Succinic Acid

BIOREFINING PROCESS SOURCE

Fermentation of 6-carbon sugars & starches. Fermentation of lignocellulosic biomass is being researched.

DESCRIPTION

Succinic acid and its salts form a platform from which many chemicals can be produced.[1] Succinic acid is valued for its derivative chemicals, which are used in producing food and pharmaceutical products, surfactants and detergents, plastics, clothing fibers, biodegradable solvents, and other products.[1, 2, 3] Although formed naturally by plants, animals, and microorganisms, commercial production of 15,000 tons per year is from petroleum,[2] while food grade product is produced through older fermentation and separation technology.[1]

The U.S. Department of Energy has funded considerable research over the past 10 years to develop improved microorganisms and separations technology to reduce the overall cost of biobased succinic acid. Advances have reduced the cost from $2.00 per pound in 1992 to about $0.50 per pound in 2003 for biobased succinic acid,[1] and further reductions in cost are anticipated. Commercialization of new low-cost approaches would significantly increase the market demand for succinic acid and its derivatives. The domestic market for these chemicals is estimated at more than $1.3 billion per year, with a resulting energy savings of 9.8 trillion Btu per year.[4] The fermentation of succinic acid is unusual in that it absorbs carbon dioxide. Commercialization is being pursued by Diversified Natural Products, formerly Applied CarboChemicals, and others.[3, 4]

REPRESENTATIVE BIOBASED PRODUCT OPPORTUNITIES

BIOBASED PRODUCT	CLASSIFICATIONS	MARKET OPPORTUNITY	MARKET SIZE
Tetrahydrofuran (THF)	Solvents, adhesives, inks	Tetrahydrofuran is a solvent and key ingredient of adhesives, printing inks, and magnetic tape. The current annual U.S. market for these uses is estimated at 255 million pounds.[1]	Potentially displace 50 million pounds per year or greater, at $1.55 per pound[1]
1,4-Butanediol (BDO)	Solvents, resins, chemical intermediate	BDO is used in solvents, coating resins, and as a intermediate for producing other solvents and chemicals. The current annual U.S. market for these uses is estimated at 680 million pounds.[1]	Potentially displace 30 million pounds per year or greater, at $0.65 to $0.90 per pound[1]
Succinic salts	Coolants	Succinate salts lower the freezing point of water. This property, coupled with corrosion inhibition properties, makes succinate salts candidates for alternatives to glycols.[3]	
Succinic salts	Deicing compounds	There is a growing need to improve the performance of runway and wing deicing at both state and federal (military) airports while reducing environmental and corrosion impacts. Many of the existing products serving airport-deicing operations are being heavily regulated by the EPA because of their environmental toxicity. Succinic salts could replace 100% of airport deicers.	Airport deicers are a 10 million pound per year market, at $0.46 to $0.88 per pound[1]
Succinic salts	Herbicides	Many herbicides are hazardous to human and animal health and have spurred the development of high performance herbicides that are safe to humans and the environment. Diversified Natural Products has proprietary technology to replace formulations and enhance the activity of glyphosate-based herbicides.[3]	
Succinate esters	Fuel Additives	Succinate esters are excellent fuel oxygenates. Incorporation of diethyl succinate (DES) in diesel fuel results in a reduction	

BIOBASED PRODUCT	CLASSIFICATIONS	MARKET OPPORTUNITY	MARKET SIZE
		in particulate emissions depending on grade of fuel. The DES is fully miscible with diesel fuel and requires no co-solvents or additional additives.[3]	
Disuccinate esters	Solvents	There is market demand for "green," alternative solvents to highly volatile and chlorinated types. Replacement solvents should be biodegradable and pose little threat of air pollution or ozone damage. Disuccinate esters are "green" solvents that have performance and environmental benefits.[3]	
Diester succinates, specialty surfactants and other proprietary compounds	Personal care products	Diester succinates, specialty surfactants and other proprietary compounds are ingredients for the personal care "natural product" sector. Target products include nail polish remover, shampoos and creams. The nail polish remover is safe, biodegradable and non-volatile so it doesn't have that "chemical" smell.[3]	

REFERENCES

[1] Energetics Incorporated. 2003. Industrial Bioproducts: Today and Tomorrow. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Office of the Biomass Program, Washington, D.C.

[2] Brown, Robert C. 2003. Biorenewable Resources Engineering New Products from Agriculture. Iowa State Press, Ames IA.

[3] Diversified Natural Products, Inc. http://www.dnpco.com/ (21 April 2004).

[4] U.S. Department of Energy, Office of Industrial Technologies. 1999. Production Of Succinic Acid From Wood Wastes And Plants Chemicals Project Fact Sheet. http://www.oit.doe.gov/chemicals/factsheets/succinic.pdf (21 April 2004).