 3564:2014 "Emulsion Wall Paint", the quantitative quality requirements for emulsion wall paint for pH are 7-9.

It was found that the acrylic emulsion paint rose and smelled bad on organoleptic inspection (**Fig. 1**). This occurs to acrylic emulsion paint samples that have a pH level of 7. The best research results were samples of acrylic emulsion paint at 27 °C and 50 °C at pH 9 with no smell and no lumps (**Table 1**).

Table 1. Organoleptic test

Paint pH	Temperature (°C)	Storage Time (day)	Organoleptic Test Result	
			Smell	Appearance
7	27	30	mild smell	few lumps
	50	30	smell	lumps
8	27	30	mild smell	no lumps
	50	30	mild smell	no lumps
9	27	30	no smell	no lumps
	50	30	no smell	no lumps

Total Plate Count (TPC) is a quantitative test to determine the number of microbes present in a sample. TPC can be used as an indicator of product hygiene, environmental microbial analysis of the finished products, and process control indicators, and can be used as a basis for suspicions that a product is acceptable or not based on its microbiological quality [7].

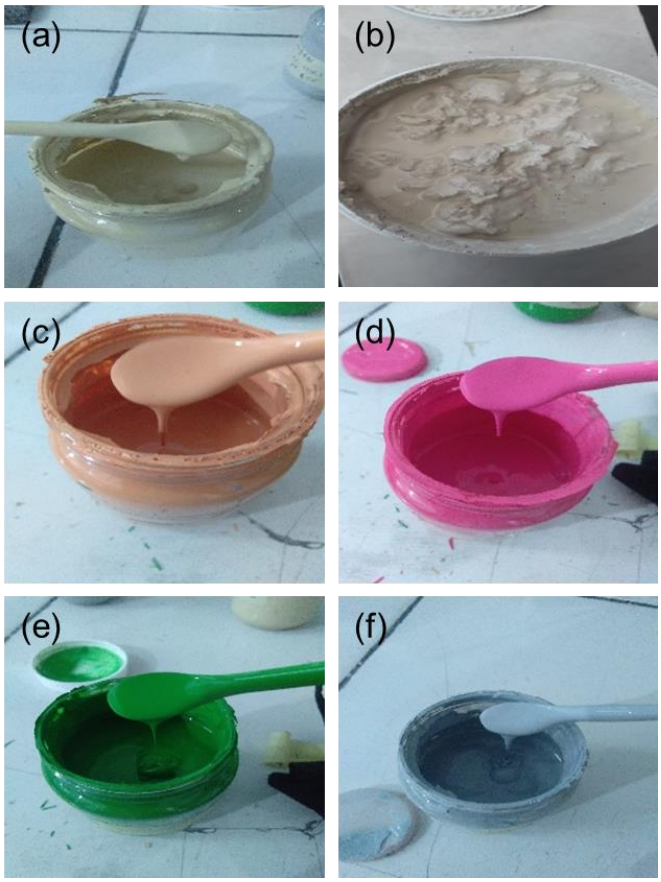

Fig. 1. Organoletic test of paint at pH 7 (a, b); 8 (c, d); and 9 (e, f)

The results of the TPC test showed that the highest number of colonies was 0.55 × 10^3 CFU/mL in the acrylic emulsion paint sample treatment at pH 7 at 50 °C and the lowest colony number was 0.25 × 10^3 CFU/mL in the acrylic emulsion paint sample treatment at pH 9 at 27 °C.

Table 2. Microbiology test

Paint	Temperature (°C)	Storage Time (day)	Microbiology Test Result (CFU/ml)
7	27	30	0.40 × 10^3
	50	30	0.55 × 10^3
8	27	30	0.30 × 10^3
	50	30	0.40 × 10^3
9	27	30	0.25 × 10^3
	50	30	0.30 × 10^3

In the organoleptic and microbiological tests, it was found that the sample had a smell with a lumpy texture and the most bacterial growth in the acrylic emulsion paint sample which had a pH level of 7 (**Table 2**). While the acrylic emulsion paint sample which had a level of 9 showed relatively safe in the storage process for 30 days. It showed good results on organoleptic and microbiological tests, which was odorless and no lumps and had relatively little bacterial growth.

The deterioration and bacterial colonization of paint are consequences of environmental conditions such as; temperature, pH condition, moisture, substrate composition, and storage time. In a humid tropical climate like Indonesia, bacterial contaminants are encouraged to grow, degrade, and deteriorate acrylic paints [8].

4. CONCLUSION

It can be concluded from this study that the paint storage could be influenced by the pH level of the paint to determine the storage period. The higher the pH of normal/acidic paint, the shorter the shelf life of the paint. The paint could be found smelling clumps quickly and the growth of bacteria was relatively fast.

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CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

AUTHOR CONTRIBUTIONS

Henny Parida Hutapea and Nathanael Setna were conducting the research and TPC calculations. Henny Parida Hutapea and Yulia Shara Sembiring wrote and revised the manuscript. All authors agreed to the final version of this manuscript. All authors agreed to the final version of this manuscript.

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