LYSINOL: A RENEWABLY RESOURCED ALTERNATIVE TO PETROCHEMICAL ETHYLENEAMINES AND AMINOALCOHOLS

Kenneth G. Moloy, Pranit S. Metkar, Mark A. Scialdone
E.I. du Pont de Nemours and Company
Central Research and Development, Experimental Station
200 Powder Mill Road
Wilmington, DE 19803, USA
kenneth.g.moloy@dupont.com

This presentation will report our investigation of the use of lysine as a raw material to manufacture useful chemicals. Lysine, an essential amino acid, is commercially manufactured by the fermentation of sugars and many other carbon sources, almost exclusively for use as an animal feed supplement. Global annual lysine production exceeds one billion kilograms and continues to grow. Combined with favorable manufacturing costs and market prices, these facts suggest that lysine may be considered to be a renewable, bio-derived, commodity chemical.

In view of this potential, we have developed the catalytic hydrogenation of lysine to lysinol (2,6-diamino-1-hexanol) and have investigated lysinol as a replacement for petrochemical-derived ethyleneamines and ethanolamines. Surprisingly few literature reports describe lysinol chemistry or applications, suggesting unrecognized potential as a renewable, platform chemical. Lysine hydrogenation proceeds with Ru/C catalyst in water (100-150 °C, 48-70 bar, pH 1.5-2) to give lysinol in good yield (100% conversion, > 90 % selectivity; 50-70 % isolated yield after purification by distillation). The impact of the various reaction parameters on lysine conversion and lysinol selectivity will be presented and discussed. Lysine hydrogenation at higher temperatures provides a pathway to piperidines and other products via further reduction and cyclization/elimination reactions involving lysinol. The demonstration of lysinol synthesis from commodity, animal feed-grade lysine sources will also be presented. An example of the potential utility of lysinol has been demonstrated by its use as an amine curing agent with a typical epoxy resin. The properties of the resulting thermoset will be compared and contrasted with that obtained with diethylenetriamine (DETA), a standard petrochemical ethyleneamine used in this type of application.