

LDPE

Low Density Polyethylene Tubular and Autoclave Process Technologies and Cost of Production Economics for LDPE film and EVA film are assessed for generic & licensors (ExxonMobil, SANTEC, LyondellBasell) plants. Also Linear Low Density Polyethylene (LLDPE) technology & economics compared to LDPE. Regional supply/demand and plant capacity data also included.

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Report Abstract
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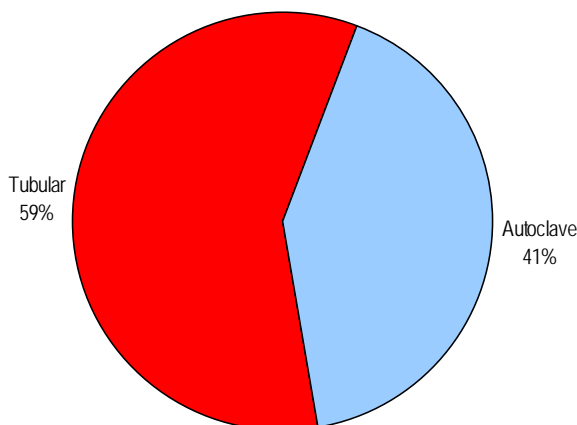
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INTRODUCTION

There are two basic processes to manufacture LDPE, tubular and autoclave, with each licensor adding specific variations. Installed capacity by process type is shown in the figure below.

Installed LDPE Capacity by Process Type



Q409_00101.0009.4101_LDPE Capacity.xls\Capacity_by_Process

For this report, Nexant has reviewed many state-of-the-art LDPE processes that are available for license. The evaluation provides:

- Recent developments highlighting key developments relating to the process technology.
- Background information on the technology including general product capabilities and a list of licensees, where applicable.
- Process description with simplified flow sheets.
- Investment and cost of production estimates for a grassroots facility. This is for a generic plant constructed by a third party and does not reflect “special situations” that could result in a lower or higher capital investment. It is generally believed that a licensor can build its own plant for a lower capital cost relative to a third party company.

The tubular and autoclave processes for the various LDPE technologies are discussed in Section 2. The recent developments, background, and process description are covered in this section. The cost of production estimates and economic basis are presented in Section 3. A comparison with LLDPE technology is also included, as ever since the inception of the gas phase LLDPE process, there has been the question of which process is less expensive.

LDPE demand, capacity, and supply/demand and net trade data is presented in Section 4 for the United States, Western Europe, and the Asia Pacific region.

TECHNOLOGY REVIEW

The recent developments, background, and process descriptions for the various LDPE technologies are discussed in this section. LDPE is the original form of polyethylene, having been invented by ICI in 1933. There are two basic processes to manufacture LDPE, tubular and autoclave, with each licensor adding specific variations. All technologies are mature, with the first autoclave process commercialized by ICI in 1938 and the first tubular reactor invented by BASF in 1938 with commercial production in 1953. For technology licensors, cost reduction and product enhancement of their technologies are critical, with numerous technologies competing for each new plant.

Tubular Processes

There are several companies that license LDPE technology based on the tubular process. There are differences between the various tubular reactor systems, particularly with regard to initiators and the use of a reactor pressure control valve to give cyclic pressure drops to improve heat transfer for fractional melt grades. The general principles and a general process description for the tubular process are presented in this report, followed by highlights of the processes and company activities for ExxonMobil, LyondellBasell, and SABTEC.

Autoclave Processes

There are also several companies who license autoclave processes. The general principles and a general process description for the autoclave process are presented in this report, followed by sections highlighting the key differentiating features of the processes and licensor activities for ExxonMobil, ICI/Simon Carves, LyondellBasell, and Polimeri Europa (EniChem).

LDPE versus LLDPE

In addition to LDPE, this report considers the competition between the newer LLDPE resins and the more established LDPE resins with which they compete for market share. While LLDPE resins use ethylene plus an alpha olefin comonomer to produce the side chains that give the linear polymer its low density and flexibility, commodity grades of LDPE use just ethylene since the process produces both long and short chain branches from ethylene.

ECONOMICS ANALYSIS

The economics for the various LDPE technologies are considered very competitive; cost of production estimates are presented for some leading technologies, as well as for generic state-of-the-art plants.

Cost of production estimates have been developed for the following:

- LDPE film production via ExxonMobil Tubular process
- LDPE film production via LyondellBasell's LUPOTECH T Tubular process
- LDPE film production via SABTEC's CTR Tubular process
- EVA Film (18% VA comonomer) via LyondellBasell's LUPOTECH T Tubular process
- EVA Film (18% VA comonomer) via SABTEC's CTR Tubular process
- EVA Film (18% VA comonomer) via ExxonMobil Autoclave process

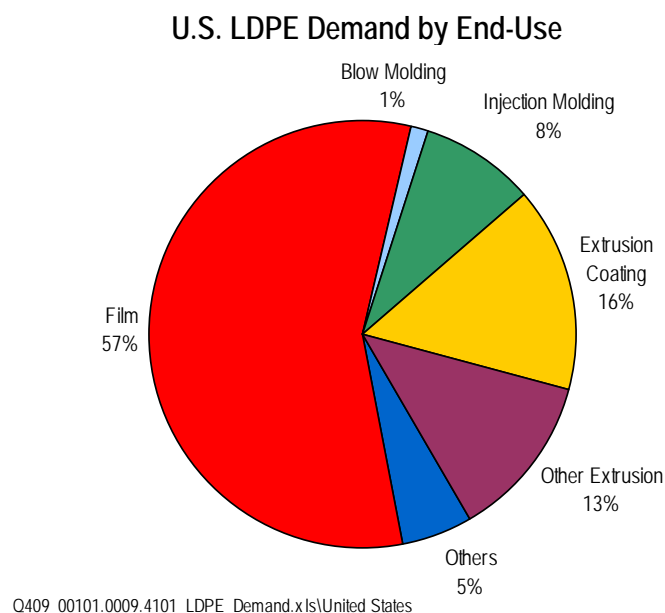
- EVA Film (18% VA comonomer) via LyondellBasell's LUPOTECH A Autoclave process
- LDPE Film via various licensors using the Autoclave process
- LDPE Film via various licensors using the Autoclave process (3 lines)

In this time of rapidly advancing developments, where many technologies are available for license, the choice between a low pressure LLDPE process and a high pressure LDPE process is becoming less obvious. Since the inception of the gas phase LLDPE process, there has always been the question of which process is less expensive.

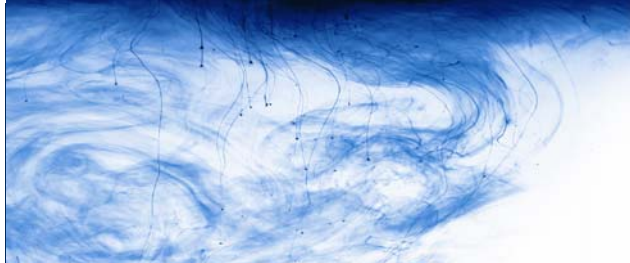
- A summary of the investment estimate (ISBL) and the offsites cost (OSBL) for a tubular LDPE plant and gas phase LLDPE plant is presented.
- The operating cost parameters for the production of polyethylene film are compared for (third-party generic) LDPE and LLDPE plants.
- The cost of production estimates for an LDPE Tubular process is compared with an LLDPE Gas Phase process (for both a case where butene-1 is the comonomer and hexene-1 is the comonomer with metallocene catalyst).

COMMERCIAL ANALYSIS

Typical markets for LDPE are illustrated by the figure below which shows the end-use demand for LDPE in the U.S.



- Supply, demand and trade data for the following regions: U.S., Western Europe, and Asia Pacific are also presented.
- Tables giving individual plant production capacity according to plant location, plant owner, technology and process used for the regions listed above are also included in the report.



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