



Typical Process Flow Diagram for the purification of lysine. There recovery of lysine in the system is at least 98.5 %.

Lysine recovery from fermentation broth using SepTor technology

Process flow diagram

The ammonia (-sulphate) content in the effluent of the adsorption zone is below 1.5% w/w and in all other waste effluents it is below 0.5%. The excess ammonia in the eluted product, approximately 1.3% w/w, will be recycled.

Introduction

L-Lysine is one of the essential amino acids, which cannot be synthesized in the body. Lysine is normally insufficiently present in staple foods. As a consequence, lysine is normally added to animal feed. The global market for food-grade L-Lysine is estimated at approximately 700,000 ton (2003 figure). The market price for bulk Lysine has dropped significantly over the past few years, forcing suppliers to apply more efficient manufacturing technologies.

L-Lysine is produced through fermentation using *Brevibacterium flavum*, which yields very high concentrations of Lysine in the broth. Lysine has molecular formula $C_6H_{14}N_2O_2$ and is normally produced

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as L-Lysine monohydrochloride (L-Lysine.HCl). Molecular weight of L-Lysine. HCl is 182.65 gram/mole. The molecule has three pK values at 2.2, 9.2 and 10.8 and the iso-electric point is at pH = 10.

After the fermentation, the lysine broth is subjected to microfiltration and ion exchange for purification, followed by concentration and crystallization. The mother liquor of the crystallization is recycled towards the ion exchange system.

Typical lysine manufacturing plants have capacities of 20 - 40 ktpa, but larger facilities have been built with production capacities up to 100 ktpa.

In this application note, a continuous chromatographic recovery process for food grade lysine will be presented. The process that will be described in this application note is designed for a production capacity of approximately 40.000 tonnes per year (40 ktpa).

Design considerations

Main contaminants in the feed solution are organic components (sugar related, representing approximately 10 - 11 % of the dry matter in solution) and metal cations (approximately 1.500 - 2.000 ppm). After the mother liquor of the crystallization has been mixed with the microfiltration permeate, the lysine concentration is approximately 12 - 14% w/w.

The lysine is bound on a sulphonated (SAC) polystyrene-DVB exchange resin, such as Dowex Monosphere 650. Similar resins are manufactured by Rohm & Haas (Amberlite resin), Purolite, Mitsubishi Chemical (Diaion resins) and generally give a comparable performance.

In order to adsorb all lysine and maximize the affinity of the lysine towards the resin (relative to the cations), the pH of solution is lowered to pH = 2, thereby charging both NH₂ groups in the lysine molecule. Generally, this is done with sulphuric acid.

After the lysine is adsorbed, the resin bed is washed in order to displace the interstitial feed solution. In a second wash (in upflow direction), the undissolved particulates (if any) are removed from the bed, by slightly expanding the resin bed. The resin is eluted with ~5% w/w ammonia solution, yielding a purified L-Lysine solution at pH = 11 - 11.5, which is further concentrated and crystallized.

Process Economics

One of the dominant criteria in the design of lysine manufacturing is the consumption of water and ammonia. In the typical design presented in this application note, the water consumption is approximately 25 liter per kg purified lysine and the ammonia consumption is approximately 285 kg (dry) ammonia per ton lysine.

One of the dominant factors in the operating expenses for lysine purification is related to the costs of the ion exchange resin. This can be related to the specific productivity of the system, which expresses the annual amount of product that can be purified per unit volume of resin. The productivity of a SepTor system for the purification of lysine typically is in the range of 240 - 270 tpa/m³.

A fixed bed system with an equivalent production capacity would approximately contain 300 - 350 m³ resin, approximately twice as high as a SepTor system. Wash and elution steps in a fixed process typically require 35 - 55% more water and chemicals than in a fixed bed process. This already represents savings in operating costs of approximately USD 2 - 5 million per year for the capacity as presented above.

Conclusions

SepTor Technologies offers a very efficient and robust process for the purification of L-Lysine from a fermentation broth. The system offers enormous flexibility, allowing minimization of the consumption of water and chemicals.

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