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EPS RECYCLING TECHNOLOGY

Polymers & Fibers
ABOUT US

> 300 ENGINEERS & SPECIALISTS

8 LOCATIONS IN GERMANY

FAMILY BUSINESS

140 YEARS OF EXPERIENCE
IDEAS INSIDE

TECHNOLOGY LICENSING

ENGINEERING SERVICES

PLANT CONSTRUCTION
TECHNOLOGY LICENSING
### Engineering Services

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Planning</td>
<td>• Technical &amp; commercial concept</td>
</tr>
<tr>
<td></td>
<td>• Feasibility Study</td>
</tr>
<tr>
<td></td>
<td>• Pre-Engineering</td>
</tr>
<tr>
<td>Engineering</td>
<td>• Process Development</td>
</tr>
<tr>
<td></td>
<td>• (Extended) Basic Engineering</td>
</tr>
<tr>
<td></td>
<td>• Authority Engineering</td>
</tr>
<tr>
<td></td>
<td>• Detail Engineering</td>
</tr>
<tr>
<td>Procurement</td>
<td>• Tendering/Awarding</td>
</tr>
<tr>
<td></td>
<td>• Supply of Equipment</td>
</tr>
<tr>
<td>Construction</td>
<td>• Construction/Installation</td>
</tr>
<tr>
<td></td>
<td>• Supervision</td>
</tr>
<tr>
<td></td>
<td>• Documentation</td>
</tr>
<tr>
<td>Commissioning &amp; Start-up</td>
<td>• Training</td>
</tr>
<tr>
<td></td>
<td>• Commissioning</td>
</tr>
<tr>
<td></td>
<td>• After-Sales Service/Maintenance</td>
</tr>
<tr>
<td></td>
<td>• Revamping</td>
</tr>
</tbody>
</table>
PLANT CONSTRUCTION

PROCESS TECHNOLOGY
ENGINEERING PACKAGE
KEY EQUIPMENT DELIVERY
SUPERVISION OF LOCAL:
  Engineering
  Installation & Construction
  Plant Start-up & Commissioning

FUNCTIONAL TURNKEY CONTRACT
WE PLAY GLOBAL

> 1,000 PROJECTS SUCCESSFULLY DELIVERED

IN > 40 COUNTRIES
OUR PORTFOLIO IN POLYMERS & FIBERS

(POC) POLYCARBONATE / Polycondensation Plants

(PA6) POLYAMIDE 6 / Polymerization Plants
including optimized Extraction Process

(PA 6.6) POLYESTER 6.6 / Polymerization Plants

(PET) POLYESTER / Polycondensation Plants

(PAN) POLYACRYLONITRILE / Polymerization Plants

(EPS) EXPANDED POLYSTYRENE / Recycling Plants

RE-VAMPING & OPTIMIZATION /
of existing Polymer Plants

MASTERBATCH PLANTS /
for various Polymers

LABORATORY & PILOT PLANTS /
for Polymer Synthesis
PC POLYCONDENSATION PLANT

EPC’s melt trans-esterification process for simultaneous production of different PC grades due to multiple finisher lines (100 kta). Patented EPC variPLANT® technology.

LOCATION / CHINA
IMPLEMENTATION / 2011 – 2015
CLIENT / OCC – Ningbo Oceanking
CONTRACT SUM / Approx. 60 Million €
SERVICES BY EPC /
• Process Technology
• Engineering Package
• Key Equipment Delivery
• FAT Quality Control
• Supervision of Installation, Pre-Commissioning and Commissioning
• Recipe Development
• Product Optimization
PC Lab Scale Plant

Lab scale plant for the research and development of EPC’s melt transesterification polycarbonat process

LOCATION / Rudolstadt, Germany
IMPLEMENTATION / 2010 – 2013
CLIENT / TITK
INVESTMENT SUM / Confidential
SERVICES BY EPC /
- General Engineering
- Equipment Supply
- Installation
- Commissioning
PLANNING, ASSEMBLING AND COMMISSIONING OF LAB SCALE PET PLANT

LOCATION / RIYADH, SAUDI ARABIA
IMPLEMENTATION / 2005 – 2006
CLIENT / SABIC R+T
INVESTMENT SUM / Approx. 1.9 Million €
SERVICES BY EPC /
• General Engineering
• Equipment Supply & Installation
• Commissioning
CONVERSION OF 4 EXISTING POLYCONDENSATION SYSTEMS

Conversion from textile fibers to food grade PET-chip production w/ simultaneous capacity increase to 1,000 t/d.

LOCATION / YANBU, SAUDI ARABIA
IMPLEMENTATION / 2007 – 2009
CLIENT / IBN Rushd Saudi Arabia (a SABIC affiliate)
CONTRACT SUM / Approx. 45 Million €

SERVICES BY EPC /
- General Engineering
- General Contractor
- Construction and Assembling Supervision
- Commissioning
TECHNOLOGY
INTRODUCTION
EPS Recycling Plants based on CreaSolv® Technology

1. Development of the CreaSolv® Cooperation
2. Structure of the CreaSolv® Cooperation
3. Facts & Figures EPS
4. Feedstock sources for the CreaSolv® Process
5. Output PS-products
6. Advantage of CreaSolv® Plants
7. EPS CreaSolv® Recycling Plants – Technological Overview
The basic technology of EPS recycling was developed until 2005 within an INNONET Project, sponsored by German government. (Fraunhofer IVV, CreaCycle, EPC Group and others)

The technology has been continuously further developed and optimized the last years by Fraunhofer IVV and CreaCycle advanced CreaSolv® Technology.

EPC is the engineering and construction partner to convert the CreaSolv® Technology into feasible and reliable recycling plants. (of the shelf or tailor made)

Key designs of recycling plants based on CreaSolv® Process have been developed by EPC Group (of the shelf).

These "standard" design cover 90% of the EPS/PS input streams from different sources.
STRUCTURE OF THE CREASOLV® COOPERATION

- Plant design & basic engineering
- Delivery of key equipment
- Basic process patent
- R&D back-up / support
- Development of solvent formulation
- Plant design & basic engineering
- Sub License – Basic process
- Sub License (Fraunhofer)
- Delivery of key equipment
- Delivery of solvent
FACTS & FIGURES FOR EPS “TARGET”

Typical PS/ EPS/ XPS waste stream:
- Production waste / cut off’s
- Non-food packaging
- Food packaging
- Building insulation
- Mixed EPS/ PS wastes

How the CreaSolv® Process will match to this situation?
- The CreaSolv® Process is the only technology for a closed loop of HBCD containing wastes
- Due to this the CreaSolv® Process will complete the existing recycling chain
FACTS & FIGURES FOR EPS „CREASOLV® ENVIRONMENTAL ASPECTS“

- EPS wastes can be recycled and reused (closed-loop) with the CreaSolv® Process
- Landfill dumping and resulting loss of raw materials can be avoided
- Alternative waste combustion is no closed-loop recycling, the high value polystyrene gets lost during combustion
- Reduced transportation required if EPS is dissolved locally in CreaSolv® Formulation at collection point.

- Environmentally benign process liquid is used in the CreaSolv® Process
- Highly efficient solvent recovery – 99% solvent recirculation
- High efficient and selective separation of EPS from other wastes
- Stripping of hazardous additives and colors possible. Also recycling of those additives becomes possible. Closed-loop for PS and additives possible. Actual POP regulations will be met with CreaSolv® Technology.
The CreaSolv® Recycling plants can handle all mixtures of incoming EPS waste streams including almost all possible impurities.

- EPS from building insulation
- EPS from Fish/ice boxes
- EPS from packaging material
- EPS from food packaging

However a pre-sorting at existing units is recommended in respect of the overall cost effectiveness. Tailor made input stream handling. Probably guide to an additional closed-loop recycling of other containing materials.
FEEDSTOCK SOURCES FOR THE CREASOLV® PROCESS

Typical standard waste compositions

EPS- Waste from fish boxes / ice boxes and food packaging
- main component: EPS
- ~5% food residuals
- ~5% moisture
- ~2% labels

EPS- Waste from building insulation, with HBCD / without HBCD
- main component: EPS
- ~5% sand / cement
- ~2% other plastics
- ~2% wood
- ~1-3% moisture
- ~1.5% HBCD
CreaSolv® Selective dissolving process leads to high purity recyclate

Resulting PS chips have nearly no color, no smell and no impurity. Recyclate quality is similar to new products.

Due to the plant design and the specific precipitation technology additives like HBCD can be reduced to meet the restrictions.

The used CreaSolv® Formulation is not considered as hazardous according to the Globally Harmonized System (GHS)

Peripheral collection possible, different forms of waste allowed (lose EPS, pressed EPS, dissolution in CreaSolv® Formulation) which can decrease the transportation costs immense

Reliable plant design which can be used for EPS and PS in changing compositions. Due to modular design, later modification/adaptions to changing waste compositions can be realized.
The following slide will give a first overview of the CreaSolv® Plant by EPC. Further detailed information are available but require individual NDA’s.

- Unsorted/ pre-sorted EPS waste
- Selective PS Dissolving in CreaSolv® Formulation
- Floating/ sedimentation and filtration steps (adapted to waste composition)
- Precipitation of PS including purification of PS
- “Pre-drying” of precipitated PS
- Re-melting and Chips cutting of recycled PS
  - Closed internal loop for all used CreaSolv® Process liquids
  - Stripping and concentration of hazardous additive like HBCD for further recycling.
EPS CREASOLV® RECYCLING PLANTS

The EPS recycling plant design by EPC based on the CreaSolv® Technology mainly consist of the shown process steps.
EPS CREASOLV® RECYCLING PLANTS

Plant layout with HBCD reduction.
EPS CREASOLV® RECYCLING PLANTS

General plot at plant site in Terneuzen
EPS CREASOLV® RECYCLING PLANTS

General plot at plant site in Terneuzen
EPS CREASOLV® RECYCLING PLANTS

General plot at plant site in Terneuzen
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EPC Group is certified per DIN EN ISO 9001
IDEAS INSIDE

THANK YOU FOR YOUR ATTENTION