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Manufacturing Of Artificial Leather By Polyvinyl Chloride (PVC)

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Abstract – *The manufacturing of the artificial leather particularly polyvinyl chloride (PVC) represents on the advancement of the material science and engineering by offering a versatile and cost-effective alternative to natural leather. It has explored on the comprehensive processes which involve the production of the PVC based artificial leather that emphasizes on the basic fabric preparation which includes polymer coating, lamination, finishing and quality control. It has suitably selected the substrates of the typically woven, knitted, non-woven fabrics to the crucial adhesion and achieving the desired properties for the products. It has process on the polymer coating where primary use of the application includes transfer coating, direct coating, and casting to achieve the required thickness and texture. This can include multiple layers to which the material softness and flexibility can be included with the embossing, product category and export growth rate of 6.88% during five years where U.S. imports of apparel increased. It can be increasing the lower-cost offshore providers and growth in the market.*

Key Words: Synthetic leather, polymer coating, sheet materials, filler, stabilizer, flame retardant, neutralizing agent.

1.INTRODUCTION

The artificial leather also known as synthetic leather where versatile material which includes automotive, fashion and upholstery. Polyvinyl chloride (PVC) is a primary component with production of artificial leather which can remarks on the cost-effectiveness, durability, and flexibility. The paper discusses the essential raw material used in manufacturing process of PVC based artificial leather and their functions.

1.1 DETAILS OF RAW MATERIAL

A Plasticizer is substance which adds on the polymer to enhance their flexibility and workability. It reduces the intermolecular forces between polymer chains, increasing the materials elasticity and pliability. It has also function on the plasticizers to improve flexibility, elongation, and ease of processing of polymers. The common types of phthalate esters, adipates, citrates and trimellitates. The applications used in the production of flexible plastics like PVC, adhesives, elastomers and coating. It has increase in the free volume between polymers chain and enhancing the flexibility and workability. Some plasticizers such as phthalates are scrutinized for potential health and environment impact and prompting the development of safer alternatives.

Fillers have added on the solid particles to modify and enhance on the strength, stiffness and thermal conductivity. The mechanical and physical characteristics such as strength and stiffness. The inorganic (silica, calcium carbonate), organic (wood flour, carbon black) and mineral fillers and are used in the rubber, plastics, construction materials, paints, coatings and pharmaceuticals. It can increase stiffness and reduce thermal expansion and improve dimensional stability. This can reduce cost-saving measures where amount for the expensive base material.

Stabilizers have added to materials to prevent or slow undesirable changes with degradation from environmental factors. It has added on the applications like UV stabilizers, heat stabilizers, oxidation stabilizers, antioxidants, metal stabilizers, light stabilizers, polymerization inhibitors and pH stabilizers and biocides.

Antimony trioxide (Sb_2O_3) where flame retardants and enhance fire resistance in material like artificial leather. The properties and composition have white crystalline powder with density of 5.2 g/cm^3. It adds on the works synergistically with halogenated compounds and preventing ignition and slow fire spread. The application used in automotive, furniture and aviation industries to enhance on the resistance. It has improved the durability and lifespan for leather products and attracting the fire-related damage.

Dolomite have added as a neutralizing agent in leather industry. It has added on the properties and composition i.e., white to off-white powder with chemical formula of $CaMg(CO_3)_2$. It has regulated on pH during the chrome tanning process and ensuing on the effectiveness with penetration of tanning salts. The fillers and whitening agents improve texture, color, feel and brightness of leather. The cost-effectiveness reduces production costs by replacing more expensive fillers. The environmental considerations help in treating effluents and generating during leather processing and making waste less toxic.

2. LITERATURE REVIEW

According to Braun (2008) have covered the PVC intrinsic properties to tailor on the resistance and flexibility and durability were preferred base polymers in artificial leather production. PVCs has achieved on the specific performance characteristics desired in the artificial leather. The polymer adaptability and ease of the processing further enhance its appeal in the application.

Carraher (2017) have involved the plasticizers to impart on the flexibility and workability to PVC. Diallyl phthalate (DAP) for showcasing the glass transition temperature of PVC and enhancing the flexibility (Rahman and Brazel, 2004). Wilkes et al (2005) highlights on the choice of the plasticizer through mechanical properties and durability of the final products. It has allowed on the DAP with the soft, pliable artificial leather suitable for various applications including upholstery and fashion.

Titow (1984) have role of stabilizers in PVC formulations is to prevent degradation during processing and extend on the materials lifespan. It has included the stabilizers where heat and UV resistance and aesthetic functional properties of artificial leather over time. It has underscores the importances of selecting stabilizers with the thermal stability and resistance to amines which can be detrimental to polymers integrity.

3. METHODOLOGY

The raw materials include DAP Diallyl phthalate (Plasticizer for paste application) for indeformable after forming with the good dimensional stability. This can add on the good thermal stability. It has included on the bending strength in unchanged sustainably used for 150-200^{0}C. The chemical erosion resistance and solvent extraction resistance with the aging resistance to molecular formula $C_{14}H_{14}O_4$. The molecular weight has 246.3 and boiling point along with the range 156^{0}C. The flash point includes >121 and vapor pressure 300^{0}F and relative density to 1.277.

Vinnolit E74 CC is a fine particle along with the homopolymer giving plastisols with the medium viscosity and good shelf life. It has added on the content with pseudoplastic over the entire shear range.

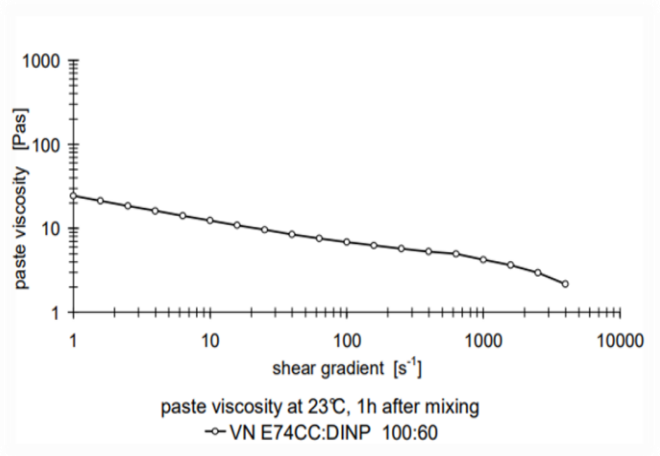

Table -1: Test Method

Raw Material Properties			
Properties	Typical Value	Unit	Test DIN EN ISO/ ISO
K-value	74	-	1628-2
Reduced viscosity	141	ml/g	1628-2
Apparent bulk density	0.420	g/ml	60
Size distribution on 0.063mm screen	≤3	%	53195
Volatile Matter	≤0.5	%	1269
Emulsifier Content	Medium	-	-
Fogging characteristics (gravimetric)	≤0.5	Mg	75201

Similarly, Baerostab ASM 711 by Baerlocher acts on the co-stabilizer in the combination with BaZn and CaZn where the heat ageing resistance with temperature range of 120-150^{0}C. it has pointed on the amine resistance with the backed-up pastemaking emulsion homopolymer with medium viscosity are good shelf.

The production of artificial leather involves on the mixing methods to achieve a homogenous mixture which includes the raw materials that utilizes the equipment.

The mechanical agitators or stirrers to mix substances. It also combines dry or liquid ingredients to form a homogenous mixture by blending. The shaking or tumbling agitates materials by shaking or tumbling in containers (Lu et al.2002).

High shear mixing applies intense mechanical forces to create on the uniform mixtures. It has utilized fluidized bed mixing through upward-flowing fluid for granulation and coating. The powder mixing (Dry mixing) combines with dry powder for uniformity.

The description of Diallyl phthalate (DAP) have added on the characteristics as low viscous, colorless transparent liquid, stable at room temperature. It adds on the properties i.e., good dimensional stability, electrical insulation, thermal stability and chemical resistance and heat resistance. Vinnolit E74 CC- PVC where fine particles have remark on the good shelf and low fogging values and excellent emboss retention and good foamability.

Baerostab ASM 711 stabilizer acts as a co-stabilizer for heat ageing and amine resistance and improve discoloration resistance. The physical and chemical properties have been added on off-white powder, odorless melting point > 100^{0}C partly soluble in water.

The flame retardant i.e., antimony trioxide has improved durability and performance attain on the white crystalline powder and synergistic with halogenated compounds and improve durability and performance. The melting point 656^0C slightly soluble in water. Dolomite fillers have utilized the neutralizing agents improves texture and whitening agents to meet with the chemical formula and density at 2.84 g/cm^3 where slight soluble in water.

4. PROJECT RESULTS

The PVC mixture is highly prepared utilizing the plasticizers, stabilizers, resin of PVC and fillers with the desired formulation. It has certainly mixed the ingredients in a roll mill or mixer until a homogeneous paste is obtained. It has also included dissolution of the homogenous mixture with the THF solvent to create a PVC solution.

The coating of the fabrics has been cut and reinforced with the polyester to meet the dimensions and clean fabrics for the impurities or contaminants. The coating process fabrics is casting mold or frame.

The curing heat press or Oven set to an appropriate temperature to around 150^0C. The testing and characterization have included mechanical testing which provide the elasticity of artificial leather. It conducts abrasion test to assess the durability of the coating. The physical test includes the durability of coating which measures the thickness and weight of the artificial leather where the surface finish and flexibility is evaluated.

Table 2: Tested Projected Results

Sample	Abrasion Cycle	Weight Loss (mg)	Thickness (mm)	Weight (g/m^2)	Tensile Strength (MPa)	Elongation (%)
1	1000	5	1.2	400	20	150
2	2000	10	1.4	450	18	140
3	3000	15	1.6	500	22	160

The artificial leather has synthesized the use of PVC exhibiting on the satisfactory mechanical properties where abrasion resistance and thickness are processed with the specifications and formulation to the process parameters were enhancing of the quality of the artificial leather can be taken place.

5. CONCLUSIONS

The manufacturing of artificial leather using polyvinyl chloride (PVC) involves a careful selection of raw materials and each contributing to the final product performance and properties. It has enhanced the flexibility and workability of PVC to use DAP and Vinnolit E74 CC provides a stable polymer base with excellent emboss retention and foamability. Antimony trioxide used a flame retardant that improve on the safety profile of the product. It has dolomite acts on the fillers for contributing on the texture feel and whitening and synergistic effects of component result in high-quality, durable, and versatile materials suitable for various applications. The process highlights the desired characteristics of artificial leather demonstrating on the complexities and precision in required modern manufacturing processes. This has been recommended that the future alternative plasticizers can improve the environmental sustainability of the process and conduct a long-term durability of the study under various conditions.

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