

Study of Mechanical Behavior of Vegetable Oil based PVC Composites

Mohd Hassan

Research Scholar

Department of Mechanical Engineering,
Integral University Lucknow

Mahmood Alam

Assistant Professor,

Department of Mechanical Engineering,
Integral University Lucknow

Abstract

The cause of this look at is to study the mechanical behaviour of vegetable oil & Poly Vinyl Chloride (PVC) composite, to broaden more solid and flexible PVC. Vegetable oils can be without problems used with PVC due to their availability, biodegradability, low cost, low toxicity & environmental characteristics. Here Epoxidised Vegetable Oils (EVOs) are used at the region of phthalates in PVC to make it non-poisonous.

Keywords: PVC; Epoxidised Vegetable Oils, Reinforcement

I. INTRODUCTION

Poly Vinyl Chloride is one of the maximum the use of thermoplastic fabric after Polypropylene & Polyethylene. It is made by means of polymerization of Vinyl chloride monomer (VCM) or Chloroethene. It is known for its numerous houses which includes durability, high thermal & oxidation resistance, high ignition temperature and many others. PVC turned into being significantly used with the intake of 45.3 million metric lots in 2017. [1]

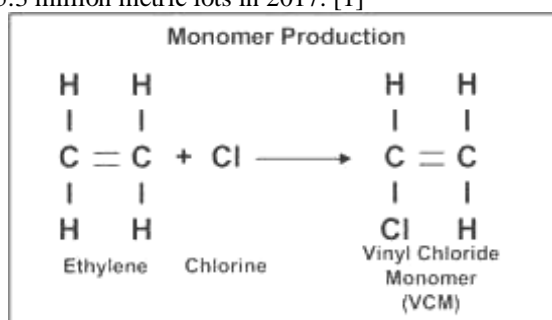


Fig. 01: Formation of VCM

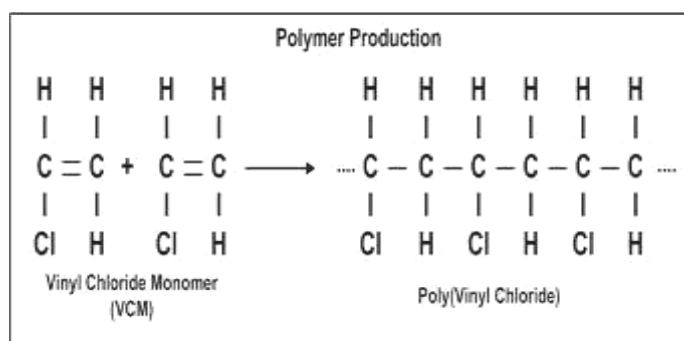


Fig. 02: Formation of PVC

PVC is subjected to a one-of-a-kind conflation of bodily and mechanical houses which makes it exclusive from other thermoplastics. After Polyethylene PVC is the second one most produced thermoplastic. [2] Poly Vinyl Chloride possesses a high value of ratio among strength & weight. It is corrosion resistance which makes it extra long lasting & usable. It is also recognised for its service existence as 60% of PVC may be used for 15-a hundred years. PVC has various packages in constructing & pipe production, transportation, packing of substances, covers, agricultural enterprise, electric powered electricity verbal exchange and so on.

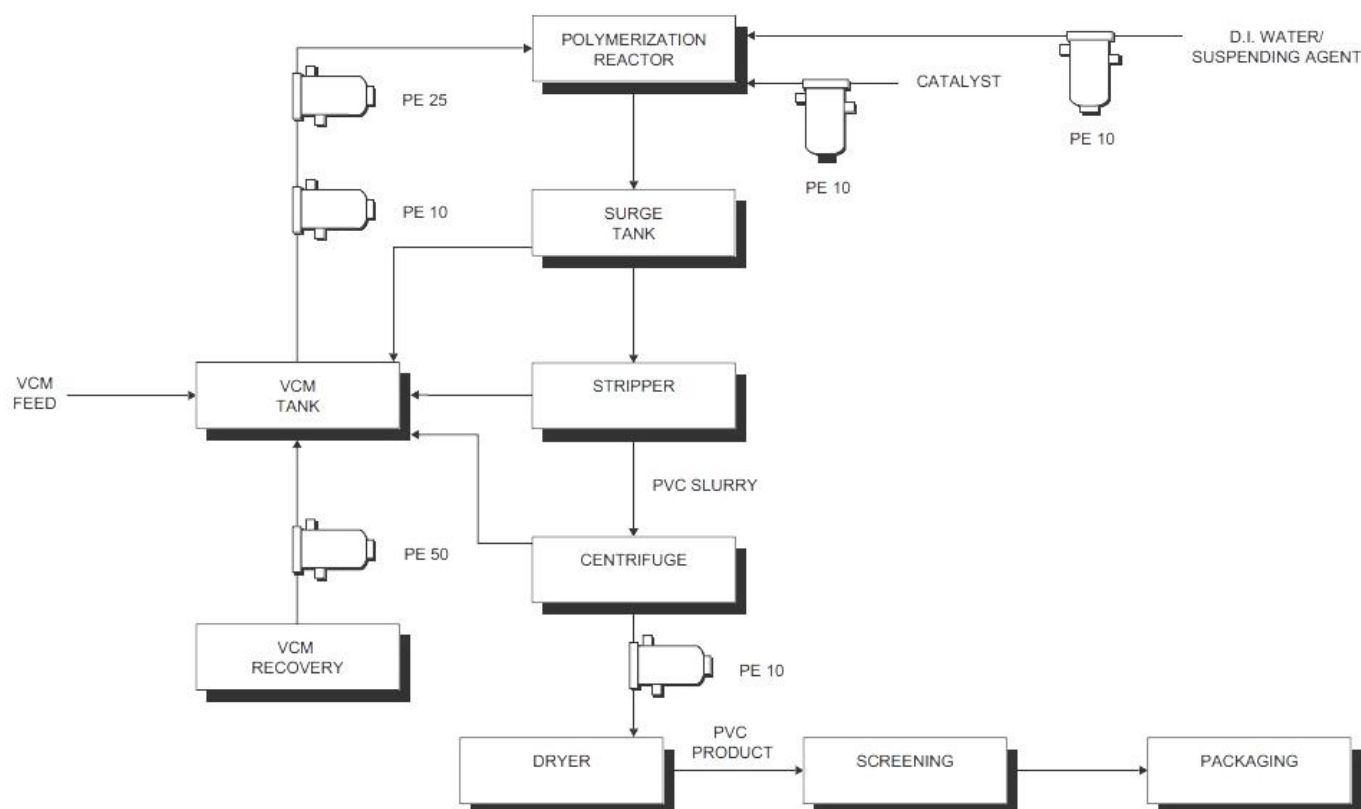


Fig. 03: Production of PVC

Table – 1
Different characteristics of PVC [20]

Specific Gravity	1.2-1.6
Elongation	22-140%
Tensile Strength	2600 psi
Compressive Strength	7200-8000psi
Melting point	125-300°C
Thermal Conductivity	0.11-0.22 W/m-K
Density	1.32 g/cm ³

PVC can also be used for packaging of drug, treatments, blood and chemicals for which it needs to possess high flexibility. But PVC is inflexible in nature with low thermal stability and it is difficult to process. In case of low thermal stability PVC starts off evolved decomposing in hydro-chloric acid and at the publicity of daylight or high temperature it starts degrading which makes PVC toxic and inapplicable for scientific cause, To conquer these limitation distinct additives are delivered. It is very crucial to conform biodegradable and eco-friendly polymers for healthy environment conditions. In this paper vegetable oil are used as additives for PVC to make it greater useful and increases in houses.

A. Reinforcement of different vegetable oils

Vegetable oils are non-conventional and maintainable source of uncooked material. Vegetable oils are essentially product of triglycerides that are also known as Triacylglycerol [4].



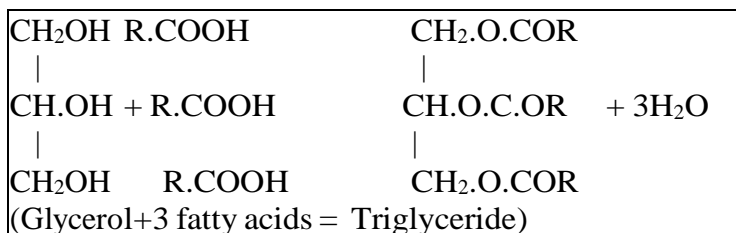


Fig. 04: Formation of triglycerides

Triglycerides are fashioned through the combination of glycerol and 3 fatty acids i.E. Linolenic acid, linoleic acid& oleic acid .

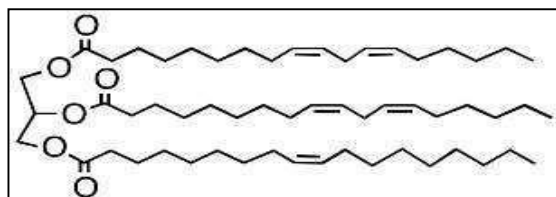


Fig. 05: Linolenic acid, linoleic acid, oleic acid [22]

Mainly vegetable oils are extracted from peanut, corn, linseed, soyabean at huge degree in which as coconut, palm, at decrease stage.

B. Types of vegetable oil:

Vegetable oils are of different types but mainly it is classified by its source and use. Vegetable oils are classified as-

1) By origin: vegetable oils which are not derived from the roots or seeds of the plant. For example- Walnut oil, Almond oil, Peanut oil etc.

2) By operation: vegetable oils which are derived from roots or seeds of the plant. For example- Sunflower oil, Soyabean oil, Olive oil etc.

Vegetable oils are used as plasticizers, stabilizers and fillers in PVC to make it extra stable [1]. For the extraordinary enhancements in behaviour of PVC epoxidised vegetable oils are the righteous alternative for the traditional phthalates [7]. These plasticizers and stabilizers are required to be brought in PVC to save you it from degradation.[3] . Phthalates had been being used as plasticizers due to the fact 1930 and Di (2-ethylhexyl) phthalate (DEHP) became the most significantly used plasticizer. These conventional plasticizers start degrading at high temperature and exposure to solar radiation [2]. It causes high toxicity& dangerous conditions. It has led to the development of renewable sources with low toxicity and excessive bio-degradability. These renewable sources are epoxidised vegetable oil including epoxidised soyabean oil, epoxidised sunflower oil, epoxidised linseed oil and so forth.[4] Epoxidised vegetable oils are extra reactive as compare to vegetable oils as EVOs possess functional epoxide organizations by which it can effortlessly make community with substances.

For instance:

Epoxidised soyabean oil can be used as primary and secondary plasticizer in addition to stabilizer for PVC that reduces scavenging of HCl and made PVC extra stable [9].

Palm oil also can be delivered in plasticized PVC as a co-plasticizer which complements distinct thermal & mechanical residences of PVC composite. This mixture offers a compound of better tensile energy & elastic modulus.[1]

Epoxidised sesame and peanut oil may be used at the location of epoxidised soyabean oil in PVC. Sesame and peanut oil have higher molecular enchantment with PVC as compare to soyabean oil.[17]

Epoxidised sunflower oil is used as secondary stabilizer in the presence of Calcium/Zinc stearate which indicates extravagant residences. This mixture reduces the probabilities of discoloration of PVC at high temperature and thermal balance[12]

The epoxidised linseed oil can be used on the location of phthalates. On mixing epoxidised linseed oil in PVC a rigid network has been made. This new composite shows low toxicity and much less degradation of PVC at high temperature. [2]

Table – 2

Different vegetable oils and their applications [4]

Vegetable oils	Application
Sunflower and Soyabean oil	Stabilization
Soyabean and Rapeseed oil	Lubrication
Castor oil, Sunflower oil, Linseed oil, corn oil, Camphor oil	Plasticization
Coconut and Palm oil	Surfactants
Peanut and Corn oil	Paints,Coatings

II. MECHANICAL BEHAVIOR

It has been discovered there is an superior improvement inside the mechanical behaviour of PVC via including epoxidised vegetable oils. PVC can be used with vegetable oil for creation work while epoxidised vegetable oil works as plasticizer and stabilizer. Epoxidised vegetable oil enhance the mechanical residences like thermal conductivity, tensile and compressive energy.[8] It may be understood via the subsequent facts-

- 1) Phthalates, the traditional plasticizers used in PVC had been changed by means of epoxidised peanut oil. Epoxidised peanut oil is used as plasticizer as well as stabiliser to lessen the degradation of PVC at some point of processing at excessive temperature [11- 12]. Addition of this oil prevents PVC from devolution as well as provides stability and versatility to PVC.[10]
- 2) Epoxidised corn oil is used as secondary stabilizer in PVC & show top notch houses whilst used with Ca/Zn stearates.
- 3) Epoxidised linseed oil, epoxidised castor oil, epoxidised palm oil also are utilized in PVC for distinct applications.
- 4) Addition of various epoxidised vegetable oil in PVC indicates exclusive variant in mechanical homes. When forty two% epoxidised vegetable oil has been delivered to PVC, mechanical residences extended while on increasing the fee of oil from 32% & forty two% a reduction in mechanical houses has been found. [17]
- 5) Peanut oil and corn strengthened PVC shows super compatibility and shows a brand new composite for growing destiny material.

III. CONCLUSION

This examine examines the of use of different epoxidised vegetable oils with PVC as reinforcing agent. It has been observed that exclusive epoxidised vegetable oils make PVC extra flexible & solid. It also can be visible that the usage of vegetable oil in PVC will increase thermal conductivity, tensile & compressive energy and reduces abrasion loss.

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