



Co-Polymer Resin for Polyvinyl Acetate Modification with Hydroxylated Sesame Seed Oil for Potential Use in the Coating Industry

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Abstract

Polymer is inevitably an essential part of human needs, naturally polymers can be found as cellulose, chitin, carbohydrate, nucleic acid, cotton, rubber, etc. which are of great importance to human being, such as food, cloth, shelter, transportation, and even for our well-being. IUPAC define polymer as substance composed of macromolecules. The use and manufacturing of environmentally friendly products are required due to the rising costs of products made from petroleum, those products' pose negative effects on the environment and government restrictions aimed at reducing ozone depletion. The aim of this research work is to develop a binder by blending hydroxylated sesame seed oil (HSSO) with polyvinyl acetate that can be used by the paint and coating industries. The study investigated the possibility of using hydroxylated oil to modify conventional polyvinyl acetate (PVA) to be utilized in the coatings industry. Extracting, epoxidizing, and hydroxylating sesame seed oil were done. Hydroxylated sesame seed oil (HSSO) was mixed with ordinary polyvinyl acetate in varying ratios (10 to 60% of hydroxylated oil) to create the HSSO/PVA copolymer binder. The different blend ratios are employed to ensure that none of the properties of the copolymer are compromised at the expense of another since polymers frequently have a molecular weight where each characteristic demonstrates its best value. A variety of composition ratios of the copolymer resin (HSSO/PVA) were studied for their significant physical characteristics. Investigated were physical characteristics such viscosity, density, turbidity, refractive index, gel time, moisture uptake, water solubility, and melting point. PVA and HSSO interacted chemically, according to FT-IR study of copolymer resin (HSSO/PVA). The blend of HSSO/PVA is soluble in water between 10 and 40%, and as the concentration of HSSO in the copolymer matrix increases, it is also observed that turbidity, moisture uptake, melting point, viscosity and density decrease. However, gel time and refractive index increase as HSSO concentration in the copolymer matrix increases. Improvements in flexibility, moisture absorption, and glossitivity—three significant drawbacks of traditional PVA—are revealed by the results. Moisture uptake, density, turbidity, viscosity, and melting point.

Keywords: Resin, Coating, epoxidized, hydroxylated, emulsion.

Introduction

It is as a result of the emerging perspective of blending, that the importance of polymer materials has now expanded beyond what can be obtained from single polymers. Polymers will continue to advance in the next years, and by all indications, this development will be achieved through the synthesis of novel polymers as well as through synthetic and actual alterations to the ones currently in use. In the end, recycling difficulties resulting from issues with nature have spurred new progressions, such as combining of plastics to synthesize a variety of useable products that have previously thought to be a waste. In order to achieve and further expand the cost in a synthetic proportion of polymeric products without having to create a specific polymer framework, mixing of at least two polymers has become a major way¹.

The blending of polymers produces novel materials of varying characteristics that are absent in conventional polymers at large. The art of blending is frequently more successful way and faster process to achieving desired characteristics of lower cost¹. In order to achieve additionally expand the cost in a synthetic proportion of polymeric products without having to create a specific polymer framework, mixing of at least two polymers has become a major way². Polymer blends produce novel compounds of varying characteristics not inherent in conventional polymers in general. In another study, avocado seed oil was used to modify traditional polyvinyl acetate for use as a binder. The oil was then extracted, epoxidized, and hydroxylated before being blended with polyvinyl acetate at various ratios; the findings show improvements in flexibility,

moisture absorptivity, and glossitivity, which are significant drawbacks of traditional polyvinyl acetate³.

Materials and methods

Materials: Sesame seed oil, sodium dihydrogen phosphate, sulphuric acid, acetic acid, polyvinyl acetate (PVA) and formic acid. Peroxygenated water. Butanol and Kaolin. Test tubes. Conical flasks and beakers. measuring cylinders, a condenser, a stirrer, a hot plate, and a three-neck flask.

Methods: Extraction of Sesame Seed Oil: The hot water flotation extraction method shown by Kalu et al.⁴ was employed for the Seed oil extraction. The sesame seeds were pre-treated to eliminate any form of contaminants, it was ground and heated to 85⁰C with stirring and allowed to cool at room temperature, this was followed by drying by mild heating and collection of the upper layer which were essentially oil.

Oil Epoxidation in Sesame Seed: The epoxidation process design was enumerated by Kalu et al.⁴ and Goud et al.⁵, were adopted; and 200ml of SSO was added to a 500ml three-neck flask having a reflux condenser. In the SSO, sulfuric acid catalyst, hydrogen peroxide, and fuming and acetic acids were introduced in a 0.5:1 molar proportion to the oil. Additionally, drop-by-drop additions of hydrogen peroxide with a molar ratio of 1.5:1 to the oil were made.

Since the epoxidation process is quite exothermic, this injection technique is necessary to prevent the system from becoming too hot. The reaction mixture was stirred mechanically using a stirrer rotating at a speed of 1500rpm. After the product had reached ambient temperature, it was decanted to eliminate the water-soluble phase from the organic-soluble components (epoxidized oil). To get rid of any remaining impurities, the epoxidized oil was rinsed with warm water (in small aliquots)⁵. For the epoxidation and hydroxylation procedures, the experimental setup for the manufacture of an alkyd polymer was used, as shown in Figure-1.

Hydroxylation of the Epoxidized Sesame Seed Oil (ESSO): The method of hydroxylation was taken from Nkafamiya et al.⁶. It was conducted within a 1000ml three-neck flask with a condenser for reflux, a thermometer for measurement, and an inert atmosphere of nitrogen gas. On a heated plate with an adjustable temperature control, the flask was put. In the reactor, 150ml of the ESSO was combined with water at a molar ratio of 2:1, epoxidized oil at a mole proportion of 4:1, and sulfuric acid catalyst. These three components were used to hydroxylate the ESSO. The reaction process took place for 5 hours at a temperature of 55 to 75°C. Using a magnetic stirrer that rotates at around 1500 rpm, consistency was kept. The organic-soluble chemicals from the water-soluble ones were then separated from the end product (polyol) by cooling and decanting. The product was then cleaned with warm water (in small aliquots) to remove any remaining impurities.

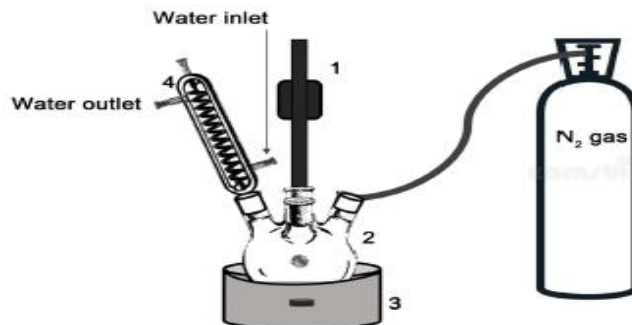


Figure-1: Experimental setup for epoxidation and hydroxylation reaction.

Preparation of HSSO/PVA Blends and Films: By mixing various amounts of HSSO with PVA resin, a blend of the two substances was created. For casting, the liquid was poured onto a glass Petri dish after being mixed and left at ambient temperature for 24 hours. Seven days at room temperature were given for the resin to set and cure. After that, the resin coatings' physical characteristics were examined².

Determination of Viscosity and Gel Time: Using a capillary put into the viscometer bath, the traditional method of determining viscosity was used. The resin was diluted to a volume of 15ml, conveyed to a viscometer using the method of liquid rise, and then tightly closed. The system of the viscometer contained water at 33⁰C temperature when the u-tube has been submerged in it. Using a stopwatch, it was recorded how long it took for the liquid to rise from the top mark to the middle mark once the cork was removed. The sample's viscosity was determined from this outcome. For each sample, three measurements were obtained, and a mean value was computed⁷. By tracking the resin's viscosity over time until a steady viscosity profile was produced, the gel point associated with the resin was determined⁸.

Refractive index, melting point, turbidity, and density determination: To evaluate the density of the resin, on a scale, the weight of resin with a known volume inside of a measuring cylinder was recorded. In order to estimate density, one uses the mass-to-volume equation. Three readings were collected for each sample, and the mean value was calculated. The turbidity of the resin materials was measured using a turbidity meter. The melting points of the film materials were ascertained using the melting point apparatus. The refractive index of the resin samples was determined using an Abbe refractometer. Using recognized methods, the aforementioned features were determined⁴.

Moisture uptake determination: Gravimetric analysis was used to determine the resin films' moisture uptakes. The resin samples were put into a desiccator with a saturated sodium chloride solution at a predetermined weight. The increase in sample weight was tracked to achieve a consistent weight.

Amount of moisture absorbed by the resin was measured as the difference between the sample's wet weight and dry weight. Each sample was subjected to three analyses, with the average result being noted⁹.

Solubility in water: By combining 1 ml of the resin mixed 5 ml of distilled water at ambient temperature, the solubility of the mixture in water was determined⁹.

Instrumentation: Using an infrared spectrophotometer, SSO, PVA, and HSSO/PVA were each subjected to an IR study between 500 and 4000cm⁻¹.

Results and discussion

Physicochemical properties of the extracted sesame seed oil:

Table-1 displays the physicochemical characteristics of sesame seed oil. Given that it had a specific gravity of 0.92, the oil was found to be less dense than water. According to Majumder¹⁰, the iodine value of 120.21 indicates that SISO is a semi-drying oil. The outcome is comparable to values found in literature reports by Ladino et al.¹¹, whose *Ximenia Americana* oil yielded 152.28g I₂/100g, Ikhuoria et al.¹², whose value for rubber seed oil was 136.2g I₂/100g, and Kalu et al.⁴, whose Sesamum indicum seed oil yielded 122.33g I₂/100g.

The SISO had a peroxide value of 5.92mEq/kg, which is similar to the peroxide value of castor seed oil reported by Onukwli & Igbokwe¹³ at 6.7mEq/kg. This similarity suggests that the SISO is less likely to undergo oxidative rancidity, as noted by Ikhuoria et al.¹². However, when compared to the findings of Ladino et al.¹¹ and Kalu et al.⁴, the peroxide value of the SISO was lower. Ladino et al.¹¹ reported a peroxide value of 31.25mEq/kg for their oil, whilst Kalu et al.⁴ found that Sesamum indicum seed oil yielded a 6.15mEq/kg peroxide value.

The SISO had a percentage free fatty acid value of 6.04, which was similar to the value obtained by Uzoh & Nwabanne¹⁴ for castor seed oil at 6.73%. However, when compared to the findings of Ladino et al.¹¹, Ikhuoria et al.¹² and Kalu et al.⁴, the percentage free fatty acid value of the SISO was lower. Ladino et al.¹¹ reported a value of 8.07% for *Ximenia americana* seed, Ikhuoria et al.¹² found a value of 9.54% for rubber seed oil, and Kalu et al.⁴ reported a value of 6.22% for Sesamum indicum seed oil. However, the value for the SISO was higher than the value obtained for castor seed oil of 1.45% as reported by Onukwli & Igbokwe¹³.

The saponification value for the SISO was 169.49mg KOH/g, which is less than the values reported by for Sesamum indicum seed oil, 182.0mg KOH/g for rubber seed oil, 178.5mg KOH/g for *Ximenia americana* seed oil, and 179.95 mg KOH/g for castor seed oil¹⁴. However, it was noted that the SISO value was greater when compared to the Ladino et al.¹¹ study, whose value was 167mg KOH/g, and this shows that the SISO may be

acceptable for the synthesis of soap due to its high molecular weight fatty acid¹⁴.

The viscosity of SISO was 64.53mPas at 30⁰C, which was lower than the 900mPas recorded by 11 for *Ximenia Americana* seed oil but comparable to the 65.29mPas reported by Kalu et al.⁴ for Sesamum indicum seed oil.

It was derived that the refractive index was 1.460 and it was found to be higher when compared to findings enumerated by¹¹ whose *Ximenia americana* seed oil yielded 1.435 and 1.468 value obtained for *Sesamum indicum* seed oil as reported by Kalu et al.⁴. However, refractive index value fell within the range of 1.460 -1.540. This information suggests that it can work as a characterization tool as well as a purity test⁴.

FT-IR characterization of the PVA, HSSO/PVA blend and HSSO:

Investigation of FTIR signals related to stretching or bending frequencies of certain bands offers information about the intermolecular exchange, the regions of these signals emerge rely proportionally to the wave intensity. The varying FTIR signals of PVA, HSSO/PVA, and HSSO are shown in Figures-2, 3, and 4.

Various pronounced signals, like the -CH₃ and -CH₂ anti-symmetric stretching vibration occurring as a doublet at 2984.62/cm and 2958.75/cm, have also been observed in the FTIR signals of PVA, which illustrates a prominent peak at 3368.32/cm which can be attributed to the stretching vibration of O-H¹⁵. One strong peak at 1639.57/cm resulting from the -CH₃ bending frequency was identified in addition to the C=O stretching vibration associated with acetate groups^{16,17}.

Corresponding to uneven vibration stretches of -C-O-C- of ester groups, another strong peak was found at 1493.96 /cm, which was followed at shorter wavelengths by a pair of peaks with maximums at 1452.94 and 1421.69 /cm¹⁸. According to Kalu et al.⁴, the peaks within 1048.24 and 1161.96 /cm are consistent with sp² C-H bending frequency.

The wide O-H peak at 3368.32 /cm in PVA emerges in the spectra of blend B. (HSSO/PVA) at a higher frequency of 3417.10 /cm. According to Shashidhara & Jayaram¹⁹, this could be because the hydroxyl groups that are H-bonded add to intricate stretches due to vibration connected to unbound inter- or intramolecular-bound groups that are hydroxylated. This finding suggests that PVA and HSSO have engaged in a chemical interaction.

It was possible to see the distinct bands at 2923.69 and 2853.99 /cm that are indicative of C-H stretches connected to hydrogen atoms in methane. The saturated ester's C=O stretching was attributed to the band at 1741.76/cm. Broad absorption at 2155.91/cm indicates that vinyl acetate is being stretched asymmetrically in a -C=C manner⁴.

Hydroxyl stretching frequencies can be seen in a broad band at 3369.74/cm in the FTIR spectrum of C. (HSSO)⁴.

In the spectrum of HSSO, the intense and broad vibrations at 2959.18/cm formed as a result of the C-H group stretching of alkanes may be easily differentiated. According to Kalu et al.⁴, the saturated ester present in the oil causes the peak at 1728.26 /cm; according to Cai et al¹⁷. The pronounced signal at 1664.22/cm can be attributed to C=C stretching characteristic vibration. Similar to this, the IR spectrum's region between 1380.14 and 1494.13/cm exhibits two peaks that are associated with the bending frequency of C-H in alkanes.

The ether connection C-O-C is responsible for the peak at 1161.34/cm⁹. According to Kalu et al.⁴, the signal at 949.13/cm can be attributed to C-H alkene bending vibration.

It is clear from looking at the vibrational frequencies for each of PVA, HSSO/PVA, and HSSO that there was a change in where the peaks at the O-H bond were located. This means that whereas the O-H bond stretching is 3368.32/cm for pure PVA (A), it is 3417.10/cm for the blend (B), and 3369.74/cm for HSSO (C). According to Chen et al.¹⁷, the acidity of the HSSO during hydroxylation may be the cause of the OH region's expansion.

The interactions of the H-bonding in the blend were, however, comparable to intermolecular interactions evident in HSSO since the C=O area of the blends does not appear to move or broaden after mixing.

The OH-groups present in HSSO and the H-atoms of the CH₃ groups present in the PVA interacted with one another throughout the entire HSSO/PVA mixture, according to the FTIR methods.

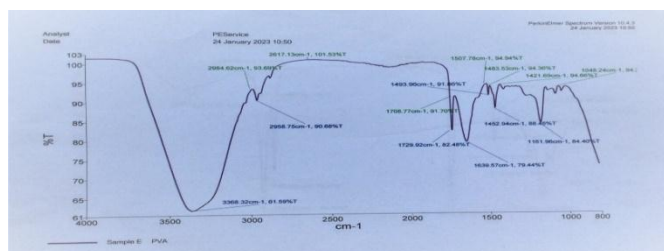


Figure-2: FTIR spectrum of PVA.

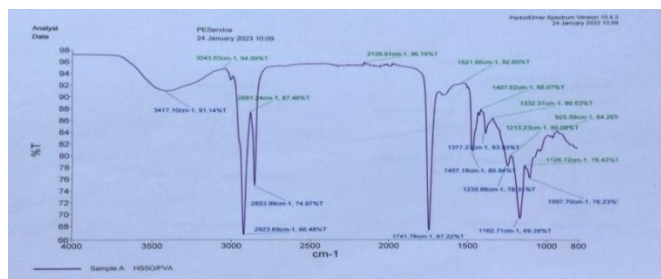


Figure-3: FTIR spectrum of HSSO/PVA.

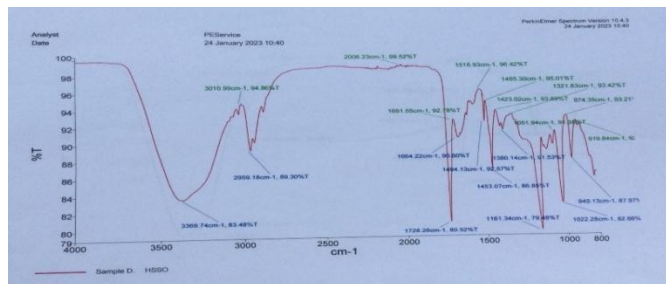


Figure-4: FTIR spectrum of HSSO.

In-situ process optimization of the HSSO/PVA Binder: Impact of HSSO dosage on HSSO/PVA Binder Turbidity: Turbidity is the amount of a fluid's blurring caused by countless microscopic particles, which are frequently invisible to the human eye. The interaction of a colloidal system with light causes turbidity. Actually, the cause of turbidity is light scattering. Increased scattering is observed in non-homogeneous processes with numerous particles because homogeneity and fewer particles lead to reduced scattering²¹.

The impact of HSSO dosage on the turbidity of HSSO/PVA resin is depicted in Figure-5a. At 0% HSSO, turbidity is somewhat high due to the foggy nature of PVA. But when HSSO is added, it becomes more homogeneous and the light scattering goes down. The suspended material in PVA is reduced to uniformly small, evenly dispersed particles as the concentration of HSSO rises, making the murky solution clearer and reducing light scattering. As a result, the system's level of turbidity can be utilized as a gauge for the degree of cross-linking between chains²².

Impact of HSSO dosage on HSSO/PVA Binder Gel Time: Gelation, which is the change in the resin's macromolecular structure and ultimately results in the loss of flow ability, is typically characterized as a rise in viscosity. Both the onset phase characterized with moderate flow development and subsequent phase characterized with rapid polymer formation are processes of gelation²³. Any paint's drying period is influenced, among other things, by the gel time of its binder. In terms of science, gel time aids paint formulators in figuring out how long to hold a binder before utilizing it to manufacture paint and is essential in figuring out adhesion²⁴.

The impact of HSSO dosage on blend formed from HSSO and PVA has been depicted in Figure-5b. It has been discovered that as HSSO concentration changes, so does the matching gel time. Because of their varying molecular weights, HSSO and PVA take longer to gel. As HSSO concentration rises, the HSSO/PVA composite's gel period increases gradually but steadily. The results showed that the resin cured and gelled two weeks after casting. Therefore, it is suggested that you utilize the binder during this period. This phenomenon might be attributed to a decrease in the cross-linking density of the copolymer, which resulted in a decrease in viscosity¹⁸.

Impact of HSSO dosage on HSSO/PVA Binder Density: In the synthesis of polymer substances, density, which denotes a mass-to-volume ratio (m/v), is a fundamental physical property. The density of a paint binder has a big impact on things like pigment dispersion, paint brush ability, flow, leveling, and drooping in the coatings industry²⁵. Figure-5c illustrates how the density of HSSO/PVA resin is affected by HSSO concentration. The density of HSSO/PVA resin gradually decreases as HSSO concentration rises.

It is anticipated that as HSSO concentration increases, the density of the HSSO/PVA resin will decrease given that pure PVA has a higher density than HSSO³. As the mechanical characteristics of polymers depend on chain length and the proportion of soft and hard segments, an increase in the number of soft segment may also be the cause of this²⁴. This behavior is consistent with the results of Osemeahon & Barminas⁹, Yelwa¹⁸, and Gidigbi et al.³ who, respectively, blended polystyrene with TMU resin, PVA with HSSO, and PVAc with HASO.

Impact of HSSO dosage on Viscosity of HSSO/PVA Binder: The various sensory qualities of emulsion lattices that are related to their rheological properties include creaminess, thickness, and smoothness. Simply put, a substance's viscosity—whether it be a liquid, gas, or fluid—is determined by how difficult it is for it to flow⁹. Hardness, brittleness, spread ability, and flowability²⁶.

A reliable and practical method for identifying changes in color, density, stability, solids, content, and molecular weight is by the measurement of viscosity²¹. The impact of HSSO on the viscosity of HSSO/PVA resin is depicted in Figure-5d. The findings demonstrated that viscosity steadily decreased with the addition of 10, 20, and 30% of HSSO, and only slightly decreased with the addition of 40 and 50% of HSSO. This results from variations in the length of the respective oil⁴. As the concentration of HSSO is increased to 60%, there is a little rise in viscosity. This happens as a result of an increase in molecular weight, which increases chain cross-linking between HSSO molecules and resulting in a rise in viscosity.

Impact of HSSO dosage on HSSO/PVA Binder Melting Point: Figure-6a illustrates how the dosage of HSSO affected the melting point of HSSO/PVA resin. As the dosage of HSSO increased, the melting point continuously fell. According to Yelwa¹⁸, this can be explained by an increase in flexibility brought on by an increase in HSSO dosage, which led to an increase in molecular mobility. However, a modest increase was seen at 40% of HSSO and a subsequent reduction as HSSO dosage increased. This might be a result of contributing variables brought on by the two polymers' various melting points. The polymer combination showed a reduced melting temperature as the HSSO level increased. In order to reduce its rigidity, PVA and HSSO may be combined³. This again addresses one of the drawbacks of PVA which its rigidity is.

Impact of HSSO dosage on HSSO/PVA Binder Refractive Index: The paint's glossiness demonstrates its ability to reflect incident light. Gloss is one property of oil paints. Emulsion paint's gloss quality must outperform oil paint's if water paint is to compete with it. The gloss attribute of the final paint composition is greatly influenced by the refractive index of the binder⁴. Figure-6b, which illustrates how the dosage of HSSO impacts on the blend's refractive index, it was observed that the refractive index changes dynamically as HSSO dosage was varied.

This result was brought about by a variation in the strength of the specific interactions between the two polymers, which has an impact on molecular weight properties, and positions dependent on morphology and density of the polymer matrix²⁶

Impact of HSSO dosage on HSSO/PVA Binder Moisture Uptake: Waterborne coatings may have issues with durability because of insufficient water resistance. If polyvinyl acetate is to meet the demands of the coatings industry, its high-water uptake capacity must be lowered^{3,4}. The thermo-mechanical, chemical, and adhesive qualities of paint are adversely affected by water. As seen in Figure-6c, the moisture uptake reduced as HSSO dosage increased. Due to HSSO's hydrophobicity, this has happened. Increased hydrophobicity of the polymer matrix results from increased HSSO content in the copolymer²⁷. This discovery reveals that HSSO/PVA copolymer possess low moisture uptake capacity, so resolving one of the problems with pure PVA's substantial moisture absorption. Hydrophobic components in the binder offer the best mix for boosting a water-borne coating's resistance to water²⁸.

Impact of HSSO dosage on HSSO/PVA Binder the Solubility in Water: Any resin's water solubility must be taken into account when selecting it as a binder for the formulation of emulsion paint. Emulsion binders are water soluble, whereas oil paint binders are not. Solubility is the property of a chemical compound known as a solute to dissolve in a solute-containing substance. Fundamentally, a substance's solubility is influenced by the solvent's physicochemical characteristics, temperature, pressure and the solution's pH¹⁷.

Table-1 shows that the resin is hydrophilic between 0 and 40%, or at low HSSO concentrations, with hydrophilic PVA predominating. This enables it to remain in aqueous solution, but with inclusion of 50% and 60% of HSSO, the resin appears to become hydrophobic, with the hydrophobic HSSO now predominating; this results in water insolubility that is observed. The water insolubility may result also from a decrease in OH groups and an increase in hydrophobicity with HSSO inclusion. Changes in the resin's ability to interact with the inclusion of HSSO may also be to blame for the insolubility⁴.

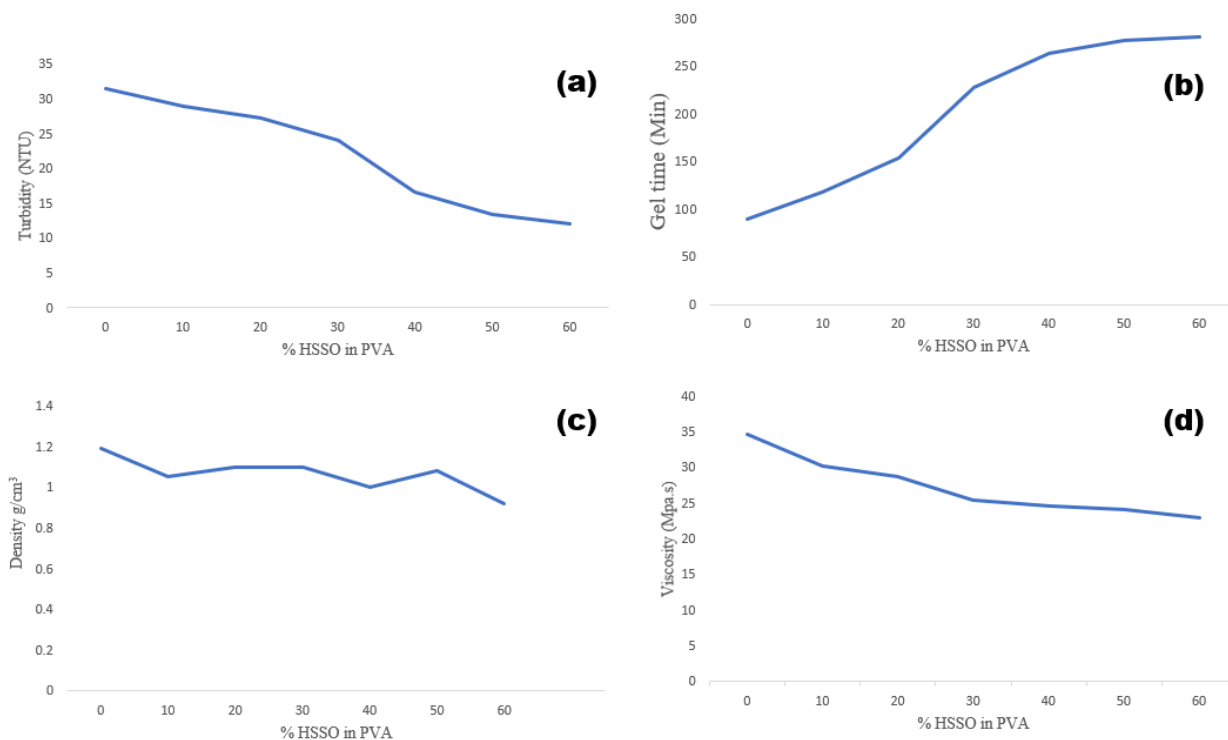


Figure-5: In-situ process optimization of the HSSO/PVA Binder: Impact of HSSO dosage on HSSO/PVA Binder Turbidity (a), Impact of HSSO dosage on HSSO/PVA Binder Gel Time (b), Impact of HSSO dosage on HSSO/PVA Binder Density (c), Impact of HSSO dosage on Viscosity of HSSO/PVA Binder (d).

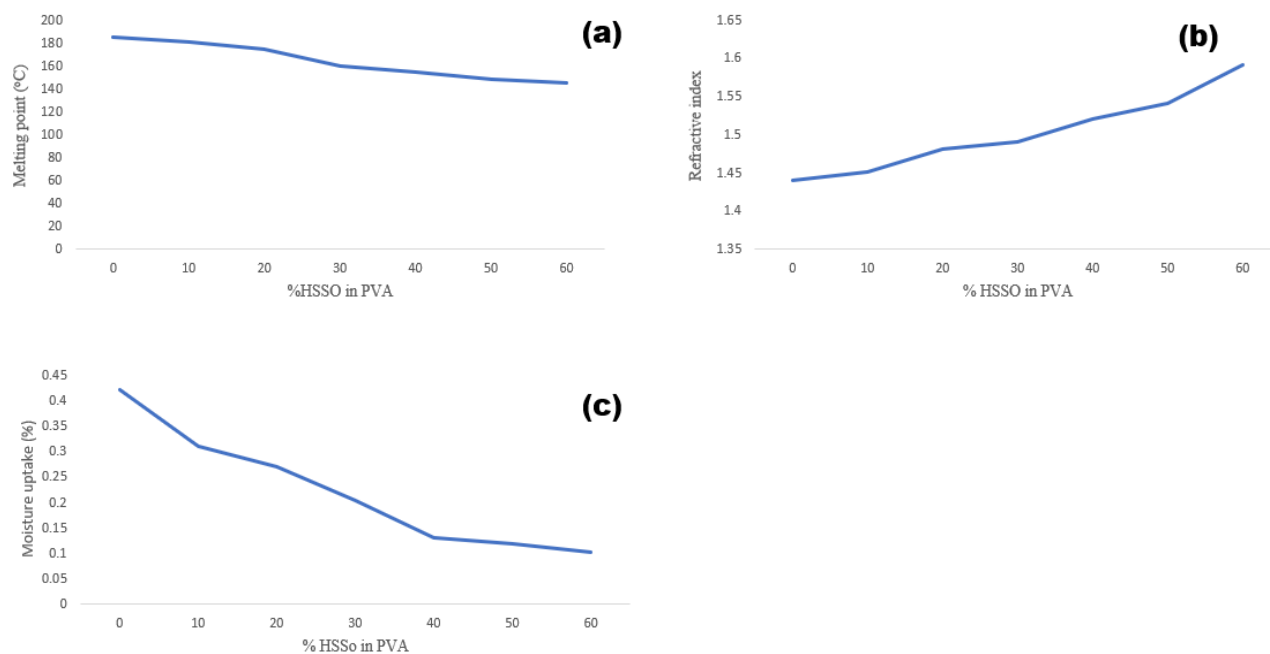


Figure-6: In-situ process optimization of the HSSO/PVA Binder: Impact of HSSO dosage on HSSO/PVA Binder Melting Point (a), Impact of HSSO dosage on HSSO/PVA Binder Refractive Index (b), Impact of HSSO dosage on HSSO/PVA Binder Moisture Uptake (c).

Comparison of the Acceptable Level in the Coating Industry and a Few Physical Properties of PVA, HSSO/PVA Resin: Table-2 compares the acceptable standard in the coatings industries with the characteristics of PVA and HSSO/PVA resins. Between PVA and HSSO/PVA, a decline in turbidity, density, moisture uptake, viscosity, and melting point were observed. This indicates improvements in film adhesion,

flexibility, superior optical quality, water resistance, and brittleness, respectively. As shown in Table-2, the refractive index and gel time increased, indicating improved gloss and consistency due to low pigment volume concentration⁴. It can be observed from Table-3 the assessment between few physical properties of HSSO/PVA resin in this study with other binders.

Table-1: HSSO/PVA binder solubility.

Dosage of HSSO in PVA (%)	Solubility
0	Soluble
10	Soluble
20	Soluble
30	Soluble
40	Partially soluble
50	Insoluble
60	Insoluble

Table-2: Assessment between few physical properties of HSSO/PVA resin with other binders.

Attributes	PVA	HSSO/PVA	Acceptable standard in the paint industry ⁹
Solubility	Soluble	Soluble	–
DENSITY gcm ⁻¹	1.19	1.09	1.07 (min)
Refractive index	1.44	1.52	1.4000 (min)
Turbidity (ntu)	31.5	16.7	–
VISCOSITY (mpa.s)	34.66	24.64	3.11-38.0
Gel time (min)	90	264	–
% Moisture uptake	0.420	0.129	3.10 (max)
Melting point °C	185	154	200 (max)

Table-3: Comparison HSSO/PVA Resin physical properties with other binders.

Types of resins	Density gcm ⁻¹	Viscosity Mpa.s	Melting point °c	Refractive index	Moisture uptake (%)	Elongation at break (%)	Formaldehyde emission (%)	Reference
HSSO/PVA	1.09	24.64	154	1.52	0.129	ND	ND	This Study
HASO/PVAc	1.098	24.11	169	1.428	0.137	418	ND	3
SSO/PVA	1.009	159.19	171	1.44	0.1381	ND	ND	18
SISOMAR	0.953	123.22	ND	1.4744	0.22	ND	ND	4
UF/PE	1.3362	32.60	130	1.432	0.008	250	0.0142	8
TMU/PS	1.0990	19.70	262	1.425	1.01	425	0.0233	2

Conclusion

To synthesize the HSSO/PVA copolymer binder, the polyvinyl acetate was successfully modified with hydroxylated sesame seed oil. The chemical interaction between the chemical structures of HSSO and PVA was established by the FT-IR study. The proposed copolymer binder's physical characteristics were examined. The outcomes demonstrate a favorable solubility interaction between polyvinyl acetate and hydroxylated sesame seed oil at 10–40% of the hydroxylated oil.

The physical characteristics complied with published data and fell within the coating industry's allowed range. The copolymer HSSO/PVA resin shows to be of low moisture uptake and better flexibility against conventional poor water resistance and brittleness associated with polyvinyl acetate. The coating industries particularly benefited from the melting point's reduction. The results of the investigation suggest that the HSSO/PVA copolymer could be used as a binder for the manufacturing of emulsion paint.

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