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The Effect of Variation of Latex Mixed Storage Time Polystyrene and Natural Rubber Concentrate Latex on the Stability of the Emulsion by Using Emulsifier Sodium Lauryl Sulfate

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Abstract. Preparation of latex polystyrene with emulsifier ammonium lauryl sulfate (ALS) has been carried out by dissolving styrofoam (foam polystyrene) in toluene (30/70). And then polystyrene solution was mixed with aquadest, at ratios polystyrene and aquadest (v/v) were 90:10, 70:30, 50:50, 70:30, and 10:90 then added 10 mL of sodium lauryl sulfate (NLS) solution at concentrations 30%. The characterizations of the latex polystyrene included the stability determination during storage by density measurement and the determination of particle sizes and forms by microscopic optic observation. The results show that latex polystyrene ratio 90:10 is the most stable with density value constant during storage, are 0,848 g/mL for 30%. The particle sizes average is 1,56 μm with the distribution particle sizes decreasing as latex is 8,3 μm. Photomicrograph microscope optic shows that latex polystyrene NLS 30% has familiar particle forms and sizes

Keywords: Emulsifier, Natrium Lauryl Sulfate, Polystyrene, Natural Rubber, Latex.

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1 Introduction

Used polystyrene is a synthetic polymer material that is widely used, especially in the form of stereo form, polystyrene itself is not recycled so polystyrene waste treatment must be carried out properly so as not to harm the environment. Utilization of used polystyrene materials is one way to minimize polystyrene waste. (Damayanthi, 2007).

Xuefeng Hu et al, (2009) have investigated the manufacture of polystyrene nano latex by routine UV-induced emulsion polymerization. This study showed that the presence of functionalized hydroxyl polymer chains can help stabilize small particle latex colloids and prevent agglomeration even at low surfactant concentrations. Surfactants are always needed to

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achieve a stable emulsion. So when a small amount of soap is added little by little into the system, the result of the mixing is an emulsion (Adamson, 1990).

The emulsifier sodium lauryl sulfate has succeeded in providing good sensitivity values in lowering the surface tension of concentrated latex, and concentrated natural rubber latex can be used as a polymer modification material, especially to increase the strength of other polymeric materials. The concentrated latex used is high ammonia type concentrated latex, so the concentrated latex used is stable for a long time (Muis. 2010).

One of the factors that determine the nature or character of the emulsion polymer is the particle size. Particle size greatly determines the flow properties and stability of the polymer. (Budianto, E.2008). In general, the stability of an emulsion or dispersion system will decrease with increasing particle size and distribution. (Supri, 2004).

This research will study the effect of variations in the storage time of a mixture of polystyrene latex and concentrated natural rubber latex on the stability of the emulsion and the effect of the mixture on particle size and distribution.

2 Materials and Methods

2.1 Equipments

The equipments were used in this research include: beaker, measuring cup, analytical balance, pycnometer, measuring flask, mixer, spatula, dropper, volume pipette, optical microscope, and suction rubber ball.

2.2 Materials

In this study, the materials used include aquadest, polystyrene foam, concentrated natural rubber latex obtained from PT Industri Karet Nusantara, toluene, and sodium lauryl sulfate.

2.3 Preparation of Concentrated Polystyrene Solution

A total of 70 mL of toluene was put into a beaker glass. Then added 30 g of polystyrene foam little by little. Then stir until all the polystyrene foam is dissolved.

2.4 Preparation of Sodium Lauryl Sulfate Solution 30%

Weighed as much as 30 g of sodium lauryl sulfate, and put into a beaker glass. Added 50 mL of distilled water, stirred and put into a 100 mL volumetric flask, and diluted to the limit.

2.5 Manufacturing of Polystyrene Latex

A total of 90 mL of polystyrene solution was put into a beaker glass. Add 10 mL of distilled water, then add 10 mL of 30% sodium lauryl sulfate solution drop by drop slowly while stirring until homogeneous.

2.6 Manufacturing of Polystyrene Latex Blends And Natural Rubber Concentrated Latex

A total of 50 mL of polystyrene latex solution was put together into a beaker glass. Added 50 mL of concentrated natural rubber latex. Then stirred using a mixer. The same treatment was also carried out for a solution of polystyrene and concentrated natural rubber latex in a ratio of 70:30, 80:20, 20:80, 60:40, 40:60 30:70, 90:10, and 10:90. The results obtained were tested for stability and observed for stable particle shape and size.

2.7 Measurement of Solution Density Polystyrene and Polystyrene Latex

This test was carried out on all polystyrene latex and a mixture of polystyrene latex with concentrated natural rubber latex formed during storage periods of 1, 3, 5, and 7 days. Prepared a 5 mL pycnometer, and weighed the mass of the empty pycnometer. The sample is inserted into the pycnometer. Then the mass was weighed using an analytical balance, weighed three times and the density value was calculated.

$$density = \frac{m_{contain\,pycnometer} - m_{empty\,pycnometer}}{v_{pycnometer}}$$

2.8 Determination of Particle Size and Shape

One drop of the sample is placed on a glass slide. The optical microscope is turned on, and the slide is placed under the microscope lens. Observed under an optical microscope at 400x magnification. The particle size distribution was calculated and then the average particle size was calculated.

3 RESULTS AND DISCUSSIONS

The most stable polystyrene latex was obtained at a ratio of 90:10 at 30% NLS concentration. Furthermore, to the most stable polystyrene latex, concentrated natural rubber latex was added in a ratio of 30:70, 70:30, 40:60, 60:40,50:50,20:80 and 80:20, and the most stable was obtained at the ratio of 50:50.

Analysis of the particle size distribution of polystyrene latex was carried out using a manual method, namely by counting the number of polystyrene latex particles that appeared in the results of observational photography of polystyrene latex particles using an optical microscope.

Table 1. Data on the density measurement of polystyrene latex with 30% NLS at various storage times

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Polystyrene solution (mL): Natural rubber concentrated latex (mL)	**Storage time (days)**			
	1	**3**	**5**	**7**
90 : 10	0.812	1.006	1.010	1.010
10 : 90	0.984	0.984	0.998	1.022
30 : 70	0.982	1.004	0.998	1.012
70 : 30	1.018	1.018	1.022	1.028
50 : 50	0.998	0.998	0.998	0.998
40 : 60	0.996	1.002	1.004	1.008
60 : 40	1.006	1.010	1.018	1.022
20 : 80	0.983	0.983	1.016	1.022
80 : 20	0.808	0.993	1.010	1.010

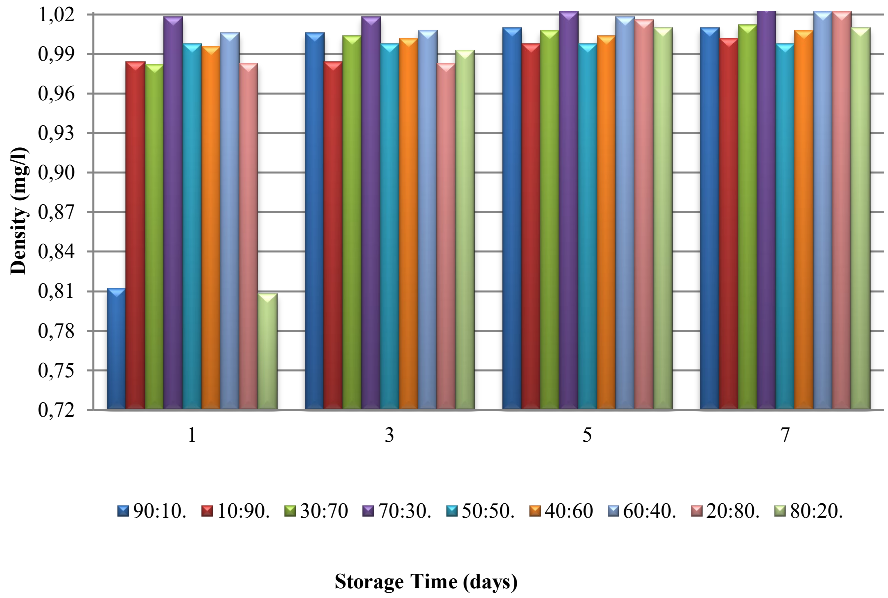

Figure 1**.** Graph of density versus storage time of a mixture of polystyrene latex with concentrated natural rubber latex

As seen in the graph from figure 1, it can be seen that the mixture of polystyrene latex and concentrated natural rubber latex with a ratio of 50:50 did not change the density value during the storage period, with a constant density value of 0.998 g/mL. It shows that the mixture of polystyrene latex and 30% NLS natural rubber concentrated latex at a ratio of 50:50 is stable during the storage period. This is due to the increase in the degree of crosslinking of the two components resulting in a more homogeneous phase and the synergistic properties of the two mixtures increase (Thamrin, 2003).

Table 2. Data from the measurement of the density of the mixture of polystyrene latex with concentrated natural rubber latex with 30% NLS at various storage time variations.

Polystyrene solution (mL): Aquades (mL)	**Storage time (days)**

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	1	**3**	**5**	**7**
90 : 10	0.848	0.848	0.848	0.848
70 : 30	0.934	0.976	0.986	0.986
50 : 50	1.056	1.056	1.064	1.13
30 : 70	1.054	1.056	1.064	1.12

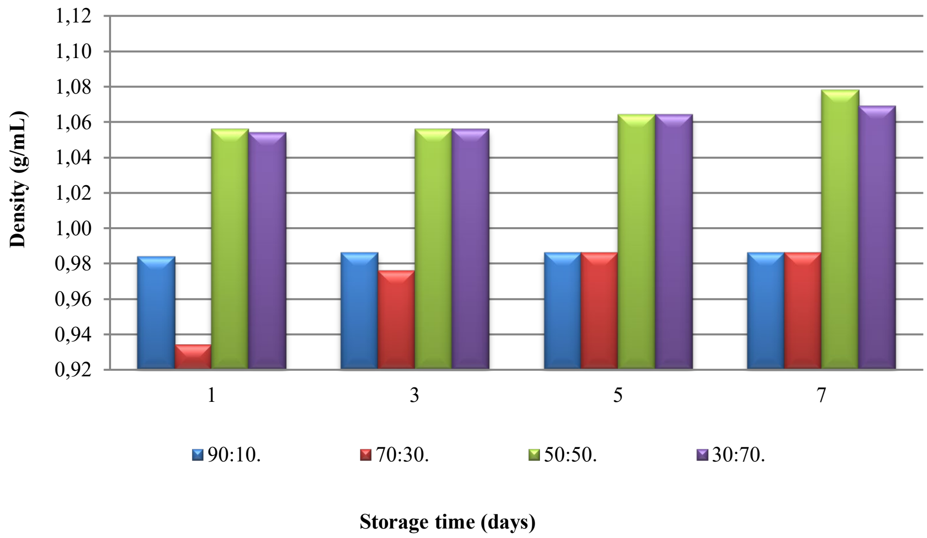

Figure 2. Graph of density versus storage time of polystyrene latex mixtures

3.1 Particle Size and Shape Analysis

Particle size greatly determines the properties of emulsion polymers such as flow properties and stability. Analysis of the particle size distribution of polystyrene latex was carried out using a manual method, namely by counting the number of polystyrene latex particles that appeared in the results of observational photography of polystyrene latex particles using an optical microscope.

Table 3. Particle Size Distribution for Polystyrene Latex at 30% NLS Concentration

Particle Size (μm)	**Frequency Distribution (%)**
1	75
2	11.1
3	4.9
4	3.4
5	2.3
6	1.5
7	0.6
8	0.1
9	0.3
10	-
11	-

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Table 4. Distribution of particle size of polystyrene latex mixture and concentrated natural rubber latex

Particle Size (μm)	Frequency Distribution (%)
1	-
2	-
3	-
4	-
5	10
6	10
7	10
8	10
9	30
10	10
11	-
12	-
13	10

From the particle size distribution data, a graph of the distribution of the latex particle size distribution is obtained as shown in the following figure:

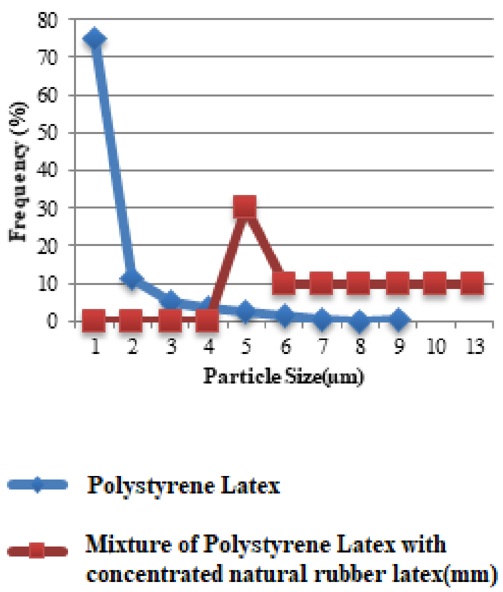

Figure 3. Particle Size Distribution of Polystyrene Latex and mixture of Polystyrene Latex with concentrated natural rubber latex

3.2 Average Particle Diameter

By using equation 1 it can be determined the average particle diameter.

$$(\overline{\mathbf{D}}_{\mathbf{n}}) = \frac{\sum n_i D_i}{\sum n_i} = \sum f_i D_i \quad \dots \textit{equation } 1$$

The average particle diameter of polystyrene latex:

$$\overline{\mathbf{D}}_{\mathbf{n}} = (1 \times 75\%) + (2 \times 11\%) + (3 \times 4.9\%) + (4 \times 2.3\%) + (5 \times 1.5\%) + (6 \times 1.5\%) + (7 \times 0.6\%) + (8 \times 0.1\%) + (9 \times 0.3\%) + (29 \times 0.1\%) = 1.56\ \mu m$$

The average particle diameter of polystyrene latex with concentrated natural rubber latex:

$$\mathbf{\overline{D}_n} = (1 \times 0\%) + (2 \times 0\%) + (3 \times 0\%) + (4 \times 10\%) + (5 \times 10\%) + (6 \times 10\%) + (7 \times 10\%) + (8 \times 10\%) + (9 \times 10\%) + (10 \times 20\%) + (12 \times 20\%) = 8.3\ \mu m$$

From figure 3, it can be seen that the average diameter ($\overline{D}_n$) of polystyrene latex particles is 1,56 μm, while the mixture of polystyrene latex with concentrated natural rubber latex is 8,3 μm. This shows that the addition of a concentrated mixture of natural rubber latex to polystyrene latex makes the particle size of the polystyrene latex formed larger. micelles that hold, the particle size of the polymer (Budianto, E, 2008).

3.3 Micrograph Optical Microscope of Particle

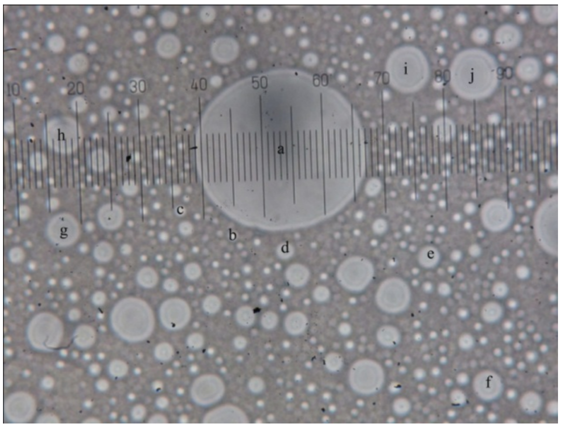

Figure 4. Polystyrene Latex with 400× magnification

In figure 4, we can see various types of particle sizes. In figure (a) 29 μm; (b) μm; (c) 2 μm; (d) 3 μm; (e) 4 μm; (f) 5 μm; (g) 6 μm; (h) 7 μm; (i) 8 μm; and (j) 9 μm.

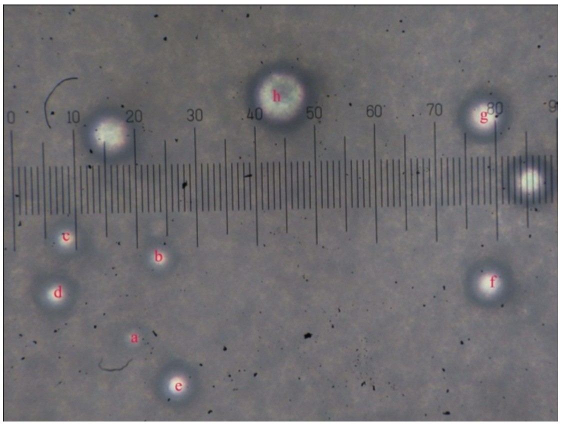

Figure 5. The mixture of polystyrene latex and concentrated natural rubber latex with 400× magnification

In figure 5, we can see various types of particle sizes. In figure (a) 4 μm; (b) 5 μm; (c) 6 μm; (d) 7 μm; (e) 8 μm; (f) 9 μm; (g) 10 μm; and (h) 12 μm.

From the micrograph optical microscope as shown in figure 4 and figure 5. Visually, it can be seen that the polystyrene latex in the image has a more uniform particle size and shape than the mixture of polystyrene latex with concentrated natural rubber latex. According to (Goodwin, 2004), the shape of the emulsion particle size is still in the general emulsion particle size scale, namely 1 - 10 μm. Because surface tension is an important parameter in controlling the particle size of the emulsion. If the surface tension is lowered to a very low level, the particle size can be reduced even further.

4 Conclusion

Polystyrene latex can be made by using used polystyrene foam dissolved in toluene with a water dispersing phase and sodium lauryl sulfate as an emulsifier. The synergistic mixture between polystyrene latex and concentrated natural rubber latex (v/v) is 50:50, where the density value during storage is 0.998 g/mL, with variations in storage time of 1, 3, 5, and 7 days and the addition of concentrated natural rubber latex to polystyrene latex increased the average particle size of polystyrene latex, from 1.56 μm to 8.3 μm after adding a mixture of concentrated natural rubber latex to polystyrene latex.

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