Innovene™ G & S technologies
Recent advances and global positioning

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PE Product Manager

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Sneak peek at INEOS

INEOS at a glance

- **Turnover**: $54 billion
- **Employees**: 17,000
- **Production**: 60 million tonnes
- **Heritage**: AMOCO, BASF, BAYER, BOREALIS, BP, DEGUSSA, DOW, ENICHEM, ERDÖLCHEMIE, HOECHST, ICI, INOGENE, LANXESS, MONSANTO, NORSK HYDRO, and SOLVAY.
- **Sites**: 65 sites in 16 countries

Growth through strategic partnership

- JV with PetroChina for refining and trading
- Former JV with BASF now wholly owned for Styrenic & PS
- Proposed JV with Solvay for the chlorine/PVC chain

Entrepreneurial & Innovative

*INOVYN™*
A new millennium company
Our polyolefins technologies

**Innovene™ G**
Clean loop gas phase
Swing LLDPE/HDPE

- Superior mLL and HAO LL products
- Unique C4-C6-C8 comonomer versatility
- Clean Loop Process
- High reliability / Low Maintenance
- Low Capex & Opex

**Innovene™ S**
Bimodal slurry loops
HDPE/Bimodal HDPE

- Superior bimodal HDPE products
- Routine swing monomodal/bimodal/Cr operations
- Quick transitions
- No wax generation
- Low Capex & Opex

**Innovene™ PP**
Plug flow gas phase
PP (homo, RCP, ICP)

- Superior ICP’s
- Highest product consistency
- Unique plug flow process
- Short transitions
- Low Capex & Opex
Our polyolefins licensing successes

20 millions tonnes

INEOS is a leading licensor or PE & PP technology

50% of our sales are based on multi-platforms projects
Trends in polyethylene

Based on Nexant POPS data

- Metallocene LLDPE
  - 2 x AAGR of LLDPE

Based on Nexant POPS and Townsend Solutions data

- Bimodal HDPE
  - 1.5 x AAGR of HDPE
Innovene™ G - an advanced gas phase

**Clean loop** technology with cyclones

**Benefits**: no circulating fines, no cleaning shutdown requirement
⇒ Unique on-stream time capability

**High Performance Condensation** for
Injecting condensation liquid into the reactor

**Benefits**: Effective liquid vapourisation directly into the reactor.
No fluidisation issues, no liquid pooling

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Provides outstanding operability and reliability
Innovene™ G product coverage

<table>
<thead>
<tr>
<th>Application</th>
<th>Type</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Film</strong></td>
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<td></td>
</tr>
<tr>
<td>LL C4</td>
<td>●</td>
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<tr>
<td>LL C6 or C8</td>
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<tr>
<td>mLL C6 or C8</td>
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<tr>
<td>mVLDPE</td>
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<tr>
<td>HDPE Cr</td>
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<tr>
<td><strong>Blow Molding</strong></td>
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<tr>
<td>Medium Mw Cr</td>
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<tr>
<td>High Mw Cr</td>
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<tr>
<td><strong>Injection Molding</strong></td>
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<tr>
<td>HDPE</td>
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<tr>
<td><strong>Pipe &amp; Conduits</strong></td>
<td>Non pressure</td>
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<tr>
<td>PE80</td>
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<tr>
<td><strong>Textile</strong></td>
<td>Monofilament</td>
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<tr>
<td>Tape</td>
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<tr>
<td><strong>Rotomolding</strong></td>
<td>MDPE C4 and C6</td>
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<tr>
<td>mMDPE</td>
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<tr>
<td><strong>Others</strong></td>
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<tr>
<td>Geomembrane</td>
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<tr>
<td>Extrusion coating</td>
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Metallocene VLDPE, LLDPE & MDPE
Superior processability, optical & ESCR properties

Ziegler LLDPE, MDPE & HDPE
Vast product & application coverage with C4-C6-C8 co-monomers

Chromium HDPE
Vast product & application coverage
Innovene™ G Footprint

- Running licensees: 5.7 MTA with 39 lines running
- Projects in design or EPC: 4.8 MTA (13 lines) under design/construction
HPLL™ High Performance Linear Low

Based on a proprietary Constrained Geometry metallocene Catalyst

LCB

Reverse Comonomer Distribution

Extrudability

Mechanicals

Optics

Sealability

Bubble Stability

INEOS HPLL

Solution C8 Metallocene

Conventional Gas Phase Metallocene
**HPLL™**, downgauging in film applications

**Formulation**: monolayer 50µm
95% mLLDPE + 5% LDPE

- **Better processability with HPLL™**
  - Bubble stability comparable to conventional LLDPE
  - HPLL™ was run at 20% higher output

- **Higher stiffness:**

  - Best balance of mechanical, optical and sealing properties available now with unmatched processability and lower energy costs

- **Outstanding Optics:**
HPLL™, low SIT film based on mVLDPE

- HPLL™ @ 912 kg/m³ matches solution 902 kg/m³ ULDPE’s
- is very close to metallocene plastomers
- but is exhibiting better mechanical properties

Extra low SIT film
still with superior processability and toughness
HPLL™, enhanced extrusion coating

- Lower seal temperature - broader processing window
- Tougher seal - higher seal integrity
- Highly increased ESCR

Broader processing window and better package integrity & ESCR still with superior processability
Innovene™ S - a streamlined process

- Catalyst
- Monomer
- Hydrogen
- Bimodal Intermediate Treatment
- Twin Reactors In Series
- Slurry Heater
- High Pressure Separator
- Low Pressure Diluent Recovery
- Nitrogen
- 95% of hydrocarbon directly recycled
- To extruder
- FL
# Innovene™ S Product Coverage

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<tr>
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<td></td>
<td>Metallocone HD</td>
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**Bimodal HDPE**
- Superior ESCR/impact balance, access to leading products like PE100RC

**Chromium based HDPE & MDPE**
- Vast product & application coverage with popular grades

**Ziegler based HDPE & LLDPE**
- Vast product & application coverage

**Metalloocene LLDPE & HDPE**
- In development (pilot scale)
Innovene™ S Footprint

7.5 MTA licensed in 9 years
Built: 7 slurry lines INEOS and licensees = 2.1 Mtpa
Design or construction: 16 lines > 6 Mtpa
Trends in pressure pipes market

1987: INEOS invented the 1st generation of PE100

PE63
PE80
PE100
PE100RC
Low Sag PE100

Performance level


2.5 m
PE100RC

Resistant to Crack PE100 designed for alternative installation techniques

PE100
Requires sand bed protection

PE100RC
Sandless Laying

Sand protection might represent up to 50% of the total cost!
INpipe™100SR a new PE100RC reference

Innovene™ S is a solution provider for all piping systems including PE100RC, today’s most performing HDPE grade
Bimodal Blow Moulding

Blow moulding

Monomodal

Bimodal
ZBM58-30HS, a new reference

Superior ESCR and processability multiplying opportunities for downgauging
Metallocene HDPE for rotomoulding

Impact

<table>
<thead>
<tr>
<th>ESCR</th>
<th>Comp. Mcene A</th>
<th>Comp. Mcene B</th>
<th>Innovene™ G Mcene</th>
<th>Innovene™ S Mcene (developmental)</th>
<th>Innovene™ G Ziegler</th>
</tr>
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<tr>
<td>Low</td>
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Promising ESCR/impact/processability balance

- Slurry process
- Gas phase process

Innovene™ S developmental resins (pilot scale)

- ZIEGLER MI = 5.2
- METALLOCENE MI = 4.2
- METALLOCENE MI = 5.4
Innovene™ G
Clean loop gas phase
Swing LLDPE/HDPE

Innovene™ S
Bimodal slurry loops
HDPE/Bimodal HDPE

Premiere platforms
Wide market recognition
Bimodal HDPE
mLLDPE / mVLDPE for all market segments
Solutions for the new millennium

INEOS Technologies

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