Abstract

Process Economics Program Report 18B

POLYETHYLENE TEREPHTHALATE

(December 2000)

Polyethylene terephthalate (Pet) is one of the three major thermoplastic families. In the year 2000 PET is expected to reach a total worldwide sales volume of 57 billion pounds (25.9 million tons). It is used in a wide variety of applications ranging from common textile fibers to blow-molded carbonated beverage bottles.

The major raw materials for PET are ethylene glycol (EG) and purified terephthalic acid (PTA). Initially dimethyl terephthalate (DMT) was used because of PTA purification difficulties. These difficulties have now been overcome and DMT is now used only in special circumstances such as in existing facilities or where DMT is available internally. PTA is the monomer examined in this report.

Four areas of PET technology are reviewed. The first three are (1) PET by conventional melt plus solid-state polymerization (SSP), (2) PET manufactured using DuPont's new predominantly solid-state process, and (3) PET using modified melt polymerization with conventional SSP. Process flow diagrams, material balances, and detailed techno-economic analyses are presented for these three technologies.

In the first process most of the polymerization is carried out in the melt phase, which produces sales-grade PET for the polyester fiber market. Solid-state polymerization allows a higher molecular weight to be obtained, which is required for the blow-molded bottle market. It is a natural extension of the fiber process to simply add a solid polymerization stage to boost the molecular weight. This process is shown to be economically the least attractive of the three examined.

The second process uses a novel technique for producing tough polymer particles at a very low molecular weight. This capability allows the mechanically complex melt polymerization section to be greatly reduced, with the bulk of the polymerization carried out in the simpler solid-state reactors. This process is, economically, the most attractive of the three processes.

The third process uses the conventional melt plus SSP approach with major improvements in the melt polymerization stage only. These improvements allow the elimination of some agitated equipment, slightly reducing both capital and operating costs. The economics of this approach are improved over the first process but poorer than the second process.

The fourth technical sect6ion examines a variety of new technologies, all of which have interesting aspects but have not yet been commercialized.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

ILLUSTRATIONS

TABLES

TABLES (Continued)

TABLES (Concluded)