Abstract

Process Economics Report 96B

POLYBUTYLENE TEREPHTHALATE AND BUTANEDIOL

(October 1997)

Both polybutylene terephthalate (PBT) and polyethylene terephthalate (PET) polyesters are produced from terephthalic acid and a diol. PBT uses 1,4-butanediol (BDO), whereas PET uses ethylene glycol. Since PBT's introduction in 1970 (in competition with PET), its market has grown rapidly. The ease of injection molding it affords and its rapid crystallization rate allow customers to take advantage of PBT's inherent heat resistance in a wide variety of automotive and other applications. Numerous applications are also being developed for higher molecular weight PBT resins in the extrusion area.

Improvements in catalyst technology have allowed reduction in the size of the early-stage reactors, and with new condensation technology BDO can be captured and recycled without the purification previously required. Solid state polymerization technology now allows continuous polymerization, which replaces the older batch technology. This report updates two previous PEP reports on the technology and cost of producing PBT.

The sizable growth in the market for PBT has increased demand for BDO. We examine five processes for producing BDO. In the most widely used process, which is based on acetylene and formaldehyde, advances in both reaction and purification have taken place. Another process, which is growing rapidly, is based on propylene oxide (PO); for this process, improvements in hydrogenation have been combined with new isomerization technology. We examine these two processes in detail.

In three other important commercial or near commercial processes, butadiene (BD), maleic anhydride (MA) via dimethyl maleate, and butane are used as starting materials. We update previous studies of these routes to provide a basis for comparing technologies and relative economics.

Capital costs are highest for the butane and the BD routes, lower for both the acetylene and PO routes, and lowest for the MA route. When product values (projected sales prices) for BDO from plants of similar size are compared, the product value of the acetylene route is the highest, followed by BDO from the BD and PO routes; the values for the MA and the butane routes are the lowest.

This report will be of interest to those that are considering producing or already produce BDO or PBT; to those that produce or are considering producing acetylene, PO, BD, butane, or MA, which are consumed in producing BDO; and to those that produce tetrahydrofuran, which constitutes the largest single use for BDO.

GLOSSARY

Term	Definition
BD	Butadiene
BDO	1,4-Butanediol
BYO	Butynediol
CSTR	Continuously stirred tank reactor
DMM	Dimethyl maleate
DMT	Dimethyl terephthalate
DPT	Davy Process Technology
GBL	gamma-Butyrolactone
HBA	4-Hydroxy-1-butyraldehyde
ITRI	Industrial Technology Research Institute of Taiwan
MA	Maleic anhydride
MFR	Melt flow rate
MMM	Monomethyl maleate
MPD	2-Methyl-1,3-propanediol
PBT	Polybutylene terephthalate
PET	Polyethylene terephthlate
PO	Propylene oxide
PVC	Polyvinyl chloride
THF	Tetrahydrofuran
TPA	Terephthalic acid
TPT	Tetraisopropyl titanate

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

ILLUSTRATIONS

TABLES

TABLES (Concluded)