Krauss Maffei Berstorff

Engineering Value

EdelweissCompounding – The efficient approach to produce high-quality Compounds from plastic waste

Plastics Recycling Show Amsterdam 2017

Carl P. Pöpel; Head of Product Management Twin-screw Extrusion PRS 2017

Agenda

- KraussMaffei Group and KraussMaffei Berstorff
- KMB Compounding
- Recycling and EdelweissCompounding
- Conclusion and Challenges

KraussMaffei Group and KraussMaffei Berstorff

KM - World market leader in machinery for plastics processing

IMM Injection Moulding Machinery 3 series (clamping force: 50 – 800 t)	IMM Injection Moulding Machinery 4 series (clamping force: 50 - 4000t)	RPM Reaction Process Machinery (polyurethane resins)	EXT Extruders and Extrusion Systems for processing plastics and rubber

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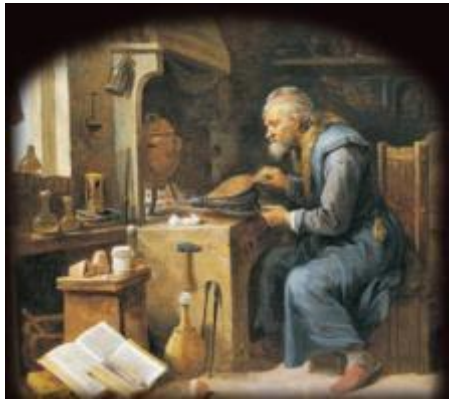
KMB Compounding
Definition

Compounding is the finishing process of Plastics through the incorporation of Additives in a melt viscous phase to create specific and optimized properties.

Process steps:

- Feeding
- Conveying / Transport
- Melting / Plastification
- Mixing (dispersive / distributive)
- Degassing
- Pressure build-up



KMB Compounding
Polymer spectrum

Standard Thermoplastics

- Low-density polyethylene (LDPE)
- Linear low-density polyethylene (LLDPE)
- High-density polyethylene (HDPE)
- Polypropylene (PP)
- Polystyrene (PS)
- Polyvinylchloride (PVC)
- Polyethyleneterephtalate (PET)

High-Performance Polymers

- Polyetheretherketone (PEEK)
- Polyphenylenoxide (PPO)
- Polysulfone (PSU)
- Fluorpolymers
- Polyimide (PI)
- Liquid crystal polymers (LCP)

Engineering Plastics

- Styrene Acrylonitrile (SAN)
- Acrylonitrile-Butadiene-Styrene (ABS)
- Polyamide (PA 6, PA6.6, PA 12)
- Polybutyleneterephtalate (PBT)
- Polycarbonate (PC)
- Polymethyl methacrylate (PMMA)
- Polyoxymethylene (POM)

Other Materials

- Thermoplastic elastomers (TPE,- S, -V, -U)
- Elastomers, e.g. SBR, EPDM, silicon rubber
- Thermosets, curable moulding compounds
- Flooring compounds
- Powder coatings, photocopy powders
- Ceramics and catalyst compounds
- Pharmaceuticals and foodstuffs

KMB Compounding
Additives spectrum

Reinforcements (abrasive)	Fillers (abrasive)	Reactive Additives (abrasive+corrosive)
▪ Glass Fibres	▪ Calciumcarbonate	▪ Antioxidants
▪ Graphite Fibres	▪ Kaolin	▪ Heat / UV Stabilizers
▪ Carbon Fibres	▪ Wood Flour	▪ Plasticizer
▪ Boron Fibres	▪ Wollastonite	▪ Process Aids
▪ Whiskers	▪ Barium Sulphate	▪ Color Pigments
▪ Basal Fibres	▪ Silica	▪ Static Inhibitors
▪ Titanium Fibres	▪ Carbon Black	▪ Microbicidal Additives
▪ Synthetic Fibres	▪ Mica	▪ Blowing Agents
▪ Glass Beads	▪ Talcum	▪ Primer
▪ Polymeric Hollow Beads	▪ Metallic oxide/ metallic powder	▪ Peroxide / Silane ▪ Flame Retardants (halogenes & halogene-free) ▪ Acids

KMB Compounding
ZE Series Extrusion portfolio

Lab Extruders:
ZE 25 A/R UTXi
ZE 28 BluePower

5 – 100 kg/h

High Performance Compounding-Extruders:
ZE 42 - 80 BluePower

500 – 5.000 kg/h

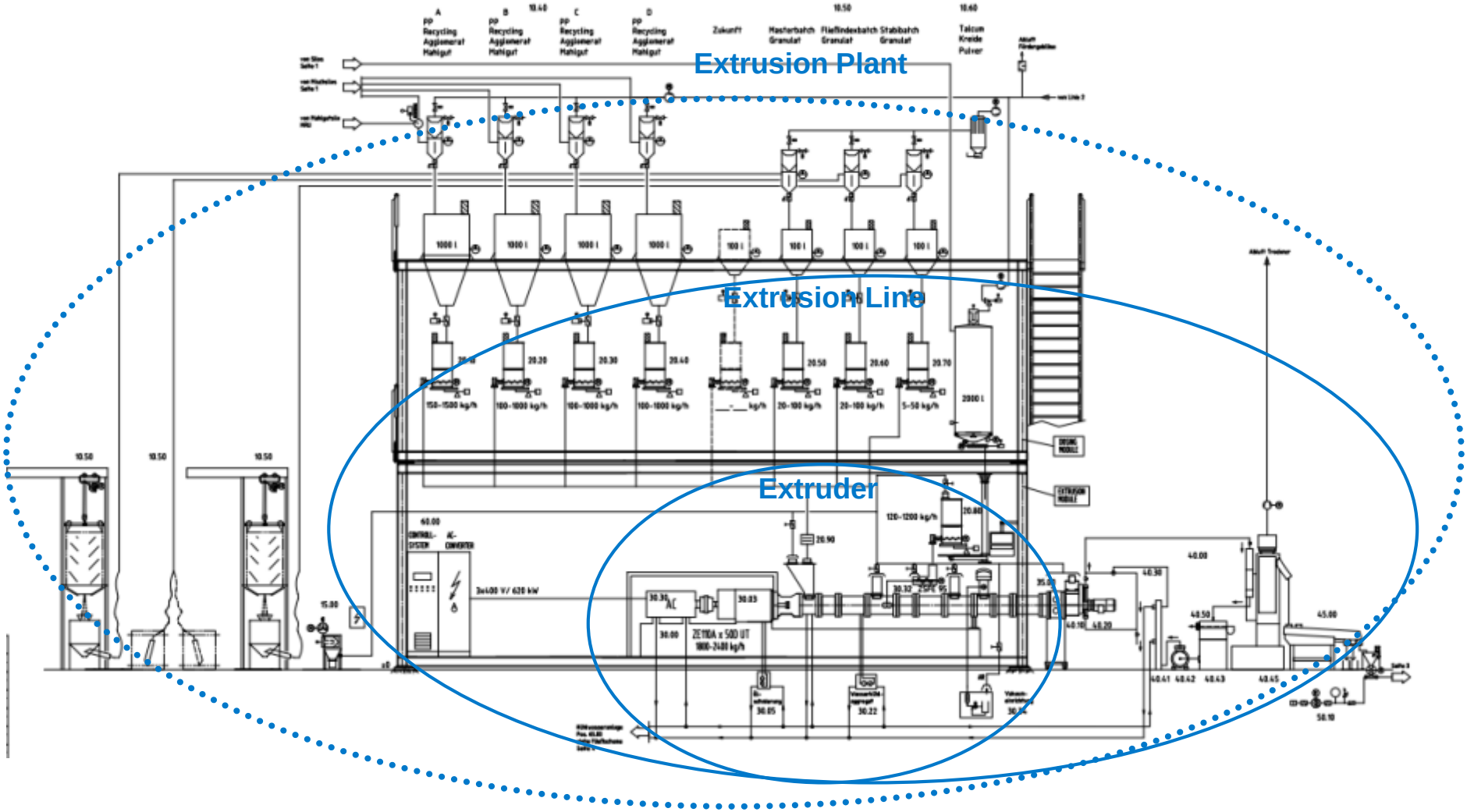
Large Extruders:
ZE 90 – 180 A/R Uti

2 – 12 t/h

Standard Extruders:
ZE 52 - 77 BASIC / Performance

300 – 3.000 kg/h

KMB Compounding
Scope of Supply



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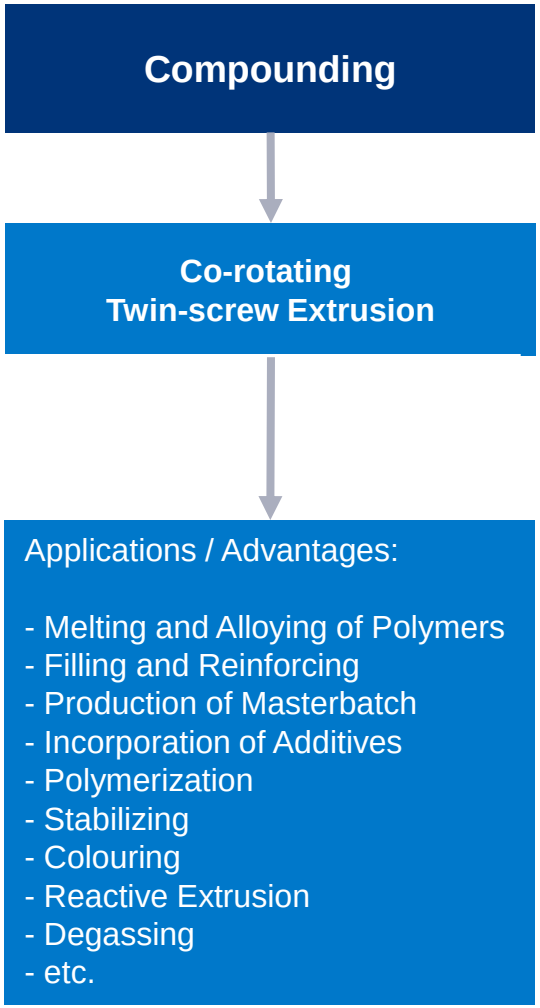
Recycling and EdelweissCompounding

KMB Overview



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Recycling and EdelweissCompounding

KMB Overview

Recycling / Re-Pelletizing

Single-screw Extrusion

Film material or Regrind; post-consumer

Twin-screw Extrusion

Regrind >0,3 kg/l; mainly post-industrial

Advantages vs. Single-screw:

- Better degassing
- Higher melt homogenity
- No throughput limitation
- Moderate shear and pressure stress
- Compounding possible

Compounding

Co-rotating Twin-screw Extrusion

Applications / Advantages:

- Melting and Alloying of Polymers
- Filling and Reinforcing
- Production of Masterbatch
- Incorporation of Additives
- Polymerization
- Stabilizing
- Colouring
- Reactive Extrusion
- Degassing
- etc.

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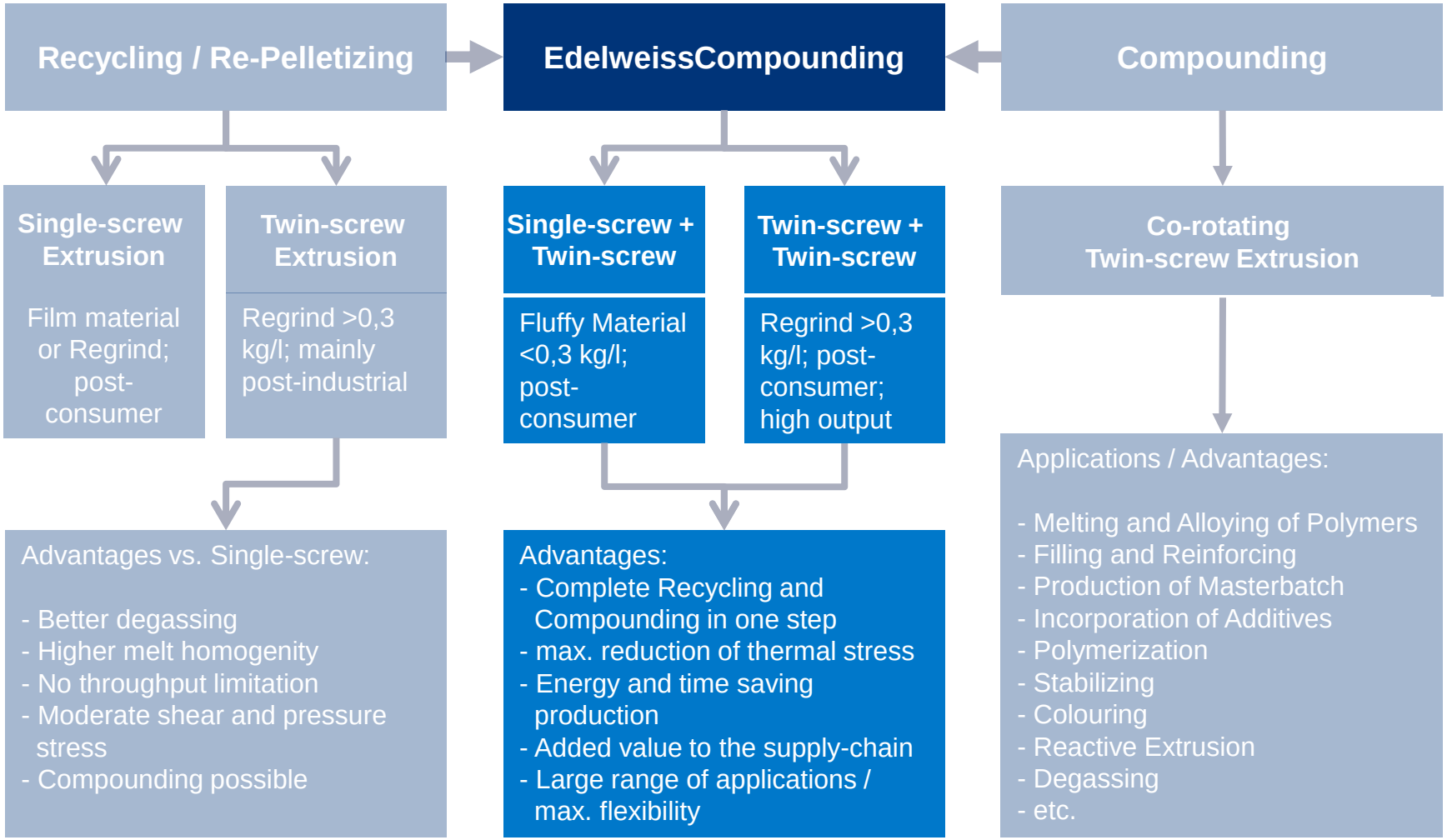
Recycling and EdelweissCompounding

KMB Overview



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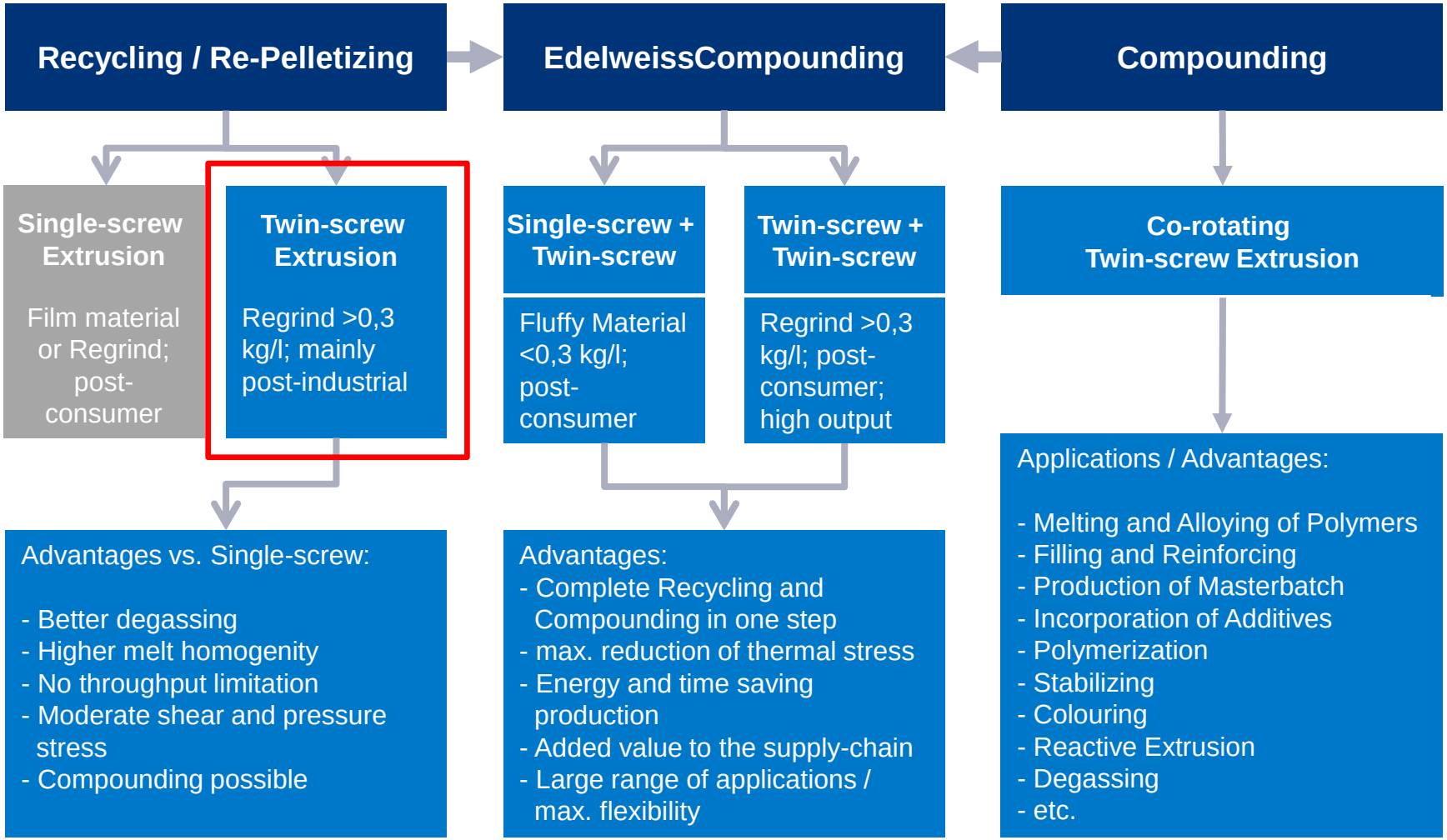
Recycling and EdelweissCompounding

Recycling with Twin-screw Extruder



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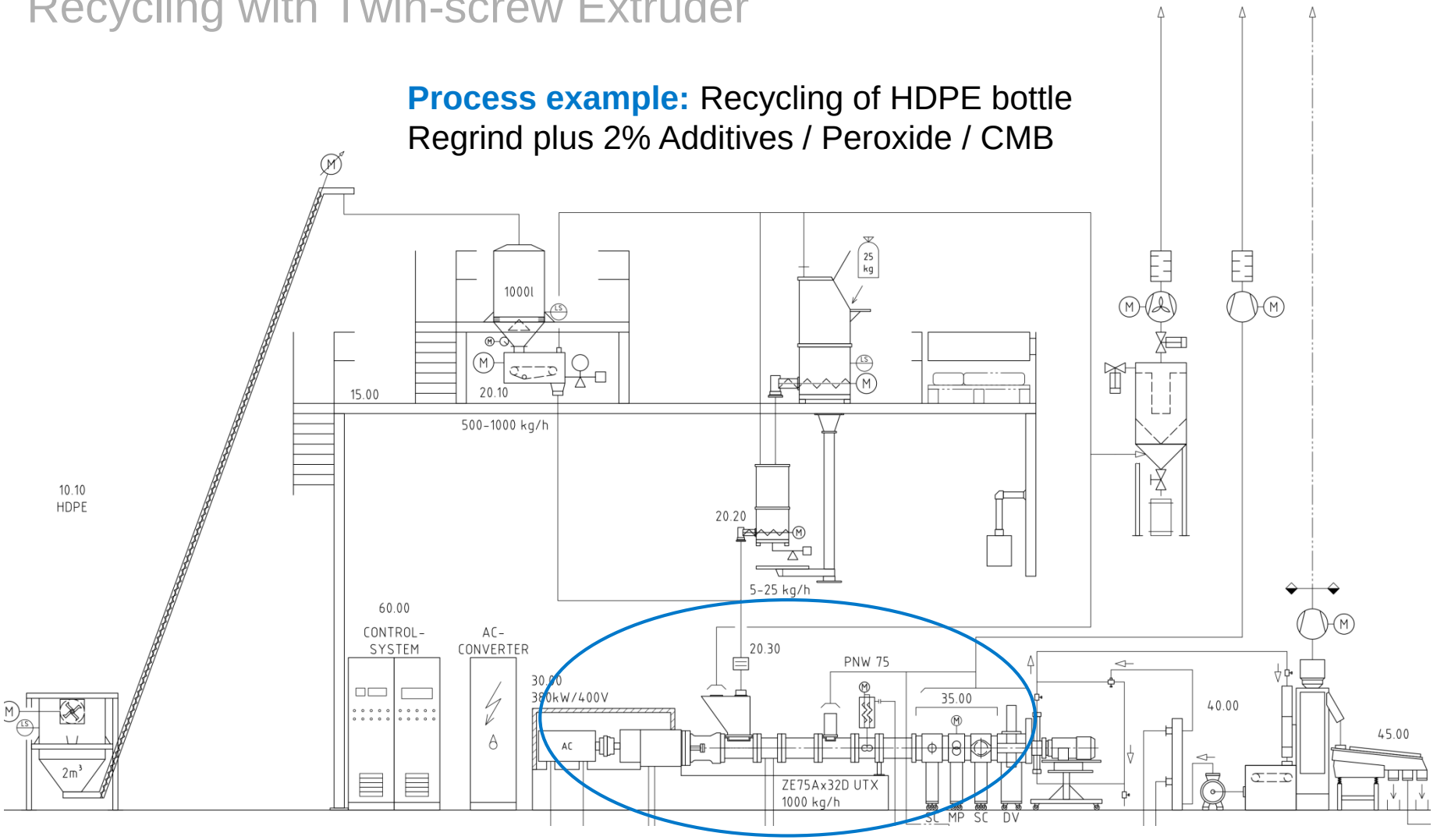
Recycling with Twin-screw Extruder

Process example: Recycling of HDPE bottle
Regrind plus 2% Additives / Peroxide / CMB



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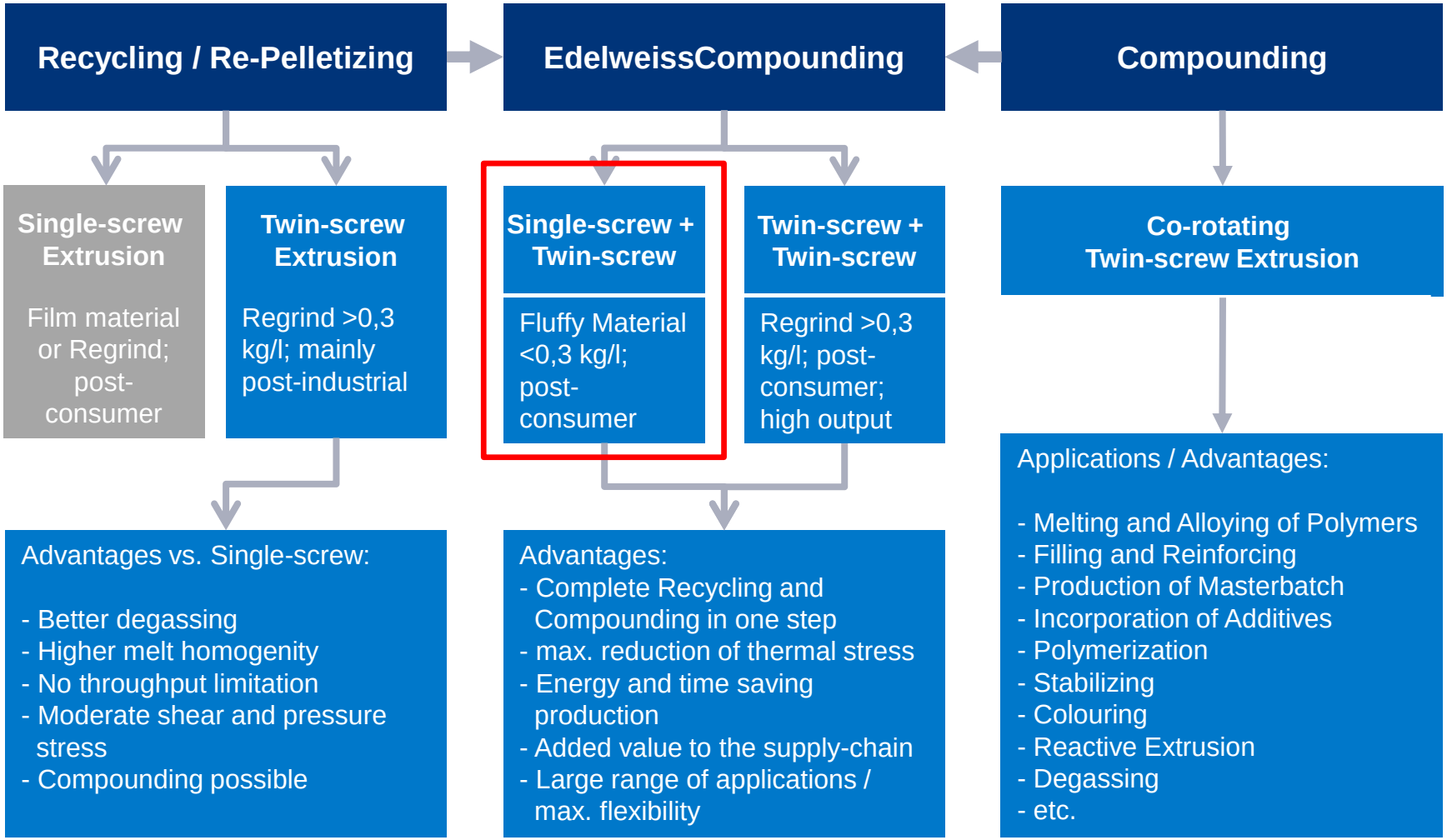
Recycling and EdelweissCompounding

EdelweissCompounding with Single-screw + Twin-screw Extruder



Recycling and EdelweissCompounding

EdelweissCompounding with Single-screw + Twin-screw Extruder

Melt Pump + Fine Filtration

CaCO3 Powder

CaCO3 Powder

CaCO3 Powder

Additive Powder

Side Feeder

VAC

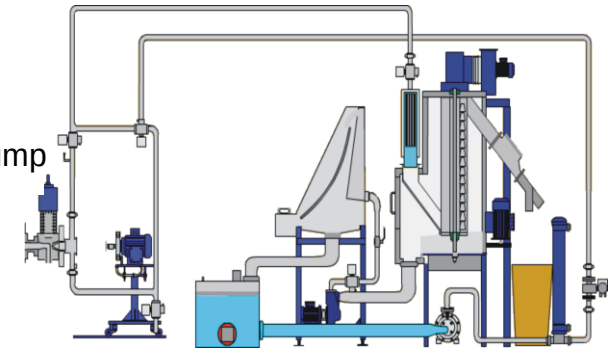
Melt Pump

AC-drive,
IP 54, water cooled

Gear box

Twin-screw Extruder

Underwater Pelletizing



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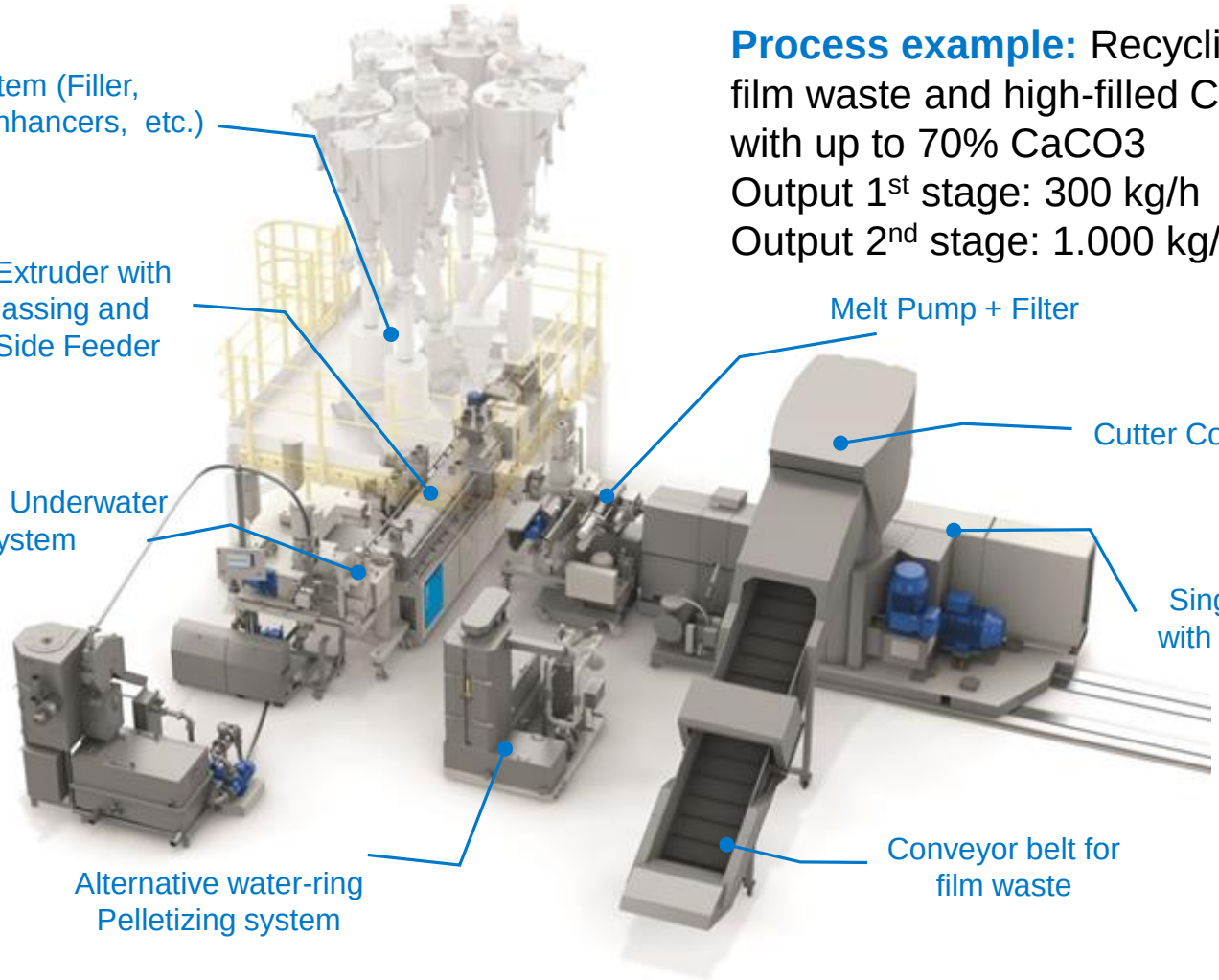
Recycling and EdelweissCompounding

EdelweissCompounding with Single-screw + Twin-screw Extruder



Process example: Recycling of LLDPE film waste and high-filled Compounding with up to 70% CaCO3
Output 1st stage: 300 kg/h
Output 2nd stage: 1.000 kg/h

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EdelweissCompounding with Twin-screw + Twin-screw Extruder

Recycling / Re-Pelletizing

Single-screw Extrusion

Film material or Regrind; post-consumer

Twin-screw Extrusion

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Advantages vs. Single-screw:

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EdelweissCompounding

Single-screw + Twin-screw

Fluffy Material <0,3 kg/l; post-consumer

Twin-screw + Twin-screw

Regrind >0,3 kg/l; post-consumer; high output

Advantages:

- Complete Recycling and Compounding in one step
- max. reduction of thermal stress
- Energy and time saving production
- Added value to the supply-chain
- Large range of applications / max. flexibility

Compounding

Co-rotating Twin-screw Extrusion

Applications / Advantages:

- Melting and Alloying of Polymers
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- Polymerization
- Stabilizing
- Colouring
- Reactive Extrusion
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- etc.

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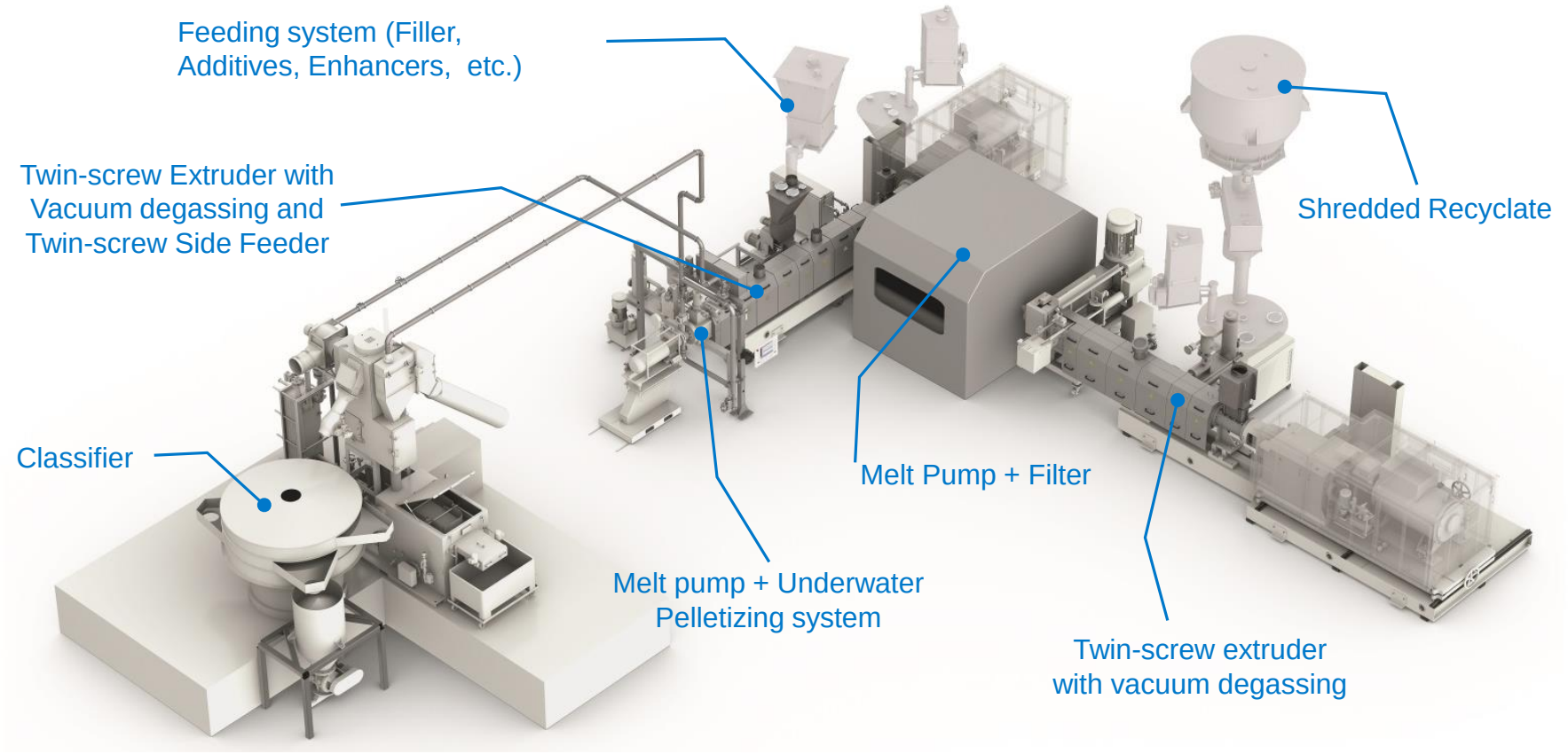
Recycling and EdelweissCompounding

EdelweissCompounding with Twin-screw + Twin-screw Extruder



Process example: 100 % PE or PP DSD-Recyclate with mineral filler (CaCO3, Talc, TiO2)
Output 1st stage: 3.000 kg/h; Output 2nd stage: 5.000 kg/h

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Up- and Downstream equipment - Filtration

Continuous Rotary drum Filter; Ettlinger design; ERF 250

Continuous Rotary Drum Filter; Nordson design, HiCon R-Type 250

Continuous Rotary Disc Filter; Erema design; Laserfilter

Continuous Rotary Disc Filter; MAS design; CDF 500D

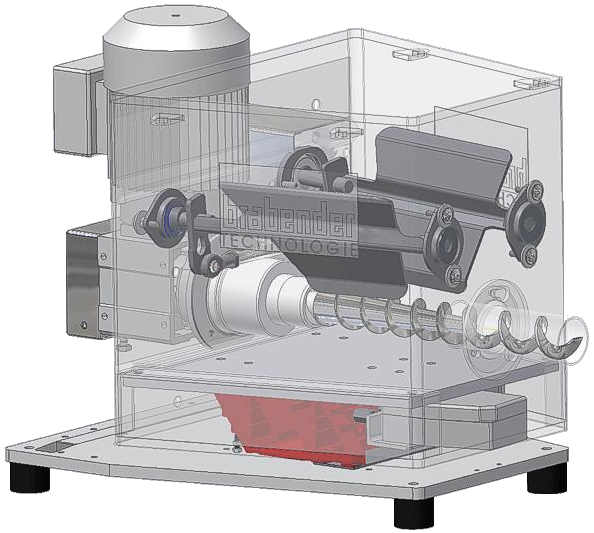
Recycling and EdelweissCompounding

Up- and Downstream equipment - Feeding

Example: Flexwall with Single-screw or

Twin-screw discharge); Brabender design

also possible:
- K-Tron
- Colortronic
- Schenck



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Up- and Downstream equipment - Pelletizing

Example: UWP-system

Gala Automatik design, Pearlo

Example: UWP-system

Econ design, EUP 1500

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Conclusion and Challenges

Conclusion

- **From waste to value**
  - Focus on high quality Compounding out of plastic waste (Fibres, Film, Regrind)
  - Value adding by Up-Cycling rather than Re-Pelletizing (“Virgin quality Compounds”)
  - Max. reduction of thermal stress
  - Energy and time saving production
  - Highest flexibility in terms of Compounding Applications

- **High capacities**
  - 1st stage: 300 kg/h up to 3.500 kg/h
  - 2nd stage: 500 kg/h up to 6.000 kg/h

- **Proven**
  - in production scale lab tests and sold lines
  - intelligent combination of proven technologies

Conclusion and Challenges

Challenges

- **Know-how / Formulations / Recipe**
  - Protected intellectual property must be supplied by Customer or 3rd party
  - Market Access (Recycler / Compounder)
- **High Outputs:**
  - Bottleneck is continuous filtration (not Twin-screw Extrusion)
- **Smell:**
  - Adding special Additives / Odours
  - Improve pre-washing process
  - Use Active Extruder degassing with Stripping
- **Availability of constant Raw-material**
  - Homogenization by mixing Silos - highest flexibility is needed

Opening of EdelweissCompounding Trial-centre

What

Opening of EdelweissCompounding Trial centre for dedicated customer trials

When

27th / 28th of June

Where

WKR GmbH, Dieselstr. 12, A-4623 Gunskirchen

Thank you!

Carl P. Pöpel
Head of Product Management
Twin-screw Extrusion

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