

Environmental and technical advantages of using rubber seed oil, compared to soybean oil

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Abstract

Vegetable oils have a huge potential for application in the field of production of polymeric materials with a high complex of properties. In addition to commercially available and common soybean oil, perspective use in this field and rubber seed oil (RSO). This oil is already used for the production of soap, alkyd paints, fats for the leather industry, lubricants and is a successful alternative to diesel fuel.

However, the full potential of this oil is not used by industry due to the lack of technology and relevant information in this field. In particular, the use of RSO and its derivative – epoxidized rubber oil in elastomers and plastics has not been studied and has the scientific and practical interest.

We have justified the efficiency of using, from an ecological and economic point of view, rubber seed oil, as a modifier of epoxy materials, produced on the basis of renewable plant raw materials. Advantages of using RSO in comparison with soybean oil are described as cheaper in the countries of growth of *Hevea brasiliensis*, which is waste material of obtaining natural rubber, extracted from grains with higher oil content, not consumed by human for food, and not used in the production of animal feeds, due to the content of cyanogenic glycosides, which under the action of a specific enzymes are converted into cyanide. It is shown that the modification of RSO causes an increase of wear resistance and an improvement of the antifriction characteristics of epoxy compositions. The joint use of commercially available soybean oil and higher fatty acids provides a high modifying effect in epoxy compositions. The water resistance of epoxy coatings, modified RSO and soybean oil remains at a sufficient level for their effective industry use. Both types of the investigated vegetable oils reduce the content of the gel fraction of epoxy compositions, that is, reduce the degree of their cross-linking. In addition, they serve as active diluents that enhance the gel time of epoxy compositions.

References

- [1] R.P. Tiger, E.M. Gotlib, V.T. Shashkova, A.V. Gorshkov, M.L. Pridatchenko, D.G. Miloslavsky, M.A. Levina. Green chemistry of polyurethanes: synthesis, composition and functionality of triglycerides of soybean oil with epoxy and cyclocarbonate groups - renewable raw materials for new urethanes. *High-molecular compounds*. **2015**. Vol.57. No.6. P.413-421. (russian)
- [2] M.A.R. Meier, J.O. Metzger, U.S. Schubert. Plant oil renewable resources as green alternatives in polymer science. *Chem. Soc. Rev*. **2007**. Vol.36. P.1788-1802.
- [3] Zhe Li, Jefferson M. Fox. Mapping rubber tree growth in mainland Southeast Asia using time-series MODIS 250 m NDVI and statistical data. *Applied Geography*. **2011**. Vol.32. P.420-432.
- [4] Chaiyan Chaiyaa, Prasert Reubroycharoen. Production of Bio Oil from Para rubber seed using Pyrolysis Process. *Energy Procedia*. **2013**. Vol.34. P.905-911.
- [5] V. Nandan, Rani Joseph, K.E. George. Rubber Seed Oil: A Multipurpose Additive in NR and SBR Compounds. *Journal of Applied Polymer Science*. **1999**. Vol.72. P.487-492.

- [6] Muhammad Yusuf Abduh, Muhammad Iqbal, Francesco Picchioni, Robert Manurung, Heeres J. Synthesis and properties of cross-linked polymers from epoxidized rubber seed oil and triethylenetetramine. *Appl. Polym. Sci.* **2015**. DOI: 10.1002/app.42591
- [7] Top-notch technology in production of oils and fats. <https://www.chempro.in/fattyacid.htm> (accessed 02.02.18)
- [8] Anh Nguyen, E.M. Gotlib, D.G. Miloslavsky, R.A. Ahmedyanova. Modification of epoxy compositions with rubber seed oil. *Bulletin of Kazan University.* **2017**. Vol.20. No.23. P.10-13. (russian)