

VARIATION OF THE EFFECTS OF ADOPOL EVS-9279X ON THE EMULSION AND FILM PROPERTIES OF EMULSION PAINT WITH TIME.

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ABSTRACT

The effects of Adopol EVS-9279X on the emulsion and film properties of emulsion paint using 5%-10% w/w sample formulations have been examined. Variation of these effects with time was investigated in this study using the same 5%-10% w/w sample formulations. The emulsion and film properties were measured at four (4) weekly intervals. Results indicate that properties, such as, surface tension, drying time and water absorption, which were initially lowered originally by Adopol EVS-9279X, especially at low formulation concentrations, showed further reductions when monitored for 8 weeks. At 7% w/w formulation, drying time was lowered from 33.5 min to 20.0 min in week 0, 19.7 min in week 4 and 19.6 min in week 8. Surface tension was lowered from $1.013 \times 10^{-1} \text{ N/m}$ to $6.56 \times 10^{-2} \text{ N/m}$ in week 0, $6.143 \times 10^{-2} \text{ N/m}$ in week 4 and $6.043 \times 10^{-2} \text{ N/m}$ in week 8 at 5% w/w. Water absorption was lowered from 25.2% to 23.5% in week 0 and 20.7% in week 8 at 5% w/w concentration.

Solid content and specific gravity of the samples were initially lowered by Adopol EVS-9279X with subsequent gradual increase within the 8 week study period. At 6% w/w sample formulation, specific gravity was lowered from 1.53 to 1.47 in week 0, this increased to 1.56 in weeks 4 and 8. At 10% w/w formulation, solid content decreased from 53.4% to 47.5% in week 0 and then increased to 49.3% in week 4 and 49.6% in week 8. The pH, which was increased by Adopol EVS-9279X, showed negligible variation while apparent viscosity and flexibility showed no variation within the 8 week period.

KEY WORDS: Adopol EVS-9279X, Emulsion paint, Time

INTRODUCTION

Adopol EVS-9279X, a product of Gamor Chemical and Allied Limited, Port Harcourt is an emulsion viscosity stabilizer for emulsion paints, agro-industrial suspension and cosmetics. The chemical nature and physical properties of Adopol EVS-9279X have been reported (Airuehia, 1992; Otaigbe and Onyemenonu, 2004; Otaigbe and Onyemenonu, 2004). It has been reported to have the ability of locking up unwanted metal ions with other additives or trace metals in compounds. This consequently makes it possible to improve shelf life, colour clarity and stability (Airuehia, 1992). The characterization and application of differential film formation in Adopol Standard Defoamer, Adopol EVS-9279X and Poly (vinyl acetate) have been studied (Ebosie, 1996). The effects of Adopol EVS-9279X on the emulsion and film properties of emulsion paint, poly (vinyl acetate) and acrylic resin have also been reported (Otaigbe and Onyemenonu, 2004; Otaigbe and Onyemenonu, 2004).

It was found in that study to have exhibited the capacity to lower the specific gravity, solid content and surface tension; increased the pH and water resistance at low formulation concentration range of 5%-6% w/w. The flexibility was improved while apparent viscosities remained unaltered. In continuation of the study of the effects of Adopol EVS-9279X on the emulsion and film properties of emulsion paint, the variation of the effects of Adopol EVS-9279X on the emulsion and film properties of emulsion paint with time is reported here. This is to establish its effect on storage stability, shelf life and application after a storage period of 8 weeks.

EXPERIMENTAL

Materials

The control emulsion paint was obtained from Saclux Paint Industries, Aba. The emulsion viscosity stabilizer Adopol EVS-9279X was obtained from Gamor Chemical and Allied Limited, Port Harcourt.

Sample Preparation

The formulation of the samples used in the study was carried out according to an earlier reported procedure (Otaigbe and Onyemenonu, 2004).

Measurement of Emulsion and Film Properties

The emulsion and film properties of the emulsion paint samples such as viscosity, surface tension, specific gravity, solid content, pH, flexibility, water resistance and drying time were measured immediately after formulation as time zero and subsequently after every four weeks (for 8 weeks) according to earlier reported procedures (Otaigbe and Onyemenonu, 2004; Airuehia, 1992; ASTM, 1960; Raju and Yaseen, 1983; ASTM, 1960; Raymond, 1977).

RESULTS AND DISCUSSION

Results in Table 1 show the effects of Adopol EVS-9279X on emulsion paint, which are in agreement with an earlier report (Otaigbe and Onyemenonu, 2004). The variation of these effects with time is shown in Tables 2, 3 and 4 respectively. Results indicate that the apparent viscosity of the paint samples was found to have remained unaltered on addition of Adopol EVS-

9279X within the concentration range studied as earlier reported. This viscosity value of 4.0 cp remained unchanged within the period of the study. This is due to the compatibility of Adopol EVS-9279X with the emulsion paint and its low solid content (2.2%), which showed no visible variation within the period of the study. Consequently, Adopol EVS-9279X could be said to serve effectively as an emulsion viscosity stabilizer during storage especially within the period of investigation.

The specific gravity was found to be lowered by Adopol EVS-9279X. The lowest value was obtained at 6% w/w sample formulation, where a reduction from 1.53 to 1.47 (3.92% reduction) was achieved. The specific gravity, which was reduced on addition of Adopol EVS-9279X increased slightly to 1.56 after 8 weeks. This slight increase in specific gravity of the samples from week 0 to 8 is probably due to the evaporation of some volatile components of the sample, which may have increased their densities slightly within this period leading to an increase in specific gravity. The implication of this is that the paint sample when stored for this period will have a slight reduction in the area it would cover during application.

The pH of emulsion paint has been reported to be increased by Adopol EVS-9279X especially at low formulation concentration of 5% w/w. According to this earlier report (Otaigbe and Onyemenonu, 2004), the pH of emulsion paint was increased from a control value of 7.01 to 8.85 at this concentration. The increased pH values due to the addition of Adopol EVS-9279X to the emulsion paint showed negligible variation during the period of the study. For instance, at 5% w/w, the sample's pH of 8.85 remained constant when measured after 4 weeks and was 8.84 after 8 weeks. However, the pH value remained well above the control value of 7.01,

indicating that the stabilization potential of Adopol EVS-9279X on emulsion paint is sustained during the period since emulsion paints are known to deteriorate faster at lower pH values.

The solid content of the emulsion paint was reported to be reduced by Adopol EVS-9279X, which agree with week 0 results. The reduction was found to be proportional to the quantity of Adopol EVS-9279X added. This reduction in solid content of the sample was due to the low solid content of Adopol EVS-9279X, which is 2.2%. The solid contents of the samples when measured after 4 and 8 weeks respectively, showed general increase in solid content of the samples. For instance, at 10% w/w sample formulation, the solid content, which decreased to 47.5% from a control value of 53.4% was found to have increased to 49.3% in week 4 and 49.6% in week 8. This increase in solid contents of the samples was due to evaporation of liquids especially volatile ones from the samples. The initial reduction in solid contents of the samples shows that the film forming capacity of the samples are equally reduced. However, the solid content improved with time, showing a recovery of film forming capacity.

Water absorption, used as index for determining water resistance was observed to have been reduced by Adopol EVS-9279X especially at low formulation concentration. When monitored for 8 weeks, the water absorption was found to be further reduced. For instance at 5% w/w sample formulation, water absorption, which was reduced originally from a control value of 25.2% to 23.5% in week 0, was observed to have been further reduced to 22.6% in week 4 and 20.7% in week 8. As reported earlier (Otaigbe and Onyemenonu, 2004), Adopol EVS-9279X tend to adsorb on the surface of the polymer film and overlap one another, thereby acting like tiles on a roof especially at

Table 1: Results of Emulsion and Film Properties of Emulsion Paint Measured in Week

Sample	Surface Tension (N/m)	Specific Gravity	Apparent Viscosity (cp)	PH	Solid Content (%)	Water Absorption (%)	Drying Time (min)
A	1.013×10^{-1}	1.53	4.0	7.01	53.4	25.2	33.5
B	0.656×10^{-1}	1.49	4.0	8.85	50.6	23.5	25.0
C	0.701×10^{-1}	1.47	4.0	8.52	49.9	24.4	22.0
D	0.742×10^{-1}	1.48	4.0	8.44	49.3	24.5	20.0
E	0.751×10^{-1}	1.48	4.0	8.61	48.8	25.7	20.5
F	0.750×10^{-1}	1.48	4.0	8.42	48.0	25.8	23.4
G	0.789×10^{-1}	1.49	4.0	8.45	47.5	26.9	26.5

Where A = pure paint sample (control), B = 5% w/w, C = 6% w/w, D = 7% w/w, E = 8% w/w, F = 9%w/w and G = 10% w/w sample formulations.

Table 2: Results of Emulsion and Film Properties of Emulsion Paint Measured in Week 4.

Sample	Surface Tension (N/m)	Specific Gravity	Apparent Viscosity (cp)	pH	Solid Content (%)	Water Absorption (%)	Drying Time (min)
A	1.000×10^{-1}	1.53	4.0	7.03	53.6	25.0	33.0
B	6.143×10^{-2}	1.55	4.0	8.85	53.1	22.6	24.5
C	6.850×10^{-2}	1.56	4.0	8.53	52.0	22.8	21.8
D	6.984×10^{-2}	1.56	4.0	8.46	51.8	23.0	19.7
E	6.998×10^{-2}	1.57	4.0	8.63	51.0	25.1	20.0
F	7.652×10^{-2}	1.56	4.0	8.42	50.1	25.3	22.5
G	7.433×10^{-2}	1.56	4.0	8.47	49.3	26.2	24.8

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Table 3: Results of Emulsion and Film Properties of Emulsion Paint Measure in Week 8

Sample	Surface Tension (N/m)	Specific Gravity	Apparent Viscosity (cp)	pH	Solid Content (%)	Water Absorption (%)	Drying Time (min)
A	9.603×10^{-2}	1.55	4.0	7.03	53.7	25.0	32.0
B	6.043×10^{-2}	1.57	4.0	8.84	53.0	20.7	22.1
C	6.651×10^{-2}	1.56	4.0	8.53	52.3	22.3	20.5
D	6.887×10^{-2}	1.56	4.0	8.45	51.8	25.0	19.6
E	6.984×10^{-2}	1.56	4.0	8.64	51.2	25.0	20.0
F	7.702×10^{-2}	1.57	4.0	8.40	50.2	24.5	22.2
G	7.357×10^{-2}	1.56	4.0	8.46	49.6	25.6	25.0

Table 4: Results of the Flexibility Measurement for Weeks 0, 4 and 8.

Sample	Size of Mandrels (inches)				Remark
	1	3/4	1/2	1/6	
A	1	3/4	1/2	1/6	Failed
B	1	3/4	1/2	1/6	Passed
C	1	3/4	1/2	1/6	Passed
D	1	3/4	1/2	1/6	Passed
E	1	3/4	1/2	1/6	Passed
F	1	3/4	1/2	1/6	Passed
G	1	3/4	1/2	1/6	Passed

low formulation concentration of 5%-7%, which is responsible for the increase in resistance to water absorption. The evaporation of some volatile liquids from the samples during the period of investigation further reinforces this characteristic. Consequently, the water resistance of emulsion paint containing Adopol EVS-9279X is indicated to improve with time.

The drying time was also found to be reduced by Adopol EVS-9279X especially at low formulation concentration with the most significant reduction achieved at 7% w/w formulation. At this concentration, drying time was lowered from a control value of 33.5 min to 20.0 min on addition of Adopol EVS-9279X and subsequently to 19.7 min in week 4 and 19.6 min in week 8. This result indicated that Adopol EVS-9279X lowers the glass transition temperature (T_g) thereby improving the paint's capacity for coalescing to form a film at room temperature, thus reducing the drying time. The observed further slight reduction in drying time is probably due to the slight reduction in liquid content as evidenced by the increase in percent solid content of the samples due to evaporation and slight increase in room temperature.

The surface tension of the emulsion paint was found to be lowered by Adopol EVS-9279X, especially at low concentration of 5% w/w. A further slight reduction was observed after 8 weeks. For instance, at this 5% w/w concentration, surface tension was lowered from a control value of 1.013×10^{-1} N/m to 6.560×10^{-2} N/m on addition of Adopol EVS-9279X and then to 6.043×10^{-2} N/m after 8 weeks. The initial reduction in surface tension of emulsion paint shows that Adopol EVS-9279X at low concentration exhibits surfactant characteristics on the emulsion paint. This lowering of surface tension improves wettability and prevents cissing. The further reduction with time was probably due to the combined

effect of the slight increase in average room temperature, oxidation by atmospheric oxygen and evaporation of volatile components of the samples.

Finally, the results of flexibility measurements revealed that the emulsion paint, which failed the flexibility test, had its flexibility improved within the concentration range studied by Adopol EVS-9279X. It is believed that the paint was made more flexible by its admixture with smaller particles of Adopol EVS-9279X, which separate the larger polymer/other non-polymer components of the paint and reduce attraction forces between them, acting as a lubricant and thus allowing the polymer molecules to slide past one another. This property was found not to vary under the experimental conditions during the period of this study. The flexibility results are shown in Table 4.

CONCLUSION

This study has shown that the effects of Adopol EVS-9279X on some emulsion and film properties of emulsion paint vary with time, while others remain unaltered especially within the 8 week period investigated. The stability of some effects and the variation trend of others show that Adopol EVS-9279X is effective in stabilizing the paint emulsions during storage, thus improving its shelf life.

REFERENCES

- Airuehia, G. I., 1992. Products Data Manual, Gamor Chemical and Allied Limited, Port Harcourt, pp. 5 - 6.
- Airuehia, G. I., 1992. Formulation, Characterization and Application of Newsprint Inks From Rubber

- Seed Oil and Cut-back Bitumen (Malthene), Fellowship Diploma Thesis, Nigeria Institute of Science Technology, Ibadan.
- ASTM., 1960. Annual Book of ASTM D-1489 Standards, Part 25.
- ASTM., 1960. Annual Book of ASTM D-1640 Standards, Parts 15, 18, 26 and 41.
- Ebosie, A. E., 1996. Differential Film Formation in Adopol Standard Defoamer, Adopol EVS-9279X and Poly (vinyl acetate) - Their Characterization and Application, M. Sc. Thesis, University of Port Harcourt, Port Harcourt.
- Otaigbe, J. O. E. and Onyemenonu, C. C., 2004. Effects of Adopol EVS-9279X on the Emulsion and Film Properties of Emulsion Paint, Global Journal of Pure and Applied Sciences, 10(2): 279-285.
- Otaigbe, J. O. E. and Onyemenonu, C. C., 2004. Effects of Adopol EVS-9279X on the Emulsion and Film Properties of Poly (vinyl acetate) and Acrylic Resin, Global Journal of Pure and Applied Sciences, 10(2): 307-314.
- Raju, K. V. S. N. and Yaseen, M., 1983. The Effect of Part Replacement of Titanium Dioxide by Barytes on the Properties of Alkyd Paints, JOCCA, New York, pp. 401-423.
- Raymond, C., 1977. Physical Chemistry with Application to Biological Systems, Wiley, New York, pp. 22- 35.