

## **Polyglue<sup>®</sup> : Adhesive Resin**

## General Aspect

### What is Polyglue® ?

The **Polyglue®** is a modified polyolefin with functional groups to bond firmly to common polyolefins, polyamides, ethylene vinyl alcohol (EVOH), wood and metals. Since polyolefin itself have no functional groups, it does not adhere to other materials. However, we have succeeded in incorporating functional groups into the “**Polyglue®**” to endow the outstanding adhesiveness to other materials without losing all the characteristic benefits of the polyolefin.

The **Polyglue®** adheres strongly to gas-barrier resins and metals by thermal action and finds broad applications in the co-extruded bottle, tubes, sheet and film, steel pipe lining and metal powder coating.



## General Aspect

### Characteristics of Polyglue®

- Strong adhesion

**Polyglue®** adhere to metals such as Al, steel and barrier resins such as EVOH, Nylon etc strongly by thermal reaction. And it bonds to PE or PP by its polyolefin characteristics also.

- Durability

Composed of polyolefin and having strong adhesion to substrates, **Polyglue®** serves high durability. It's durability enables for composite pipe to be used in hot & cold water pipe lining (e.g. floor heating pipe)

- Simple and easy processing

It is useful in pellet form for use conventional extrusion equipment designed for polyolefin processing. Based on PE & PP that is thermoplastic, process condition of **Polyglue®** is similar to common polyolefin.

## Technical Information

### Physical properties of Polyglue® for steel pipe coating



| Item                        | Unit               | Typical value |              |              |              |
|-----------------------------|--------------------|---------------|--------------|--------------|--------------|
|                             |                    | LE149V        | LE200T       | LE851P       | RE340B       |
| Melt index                  | g/10min            | 1.5           | 4.0          | 4.4          | 8.0          |
| Density                     | g/cm <sup>3</sup>  | 0.921         | 0.927        | 0.923        | 0.900        |
| Tensile strength (at break) | Kg/cm <sup>2</sup> | 220           | 180          | 215          | 220          |
| Elongation                  | %                  | 800           | 800          | 800          | 600          |
| Hardness                    | Shore D/R-scale    | 48 (Shore D)  | 47 (Shore D) | 43 (Shore D) | 78 (R-scale) |
| Vicat softening point       | ℃                  | 102           | 98           | 94           | 130          |
| Brittleness temp.           | ℃                  | ≤ -70         | ≤ -70        | ≤ -70        | -            |
| Peel strength               | kg/cm              | ≥ 3.0         | ≥ 3.5        | ≥ 3.0        | ≥ 4.0        |
| Water absorption            | %                  | ≤ 0.01        | ≤ 0.01       | ≤ 0.01       | ≤ 0.01       |

## Comparison of physical properties

### Polyglue® LE149V

| Item                        | Unit               | LE149V<br>(HDEP) | MB158D<br>(Dupont) | ME0420<br>(Borealis) |
|-----------------------------|--------------------|------------------|--------------------|----------------------|
| Melt index                  | g/10min            | 1.5              | 1.8                | 1.0                  |
| Density                     | g/cm <sup>3</sup>  | 0.921            | 0.924              | 0.934                |
| Tensile strength (at break) | Kg/cm <sup>2</sup> | 220              | 230                | 180                  |
| Elongation                  | %                  | 800              | 800                | 600                  |
| Hardness                    | Shore D            | 48               | 50                 | 47                   |
| Vicat softening point       | ℃                  | 102              | 110                | 94                   |
| Brittleness temp.           | ℃                  | ≤ -70            | < -70              | < -80                |
| Water absorption            | %                  | ≤ 0.01           | < 0.01             | < 0.01               |
| Melting point               | ℃                  | 121              | 127                | 124                  |

## Adhesion Strength in Field Test

### Result of 'T' peel test : Polyglue® LE149V

|               | Epoxy              | Adhesive                   | Peel strength ( N/inch) |
|---------------|--------------------|----------------------------|-------------------------|
| Case 1        | JOTUN / EP1197     | Dupont / MB158D            | 354                     |
| Case 2        | JOTUN / EP1197     | Hyundai EP / LE149V        | 436                     |
| <b>Case 3</b> | <b>KCC / L-300</b> | <b>Hyundai EP / LE149V</b> | <b>Ave. 600</b>         |

\*\* Peel speed: 10 mm/min, width: 1 inch

\*\* These are test results of field in PPSC of Malaysia.

#### Coating conditions

- Line speed : 2 m/min
- Pipe temperature : 186 ~ 191 °C
- Epoxy gelling time : 18 sec
- Adhesion time : 40 sec (time between top coating to quenching)

## Compatibility Information

| Epoxy primer<br>( Manufacture )    | Adhesive polymer<br>( Hyundai EP ) | Black PE Compound<br>( Manufacture )  |
|------------------------------------|------------------------------------|---------------------------------------|
| BASFOX PE-50-1081<br>( BASF )      |                                    | <b>ET509B</b><br>( Hyundai EP )       |
| EP-971197 / EP-F-2001<br>( JOTUN ) | <b>LE149V</b>                      | HE3450<br>( BOREALIS )                |
| SCOTCHKOTE 228<br>( 3M )           | <b>LE200T</b>                      | SCLAIR 35BP / 35BPM<br>( NOVA )       |
| KARUMEL EX4413<br>( KCC )          | <b>LE851P</b>                      | LACQTENE 2006PBK35<br>( ELF-ATOCHEM ) |
| EUROKOTE 714BP<br>( ELF-ATOCHEM )  |                                    | LUPOLEN 3653 DSW<br>( BASELL )        |

\* Above information is based on the data from testing by PSL (India), Saw Pipe (India), Socotherm (Italy), PPSC (Malaysia), Petrojet (Egypt).

## **Marketing History**



## Marketing History



## Egypt

▶ **Project name : Domestic Oil Pipe Line Coating Project**

- Owner / Year : Egypt Government / 1999
- Applicator : Petrojet

▶ **Project name : Offshore Gas Pipeline**

- Owner / Year : EGPC / 2001
- Applicator : Petrojet

**Project name : Egyptian Gas Transmission Network**

- ▶
- Owner / Year : EGPC / 2002
  - Applicator : Petrojet

**Project name : Shams Tarek Pipe Lines, Gas El-Kasr Pipe Lines, Om Baraka Melleha Pipe Line Project**

- ▶
- Owner / Year : KHALDA Petroleum Company / 2004
  - Applicator : Petrojet

▶ **Project name : Burullus Gas Simian Sienna/Sierra & Shapphire Project**

- Owner / Year : KHALDA Petroleum Company / 2004
- Applicator : Petrojet

▶ **Project name : Egypt Domestic Pipe Line Project**

- Owner / Year : N/A / 2005
- Applicator : Petrojet

▶ **Project name : N/A**

- Owner / Year : N/A / 2007-2008
- Applicator : Petrojet

## India

- ▶ **Project name : Jamnagar - Loni LNG Pipe Line Coating Project**
  - Owner / Year : GAIL(Gas Authority of India) / 1999
  - Consultant : EIL(Engineers India Limited)
  - Applicator : PSL Holdings Ltd.
- ▶ **Project name : Baruni-patna Pipe Line Project**
  - Owner / Year : IOCL (Indian Oil Comp. ltd)) / 2000
  - Applicator : SAW Pipe Ltd.
- ▶ **Project name : Para-deep Pipe Line Project**
  - Owner / Year : IOCL (Indian Oil Comp. Ltd) / 2001
  - Applicator : PSL Holdings Ltd.
- ▶ **Project name : Vizag-Secondrabad Pipeline Project**
  - Owner / Year : EIL / 2002
  - Applicator : PSL Holdings Ltd.
- ▶ **Project name : Mora Sajod Gas Pipeline Project**
  - Owner / Year : IOCL / 2003
  - Applicator : SAW Pipe Ltd.
- ▶ **Project name : Merut Basin Oil Development Project**
  - Owner / Year : Petrodar(SUDAN) / 2004 - 2005
  - Applicator : PSL Ltd.
- ▶ **Project name : GAIL Project**
  - Owner / Year : 2009
  - Applicator : PSL Ltd.
- ▶ **Project name : Clough Offshore Pipeline Project**
  - Owner / Year : N/A / 2005
  - Applicator : PSL Ltd.
- ▶ **Project name : GASCO Project**
  - Owner / Year : 2010
  - Applicator : Jindal Saw Ltd. & Maharashtra Seamless Pipe

## Malaysia

- ▶ **Project name : LoopⅡ Project**
  - Owner / Year : Petronas / 1999
  - Applicator : PPSC Malaysia
- ▶ **Project name : Fahud Sohar Gas Pipeline Project**
  - Owner / Year : Oman Government / 2001
  - Applicator : PPSC
- ▶ **Project name : In Salah Gas Development Project**
  - Owner / Year : BP & Sonatrach / 2002
  - Applicator : PPSC
- ▶ **Project name : Trans Thai Malaysia Project**
  - Owner / Year : Gas Transmission Company Ltd.(GTCL) / 2004
  - Applicator : PSL Limited
- ▶ **Project name : Sakhalin 2 Phase 2 Project**
  - Owner / Year : S.E.I.C. / 2004
  - Applicator : Bredero Shaw Malaysia
- ▶ **Project name : PTT 3<sup>rd</sup> Transmission Project**
  - Owner / Year : PTT(THAI) / 2004 - 2006
  - Applicator : PPSC Malaysia
- ▶ **Project name : DBNGP Stage 4 Expansion Project – Loop 10**
  - Owner / Year : Worley Parsons / 2005 - 2006
  - Applicator : Bredero Shaw Malaysia
- ▶ **Project name : LoopⅢ Project**
  - Owner / Year : Petronas / 2000
  - Applicator : PPSC
- ▶ **Project name : BTC Pipeline (Baku-Tbilisi-Cweyhan) Project**
  - Owner / Year : BP Consortium / 2002
  - Applicator : PPSC
- ▶ **Project name : Sakhalin II Project**
  - Owner / Year : S.E.I.C. / 2003
  - Applicator : PPSC Malaysia
- ▶ **Project name : SCP(South Caucasus Pipeline) Project**
  - Owner / Year : BP Consortium / 2004
  - Applicator : PPSC Malaysia
- ▶ **Project name : PTT Sai Noi Project**
  - Owner / Year : PTT (THAI) / 2004 - 2005
  - Applicator : Bredero Shaw Malaysia
- ▶ **Project name : Yeman LNG Project**
  - Owner / Year : Mitsui / 2005 - 2006
  - Applicator : Bredero Shaw Malaysia

## China

- ▶ **Project name : Domestic Gas Transportation Pipe Line Project**
  - Supervisor : CNPC / 2000-2001
  - Applicator : Hualong Petroleum Anti-corrosion Co. Ltd  
Yadong Anti-corrosion Co. Ltd
- ▶ **Project name : West-East Pipe Line Project**
  - Owner / Year : CNPC / 2001-2002
  - Applicator : Hualong Petroleum Anti-corrosion Co. Ltd  
Yadong Anti-corrosion Co. Ltd
- ▶ **Project name : Onshore Pipeline Project**
  - Supervisor : CNOOC / 2002
  - Applicator : Yadong Anti-corrosion Co. Ltd
- ▶ **Project name : Sudan Pipe Line Project**
  - Owner / Year : CPTDC China / 2003
  - Applicator : CNPC
- ▶ **Project name : Sudan Pipe Line Project**
  - Owner / Year : CPTDC China / 2003
  - Applicator : CNPC
- ▶ **Project name : Merut Basin Oil Develpoment Project**
  - Owner / Year : Petrodar(SUDAN) / 2004 - 2005
  - Applicator : CPTDC
- ▶ **Project name : Kazakhstan Project**
  - Owner / Year : N/A / 2005
  - Applicator : CPTDC
- ▶ **Project name : ACCESS Project**
  - Owner / Year : N/A / 2005
  - Applicator : Garneau Inc.

## Indonesia

▶ **Project name : Domestic Pipe Line Coating Project**

- Owner / Year : PGN Indonesia / 1997
- Applicator : Hyundai Metal Indonesia

▶ **Project name : West Semo PM (Oil Station Construction) Project**

- Owner / Year : Indonesian Government / 2002
- Applicator : WISTCO (Supervisor : Unocal)

▶ **Project name : Indonesia Domestic Project**

- Owner / Year : N/A / 2003
- Applicator : Shinho Korindo.

▶ **Project name : Indonesian Domestic Project**

- Owner / Year : N/A / 2005
- Applicator : PT SPINDIO

▶ **Project name : Indonesian Domestic Project**

- Owner / Year : N/A / 2005
- Applicator : Indo Jaya Pipe

▶ **Project name : Indonesian Domestic Project**

- Owner / Year : N/A / 2005
- Applicator : Indo Jaya Pipe

## **Japan**

- ▶ **Project name : Canadian Project**
  - Owner / Year : N/A / 2004
  - Applicator : Sumitomo Metal Industry

- ▶ **Project name : Japan Domestic Project**
  - Owner / Year : Teikoku Oil Co.Ltd. / 2005
  - Applicator : Sumitomo Metal Industry

- ▶ **Project name : N/A**
  - Owner / Year : BP / 2005
  - Applicator : Sumitomo Metal Industry

- ▶ **Project name : South Sumatra-West Java Project**
  - Owner / Year : Nittetsu Anti-corrosion / 2005
  - Applicator : Sumitomo Metal Industry

- ▶ **Project name : N/A**
  - Owner / Year : BP / 2006.5-2006.6
  - Applicator : Sumitomo Metal Industry

## **Pakistan & Iran**

### **Pakistan**

- ▶ **Project name : Domestic Oil Pipe Line Coating Project**
  - Owner / Year : Pakistan Government / 1999
  - Applicator : Crescent Steel
  
- ▶ **Project name : WOPP Pipe Line Project**
  - Owner / Year : CPECC China / 2003
  - Applicator : Data Steel & CNPC
  
- ▶ **Project name : Pakistan Domestic Project**
  - Owner / Year : N/A / 2005
  - Applicator : DATA Steel
  
- ▶ **Project name : Pakistan Domestic Project**
  - Owner / Year : N/A / 2006.5-2006.7
  - Applicator : Shashi Steel Pipe

### **Australia**

- ▶ **Project name : Sea-gas Pipeline Project**
  - Owner / Year : Sea-gas / 2002
  - Applicator : Socotherm Australia
  
- ▶ **Project name : Enertrade Project**
  - Owner / Year : Enertrade / 2003-2004
  - Applicator : Bredero Shaw Australia
  
- ▶ **Project name : N/A**
  - Owner / Year : Bredero Shaw Australia / 2006
  - Applicator : Bredero Shaw Australia



## **Others customer**

### **Saudi arabia**

- ▶ **Project name : Domestic Oil Pipe Line Coating Project**
  - Owner / Year : Aramco / 2000
  - Applicator : AL-Qahtani Pipe Coating Terminal

### **Iran**

- ▶ **Project name : Domestic Oil Pipe Line Coating Project**
  - Owner / Year : NIOC / 2002
  - Applicator : Ahwaz Pipe Mills.
  
- ▶ **Project name : Domestic Oil Pipe Line Coating Project**
  - Owner / Year : NIOC / 2003
  - Applicator : Ahwaz Pipe Mills.

### **Syria**

- ▶ **Project name : Aleppo-Palmyra Gas Pipeline Project**
  - Owner / Year : Syrian Petroleum Company / 2001
  - Applicator : Dongsung C-Tech

### **Israel**

- ▶ **Project name : Israeli Domestic Pipe Line Project**
  - Owner / Year : N/A / 2006.4-2006.6
  - Applicator : Metco

### **Russia**

- ▶ **Project name : N/A**
  - Owner / Year : N/A / 2007-2009
  - Applicator : Chelyabinsk

# **Quality Control**

## **Quality Control**

### **Certification**

ISO 9001

ISO14001

### **Quality Control System**

By the standard of ISO 9001, Hyundai Engineering Plastics has secured a quality control system. All the physical properties of **Polyglue®** and **Top Coat PE** are estimated by Quality Control System and issued in the form of analysis test report at every batch.

### **Evaluation of Physical Properties**

ASTM (American Standard Test Method) is the evaluation standard of quality control and technical service. And we do estimate all the characteristics of materials according to this standard.

## Quality Control

### Certification

