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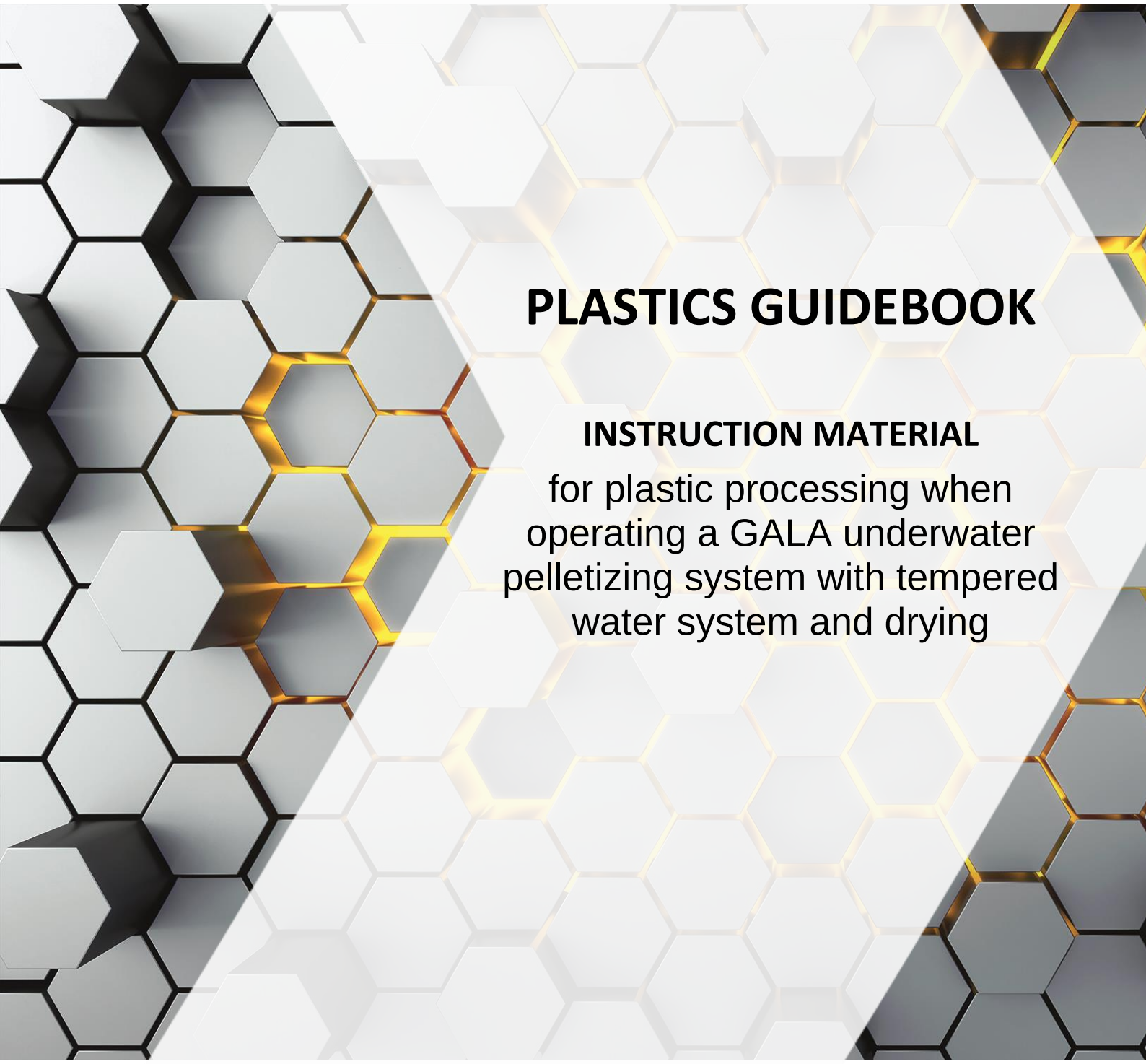

# PLASTICS GUIDEBOOK

## INSTRUCTION MATERIAL

for plastic processing when operating a GALA underwater pelletizing system with tempered water system and drying

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## Table of contents






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## 1. Polyolefine (PO)

### 1.1 Polypropylene (PP)

- Underwater pelletizing of PP produces very good results for all standard pellet sizes, including PP copo, PP homo., PP block copo. and PP random copo. PP is easy to pelletize with nearly all commercial fillers.

- CaCO3, talc, chalk, TiO2, carbon black, wollastonite, EPDM, EPR etc. are used as fillers, but also pigments and other additives or stabilizers are possible.

- Products are tacky in processing (high MFI > 100).

- Polymers with MFI values of > 1500 g/10 min at 2.16 kg can be processed today.

- In micro-pelletizing PP, pellet sizes of approx. 0,6 mm are currently possible.

**The advantages of underwater pelletizing include the avoidance of chain formation and a significant improvement in the shape which also minimizes the residual moisture of the pellets.**
**The direct introduction of melt into the water flow prevents this polymer from sticking and/or forming agglomerates.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy cost
- Low tooling cost
- Fully automatic and redundant design
- Low sound pressure level < 80 dB(A)



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**Overview for process design PP (extract)**

| filler type | MFI in g | die hole in mm | rate kg/h/hole | No. of blades | water temp. in °C | Specials |
|---|---|---|---|---|---|---|
| N/A | 0,1 - 10 | 2,8 - 3,2 | 10 - 35 | 4 - 8 | 60 | --- |
| N/A | 10 - 100 | 2,4 - 2,8 | 20 - 30 | 6 - 12 | 30 - 50 | --- |
| N/A | 100 - 1500 | 1,8 - 2,4 | 25 - 40 | 6 - 12 | 20 - 30 | --- |
| $CaCO_3$/ Chalk | 0.2 - 20 | 2,8 - 3,2 | 20 - 50 | 6 - 8 | 30 - 60 | depending on the %, work with ½ thick blades to reduce fines |
| Talc | 0,2 - 15 | 2,8 - 3,2 | 20 - 35 | 6 - 8 | 30 - 50 | --- |
| WPC | 0,2 - 15 | 3,2 - 4,0 | 20 – 45 | 6 - 8 | 45 - 70 | pay attention to melt temp. |
| EPDM / EPR | 2 - 20 | 2,4 - 2,8 | 15 - 25 | 6 - 8 | 25 - 50 | --- |
| $TiO_2$ | 2 - 25 | 1,8 - 3,2 | 20 - 50 | 6 - 8 | 40 - 70 | can produce wear, depending on % high density |
| Carbon black | 1 - 40 | 2,8 - 3,2 | 10 - 20 | 6 - 8 | 30 - 50 | pay attention to melt temp. |
| Glass | 2 - 25 | 2,8 - 3,5 | 20 - 50 | 6 - 12 | 40 - 70 | wear protection required |
| HFR | 1 - 40 | 2,8 - 3,2 | 10 - 20 | 4 - 8 | 30 - 50 | pay attention to melt temp. |

**As a general rule**: choose the volume of water on the basis of the required table (table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- PP is sticky, if the MFI is higher than 80 and / or the Talc share lies between 10% and 20 % and / or a high share of carbon black was included.
- PEARLO® cutter hub and blades have shown to be advantageous in pellet shaping.



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### 1.2 Polyethylene (PE)

- Easy to pelletize at all densities and in all pellet sizes; easy to pelletize with all commercial fillers.
- Fillers are CaCO3, talc, chalc, TiO2, carbon black, wollastonite, EPDM, EPR etc. but also pigments and other additives or stabilizers.
- Materials, without fillers in the melt, are sticky in processing (high MFI).
- Product is easy to handle – no processing problems are to be expected.
- PE, LDPE, LLDPE, LMDPE, LMDPE, HDPE, UHMWPE etc. have already been processed successfully.
- In micro-pelletizing PE, pellet sizes of aprox. 0,3 mm are currently possible.

**The advantage of underwater pelletizing in this field is the simple processing of these products.**

**Special die plate designs permit excellent results for foamable PE and cross-linked PE, too.**

**Thanks to the high level of flexibility offered by the GALA systems, a wide range of pellet sizes is possible, simply by selecting the appropriate die plate and dryer screens.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)



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**Overview for process design PE (extract)**

| filler type | MFI in g | die hole in mm | rate kg/h/hole | No. of blades | water temp. in °C | Specials |
|---|---|---|---|---|---|---|
| N/A | 0,1 - 10 | 2,8 - 3,2 | 10 - 25 | 4 - 6 | 40 - 60 | pressure reduced die plate recommended |
| N/A | 10 - 100 | 2,4 - 2,8 | 20 - 30 | 4 - 8 | 30 - 60 | --- |
| $CaCO_3$ | 0,2 - 10 | 2,8 - 3,5 | 20 - 50 | 6 - 8 | 30 - 60 | special die plate design needed |
| Talc | 0,2 - 15 | 2,8 - 3,2 | 20 - 40 | 6 - 8 | 30 - 60 | depending on % and origin of the talc, high wear can be created |
| Chalc | 0,2 - 10 | 2,8 - 3,2 | 20 - 40 | 6 - 8 | 30 - 60 | special die plate design needed |
| EPDM / EPR | 5 - 30 | 2,4 - 2,8 | 15 - 35 | 6 - 8 | 45 | --- |
| $TiO_2$ | 2 - 40 | 2,4 - 3,2 | 30 - 60 | 6 - 8 | 45 - 70 | depending on % and origin of the $TiO_2$, high wear can be created |
| Carbon black | 1 - 40 | 2,4 - 3,2 | 10 - 20 | 6 - 10 | 40 - 50 | pay attention to the melt temp. |
| ATH | 5 - 20 | 3,2 - 3,5 | 5 - 20 | 4 - 8 | 45 | special die plate design needed, pay attention to the melt temp. |

**As a general rule**: choose the volume of water on the basis of the required rate (Table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- PE is sticky, at a share of 10 -25 %Talc and / or a high share of carbon black and a high MFI value.
- Materials with a low MFI value and / or a special hardness will be processed with specific modified die plates to reduce melt breakages. (Pipe grade HDPE, LLDPE )
- Materials with a high content of CaCO3, chalk or ATH re processed with specially modified die plates.
- For carbon black – pay attention to the melt temperature, depending o the upstream system.

## 2. Styrene and their components

### 2.1 Polystyrene (PS)

- Easy to pelletize in all variants and pellet sizes.
- Easy to handle – no processing problems are to be expected.
- PS has been successfully pelletized both, in HI and GP grades (high impact strength and crystal clear)
- Micro-pelletizing of foamed variants with pentane or butane, so-called EPS products, has been also successfully.
- In micro-pelletizing PS, pellet sizes of approx. 0.4mm are currently possible.

**The advantage of underwater pelletizing in this field is the simple processing of these products.**

**Further advantages of a GALA pelletizing system for PS is the encapsulation of typical odors and gases.**

**The noise emission level can be minimized by selecting an appropriate dryer.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)



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**Overview for process design PS HI und GP (extract)**

| filler type | MFI in g | die hole In mm | rate kg/h/Loch | No. of blades | water temp. In °C | Specials |
|---|---|---|---|---|---|---|
| N/A | 0,1 - 10 | 2,8 - 3,2 | 10 - 20 | 4 - 8 | 50 – 80 | Pressure reduced die plate recommended |
| N/A | 10 - 100 | 2,4 - 2,8 | 20 - 30 | 4 - 10 | 50 – 80 | --- |
| $TiO_2$ | 2 - 25 | 2,4 - 3,2 | 30 - 60 | 6 - 10 | 55 – 80 | --- |
| Carbon black | 1 - 40 | 2,4 - 3,2 | 10 - 30 | 6 - 10 | 45 - 60 | pay attention to melt temp. |

**As a general rule**: choose the volume of water on the basis of the required rate (Table for water systems)

**In particular**: if the material is heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- Materials with a low MFI value and / or a special hardness will be processed with specific modified die plates to reduce melt breakages. (Pipe grade HDPE, LLDPE).
- Products, filled with TiO2 and CaCO3, could get grey pressure marks, which may have influence on the visible pellet quality.
- The foamed EPS variant needs to be considered separately.

**2.2 ABS, SAN, ASA …**

- Easy to pelletize in all variants and pellet sizes.
- In micro-pelletizing pellet sizes of approx. 0,5 mm are currently possible.
- Easy to handle – no processing problems are to be expected.

**The advantage of underwater pelletizing in this field is the simple handling of these products in the pelletizing process.**

**Another advantage of using GALA pelletizing system for ABS and SAN is the encapsulation of the typical odors and gases.**

**The underwater pelletizing system reduces the operating costs for maintenance and repairs significantly, because the product will be cut in a hot (= soft) condition.**

**The noise emission level can be minimized by selecting an appropriate dryer.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advances technologies
- Low sound pressure level < 80 dB(A)



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**Overview for process design ABS, SAN, ASA ... (extract)**

| filler type | MFI in g | die hole in mm | rate kg/h/Loch | wear J oder N/A | No. of blades | water temp. in °C |
|---|---|---|---|---|---|---|
| N/A | 0,1 - 10 | 2,8 - 3,5 | 10 - 20 | J | 4 - 8 | 60 - 90 |
| N/A | 10 - 100 | 2,8 - 3,5 | 20 - 30 | J | 4 - 10 | 50 - 80 |
| $TiO_2$ | 2 - 25 | 2,4 - 3,5 | 30 - 60 | J | 6 - 10 | 60 - 80 |
| Carbon black | 1 - 40 | 2,4 - 3,2 | 10 - 20 | J | 6 - 10 | 60 - 80 |

**As a general rule**: choose the volume of water on the basis of the required rate (Table for water systems)

**In particular**: if the material is heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- Materials with a low MFI value and / or a special hardness will be processed with specific modified die plates to reduce melt breakages.



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## 3. Vinyl chloride and Vinyl acetate

### 3.1 Polyvinyl chloride (PVC)

- Easy to pelletize in all variants.
- In particular soft PVC is easy to handle – no processing problems are to be expected.
- Apart from standard fillers and pigments, also ABS and foam related to the production of films are used.
- In micro-pelletizing soft PVC, pellet sizes of approx. 0.3mm are currently possible.

**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow.**

**Another benefit of using GALA pelletizing systems for PVC is the containment of the typical odors and vapors.**

**The noise emission level can be minimized by selecting an appropriate dryer.**

**An important field of application of GALA pelletizing systems is the processing of PVC recycling products.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)



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**Overview for process design PVC soft and hard (extract)**

| filler type | Hardness | die hole in mm | rate kg/h/Loch | No. of blades | water temp. in °C | Note |
|---|---|---|---|---|---|---|
| N/A | soft | 2,4 - 3,2 | 5 - 30 | 4 - 6 | 30 - 60 | --- |
| N/A | hard | 3,2 - 4,8 | 5 - 15 | 4 | 60 - 90 | pay attention to melt temp.; choose no dead areas |
| ABS | soft | 2,8 - 3,2 | 20 - 30 | 6 - 8 | 60 - 70 | |
| foam | soft | 2,4 - 3,2 | 10 - 20 | 4 - 6 | 45 | |
| wood flour | hard | 3,5 - 4,8 | 5 | 4 – 6 | 75 - 90 | pay attention to melt temp.; choose no dead areas |
| Glass fibre | hard | 3,5 - 4,8 | 5 - 10 | 4 - 6 | 70 - 90 | pay attention to melt temp.; choose no dead areas |

**As a general rule**: choose the volume of water on the basis of the required rate (Table for water systems)

**In particular**: if the material is heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- Materials with a high hardness will be processed with specific modified die plates for reduction of the pressure generation and with geometric prepared die holes.
- By processing PVC the line should be protected against wear and corrosion at all rotating parts and should have a coating at all parts, which have direct contact with the product (especially PVC hard), because of its abrasiveness.

### 3.2 Ethylene vinyl acetate (EVA)

- Easy to pelletize at all variants.
- Easy to handle – no processing problems are to be expected.
- EVA can be processed with standard fillers and pigments and is mainly used in the cable and adhesives industries.
- In micro-pelletizing, pellet sizes of approx. 0.5mm are currently possible.

**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow.**

**Since also cold water can be used, surface tack can be fully eliminated.**

**Underwater pelletizing produces ball-shaped pellets that do not have any linear adhesion surfaces even after leaving the water flow, as are known from standard cylindrical pellets.**

**For medical applications, a very high level of purity can be achieved.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

**Overview for process design EVA (extract)**

| filler type | MFI in g | die hole in mm | rate kg/h/Loch | No. of blades | water temp. in °C |
|---|---|---|---|---|---|
| N/A | 5 - 50 | 2,4 - 3,2 | 10 - 30 | 4 - 8 | 20 - 40 |
| N/A | 50 - 500 | 1,8 | 10 - 20 | 4 - 8 | 20 - 30 |
| ATH | 1 - 30 | 3,2 - 4,0 | 5 - 20 | 4 - 6 | 50 |
| ALOH | 2 - 10 | 2,4 - 2,8 | 10 - 15 | 4 - 8 | 45 |
| PE | 1 - 15 | 2,8 - 3,2 | 10 - 40 | 4 - 8 | 30 - 50 |
| EPDM | 10 - 30 | 2,4 - 3,2 | 10 - 40 | 6 - 10 | 30 - 50 |
| PP | 15 - 30 | 2,8 - 3,2 | 10 - 25 | 6 - 8 | 50 |

**As a general rule**: choose the volume of water on the basis of the required rate (Table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- Materials are sticky in general, if a high MFI and / or EVA alone should be processed. (sticky as melt)

**4. Polyurethane (TPU, PUR) of a wide range of shore hardness**

- Easy to pelletize in all variants.
- Easy to handle – no processing problems are to be expected.
- In addition to the normal addition of fillers and pigments, GALA systems permit processing TPU in both, compounding and reaction processes.
- In micro-pelletizing soft TPU, pellet sizes of approx. 0.5mm are currently possible.

**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow.**

**Since also cold water can be used, surface tack can be fully eliminated.**

**Underwater pelletizing produces ball-shaped pellets that do not have any linear adhesion surfaces even after leaving the water flow, as are known from standard cylindrical pellets.**

**GALA systems permit the processing of TPU of a shore hardness of 50 A to 75 D – without any conversion.**

**The reaction and / or crystallization processes of pellets can be realized in appropriately sized piping or in GALA crystallization systems.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)



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## TPU, PUR of a wide range of shore hardness (TPE-U)

### Overview for process design TPU, PUR (extract)

| filler type | hardness | die hole in mm | rate kg/h/Loch | No. of blades | water temp. in °C |
|---|---|---|---|---|---|
| N/A | 50A - 80A | 2,4 -3,2 | 10 - 40 | 4 - 8 | 20 - 30 |
| N/A | 80A - 55D | 2,8 - 3,2 | 10 - 40 | 4 - 8 | 30 - 65 |
| N/A | 55D - 75D | 3,2 - 3,5 | 10 - 40 | 4 - 8 | 60 - 80 |

**As a general rule**: choose the volume of water on the basis of the required rate (Table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- TPU is sticky, if the shore hardness is between 50 A and 92 A and / or when the TPU is pronounced explicitly as hot melt.
- Normally the TPU materials will be completely cooled down in a long piping (up to 100m is normal), so the surface adhesives of the soft materials will be prevented.
- The foamed TPU variant must be considered separately.
- PEARLO cutter hubs and blades have shown to be advantageous in pellet shaping.

**5. Thermoplastic elastomers (TPE-S, TPE-E, TPE-U, TPE-A, TPE-V, TPE-O)**

- Easy to pelletize in all variants.
- Easy to handle – no processing problems are to be expected.
- In addition to the normal addition of fillers and pigments, TPE is mainly used in the automotive industry and for medical applications.
- In micro-pelletizing, pellet sizes of approx. 0.5mm are currently possible.

**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow.**

**For medical applications, a very high level of purity can be achieved.**

**Surface tack can be fully eliminated, since cold water can be used also.**

**Underwater pelletizing produces ball-shaped pellets that do not have any linear adhesion surfaces even after leaving the water flow, as are know from standard cylindrical pellets.**

**GALA systems permit the processing of TPE of a shore hardness of 0 A to 75 D without any conversion.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

**Overview for process design TPE (extract)**

| filler basis | shore grade | die hole in mm | rate kg/h/Loch | No. of blades | water temp. in °C |
|---|---|---|---|---|---|
| EPDM/EPR | 5A - 72D | 2,8 - 3,2 | 15 - 35 | 6 - 8 | 20 – 60 |
| PP/PO/PE | 5A - 72D | 2,4 – 3,2 | 20 - 40 | 4 - 10 | 20 – 70 |
| PS | 5A - 72D | 1,8 – 3,2 | 20 - 40 | 6 – 10 | 40 – 60 |
| ABS/NBR | 5A - 72D | 1,8 - 3,2 | 20 - 40 | 6 – 10 | 40 – 70 |
| SIS | 0A - 72D | 1,8 - 2,4 | 20 - 30 | 6 – 8 | 15 - 25 |
| SBS | 0A - 72D | 2,8 - 3,2 | 15 - 30 | 6 – 10 | 30 - 50 |
| SEBS | 0A - 72D | 2,8 - 3,2 | 15 - 35 | 6 – 10 | 30 - 50 |
| PET/PBT | 5A - 72D | 2,4 - 2,8 | 20 - 30 | 6 | 40 - 50 |
| PVC/PVDC | 5A - 72D | 1,8 – 3,2 | 20 - 30 | 6 – 10 | 30 - 50 |
| EVA | 5A - 72D | 1,8 - 2,4 | 20 - 30 | 6 – 10 | 30 - 40 |
| PA | 5A - 72D | 1,8 – 3,2 | 20 - 30 | 6 – 10 | 40 – 70 |
| PU | 5A - 72D | 2,4 - 3,2 | 20 - 30 | 6 – 10 | 20 – 30 |
| Resin | 5A - 72D | 1,8 - 2,4 | 20 - 30 | 6 – 10 | 15 – 25 |
| $CaCO_3$ | 5A - 72D | 2,8 - 3,2 | 20 - 40 | 6 – 10 | 30 - 60 |
| $TiO_2$ | 5A - 72D | 2,8 - 3,2 | 30 - 50 | 6 – 10 | 40 – 65 |
| Carbon black | 5A - 72D | 2,4 - 2,8 | 10 - 25 | 6 – 10 | 30 - 50 |
| Chalc | 5A - 72D | 2,8 - 3,2 | 20 - 40 | 6 – 10 | 30 - 50 |
| Talc | 5A - 72D | 2,8 - 3,2 | 10 - 15 | 6 – 10 | 30 - 50 |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.
- Materials are sticky, if a high MFI and / or resin are used as filler or at a low shore grade.
- Materials below 50 A require additional air turbulence at the dryer outlet.

**6. Polyester - Polyetherterephtalat (PET), Polybutadienterephtalat (PBT), Polyethersulfon (PES)**

- Easy to pelletize in all variants.
- Materials are hygroscopic
- Materials have a high crystalline melting point
- In micro-pelletizing, pellet sizes of approx. 0.8mm are currently possible.

**The advantage of underwater pelletizing in this field is the round or elliptic pellet shape and the resulting free-flowing properties of the product in the subsequent use.**

**A further advantage of using GALA pelletizing systems for polyester is the closed system, preventing any contact of the product to oxygen.**

**The noise emission can be minimized by selecting an appropriate dryer.**

**Die plates with specially designed heat conduction for an ideal heat transfer at the interface have considerably extended the range of applications.**

**Direct crystallization easily possible with additional aggregates.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs, low costs for water treatment, because the pellet outlet temp. will be > 90°C
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

**For these applications, pelletizing systems are available for installation downstream of extruders but also for use with reactor lines with melt delivery pumps.**

**Overview for process design PET, PBT, PES (extract)**

| filler type | IV | die hole in mm | rate kg/h/Loch | No. of blades | water temp. min. °C | Specials |
|---|---|---|---|---|---|---|
| N/A | 0,35 –0,5 | 2,8 | 30 - 60 | 8 – 10 | 70 - 80 | special die plate design recommended |
| N/A | 0,5 – 0,7 | 2,8 – 3,2 | 20 - 40 | 8 – 14 | 70 - 85 | --- |
| N/A | 0,7 – 1,0 | 2,8 - 3,5 | 10 - 60 | 8 – 14 | 70 - 90 | --- |
| $TiO_2$ | 0,5 – 0,8 | 2,8 - 3,2 | 30 - 70 | 8 – 14 | 70 – 90 | --- |
| Carbon black | 0,5 – 0,8 | 2,8 - 3,2 | 20 - 35 | 8 – 10 | 70 | --- |
| $CaCO_3$ | 0,5 – 0,8 | 2,8 - 3,2 | 20 - 50 | 8 – 10 | 70 – 80 | --- |
| glass fibre | 0,5 – 0,8 | 2,8 - 3,8 | 30 - 50 | 8 – 10 | 70 – 90 | wear protection needed |
| $Sb2O_3$ | 0,5 – 0,8 | 4,2 | 10 - 50 | 8 – 10 | 70 - 90 | --- |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0 g/cm³.

  Materials are hygroscopic, therefore using a piping as short as possible.

- Materials are sensitive for freezing, therefore the sealing of the die plate should be in HTA design, with GEP or Flatface design.

**7. Polyamides (PA)**

- Easy to pelletize in all variants (PA11, PA12, PA6, PA 6.6,...).
- Materials are hygroscopic.
- Materials have a high crystalline melting point.
- In micro-pelletizing, pellet sizes of approx. 0.8mm are currently possible.

**The advantage of underwater pelletizing PA is the round or elliptic pellet shape and the resulting free-flowing properties of the product in the subsequent use.**

**Another benefit of using GALA pelletizing systems for PA is the encapsulation of the pellets in the water circuit without any contact to the air.**

**The noise emission level can be minimized by selecting an appropriate dryer.**

**Die plates with specially designed heat conduction for an ideal heat transfer at the interface have considerably extended the range of applications.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs, low costs for water treatment, because the pellet outlet temp. will be > 90°C
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

**For these applications, pelletizing systems are available for installation downstream of extruders but also for the use with reactor lines with melt delivery pump. A distinction is made between unextracted and extracted PA 6. This refers to the discharge of the pellets before and after the extraction of the caprolactam.**

**Overview for process design PA (extract)**

| filler basis | die hole in mm | rate kg/h/Loch | No. of blades | water temp. In °C |
|---|---|---|---|---|
| PA 11/12 | 2,8 - 3,2 | 20 - 35 | 6 - 8 | 55 - 70 |
| PA 6 | 2,4 - 3,2 | 20 - 40 | 4 – 8 | 45 - 70 |
| PA 6.6 | 2,8 - 3,2 | 20 – 50 | 6 – 8 | 70 - 90 |
| PA 4.6 | 2,4 - 3,2 | 15 – 50 | 6 – 8 | 60 |
| $TiO_2$ | 2,8 - 3,2 | 30 - 70 | 6 – 8 | 70 - 80 |
| Carbon black | 2,4 - 2,8 | 15 - 35 | 6 – 10 | 70 |
| glass fibre | 2,8 - 3,2 | 20 - 40 | 6 – 10 | 70 - 80 |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

- Materials are characterized as heavy, if the density rises up definitely over 1,0g/cm³.
- Materials are hygroscopic, therefore using a piping as short as possible.
- Materials are sensitive for freezing, therefore the sealing of the die plate should be in HTA design, with GEP or Flatface design.
- Materials filled with glass fibre should be protected against wear at all parts, which have direct contact with the product
- PEARLO cutter hubs and blades have shown to be advantageous in pellet shaping.

**8. Hot melt adhesives (HMA)**

- Easy to pelletize in all variants.
- Easy to handle - no processing problems are to be expected.
- Easy to pelletize in the ball-shapes and sizes, which are demanded by the market.

**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow. Because cooling of the pellets takes place in a long piping, the space requirements are low.**

**By using cold water, surface tack can be fully eliminated.**
**Underwater pelletizing produces ball-shaped pellets that do not have any linear adhesion surfaces even after leaving the water flow, as are known from standard cylindrical pellets.**

**GALA systems permit the pelletizing of hot melt adhesives of a viscosity ≥ 3,000mPas. Lower viscosities will be processed with melt cooler.**

**For these applications, pelletizing systems are available for installation downstream of extruders but also for the use with mixers and kneaders with melt delivery pumps.**

**Pressure-sensitive HMA types require special process designs.**

**Reasons for preferring a GALA underwater pelletizing system**:

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Low sound pressure < 80 dB(A)

**Overview for process design HMA (extract)**

| filler basis | viscosity mPas | die hole in mm | rate kg/h/Loch | wear Y or N/A | No. of blades | water temp. in °C |
|---|---|---|---|---|---|---|
| EVA | ab 3000 | 1,8 + 3,2 | 20 - 30 | N/A | 4 - 6 | 15 |
| APP | ab 3000 | 1,8 – 2,4 | 20 - 40 | N/A | 4 - 6 | 15 |
| APAO | ab 3000 | 1,8 – 2,4 | 20 - 30 | N/A | 4 - 6 | 15 |
| PE COPO | ab 3000 | 2,4 | 20 - 30 | N/A | 4 - 6 | 15 |
| SBS/SEBS | ab 3000 | 2,8 | 20 - 30 | N/A | 4 - 6 | 15 |
| PA | ab 3000 | 1,8 + 3,2 | 20 - 40 | N/A | 4 - 6 | 15 |
| PET | ab 3000 | 2,4 | 20 - 30 | N/A | 4 - 6 | 15 |
| TPU | ab 3000 | 2,8 | 20 - 30 | N/A | 4 - 6 | 15 |
| Resins | ab 3000 | 2,8 | 10 - 20 | N/A | 4 - 6 | 15 |
| Waxes | ab 3000 | 3,2 | 10 - 30 | N/A | 4 - 10 | 15 |
| Calcium fluoride | ab 3000 | 1,8 + 3,2 | 20 - 40 | Y | 6 - 8 | 15 |
| $BaSO_4$ | ab 3000 | 1,8 + 3,2 | 20 - 40 | Y | 6 - 8 | 15 |
| Talc | ab 3000 | 1,8 + 3,2 | 20 - 40 | Y | 6 - 8 | 15 |
| Chalc | ab 3000 | 1,8 + 3,2 | 20 - 40 | Y | 6 - 8 | 15 |
| $CaCO_3$ | ab 3000 | 1,8 + 3,2 | 20 - 40 | Y | 6 - 8 | 15 |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

- Materials are sticky, therefore using a piping as long as possible with an oversized volume of water.
- Materials with a viscosity < 3000 mPas will be processed with melt cooler.

**9. Gum Bases**

- Easy to pelletize in all variants.
- Easy to handle – no processing problems are to be expected.
- Easy to pelletize in the ball-shapes and sizes, which are demanded by the market

The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow. The space requirements are low, because cooling of the pellets takes place in a long piping.

**Special designs and cleaning requirements of the food processing industry can be easily integrated.**

**Underwater pelletizing produces ball-shaped pellets that do not have any linear adhesion surfaces even after leaving the water flow, as are known from standard drop and / or pastille shaped pellets.**

GALA systems permit the pelletizing of gum bases of a viscosity > 3,000mPas. Lower viscosities will be processed with melt cooler.

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

For these applications, pelletizing systems are available for installation downstream of extruders but also for the use with mixers and kneaders with melt delivery pumps.

**Overview for process design Gum Base (extract)**

| filler basis | viscosity mPas | die hole in mm | rate kg/h/Loch | wear Y oder N/A | No. of blades | water temp. in °C |
|---|---|---|---|---|---|---|
| Waxes | ≥ 3000 | 1,8 – 2,8 | 20 - 35 | N/A | 4 | 10 - 25 |
| $CaCO_3$ | ≥ 3000 | 2,4 – 2,8 | 30 – 60 | Y | 4 - 6 | 10 - 15 |
| Chalc | ≥ 3000 | 2,4 – 2,8 | 30 - 50 | Y | 4 - 6 | 10 - 15 |
| Talc | ≥ 3000 | 2,4 – 2,8 | 50 | Y | 4 - 6 | 10 - 15 |
| Rubber | ≥ 3000 | 2,4 – 2,8 | 50 | N/A | 4 - 6 | 10 - 15 |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

**In patricular**: if the material is sticky or heavy, the volume of water should be sized generously.

- Materials are sticky, therefore using a piping as long as possible with an oversized volume of water.
- Materials with a viscosity < 3000 mPas, will be processed with melt cooler.

**10. Other polymers (extract):**

**CA, EMA, EAA, EPDM, EP, IM, PC, PMMA, POM, PSU, PTFE, PVAC, Waxes, PLA**

- CA is easy to pelletize, in micro-pelletizing pellet sizes ≥ 0,8mm are possible.
- EMA and EAA is easy to pelletize, comparable to EVA, down to a minimal size of 0,5mm.
- EPDM, EPR, EPM etc. are easy to pelletize; in some cases long cooling pipes or powdering are necessary.
- EP, the epoxy resin, can be pelletized with good results with a viscosity ≥ 3000 mPas. The pellet drying should be very gentle.
- Underwater pelletizing of IM ionomers produces very good pellets.
- PC is easy to pelletize.
    - Materials are sensitive to freezing: use thermal optimized die plates for best heat transfer at cutting surface
- PMMA is easy to pelletize, but tends to melt breakages marginally.
- POM is easy to pelletize, tends to separation of formaldehyde at extreme shearing resp. at high pressure load.
- PSU is easy to pelletize.
    - Materials are sensitive to freezing, use thermal optimized die plates for best heat transfer at cutting surface
- PTFE is easy to pelletize, while the extrusion is in the according framework.
- PVAC is really easy and simple to pelletize, the drying of the pellets should be very gentle.
- Waxes with viscosities > 3000 mPas are easy to pelletize.
- PLA is easy to pelletize. Direct crystallization is easily possible by using additional aggregate.



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**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow.**

**Another benefit of using GALA pelletizing systems is the containment of the typical odors and gases.**

**The ball-shape of the pellets permits a simple and exact dosing.**

**The noise emission level can be minimized by selecting an appropriate dryer.**

**A further advantage of underwater pelletizing in this field is the round or elliptic pellet shape and the resulting free-flowing properties of the product in the subsequent use.**

**Die plates with specially designed heat conduction for an ideal heat transfer at the interface have considerably extended the range of applications for these products.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

## 11. Special groups (compounds and masterbatches)

### 11.1 Compounds

- Compounds are easy to pelletize in all standard pellet sizes and with all commercial fillers.
- Fillers are CaCO3, talc, chalk, TiO2, carbon black, wollastonite, EPDM, EPR etc., but also pigments and other additives or stabilizers.
- Products are tacky in processing (high MFI)
- In micro-pelletizing, pellet sizes of approx. 0,5mm are currently possible. Pellet distribution in narrow limits with excellent dosing properties permits ideal melting behaviour: micro-pellets = efficient performance improvement of extrusion lines.

**The advantage of underwater pelletizing in this field is the good cooling of the pellets in the water flow.**

**Another benefit is the round or elliptic pellet shape and the resulting free flowing properties of the product in the subsequent use.**

**Die plates with specially designed heat conduction for an ideal heat transfer at the interface have considerably extended the range of applications for these products**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

**Overview for process design (extract)**

| filler basis | MFI g | die hole in mm | rate kg/h/Loch | No. of blades | water temp. in °C |
|---|---|---|---|---|---|
| PE | 0,2 - 40 | 2,4 – 3,2 | 20 - 35 | 6 - 8 | 30 - 50 |
| PP | 1 - 40 | 2,8 | 20 - 35 | 6 - 8 | 35 |
| EPDM | 1 - 40 | 2,8 – 3,2 | 20 - 35 | 4 - 6 | 35 |
| PS | 1 - 30 | 2,8 – 3,2 | 20 - 35 | 6 - 8 | 45 - 70 |
| SBS/SEBS | 1 - 60 | 3,2 | 10 - 15 | 4 - 8 | 35 |
| Chalk | 1 - 50 | 2,8 – 3,2 | 20 - 40 | 6 - 8 | 30 - 50 |
| $CaCO_3$ | 1 - 50 | 2,8 – 3,2 | 20 - 40 | 6 - 8 | 30 - 60 |
| Talc | 1 - 50 | 2,8 | 20 - 40 | 4 - 6 | 40 |
| EPR | 10 - 30 | 3,2 | 10 - 20 | 4 – 8 | 30 |
| Carbon black | 1 - 30 | 2,8 – 3,2 | 15 - 25 | 4 – 8 | 35 - 50 |
| $TiO_2$ | 1 - 50 | 2,4 | 20 - 50 | 4 – 8 | 50 - 70 |
| Organic pigments | 10 - 40 % | 0,5 - 2,4 | 0,1 - 20 | 4 – 8 | 30 - 70 |
| Inorganic pigments | 10 - 80 % | 0,5 - 2,4 | 0,5 - 20 | 4 – 8 | 30 - 70 |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

**Further instructions, see respective basic polymer**

**11.2 Masterbatches**

- Easy to pelletize as supplier of concentrated additives and pigments in the form of pellets, both in standard pellets and in micro-pellets.

- Masterbatches are easy to pelletize with almost all commercial fillers. Fillers are pigments and other additives or stabilizers.

- Micro-pellets = uniform distribution of concentrates at mixing processes, problems with the material supply will be reduced.
  In micro-pelletizing pellet sizes of approx. 0,5mm are currently possible. Masterbatch materials for pigments, additives and fillers offer a high level of uniformity at grain sizes of 500 µm to 1500 µm.

**Masterbatch micro pellets offer special advantages, because plasticating lengths, mixing behavior and mixing exactness could be improved significantly, at reduced extruder lengths.**

**Low energy requirements, low shearing effort at reduced effective length of the extruders. Reduced extruder lengths = reduced risk of polymer degradation.**

**Uniform distribution of concentrates plus larger surfaces per unit of volume = shorter time for plastifying, uniform material flow**

**An advantage of the underwater pelletizing in this field is the round or elliptic pellet shape and the resulting free-flowing properties of the product.**

**Systems available for color control and adjustment by SPC (single pigment compound)**

**Compact systems for easy quick product change and, if necessary, without changing the process water available**

**Problematic fillers will be provided in the form of pellets in a clean, dust-free and environmentally compatible bond with a high load.**

**Performance increase / cost reduction by using the PEARLO® series.**

**Reasons for preferring a GALA underwater pelletizing system:**

- Low capital expenditure
- Low space requirements
- Low energy costs
- Low tooling costs
- Fully automatic design utilizing the most advanced technologies
- Low sound pressure level < 80 dB(A)

**Overview for process design (extract)**

| filler basis | MFI / viscosity | die hole in mm | rate kg/h/Loch | No. of blades | water temp. in °C |
|---|---|---|---|---|---|
| PE | all | 2,8 | 20 - 35 | 6 - 8 | 40 |
| PP | all | 2,8 | 20 - 45 | 6 - 8 | 20 - 40 |
| EVA | all | 2,8 | 20 - 35 | 4 - 6 | 25 |
| PS | all | 2,8 | 20 - 35 | 6 - 8 | 65 |
| PET/PBT | all | 3,2 | 30 – 50 | 4 - 8 | 65 - 85 |
| PA | all | 3,2 | 30 – 50 | 4 - 6 | 70 |
| PVC | all | 3,2 | 10 – 25 | 4 - 6 | 30 - 50 |
| TPU | 60A-72D | 3,2 | 20 – 30 | 4 - 6 | 20 |
| TPE | 10A-72D | 3,2 | 10 – 40 | 4 - 6 | 30 |
| Wax | > 3000 | 3,2 | 10 – 30 | 4 - 6 | 30 |
| Carbon black | 10 – 45 % | 2,8 | 15 – 25 | 4 - 6 | 35 |
| $TiO_2$ | 10 – 80 % | 2,4 | 20 – 50 | 4 - 6 | 50 |
| Organic pigments | 10 - 40 % | 0,5 - 2,4 | 10 - 30 | 4 - 6 | 70 |
| Inorganic pigments | 10 - 80 % | 0,5 - 2,4 | 10 - 60 | 4 - 6 | 70 |

**As a general rule**: choose the volume of water on the basis of the required rate (table for water systems)

**In particular**: if the material is sticky or heavy, the volume of water should be sized generously.

**Further instructions, see respective basic polymer**