Future Trends and Developments in Engineering Plastics

European Plastics Distribution Association
Thilo Bischoff – Vice President Product Management – BASF Performance Materials Europe
1. BASF – We create chemistry
2. A snapshot of the global plastics market
3. BASF Performance Materials
4. Recent innovations in engineering plastics
5. A focus on extrusion
6. Summary
Our chemistry is used in almost all industries

We combine economic success, social responsibility and environmental protection

Sales 2014: €74,326 million

EBIT 2014: €7,626 million

Employees (as of December 31, 2014): 113,292

6 Verbund sites and 353 other production sites
Demographic challenges set the stage for the future of the chemical industry

In 2050: More than nine billion people **but** only one earth

Resources, Environment and Climate

Food and Nutrition

Quality of Life

Chemistry as enabler
Our strategic principles

1. We add value as one company
2. We innovate to make our customers more successful
3. We drive sustainable solutions
4. We form the best team
Chemistry-based innovations
Growth and technology fields

Global needs
- Resources, Environment and Climate
- Food and Nutrition
- Quality of Life

Customer industries
- Transportation
- Agriculture
- Construction
- Energy & Resources
- Consumer Goods
- Electronics
- Health & Nutrition

Growth fields
- Automotive Lightweight Composites
- Batteries for Mobility
- Enzymes
- E-Power Management
- Functional Crop Care
- Heat Management for Construction
- Organic Electronics
- Plant Biotechnology
- Water Solutions
- Wind Energy
- ...

Technology fields
- Materials, Systems & Nanotechnology
- Raw Material Change
- White Biotechnology
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Plastics are a global success story.

- Continuous growth for more than 50 years.
- Plastics production ramped up from 1.5 Mio t in 1950 to ~311 Mio t in 2014.
- In 2014 global plastic’s production grew by 3.8% compared to 2013.
- Compound Annual Growth Rate (CAGR) from 1950 to 2014 is 8.7%.


Source: PlasticsEurope Market Research Group (PEMRG) / Consultic Marketing & Industrieberatung GmbH
World plastic materials demand 2014 by types

- Polyolefins account for more than 55% of global Plastics Materials demand.
- PVC is the second largest resin type following Polyolefins.
- Standard Plastics (Polyolefins, PVC, PS & EPS, PET) account for approx. 85% of the total demand.
Asia is leading, China as biggest producer

- Asia with the leading country China (26%) meanwhile accounts for 47% of worldwide production.
- Europe and NAFTA are on a similar level each with a share of around 19%~20%.
- Due to the economic crisis, Europe lost global production shares.
European demand is dominated by packaging & construction

- Packaging and Building & Construction by far represent the largest end-use markets.
- The third biggest end-use market is the Automotive Industry.
- E & E accounts for 6%.
- Others includes consumer, agriculture, household, appliances, furniture, medical, etc.

* EU27+N, CH incl. Other Plastics (~5.5 Mio t), excluding Croatia
Source: PlasticsEurope Market Research Group (PEMRG) & in Cooperation with Eastern and Central European Business Development (ECEBD)/ Consultic Marketing & Industrieverantwortung GmbH
The industry is changing constantly (examples)

Aquafil, part of the Bonazzi Group (ITA), sold the technopolymers business to Domo Chemicals (BE). With the transaction, Domo Chemicals increased its presence in the engineering plastics market, while Aquafil intends to re-invest the capital into its activities in the fiber business. (2013-6)

Ravago (BE) acquired Styron’s (CH) expandable polystyrene resin segment, following its expansion strategy in their EPS business. The transaction included the sales of the Styron plant in Schkopau (Germany). (2013-07)

DEXPlastomers VOF, a joint between DSM Nederland and ExxonMobil Benelux, was acquired by Borealis. Products manufactured at the site in Geleen (NL) are specialty products, complementary to Borealis' plastic solutions. (2013-3)

Ineos Barex (CH) acquired the polyacrylonitrile business from Mitsui Chemicals (JP) to supply the Asian market with Barex PAN products. (2013-5)
The industry is changing constantly

Borealis (AT) acquired joint venture partner DuPont’s (US) shares of Speciality Polymers Antwerp NV. Speciality Polymers Antwerp NV will continue to supply DuPont with EVA and copolymers of acrylates. (2014-08)

After founding the 50/50 joint venture Styrolution, BASF completed the sale of its 50% share to INEOS in November 2014, making it the leading global styrenics supplier.

Ineos (CH) and Doeflex Compounding (UK) merged their PVC-compound activities. The cooperative venture operates under the name Ineos Compounds and produces in UK, Switzerland and Sweden. (2014-09)

Solvay (BE) acquired Chevron Phillips Chemical’s “Ryton” polyphenylsulphone (PPS) segment. The business will be fully consolidated in Solvay’s business unit “Specialty Polymers”. (2014-09)
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Strong orientation on industries and customers

Classical Chemicals

Product Focus

Performance Materials

Industry Focus
We focus on four target industries:

- Consumer
- Transportation
- Construction
- Industrial
## Our product portfolio

### Polyurethanes

- Cellasto®
- Elastocoat®
- Elastopan®
- Elastoflex®
- Elastopor®
- Elastofoam®
- Elastospray
- Elastollan®
- Elasturan®
- Elastolit®
- Infinery®

### Engineering Plastics

- Ultramid®
- Ultradur®
- Ultraform®
- Ultracom®

### Styrenic Foams

- Styropor®
- Neopor®
- Styrodur®

### Specialty Plastics

- ecovio®
- ecoflex®
- Baxxodur®
- Kerdyn®
- Basotect®
- Palusol®
- Ultrason®
- Neopolen®
We develop new markets and products

New Market Development
- Identifies new markets
- Develops new business models
- Scouts with R&D and customers

Innovation

Product Development
- Enhances product benefits
- Explores new products
- Co-develops with customers
We go beyond the product: designfabrik®

- Showroom for innovative materials: test, touch, feel
- Translates design thinking into engineering options
- Link to universities and freelance designers
- Determines the colors and surface finishes right through to optimizing the design and choice of material
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Infinergy® - The world’s first E-TPU
Infinergy® combines properties of foams and TPU

Material expertise of TPU

+ Particle foam know-how

= Innovation E-TPU
Infinerg® by BASF: A boost™ for adidas

Spring/Summer ’13:

1 running shoe

300,000 pairs
The run has just begun

Fall/Winter ’15:

11 running shoes.

50 in other sports.

12.000.000 pairs
The latest boost innovations

Boost Snowboard boots

Nov. 2014 released by Adidas

UltraBoost

Jan. 2015 released by Adidas
Diverse applications in sports and leisure

- Sports and floors
- Inner tubes for bicycles
- Ship fenders
Ultrasim®: Unique simulation toolbox
Ultrasim®: Commercial success

Lower Bumper Stiffener

Engine Mounts

Engine Applications

ESP E&E

Solar Applications

Seating

Pedal Brackets

Plastic Air Spring Piston

Frontend Modules

VW GROUP AWARD 2013
BASF customizes Open-Source library OpenFOAM for simulation of

- Chemical mixing
- PU Foaming
- Resin transfer molding
- Extrusion
PU Foaming simulation as new CAE service

CAE model of customer part

BASF Material model

Material characterization

BASF foaming simulation

Simulation results
- Manufacturability
- Void prediction
- Optimized process settings
High orientation of glass fibers in extrusion process
- Continuously increasing while melt passes through die
- However, orientation is partially lost due to swelling of strand after the die
- Optimized die geometry preserves fiber orientation
Ultracom™
Thermoplastic Composite System

Weight, cost and performance optimized parts

Ultracom™

Semi-finished products (tapes / laminates)

Overmolding material (compounds)

Engineering service

Ultratape™
Ultralaminate™

Ultramid® COM

Ultrasim® + processing + parts testing
Economic Composite Design Loves Smart Combination of Materials and Processes

Combination of local continuous fiber reinforcement in injection and compression moulding \(\rightarrow\) Function integration in complex parts with high strength and stiffness

- Injection/Compression Moulding
- Geometrical complexity \(\rightarrow\) Stiffness by ribs
- Short fiber
- Long fiber
- Woven Laminate Tape
- Fiber length
- Stiffness by material properties

Quelle: SAMPE Deutschland
18.-19.02.2015, M. Schulitz, TU Darmstadt
Future demands: Higher performance, new material combinations, new applications
New technologies and designs demand higher material performance: Increasing energy density & metal replacement

- Heat ageing
- Heat resistance
- Reflow soldering
- Chemical resistance
- Mechanical stability
- Dimensional stability
- Surface quality
- Regardless of temperature and humidity
Joining Technologies Lab

Comprehensive Test Equipment under one roof

Infrared, Hot Gas and Hot Plate Welding Machine
Vibration Welding Machine
Screwing Machine
Ultrasonic Welding Machine
Laser: FOBA DP50
Laser Type: Nd:YAG
Main Joining Technologies

Plastic+Plastic // Plastic+Multi-Material Design

- Welding
- Snap joint
- Adhesive bonding
- Rivet joint
- Joining by injection molding
- Screw joint
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Broad Portfolio for Extrusion Applications

**Extrusion Portfolio**

- **POM**
  Semi Finished Parts (Stock Shapes)

- **PBT**
  Fibre Optical Cable
  Semi Finished Parts (Stock Shapes)
  Profiles and Specialities (i.e. Window Insulation Stripes)

- **PSU/PPSU**
  Medical Applications (i.e. Membranes and Stock Shapes)

- **PA**
  Semi Finished Parts (Stock Shapes)

- **TPU**
  Tubes, cables, films, sheets

**Portfolio Examples**

- **Medical Applications** (Filter Membranes & Stock Shapes)
- **Fiber Optical Cable**
- **Reinforcement insulation stripe**
- **Classical Stock Shapes**
- **Profiles (Specialties i.e. hollow profiles)**
New applications: Bicycle inner tube for Schwalbe - Elastollan®

Need

- Bicycle inner tube that is lightweight and offers high durability and toughness

BASF Solution

- Material, processing and manufacturing expertise (Elastollan®)

Results

- Combined solution for tube, valve base, valve stem and a simplified production process
- Weight savings up to 65% compared with butyl rubber tubes
- Extraordinary high puncture resistance
- Inner tube can withstand very high level of continuous load
- Very low air permeability
New Dimensions in Extruded Stocks

- **Customer:**
  Gehr GmbH, Mannheim

- **Material:**
  Ultraform® H4320 UN

- **Dimensions:**
  Ø 600 mm
  length 1,000 mm
  weight 400 kg
One slice with impressive dimensions:
- **600 mm** diameter
- **100 mm** thickness
- Weight approx. **50 kg**

...more than all other exhibits together

Proudly presented at Fakuma – thanks to GEHR GmbH
Agenda

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Plastics are still a global success story with strong growth potential, especially in Asia.

The industry is changing: More specialization, consolidation and restructuring.

Innovation is happening in products, processes, services and partnerships at the same time.

It’s about more than just the material: Simulation & Testing become increasingly crucial.

Changing consumer requirements call for new high-performance materials.

Extrusion offers significant potential to realize demanding applications.
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