Nature & Environment
Vol. 19 (1), 2014: 35-38
Website: www.natureandenvironment.com

ISSN (Print) : 2321-810X
ISSN (Online) : 2321-8738

RESEARCH ARTICLE

Eco-Friendly Polymeric Materials Derived from Vegetable Oils: An overview

A. Hasant
Department of Chemistry, Gandhi Faiz-e-Aam College, Shahjahanpur-242001
(Affiliated to M.J.P. Rohilkhand University, Bareilly), U.P. India

Received: 2nd Dec. 2013, Revised: 27th Dec. 2013, Accepted: 3rd Jan 2014

ABSTRACT

Polymers are playing valuable role in present society and replace the metals in diverse field life. They are comprehensively used in developing small house hold articles to outstanding machineries, in addition to their outstanding utility in biomedical, bioengineering, textile industries, adhesive industries, coatings and paints industries and many others. The majority of polymeric materials are synthesized from petrochemicals a finite resource and is going to drain with day by day. Furthermore use of petrochemicals affects the environment appreciably with the increase in discharge of green house gases and enlargement of non-biodegradable waste on earth. Therefore there are potential demands throughout the world to replace the petroleum based raw materials with renewable ones due to societal and environmental points of view. Today investigations are therefore, focused on developing polymeric materials from plants beginning and agriculture waste. Among different renewable resources vegetable oils, a triglyceride embedded with different unsaturated and saturated fatty acids play very important role in the synthesis of polymeric materials of flexible utility. In the present communication efforts has been made to illustrate some useful polymeric materials of film forming ability obtained from vegetable oils.

Key words: *Vegetable oil based polymers, Alkyds, Polyesteramide, Polyurethane*

INTRODUCTION

Polymer based products become essential part of the modern society and replaces the metals in diverse fields of life. They have received important positions in making small house hold articles to splendid machineries, in addition to their versatile utility in biomedical, bio-engineering's, adhesive industries, coatings and paints industries (Lochab, *et al.* 2012, Meier, *et al.* 2007, Narine and Kong 2005). The cause of usefulness is due to their easy availability, their outstanding properties like molding ability in any design with small efforts, high resistivity towards erosion and corrosion (Lebarbe, *et al.* 2012, Guner, *et al.* 2006).

However, the precincts of polymeric materials are their non-biodegradable character; especially those derived from petrochemicals, which ultimately cause several threats to environment like heaping of waste materials on the earth surface, discharge of huge amount of green house gasses during process (Ahmad, *et al.* 2006). Depletion of petrochemical stock day by day further worried the academician and scientist to search some alternative sources which can reduce the dependency on petrochemicals and also suitable to environment (Alam 2009). Recent investigations are therefore, focused on to develop the polymers from plants origins.

Number of renewable resources such as starch, lignin, protein, cellulose, wool fibers and vegetable oil etc are extensively used a precursor for polymers (Akintayo and Adebowale 2004, 2007). Among the numerous renewable sources vegetable oils obtained from the seeds of different plants are non toxic, non-depletable, domestically abundant, non-volatile and biodegradable resources provides good prospective to polymer syntheses (Yadav, *et al.* 2009). Vegetable oils like soybean, castor, coconut, sunflower and many others have been extensively used in polymer synthesis for long time. These polymers got prominent applications in the development of corrosion protective coatings and paints. To improve the physicochemical and corrosion/ chemical resistance performances the developed vegetable

oil based polymers were modified with the other monomers and polymers. In the present communication efforts has been made to describe some important polymeric materials derived from vegetable oil with special emphasis of their use as coating materials.

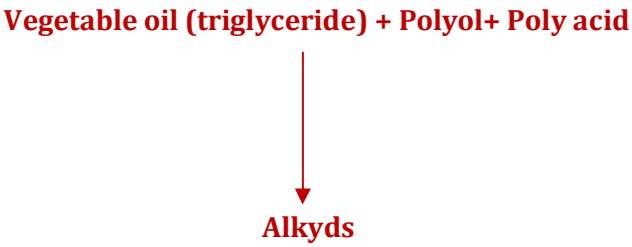
POLYMERS DERIVED FROM VEGETABLE OILS

The vegetable oils have enormous potential and are proven for the polymer syntheses. They have several reactive sites such as double bonds, hydroxyls, esters, epoxies and many others for the syntheses of polymers of film forming ability. Numerous polymeric materials such alkyds, poly(ester-amide), epoxies, poly(urethane)s, poly(ether-amide)s, polyamides have been derived using the vegetable oils as a precursors. These polymers are extensively used as the binders for the paints and coatings in addition to different areas of industries and domestic purposes. Alkyds, poly(ester-amide)s, and poly(urethane)s derived from vegetable oils extensively used in formulations of coatings and paints (Yadav, *et al.* 2009, Toliwal and Patel 2006, Kumar, *et al.* 2010).

Alkyds:

Alkyds resins are poly (condensation) product of the vegetable oils, polyacids and polyols and systematically can be represented as

Fig. 1: General scheme for the formulation of alkyds

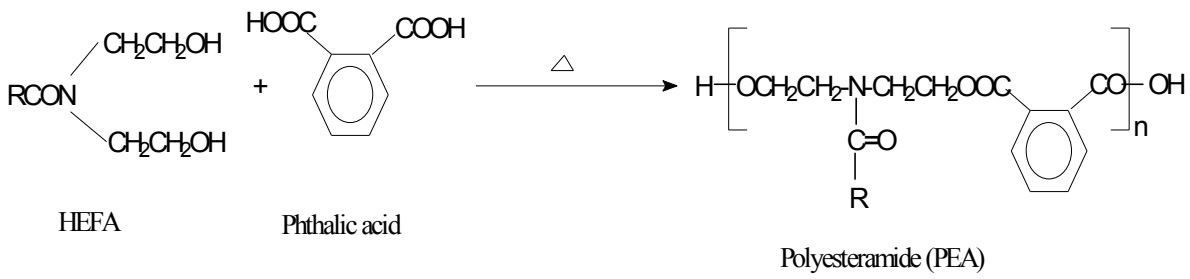


Alkyd resins are one of most versatile resin largely used as a binder for the paints and coatings. Several modifications were performed in view to improve its performances in several service conditions (Kumar, *et al.* 2010, Gunduz, *et al.* 2004).

Poly (ester-amide):

Poly (ester-amide)s are commonly known as modified alkyd. These are embedded with both repeating ester and pendant amide groups. The presence of amide linkages improve the several properties of the final resin like scratch hardness, ease of drying, water vapor and chemical resistivity. These are obtained by the amidation of vegetable oil followed by poly(condensation) with polyacids. Numerous poly(ester-amide)s were tailored from various vegetable oils. Several metal containing poly(ester-amide)s were developed in view to reduce the curing temperature with improve performances. Metal containing poly(ester-amide) were also claimed for antimicrobial activities (Ahmad, et al. 2003, Mahapatra and Karak 2004, Akintayo and Adebowale 2004).

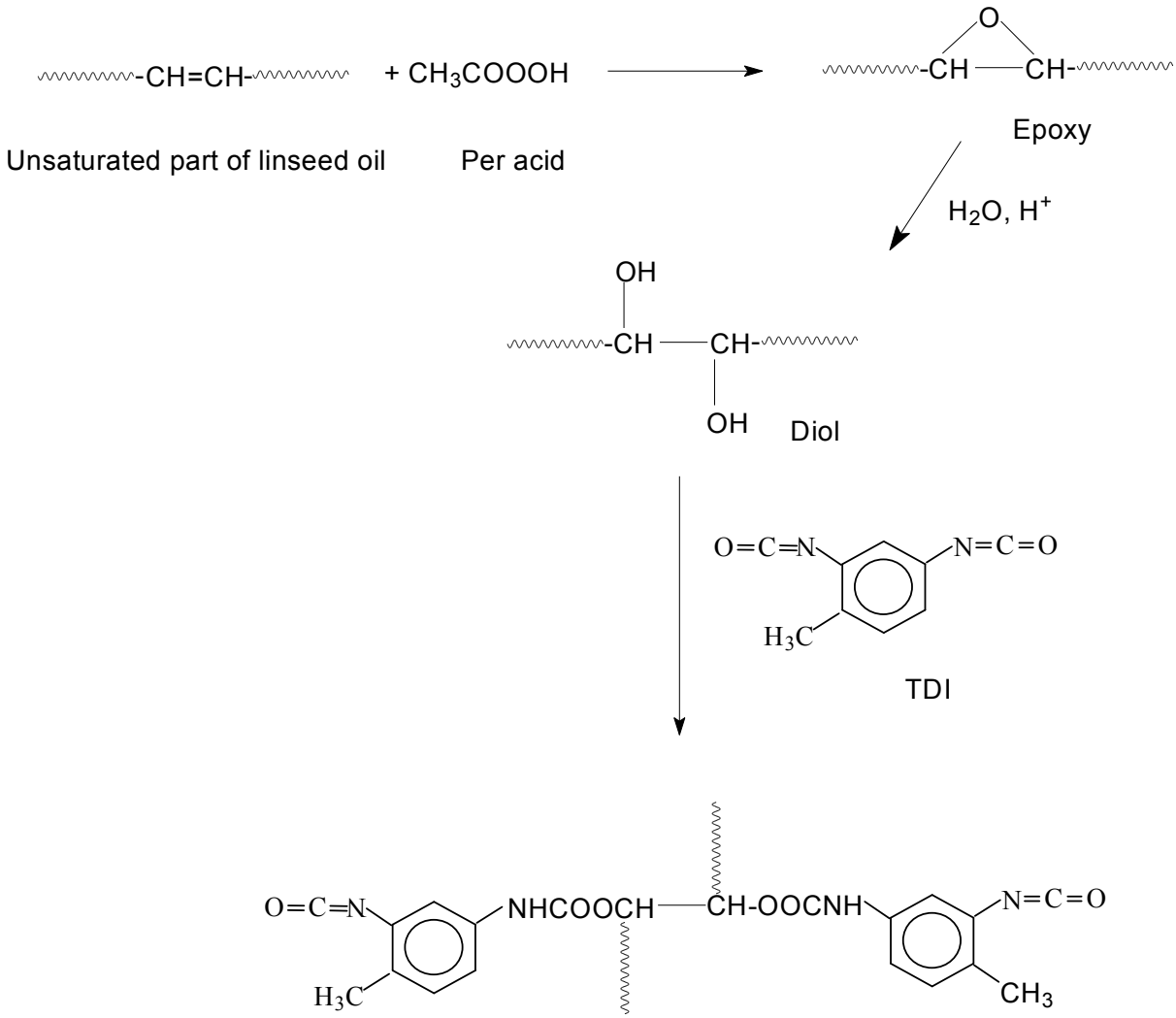
Fig. 2: Reaction Scheme for synthesis of Polyesteramide



Poly (urethane):

Poly (urethane)s are versatile class of polymer contain urethane linkages as repeating units. They are prepared by the interaction of isocyanate and alcoholic groups. Several ways have been documented in literature to use the vegetable oils as polyols for the poly (urethane) syntheses. Direct route for the hydroxylation in which trans diol is obtained at the unsaturation through the epoxidation process largely used for the polyurethane synthesis (5).

Fig. 3: Reaction scheme for the poly(urethane)



CONCLUSION

The studies indicate that the vegetable oils have proven to be cheaper, abundantly available raw materials for the syntheses of polymers for colossal applications in different areas. The utilization of vegetable oils can serve as an ideal source for the polymer syntheses with low or without environmental problems.

REFERENCES

1. Ahmad S., Ashraf S. M. A., Naqvi F., Yadav S. and Zafar F. (2006): Alumina-incorporated polyesteramide from non- edible seed oil, J. Macromol. Sci., Part A: Pure and Appl. Chem., 43: 1409-1419.
2. Ahmad S., Ashraf S.M., Naqvi F., Yadav S. and Hasnat A. (2003): A polyesteramide from *Pongamia glabra* oil for biologically safe anticorrosive coating. Prog. Org. Coat., 47: 95-102.
3. Akintayo C.O. and Adebowale K.O. (2004): Synthesis and characterization of acrylated Albiziabenth medium oil alkyds, Prog. Org. Coat., 50: 207-212.

4. Akintayo C.O. and Adebowale K.O. (2004): Synthesis and characterization of acrylated Albiziabenth medium oil alkyds, Prog. Org. Coat., 50: 207-212.
5. Akintayo C.O. and Adebowale K.O. (2007): Synthesis and characterization of acrylated *Albizia benth* medium oil alkyds, Prog. Org. Coat., 50: 207-212.
6. Alam M., Ray A.R. and Ahmad S. (2009): Synthesis and characterization of poly (esteramide-urethane) from linseed oil as anticorrosive coatings, J. Appl. Polym. Sci., 3268-3273.
7. Gunduz G., Khalid A.H., Mecidoglu I.A. and Aras L. (2004): Water-borne air-drying oil-based resins, Prog. Org. Coat., 49: 259-269.
8. Guner F.S., Yagci Y. and Erciyes A.T. (2006): Polymers from triglyceride oil, Prog. Polym. Sci., 31: 633-670.
9. Kumar M.N.S., Maimunah Z.Y. and Abdullah S.R.S. (2010): Synthesis of alkyd resin from non-edible Jatropha seed oil, J. Polym. Env., 18: 539-544.
10. Lebarbe T., Maisonneuve L., Nguyen T.H.N., Gadenne B., Alfos C. and Cramail H. (2012): Methyl 10-undecenoate as a raw material for the synthesis of renewable semi-crystalline polyesters and poly(ester-amide)s, Polym. Chem. 3: 2842-2851.
11. Lochab B., Varma I.K. and Bijwe J. (2012): Sustainable polymers derived from naturally occurring materials, Ad. Mater. Phy. Chem., 2: 221-225.
12. Mahapatra S.S. and Karak N. (2004): Synthesis and characterization of polyesteramide resins from Nahar seed oil for surface coating application, Prog. Org. Coat., 51: 103-108.
13. Meier M.A.R., Metzger J.O. and Schubert U.S. (2007): Plant oil renewable resources as green alternatives in polymer science, Chem. Soc. Rev., 36: 1788-1802.
14. Narine S.S. and Kong X. (2005): Vegetable oils in production of polymers and plastics, Bailey's industrial oil and fat products, 6th edn., Vol. 6th , John Wiley& Sons Inc.
15. Toliwal S.D. and Patel K. (2006): Modified neem (*Azadirachta indica* juss) oil based curing of acid functional acrylic copolymer resin for anticorrosive coating, J. Sci. Ind. Res., 65: 590-593.
16. Yadav S., Zafar F., Hasnat A. and Ahmad S. (2009): Poly(urethane fatty amide) resin from linseed oil-A renewable resource, Prog in Org Coat., 64: 27-32.