
Technical Information

Kolliccoat® Smartseal 100 P

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1. Introduction

Kollicoat® Smartseal 100 P is a powdery grade of a film forming polymer for taste masking and moisture barrier applications. It provides effective protection from unpleasant taste and humidity while ensuring quick release of active ingredients in the stomach.

Kollicoat® Smartseal 100 P can be used in aqueous and solvent based film coating processes. It is obtained from the polymer dispersion Kollicoat® Smartseal 30 D.

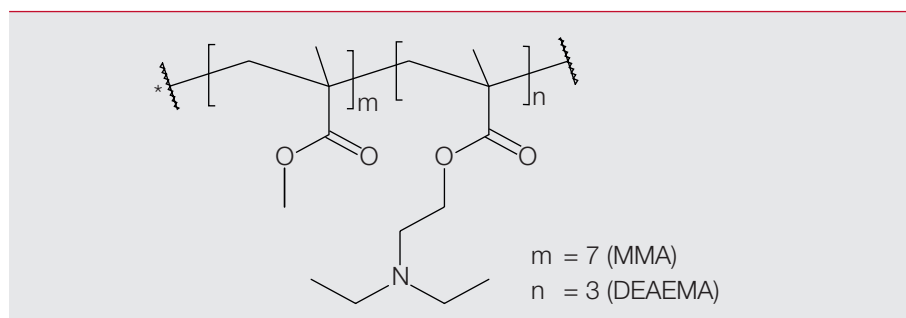
Kollicoat® Smartseal 30 D has a separate Technical Information Sheet which can be found on BASF WorldAccount.

2. Technical properties

Description

Kollicoat® Smartseal 100 P is a spray dried powder of a methyl methacrylate (MMA) and diethylaminoethyl methacrylate (DEAEMA) copolymer. The molar ratio of the monomers MMA and DEAEMA in the copolymer is 7:3. The powder contains approx. 2.0% macrogol cetostearyl ether and 2.5% sodium lauryl sulfate. It is white and has a pleasant characteristic odor.

Structural formula



Trivial name

Methyl methacrylate and diethylaminoethyl methacrylate copolymer 7:3.

CAS number

27027-16-3

Molecular weight

The weight average molecular weight (M_w) of the polymer is approx. 200 000 Dalton (method: size exclusion chromatography (SEC) coupled with light scattering).

Glas Transition Temperature (T_g)

Approx. 63 °C

(method: differential scanning calorimetry (DSC))

The polymer of Kollicoat® Smartseal 100 P is brittle. Therefore, a plasticizer is needed.

Minimum film forming temperature (MFFT)

Approx. 57 °C

(method: heating block system)

The MFFT only applies to aqueous coating. The polymer of Kollicoat® Smartseal 100 P is very lipophilic. This means that water cannot act as a plasticizer during aqueous film coating and a plasticizer is needed for lowering the MFFT.

Solubility

Water:

Kollicoat® Smartseal 100 P is insoluble in water at neutral and basic pH values. Below pH 5.5 it becomes water soluble.

Organic solvents:

Kollicoat® Smartseal 100 P is soluble in acetone. Acetone solutions can be diluted with isopropanol in a ratio up to 1:2. The polymer is insoluble in pure isopropanol.

Kollicoat® Smartseal 100 P can be redispersed into water by employing organic acids. For more details please see page 7.

3. Functionality

Taste Masking

The premise for an effective protection from unpleasant taste is the insolubility of the film coating polymer in the saliva (pH 6.8 – 7.2). Polymer films obtained with Kollicoat® Smartseal 100 P can be formulated in a way that they are insoluble in neutral or basic media for more than 2 hours. In acidic media with $\text{pH} \leq 5.5$ the polymer dissolves due to protonation of the amino functional groups in the copolymer structure.

This pH-dependent solubility ensures an effective protection in saliva and a quick release of active ingredients in the stomach. A coating level of 2 – 6 mg /cm² is recommended for taste masking applications on tablets.

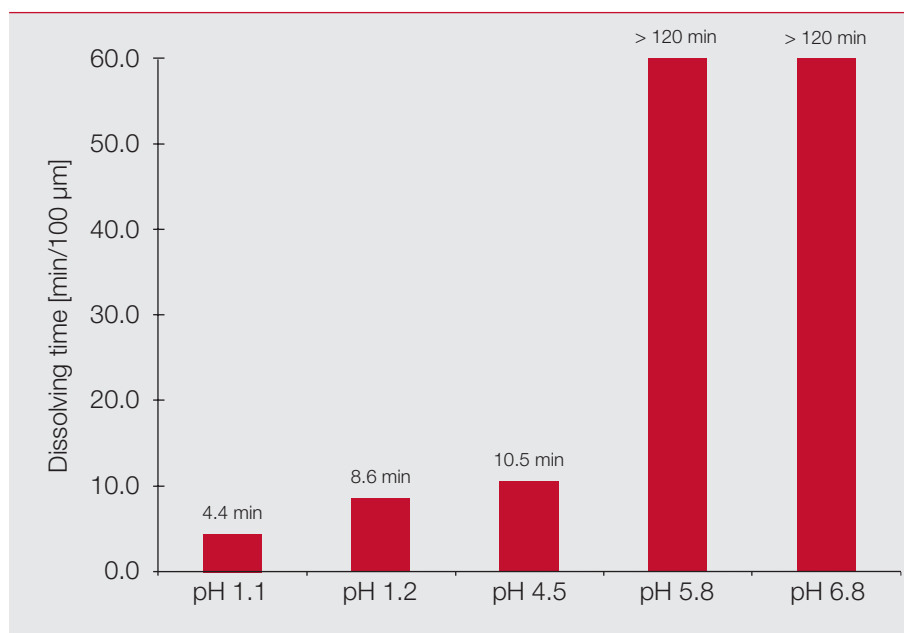


Figure 1: Dissolving time of 100 µm isolated polymer films at different pH values (films obtained from Kollicoat® Smartseal 30 D).

Moisture Protection

Film coatings with low water vapor permeability can delay the moisture uptake of sensitive dosage forms. As Kollicoat® Smartseal 100 P is very lipophilic, water vapor permeation is low and polymer films provide an effective moisture barrier functionality. A coating level of 5 – 20 mg/cm² is recommended for moisture barrier applications on tablets.

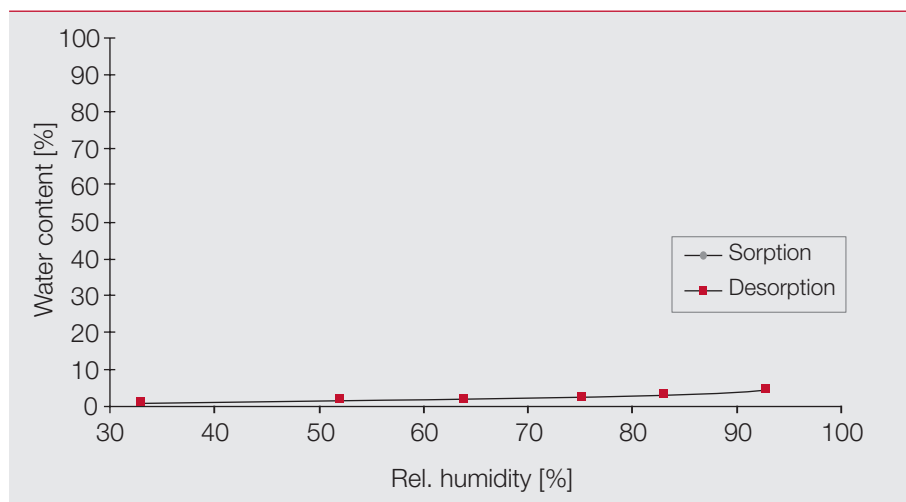


Figure 2: Sorption isotherm of 100 µm isolated polymer films (obtained from Kollicoat® Smartseal 30 D).

The moisture barrier properties of isolated films obtained from Kollicoat® Smartseal 100 P can be optimized by employing lipophilic plasticizers (such as acetyl tributyl citrate) or by the addition of talcum. Figure 3 shows the water vapor permeability of isolated films that contain different amounts of talcum (w/w based on the polymer).

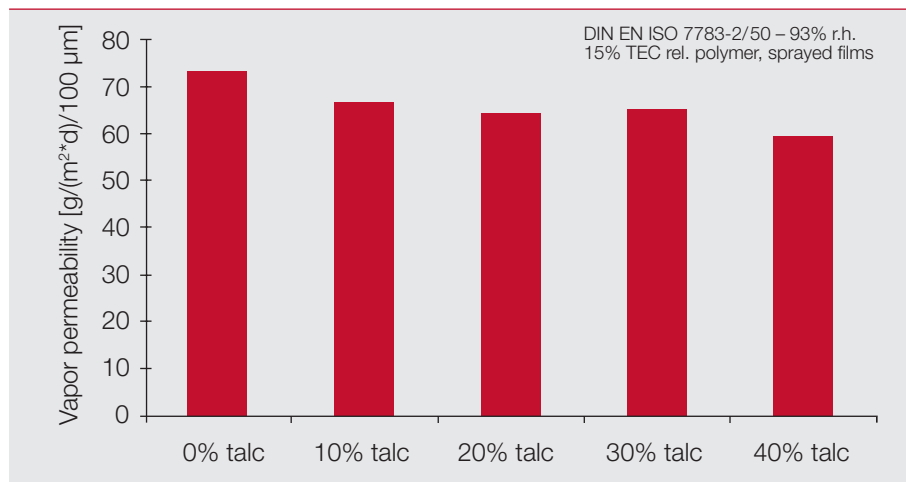


Figure 3: Impact of talcum on the water vapor permeability of 100 µm isolated polymer films (obtained from Kollicoat® Smartseal 30 D).

4. Application and Processing Selection of a plasticizer

Kollicoat® Smartseal 100 P is a brittle polymer. Therefore, dried polymer films need a plasticizer for preventing crackings and for retaining film functionality.

When applying Kollicoat® Smartseal 100 P in aqueous coating a plasticizer is also needed to reduce the high minimum film forming temperature (MFFT) of the polymer from ~ 57 °C to temperature regions where film coatings experiments are typically carried out. This is necessary as the polymer is very lipophilic and dispersion water has no plasticizing effect. (the minimum film forming temperature is not applicable to organic coating where the polymer is fully dissolved).

Recommended plasticizer concentration (w/w based on the polymer):

- 13 – 15% for aqueous coating
- 10 – 12% for organic coating

The following plasticizers are suitable for Kollicoat® Smartseal 100 P:

- Acetyltributyl citrate (ATBC)**
- Triethyl citrate (TEC)*
- Dibutyl sebacate (DBS)**
- suitable but without history of use in human oral dosage forms: tributyl citrate (TBC) and acetyltriethyl citrate (ATEC)*

* When using TEC or ATEC it is important that film coating dispersions are freshly prepared prior to use. Reason is that both plasticizers have shown to hydrolyse into acids and thus impact functionality when dispersions are stored overnight.

** When using ATBC or DBS in aqueous coating, the use of 2% docusate sodium is recommended to facilitate plasticizer incorporation.

With the impact on the glass transition temperature, plasticizers also impact the mechanical properties of the films. Figure 4 shows that the recommended plasticizer concentration of 13 – 15% (w/w based on the polymer) increases the elongation at break to approximately 100%.

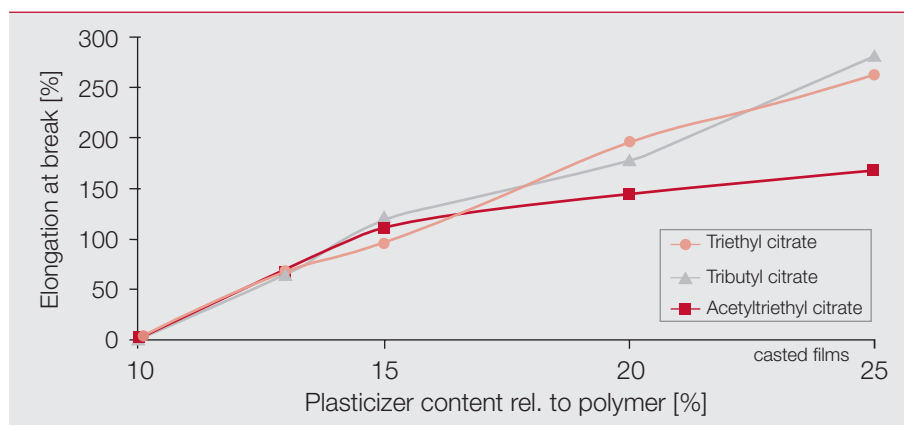


Figure 4: Impact of plasticizers on the mechanical properties of isolated polymer films of Kollicoat® Smartseal.

Addition of an antioxidant

Kollicoat® Smartseal 100 P based films always require an antioxidant to stabilize the amino ester moiety of the polymer. Without plasticizer, yellowing and a delayed dissolution may occur.

The recommendation is to use 1.0 – 2.5% of the lipophilic antioxidant butylated hydroxytoluene (BHT) based on polymer weight.

In aqueous coating, hydrophilic antioxidants like sodium carbonate can be used alternatively.

Curing

Curing is recommended for coatings obtained by means of aqueous coating with redispersed Kollicoat® Smartseal 100 P. This assures proper film formation and stable dissolution profiles that do not change over time.

Recommended conditions: 2 hours at 60 °C.

Curing for longer time allows to reduce temperatures. The effect of curing is stronger for tablets. Granules may not require curing.

Coatings obtained from organic coating with Kollicoat® Smartseal 100 P do not require curing.

Anti-tacking agents

An anti-tacking agent is always needed when working with Kollicoat® Smartseal 100 P to prevent sticking. Sticking was found to be more pronounced for Kollicoat® Smartseal 100 P in aqueous coating than in organic coating.

It is recommended to use talcum as anti-tacking agent in amounts between 4 and 8% relative to the polymer.

Alternatively, coated dosage forms can be blended directly after the coating process by addition of micro talcum.

Preparation of the coating suspension

The preparation process is different for aqueous and organic coating. Whereas Kollicoat® Smartseal 100 P can directly be dissolved in acetone for organic coating, partial neutralization with weak acids is required to redisperse it into water for aqueous coating.

Organic coating

Step 1: Dissolve Kollicoat® Smartseal 100 P in acetone while stirring.

Step 2: Add isopropanol to the fully dissolved acetone solution until the targeted mixture is reached. The maximum is a 1:2 mixture of acetone/isopropanol. Recommended is 1:1.

Step 3: Add plasticizer and BHT to the organic solution and stir until both are fully dissolved.

Step 4: Add pigments to the organic solution of step 2.

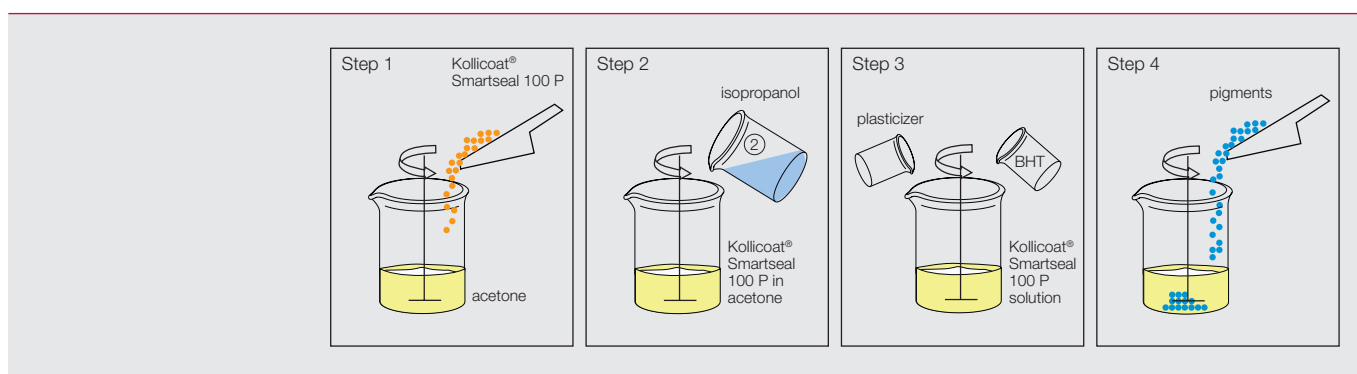


Figure 5: Preparation of the coating suspension for organic coating.

Aqueous coating

For aqueous coating, Kollicoat® Smartseal 100 P needs to be redispersed into water. Redispersion requires partial neutralization of the amino-functional groups in the polymer by employing weak acids.

For the redispersion succinic acid is recommended. Alternatively, adipic acid or malonic acid can be used.

- Succinic acid (Mw = 118.09 g/mol)
- Adipic acid (Mw = 146.14 g/mol)
- Malonic acid (Mw = 104.66 g/mol)

The acid shall be added in about 8 mol% relative to the amount of amino-functional groups. The calculation can be done the following way:

100 g Kollicoat® Smartseal 100 P contain about 40 g of the amino-functional monomer DEAEEMA (Mw = 185.27 g/mol), which equals 0.22 mol. 8% of this are 0.0173 mol. This means:

per 100 g Kollicoat® Smartseal 100 P, 0.017 mol of the acid need to be added.

This reveals for the recommended acids:

- Succinic acid: 2.04 g succinic acid per 100 g Kollicoat® Smartseal 100 P
- Adipic acid: 2.53 g per 100 g polymer
- Malonic acid: 1.81 g per 100 g polymer

- Step 1:** Dissolve the lipophilic antioxidant in the plasticizer. Elevated temperatures of approx. 50 °C can speed up this process.
- Step 2 & Step 3:** Dissolve the succinic acid in water until a solution is obtained (recommendation is an appr. 1 mol/L aqueous solution). Then add Kollicoat® Smartseal 100 P and stir for 10 min until it is fully redispersed.
- Step 4:** Disperse the pigments into water (approx. 20% suspension) with a high shear mixer for approx. 10 minutes.
- Step 5:** Add the pigment dispersion to the redispersed Kollicoat® Smartseal 100 P and subsequently add the mixture of plasticizer and antioxidant. Stir for 2 hours and pass through a 500 µm sieve prior to use.

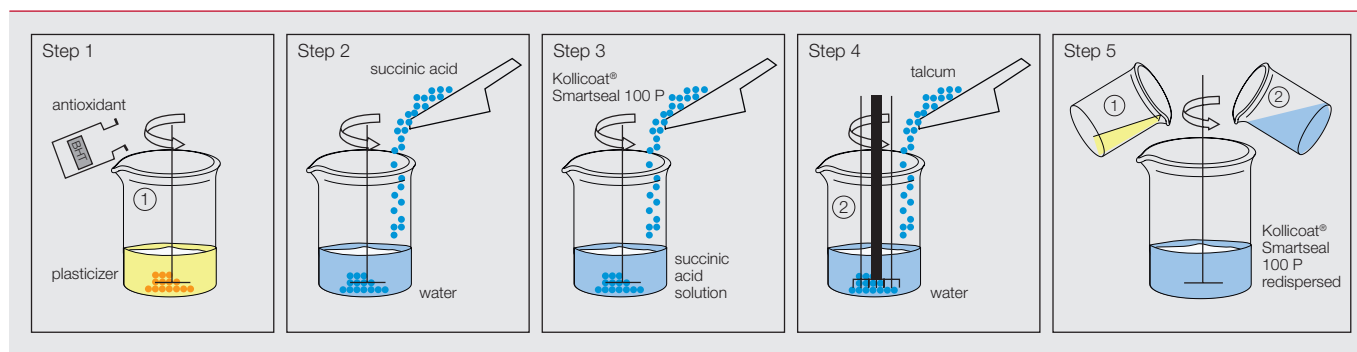


Figure 6: Preparation of the coating suspension for aqueous coating.

Cleaning recommendations

As the polymer is readily soluble below pH 5.5, weak acids are suitable for cleaning off residues of Kollicoat® Smartseal 100 P based formulations from coating equipment. Recommended are e.g. aqueous solutions of acetic acid, formic acid or citric acid, or commercially available cleaning agents.

5. Example application

Caffeine tablets

Cores

round, convex Ø 9 mm, 350 mg, composition: caffeine 15.5%, Ludipress® LCE 74.0%, Kollidon® VA 64 fine 5.0%, Kollidon® CL-F 5.0%, magnesium stearate 0.5%.

Composition of spray suspension

Ingredients	Content [%]
Kollicoat® Smartseal 100 P	10.2
Acetyltributyl citrate (ATBC)	1.5 (15% rel. to polymer)
Butylated hydroxytoluene (BHT)	0.3 (2.5% rel. to polymer)
Succinic acid	8.0 mol% (based on monomer DEAEMA)
Talcum	8.0 (50.0% rel. to polymer)
Water	80
Total	100
Solid content in the spray suspension	20

Process parameters

Parameter	Value
Machine	Manesty Accela Cota XL Lab01
Batch size	5 kg
Inlet air temperature	55 °C
Product temperature	37 – 39 °C
Nozzle diameter	1.2 mm
Spray rate	20 – 23 g/min
Spray pressure	1 bar
Atomized air	1.2 bar
Inlet air	350 l/s
Drum speed	10 Upm
Final drying	~ 45 °C product temperature
Curing	2 h @ 60 °C
Coating level	3 mg/cm ²

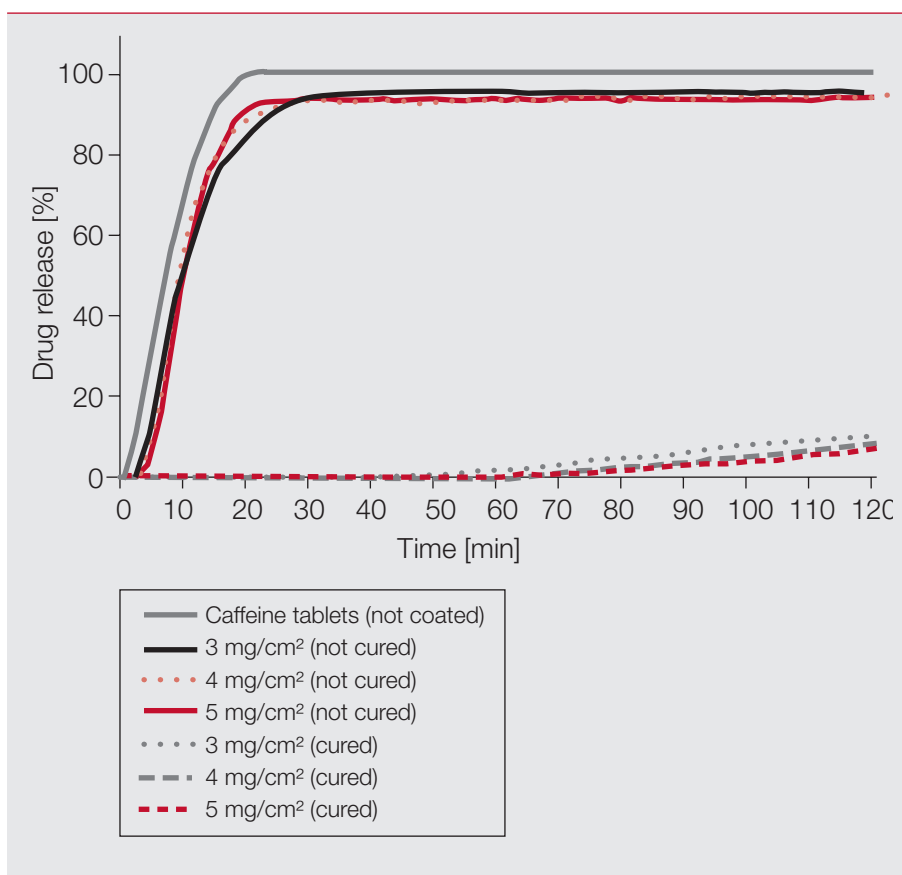


Figure 7: Release from caffeine tablets in dependency of weight gain and curing.

Caffeine granules (aqueous coating)**Substrate**

caffeine granules 0.2/0.5 µm.

Composition of spray suspension

Ingredients	Content [%]
Kollicoat® Smartseal 100 P	11.9
Acetyltributyl citrate (ATBC)	1.8 (15% rel to polymer)
Butylated hydroxytoluene (BHT)	0.3 (2.5% rel. to polymer)
Succinic acid	8.0 mol% (based on monomer DEAEMA)
Talcum	6.0 (50% rel. to polymer)
Water	80
Total	100
Solid content in the spray suspension	20

Process parameters

Parameter	Value
Machine	Glatt GPCG 3.1
Spray set-up	Bottom spray, 25 cm Wurster 7" column
Batch size	1.33 kg
Inlet air temperature	55 °C
Product temperature	31 – 35 °C
Nozzle diameter	1.0 mm
Spray rate	~ 20 g/min
Spray pressure	1.5 bar
Inlet air	88 – 100 m³/h
Final drying	~ 45 °C product temperature
Curing	2h @ 60 °C
Weight gain	15, 20, 25, 30%

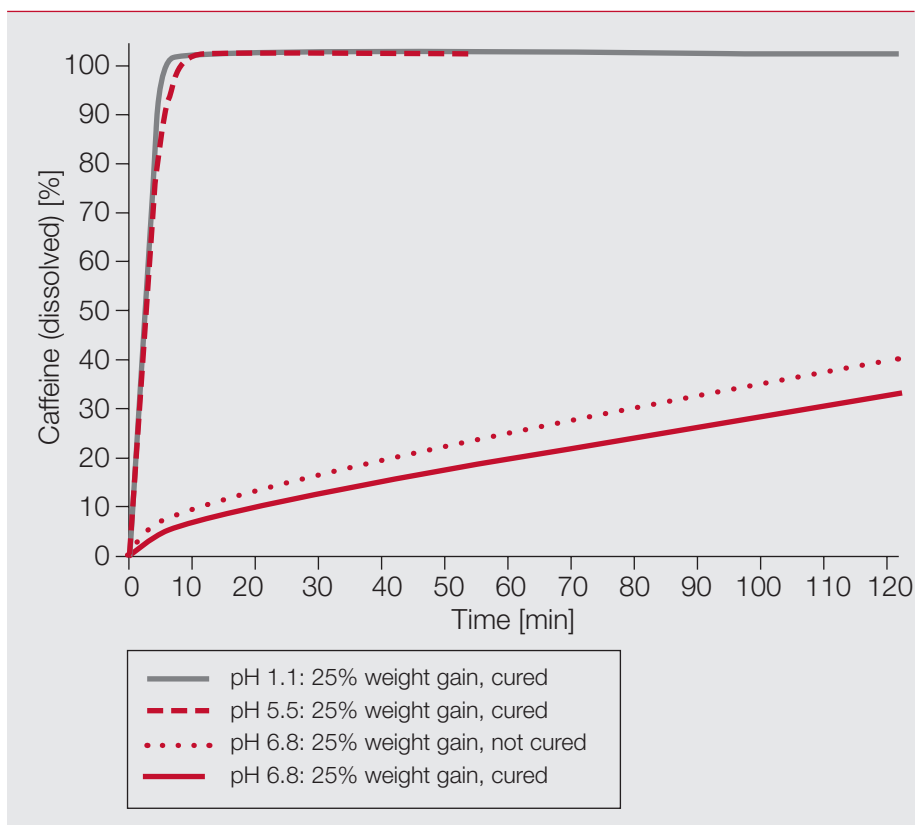


Figure 8: Release from caffeine granules with 25% weight gain at different pH values.

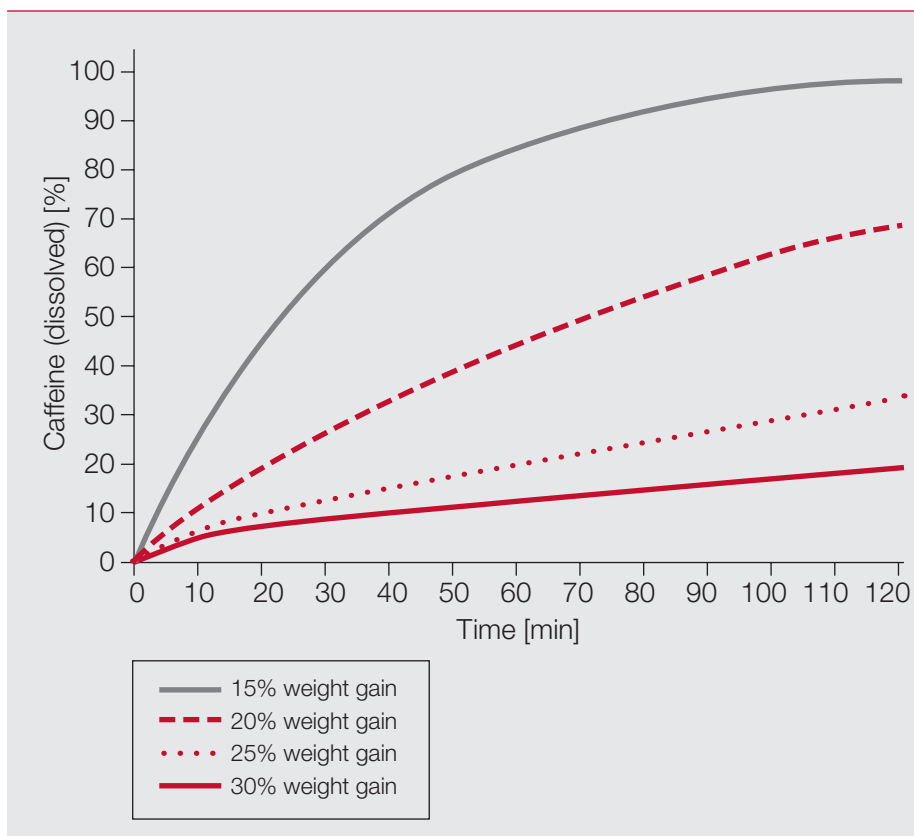


Figure 9: Release at pH 6.8 from caffeine granules with different weight gains (all tablets cured).

Caffeine granules (organic coating)

Substrate

caffeine granules 0.2/0.5 µm

Composition of spray suspension

Ingredients	Content [%]
Kollicoat® Smartseal 100 P	8.9
Acetyltributyl citrate (ATBC)	0.9 (10% rel. to polymer)
Butylated hydroxytoluene (BHT)	0.2 (2.5% rel. to polymer)
Acetone	45
Isopropanol	45
Total	100
Solid content in the spray suspension	10

After the coating process the granules were blended with 1% micro talcum (Micro Talk 50) to avoid sticking.

Process parameters

Parameter	Value
Machine	Glatt GPCG 3.1
Spray set-up	Bottom spray, 25 cm Wurster 7" column
Batch size	1.3 kg
Inlet air temperature	25 °C
Product temperature	31 – 36 °C
Nozzle diameter	1.0 mm
Spray rate	17 – 20 g/min
Spray pressure	1.5 bar
Inlet air	90 – 110 m³/h
Final drying	~ 45 °C product temperature
Weight gain	15, 20, 25, 30%

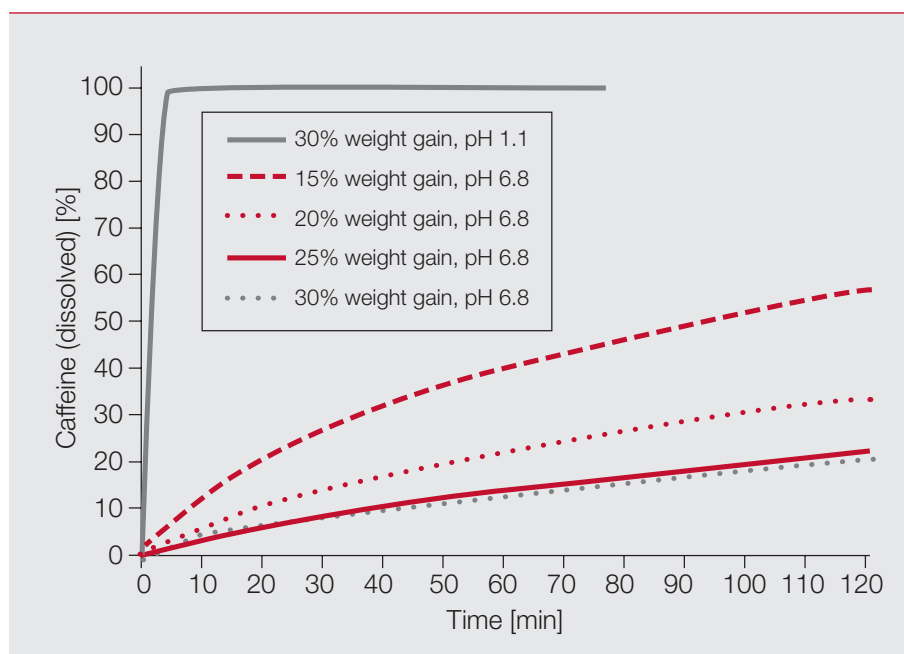


Figure 10: Release from caffeine granules with different weight gains at pH 1.1 and pH 6.8.

6. Handling & Safety

Please refer to the individual material safety data sheet (MSDS) for instructions on safe and proper handling and disposal. Material safety data sheets are sent with every consignment. In addition they are available on BASF WorldAccount* or from your local BASF sales representative.

7. Product Specification

The current version of the product specification is available on BASF WorldAccount* or from your local BASF sales representative.

8. Regulatory & Quality

Please refer to the individual document quality & regulatory product information (QRPI) which is available on BASF WorldAccount* and from your local sales representative. **The QRPI covers all relevant information including retest dates, and storage conditions.**

9. Toxicology

The safety of the polymer in Kollicoat® Smartseal 30 D as pharmaceutical excipient in film coating of solid oral dosage forms is supported by a comprehensive non-clinical study. A summary of the study is available on BASF WorldAccount* or from your local sales representative. A detailed report can be shared as part of a non-disclosure agreement.

* <https://worldaccount.basf.com>

10. PRD and Article numbers

PRD-No.*	Product name	Article numbers	Packaging
30585559	Kollicoat® Smartseal 100 P	50341064	15 kg cardboard box with PE liner

* BASF's commercial product number.

11. Publications

Publications including scientific posters are available on <http://pharmaceutical.basf.com/en.html>

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