ABSTRACT

Polyols are polymer products with an extended carbon chain and multiple reactive functional groups. Many vegetable-based oils have structures that lend themselves well as a base for these products, leading to the production of bio-based polyols. Naturally occurring variations in composition can be dealt with using a variety of process strategies. In the United States, several different processes have been developed for converting soybean oil into polyols for flexible polyurethane foams. Urethane Soy Systems Company produces a family of polyols made by auto oxidation, also known as blown soybean oil. Cargill Industrial BioProducts has developed polyols made by ring opening oligomerization of epoxidized soybean oil. Dow Chemical Company is developing soy-based polyols that are made in four main steps from soybean oil: (1) methanolysis, (2) hydroformylation, (3) hydrogenation and (4) polymerization.

Bio-derived materials such as soy-based polyols can offer significant advantages over conventional polyols in regard to sustainability, reduction of petroleum dependence and potential lower cost. They also are often characterized by higher thermal stability and less sensitivity to hydrolysis. But an important issue for soy-based polyols is the growing biodiesel market. Growing biodiesel demand significantly drove up soybean oil prices in 2007. A question that arises is how the process economics of soy-based polyols are impacted and whether these new bio-derived materials can remain competitive with conventional polyols. In this report, PEP presents process designs and associated cost estimates for bio-based polyols made by auto oxidation, ring opening oligomerization and hydroformylation. In general, technology development is still in the semi-commercial stage with only one commercial scale facility in the United States. The general conclusions are summarized below:

- Until 2006, price increases for conventional polyols helped to stimulate interest in bio-based polyols. However, rising demand for biodiesel has driven up natural oil prices and subsequent costs of bio-based polyols. Producers back integrated to the production of natural oils will have an advantage in this environment.

- Production of soy-based polyols by auto oxidation or ring-opening oligomerization are relatively simple processes without complicated unit operations. However, production by hydroformylation is a complicated multi-step process with more demanding capital requirements.
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