

Highly water-efficient process for preparing purified epsilon-caprolactam from polyamide 6

The present invention relates to a process for preparing purified ϵ -caprolactam from polyamide 6 comprising hydrolytically depolymerizing polyamide 6 contained in a solid material, wherein
5 downstream of the depolymerization stage, water which is comprised in the mixture obtained from depolymerization is highly efficiently used and recycled within the overall process which comprises downstream purification of the crude ϵ -caprolactam obtained from the depolymerization. Further according to the present invention, heat contained in the mixture obtained from the depolymerization is highly efficiently used within the overall process to obtain
10 highly purified ϵ -caprolactam. In summary, the present invention relates to a highly integrated process for recovering purified ϵ -caprolactam from a polyamide 6 containing material wherein said process is characterized by a highly optimized use and re-use of water and energy in different stages of the process.

15 Polyamide, and in particular polyamide 6 being characterized by the formula $(-\text{NH}-(\text{CH}_2)_5-\text{CO}-)_n$, can be found in numerous materials, such as packaging, engineering plastics from automotive and textile filaments. The latter represents about 40 % of the polyamide 6 global market. At present, only a very small part of the textile filaments is recycled while it represents a significant percentage of the global CO_2 emissions. There is thus a need to recycle polyamide 6 from such
20 materials. Usually, such recycling processes are energy-intensive processes. Thus, there is a constant need to provide an improved process for depolymerizing a polyamide suitable to overcome these issues. Yet further, in view of economic and in particular ecologic requirements, there is the need provide a recycling process where the water balance is as positive as possible, i.e. where as much water as possible is re-used and recycled.

25 Surprisingly, it was found that the process of the present invention according to which polyamide 6 comprised in a solid material is hydrolytically depolymerized, wherein the stream obtained from aqueous depolymerization of polyamide 6 is suitably processed so as to obtain a variety of aqueous streams having specific mass flows, wherein these aqueous streams are obtained and
30 prepared both in liquid and in vapor form in the course of the overall process comprising the depolymerization of polyamide 6 as well as the downstream purification of ϵ -caprolactam, and wherein the aqueous vapor streams are essentially used for heat-integration purposes and the liquid aqueous streams are essentially suitably recycled, represents such a process meeting the mentioned economic and in particular ecologic requirements. In total, it was found that this
35 specific design of the process with regard to the overall water balance is a robust and, at the same time, a highly water- and heat-effective process. Thus, the process of the present invention permits to optimize the water consumption of the ϵ -caprolactam recovering process, and further the energy consumption. Yet further, using the inventive water- and heat-integrated process permits to reduce the CO_2 footprint of the ϵ -caprolactam recycling process, an essential feature of
40 any up-to-date industrial-scale process.

Therefore, the present invention relates to a process for preparing purified ϵ -caprolactam from polyamide 6 comprised in a solid material M, the process comprising

- (i) preparing an aqueous liquid stream S_R comprising ϵ -caprolactam dissolved in water, comprising
- (i.1) providing the solid material M comprising polyamide 6;
- (i.2) preparing an aqueous liquid stream S_W exhibiting a water mass flow μ_W , the stream S_W comprising an aqueous recycle stream S_{WR} exhibiting a water mass flow μ_{WR} and an aqueous makeup stream S_{WF} exhibiting a water mass flow μ_{WF} , wherein $\mu_{WR} + \mu_{WF} = \mu_W$;
- (i.3) preparing an aqueous depolymerization mixture based on the solid material M provided according to (i.1) and the aqueous liquid stream S_W provided according to (i.2);
- (i.4) subjecting in a chemical reaction unit U_R the aqueous depolymerization mixture prepared according to (i.3) to depolymerization conditions comprising a depolymerization temperature T_D at a depolymerization pressure p_D , obtaining in U_R a liquid aqueous reaction mixture M_R comprising ϵ -caprolactam dissolved in water;
- (i.5) removing from U_R the aqueous liquid stream S_R exhibiting a water mass flow μ_R ;
- (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E at least one aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$;
- (iii) reprocessing the stream S_L obtained according to (ii) in a heat-consuming purification and recycle unit U_{PR} , the reprocessing comprising
- (iii.1) subjecting the aqueous liquid stream S_L to ϵ -caprolactam purification in the unit U_{PR} , obtaining from U_{PR} a stream S_{CPL} comprising purified ϵ -caprolactam, and further obtaining from U_{PR} at least one separated aqueous stream S_{WS} exhibiting a total water mass flow μ_{WS} ;
- (iii.2) providing at least part of the heat consumed in U_{PR} by the at least one aqueous vapor stream S_{EV} obtained according to (ii), obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL} exhibiting a total water mass flow μ_{EL} ;
- (iii.3) recycling the at least one aqueous stream S_{WS} obtained according to (iii.1) and the at least one aqueous stream S_{EL} obtained according to (iii.2) as aqueous recycle stream S_{WR} to (i.2), wherein $\mu_{WS} + \mu_{EL} = \mu_{WR}$;
- wherein
- μ_{EV} / μ_L is in the range of from 0.50 to 0.9;
- μ_{WR} / μ_W is in the range of from 0.02 to 0.3.

The term "total mass flow" used, for example, in the context of the at least one aqueous vapor stream S_{EV} refers to the sum of all mass flows of individual aqueous vapor streams S_{EV} in case there is more than one vapor stream S_{EV} .

Preferably according to the present invention, no polyamide 6 depolymerization catalyst such as a mineral acid and/or a zinc salt such as zinc chloride, zinc acetate or zinc triflate is used for

preparing or is contained in the depolymerisation mixture to be subjected to depolymerisation conditions.

5 Preferably, μ_{EV} / μ_L is in the range of from 0.5 to 0.8, more preferably in the range of from 0.5 to 0.7, more preferably in the range of from 0.5 to 0.65.

10 If, for example, the mass ratio of water relative to polyamide 6 in the depolymerization mixture is about 10:1, preferred values of μ_{EV} / μ_L may be in the range of from 0.6 to 0.65. If, for example, the mass ratio of water relative to polyamide 6 in the depolymerization mixture is about 5:1, preferred values of μ_{EV} / μ_L may be in the range of from 0.5 to 0.55.

Further preferably, μ_{WR} / μ_W is in the range of from 0.03 to 0.3, more preferably in the range of from 0.04 to 0.25 more preferably in the range of from 0.05 to 0.2.

15 Yet further preferably, μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9, preferably in the range of from 0.6 to 0.85, more preferably in the range of from 0.65 to 0.8.

20 Therefore, it is preferred that μ_{EV} / μ_L is in the range of from 0.5 to 0.8, more preferably in the range of from 0.5 to 0.7, more preferably in the range of from 0.5 to 0.65; that μ_{WR} / μ_W is in the range of from 0.03 to 0.3, more preferably in the range of from 0.04 to 0.25 more preferably in the range of from 0.05 to 0.2; and that μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9, preferably in the range of from 0.6 to 0.85, more preferably in the range of from 0.65 to 0.8.

25 In particular, it is preferred that μ_{EV} / μ_L is in the range of from 0.5 to 0.8; that μ_{WR} / μ_W is in the range of from 0.03 to 0.3, more preferably in the range of from 0.04 to 0.25 more preferably in the range of from 0.05 to 0.2; and that μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9, preferably in the range of from 0.6 to 0.85, more preferably in the range of from 0.65 to 0.8.

30 Further, it is preferred that μ_{EV} / μ_L is in the range of from 0.5 to 0.8, more preferably in the range of from 0.5 to 0.7, more preferably in the range of from 0.5 to 0.65; that μ_{WR} / μ_W is in the range of from 0.03 to 0.3; and that μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9, preferably in the range of from 0.6 to 0.85, more preferably in the range of from 0.65 to 0.8.

35 Yet further, it is preferred that μ_{EV} / μ_L is in the range of from 0.5 to 0.8, more preferably in the range of from 0.5 to 0.7, more preferably in the range of from 0.5 to 0.65; that μ_{WR} / μ_W is in the range of from 0.03 to 0.3, more preferably in the range of from 0.04 to 0.25 more preferably in the range of from 0.05 to 0.2; and that μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9.

40 With regard to the purification stages of the process of the present invention, it is preferred that stream S_R obtained according to (i.5) exhibits an ϵ -caprolactam concentration C_{SR} , the stream S_L obtained according to (ii) exhibits an ϵ -caprolactam concentration C_{SL} , and the stream S_{CPL} obtained according to (iii.1) exhibits an ϵ -caprolactam concentration C_{SCPL} , with $C_{SCPL} \gg C_{SL} > C_{SR}$.

The symbol “>” compared to the symbol “>” indicates that the ratio $c_{\text{SCPL}} / c_{\text{S}}$ is significantly higher than the ratio $c_{\text{SL}} / c_{\text{SR}}$.

Regarding the heat-consuming purification and recycle unit U_{PR} , it is preferred that it comprises a heat-consuming water separation unit U_{WS} which in turn comprises two heat-consuming water separation sub-units $U_{\text{WS}}(1)$ and $U_{\text{WS}}(2)$. In this regard, it is further preferred that step (iii.1) of the process of the present invention comprises subjecting the aqueous liquid stream S_{L} to water separation in $U_{\text{WS}}(1)$, obtaining a separated aqueous stream $S_{\text{WS}}(1)$ and an aqueous stream S_{UWS1} exhibiting an ϵ -caprolactam concentration c_{SUWS1} with $c_{\text{SUWS1}} > c_{\text{SL}}$, and further comprises subjecting the aqueous stream S_{UWS1} , optionally after an intermediate treatment in a high boiler separation unit U_{HS} , to further water separation in $U_{\text{WS}}(2)$, obtaining a separated aqueous stream $S_{\text{WS}}(2)$ and an aqueous stream S_{UWS2} exhibiting an ϵ -caprolactam concentration c_{SUWS2} with $c_{\text{SUWS2}} > c_{\text{SUWS1}}$. As far as the mass flows of individual streams is concerned, it is preferred that the stream $S_{\text{WS}}(1)$ exhibits a water mass flow μ_{WS1} and the stream $S_{\text{WS}}(2)$ exhibits a water mass flow μ_{WS2} , wherein $\mu_{\text{WS1}} + \mu_{\text{WS2}} = \mu_{\text{WS}}$ and wherein $\mu_{\text{WS1}} / \mu_{\text{WS2}}$ is preferably in the range of from 10 to 32.5, more preferably in the range of from 11 to 30, more preferably in the range of from 12 to 27.5.

As mentioned above, the process of the present invention is characterized, among others, that at least one aqueous vapor stream S_{EV} is obtained according to (ii). Preferably, at least part of the heat consumed in the above-described unit $U_{\text{WS}}(1)$ is provided by at least one aqueous vapor stream S_{EV} . Preferably, the at least one aqueous vapor stream S_{EV} used for this purpose has a pressure in the range of from 0.95 to 1.5 bar, more preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and a temperature preferably in the range of from 90 to 140 °C, preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C. Also preferably, at least part of the heat consumed in the unit $U_{\text{WS}}(2)$ is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii). Preferably, the at least one aqueous vapor stream S_{EV} used for this purpose has a pressure in the range of from 5 to 11 bar, more preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and a temperature preferably in the range of from 150 to 210 °C, more preferably in the range of from 160 to 200 °C, more preferably in the range of from 170 to 190 °C.

With regard to the specific apparatus design of the sub-unit $U_{\text{WS}}(1)$ and sub-unit $U_{\text{WS}}(2)$, it is preferred that the sub-unit $U_{\text{WS}}(1)$ comprises one or more of a falling film evaporator, a flash tank, a forced circulation evaporator, and a distillation column, more preferably one or more of a falling film evaporator and a flash tank, more preferably a falling film evaporator and a flash tank, and that the sub-unit $U_{\text{WS}}(2)$ comprises one or more of a falling film evaporator, a flash tank and a distillation column, more preferably a distillation column.

According to the present invention, the heat-consuming purification and recycle unit U_{PR} preferably further comprises one or more of a heat-consuming water distillation unit U_{DI} and a heat consuming crystallization unit U_{CR} , more preferably a heat-consuming water distillation unit U_{DI} and a heat-consuming crystallization unit U_{CR} . In this regard, it is preferred that step (iii.1) of

the process of the present invention further comprises subjecting the aqueous liquid stream S_{UWS2} to distillation in U_{DI} , obtaining a stream S_{UDI} exhibiting an ϵ -caprolactam concentration c_{SUDI} with $c_{SUDI} > c_{SUWS1}$, and further comprises subjecting the aqueous stream S_{UDI} to crystallization in U_{CR} , obtaining from U_{CR} the stream S_{CPL} exhibiting an ϵ -caprolactam concentration c_{SCPL} with

5 $c_{SCPL} > c_{SUDI}$. Preferably, at least part of the heat consumed in the unit U_{DI} is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii). More preferably, the at least one aqueous vapor stream S_{EV} used for this purpose has a pressure in the range of from 5 to 11 bar, more preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and a temperature preferably in the range of from 150 to 210 °C, more preferably in the range of

10 from 160 to 200 °C, more preferably in the range of from 170 to 190 °C. Also preferably, at least part of the heat consumed in the unit U_{CR} is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii). More preferably, the at least one aqueous vapor stream S_{EV} for this purpose has a pressure in the range of from 0.95 to 1.5 bar, more preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and a temperature preferably in

15 the range of from 90 to 140 °C, more preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C.

Preferably according to the present invention, the heat-consuming purification and recycle unit U_{PR} further comprises at least one heat-consuming heating unit U_H . In this regard, it is preferred

20 that recycling according to (iii.3) further comprises passing one or more of the at least one stream S_{WS} and the at least one stream S_{EL} and the stream S_{WF} , or one or more combined streams thereof, through the at least one heating unit U_H , obtaining a respectively heated stream or heated streams. Preferably, at least part of the heat consumed in at least one of the units U_H is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii). Further preferably,

25 the stream S_{WF} is passed through a unit $U_H(2)$, obtaining a heated stream S_{WF} , wherein at least part of the heat consumed in $U_H(2)$ is provided by an aqueous vapor stream S_{EV} obtained according to (ii) wherein the vapor stream S_{EV} used for this purpose has a pressure preferably in the range of from 0.95 to 1.5 bar, more preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and a temperature preferably in the range of from

30 90 to 140 °C, more preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C. Also preferably, a combined stream of the at least one stream S_{WS} and the at least one stream S_{EL} is passed through a unit $U_H(1)$, obtaining a heated combined stream, wherein at least part of the heat consumed in $U_H(1)$ is provided by an aqueous vapor stream S_{EV} obtained according to (ii), wherein the vapor stream S_{EV} used for this purpose has a pressure

35 preferably in the range of from 13 to 19 bar, more preferably in the range of from 14 to 18 bar, more preferably in the range of from 15 to 17 bar; and a temperature preferably in the range of from 170 to 230 °C, preferably in the range of from 180 to 220 °C, more preferably in the range of from 190 to 210 °C. Still further preferably, the combined stream passed through the unit $U_H(1)$ further comprises the heated stream S_{WF} obtained as described above.

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Regarding the preparation of the at least one aqueous vapor stream S_{EV} is concerned, it is preferred that step (ii) of the process of the present invention comprises subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E ,

- obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E three aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$, wherein a first stream S_{EV1} has a pressure p_{EV1} and a temperature T_{EV1} , a second stream S_{EV2} has a pressure p_{EV2} and a temperature T_{EV2} , and a third stream S_{EV3} has a pressure p_{EV3} and a temperature T_{EV3} , wherein
- 5 $p_{EV1} > p_{EV2} > p_{EV3}$;
and wherein
- p_{EV1} is preferably in the range of from 13 to 19 bar, more preferably in the range of from 14 to 18 bar, more preferably in the range of from 15 to 17 bar; and
 - 10 T_{EV1} is preferably in the range of from 170 to 230 °C, more preferably in the range of from 180 to 220 °C, more preferably in the range of from 190 to 210 °C;
 - p_{EV2} is preferably in the range of from 5 to 11 bar, more preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and
 T_{EV2} is preferably in the range of from 150 to 210 °C, more preferably in the range of from 160
 - 15 to 200 °C, more preferably in the range of from 170 to 190 °C;
 - p_{EV3} is preferably in the range of from 0.95 to 1.5 bar, more preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and
 T_{EV3} is preferably in the range of from 90 to 140 °C, more preferably in the range of from 100
 - 20 to 130 °C, more preferably in the range of from 110 to 120 °C;
- wherein the stream S_{EV1} exhibits a mass flow μ_{EV1} , the stream S_{EV2} exhibits a mass flow μ_{EV2} and the stream S_{EV3} exhibits a mass flow μ_{EV3} , wherein $\mu_{EV1} + \mu_{EV2} + \mu_{EV3} = \mu_{EV}$.

- Preferably, μ_{EV1} / μ_{EV} is in the range of from 0.01 to 0.55, more preferably in the range of from 0.02 to 0.5, more preferably in the range of from 0.03 to 0.45; μ_{EV2} / μ_{EV} is in the range of from 0.1
- 25 to 0.75, more preferably in the range of from 0.15 to 0.7, more preferably in the range of from 0.2 to 0.65; and μ_{EV3} / μ_{EV} is in the range of from 0.2 to 0.55, more preferably in the range of from 0.25 to 0.45, more preferably in the range of from 0.3 to 0.4.

- Regarding this preferred preparation of three aqueous vapor streams having different pressure, it
- 30 is further preferred that the step (iii.2) of the process of the present invention comprises providing at least part of the heat consumed in U_{PR} by the streams S_{EV1} , S_{EV2} and S_{EV3} obtained according to (ii) or one or more part streams thereof, obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL1} , at least one at least partially condensed aqueous stream S_{EL2} and at least one at least partially condensed aqueous stream S_{EL3} , said at least one at least
- 35 partially condensed aqueous stream S_{EL1} , said at least one at least partially condensed aqueous stream S_{EL2} and said at least one at least partially condensed aqueous stream S_{EL2} together exhibiting a total water mass flow μ_{EL} . In this regard, it is preferred that (iii) comprises
- (iii.1) subjecting the aqueous liquid stream S_L to ϵ -caprolactam purification in the unit U_{PR} , obtaining from U_{PR} a stream S_{CPL} comprising purified ϵ -caprolactam, and further obtaining
- 40 from U_{PR} at least one separated aqueous stream S_{WS} exhibiting a total water mass flow μ_{WS} , comprising
- (iii.1.1) subjecting the aqueous liquid stream S_L to water separation in a first water separation unit $U_{WS}(1)$, obtaining a separated aqueous stream $S_{WS}(1)$ and an

- aqueous stream S_{UWS1} exhibiting an ϵ -caprolactam concentration C_{SUWS1} with $C_{SUWS1} > C_{SL}$, and further comprises subjecting the aqueous stream S_{UWS1} , optionally after an intermediate treatment in a high boiler separation unit U_{HS} , to further water separation in a second water separation unit $U_{WS}(2)$, obtaining a separated aqueous stream $S_{WS}(2)$ and an aqueous stream S_{UWS2} exhibiting an ϵ -caprolactam concentration C_{SUWS2} with $C_{SUWS2} > C_{SUWS1}$;
- (iii.1.2) subjecting the aqueous liquid stream S_{UWS2} to distillation in a distillation unit U_{DI} , obtaining a stream S_{UDI} exhibiting an ϵ -caprolactam concentration C_{SUDI} with $C_{SUDI} > C_{SUWS1}$, and further comprises subjecting the aqueous stream S_{UDI} to crystallization in a crystallization unit U_{CR} , obtaining from U_{CR} the stream S_{CPL} exhibiting an ϵ -caprolactam concentration C_{SCPL} with $C_{SCPL} > C_{SUDI}$;
- (iii.2) providing at least part of the heat consumed in U_{PR} by the streams S_{EV1} , S_{EV2} and S_{EV3} obtained according to (ii) or one or more part streams thereof, obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL1} , at least one at least partially condensed aqueous stream S_{EL2} and at least one at least partially condensed aqueous stream S_{EL3} , said at least one at least partially condensed aqueous stream S_{EL1} , said at least one at least partially condensed aqueous stream S_{EL2} and said at least one at least partially condensed aqueous stream S_{EL2} together exhibiting a total water mass flow μ_{EL} , said providing comprising
- (iii.2.1) providing at least part of the heat consumed in $U_{WS}(1)$ by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- (iii.2.2) providing at least part of the heat consumed in $U_{WS}(2)$ by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} ;
- (iii.2.3) providing at least part of the heat consumed in U_{DI} by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} ;
- (iii.2.4) providing at least part of the heat consumed in U_{CR} by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- (iii.2.5) providing at least part of the heat consumed in $U_H(1)$ as defined in (iii.3) by at least one part stream of the stream S_{EV1} , obtaining at least one at least partially condensed stream S_{EL1} , each having a pressure p_{EL1} and a temperature T_{EL1} ;
- (iii.2.6) providing at least part of the heat consumed in $U_H(2)$ as defined in (iii.3) by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- (iii.3) recycling the aqueous stream $S_{WS}(1)$, the aqueous stream $S_{WS}(2)$ obtained according to (iii.1.1) and the aqueous streams S_{EL1} , S_{EL2} , S_{EL2} obtained according to (iii.2) as aqueous recycle stream S_{WR} to (i.2), wherein $\mu_{WS} + \mu_{EL} = \mu_{WR}$.

Still further preferably, the process comprises

- (iii.2.1) providing at least part of the heat consumed in $U_{WS}(1)$ by at least one part stream of the

- stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{WS1})$;
- (iii.2.2) providing at least part of the heat consumed in $U_{WS}(2)$ by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} , said at least one part stream of the stream S_{EV2} exhibiting a total mass flow $\mu_{EV2}(U_{WS2})$;
- (iii.2.3) providing at least part of the heat consumed in U_{DI} by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} , said at least one part stream of the stream S_{EV2} exhibiting a total mass flow $\mu_{EV2}(U_{DI})$;
- (iii.2.4) providing at least part of the heat consumed in U_{CR} by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{CR})$;
- (iii.2.5) providing at least part of the heat consumed in $U_H(1)$ as defined in (iii.3) by at least one part stream of the stream S_{EV1} , obtaining at least one at least partially condensed stream S_{EL1} , each having a pressure p_{EL1} and a temperature T_{EL1} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV1}(U_{H1})$;
- (iii.2.6) providing at least part of the heat consumed in $U_H(2)$ as defined in (iii.3) by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{H2})$;
- wherein
- $\mu_{EV1}(U_{H1}) / \mu_{EV1}$ is preferably in the range of from 0.85 to 1, more preferably in the range of from 0.9 to 1, more preferably in the range of from 0.95 to 1;
- $\mu_{EV2}(U_{WS2}) / \mu_{EV2}$ is preferably in the range of from 0.03 to 0.2, more preferably in the range of from 0.04 to 0.15, more preferably in the range of from 0.05 to 0.1;
- $\mu_{EV2}(U_{DI}) / \mu_{EV2}$ is preferably in the range of from 0.8 to 0.97, more preferably in the range of from 0.85 to 0.96, more preferably in the range of from 0.9 to 0.95;
- $\mu_{EV3}(U_{WS1}) / \mu_{EV3}$ preferably is in the range of from 0.1 to 0.9, more preferably in the range of from 0.2 to 0.85, more preferably in the range of from 0.3 to 0.8;
- $\mu_{EV3}(U_{CR}) / \mu_{EV3}$ preferably is in the range of from 0.1 to 0.9, more preferably in the range of from 0.2 to 0.85, more preferably in the range of from 0.3 to 0.8;
- $\mu_{EV3}(U_{H2}) / \mu_{E3}$ is preferably in the range of from 0.01 to 0.04, more preferably in the range of from 0.01 to 0.03, more preferably in the range of from 0.01 to 0.02.

Regarding pressures and temperatures of specific streams according to this process design, it is preferred that

- $0.95 p_{EV1} \leq p_{EL1} \leq p_{EV1}$; and
 $\Delta T_{VL1} = T_{EV1} - T_{EL1}$ is in the range of from 2 to 10 °C, preferably in the range of from 3 to 8 °C, more preferably in the range of from 4 to 6 °C;
- $0.95 p_{EV2} \leq p_{EL2} \leq p_{EV2}$; and

- $\Delta T_{VL2} = T_{EV2} - T_{EL2}$ is in the range of from 15 to 40 °C, preferably in the range of from 18 to 32 °C, more preferably in the range of from 20 to 30 °C;
- $0.95 p_{EV3} \leq p_{EL3} \leq p_{EV3}$; and
- $\Delta T_{VL3} = T_{EV3} - T_{EL3}$ is in the range of from 10 to 30 °C, preferably in the range of from 12.5 to 27.5 °C, more preferably in the range of from 15 to 25 °C.

Also preferred is a process wherein the preparation of the aqueous vapor streams according to (ii) comprises

- (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E three aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$, wherein a first stream S_{EV1} has a pressure p_{EV1} and a temperature T_{EV1} , a second stream S_{EV2} has a pressure p_{EV2} and a temperature T_{EV2} , and a third stream S_{EV3} has a pressure p_{EV3} and a temperature T_{EV3} , wherein $p_{EV1} > p_{EV2} > p_{EV3}$, wherein obtaining from U_E three aqueous vapor stream S_{EV} comprises
 - (ii.1) subjecting the liquid aqueous stream S_R obtained according to (i.5) to depressurization in a first evaporation sub-unit U_{E1} , obtaining from U_{E1} an aqueous vapor stream S_{EV1A} having the pressure p_{EV1} , and further obtaining an at least partially aqueous liquid stream S_{LU1} ;
 - (ii.2) dividing the stream S_{EV1A} , obtaining the stream S_{EV1} and a stream S_{EV1B} having the pressure p_{EV1} ;
 - (ii.3) subjecting the stream S_{EV1B} to depressurization in a unit U_{V1} , U_{V1} preferably comprising a valve, more preferably a pressure relief valve, obtaining the stream S_{EV2} ;
 - (ii.4) subjecting the stream S_{LU1} obtained according to (ii.1) to depressurization in a second evaporation sub-unit U_{E2} , obtaining from U_{E2} an aqueous vapor stream S_{EV3A} and the liquid stream S_L , wherein the aqueous vapor stream S_{EV3A} is the aqueous vapor stream S_{EV3} .
- With regard to this process design, it is further preferred that obtaining the stream S_{EV3} further comprises one or more of (ii.5.1) and (ii.5.2):
- (ii.5.1) separating a stream S_{EV1C} from the stream S_{EV1A} , obtained according to (ii.1), the stream S_{EV1C} having the pressure p_{EV1} ; subjecting the stream S_{EV1C} to depressurization in a unit U_{V2} , U_{V2} preferably comprising a valve, more preferably a pressure relief valve, obtaining a stream S_{EV3B} having the pressure p_{EV3} ;
 - (ii.5.2) separating a stream S_{EV2A} from the stream S_{EV2} obtained according to (ii.3), the stream S_{EV2A} having the pressure p_{EV2} ; subjecting the stream S_{EV2A} to depressurization in a unit U_{V3} , U_{V3} preferably comprising a valve, more preferably a pressure relief valve, obtaining a stream S_{EV3C} having the pressure p_{EV3} ;
- and further comprises
- (ii.6) admixing one or more of the streams S_{EV3B} obtained according to (ii.5.1) and the stream S_{EV3C} obtained according to (ii.5.2) to the stream S_{EV3A} obtained according to (ii.4), obtaining the stream S_{EV3} .

According to the process of the present invention, it is particularly preferred that the solid material M which is provided according to (i.1) comprises, preferably consists of, a waste material, preferably one or more of a textile waste material and an engineering plastics waste material, more preferably of a textile waste material. Preferably, from 10 to 100 weight-%, more preferably from 30 to 100 weight-%, more preferably from 50 to 100 weight-%, more preferably from 80 to 100 weight-% of the solid material M consist of the polyamide 6. Also preferably, from 10 to 99 weight-%, more preferably from 30 to 98.5 weight-%, more preferably from 50 to 98 weight-%, more preferably from 80 to 98 weight-%, of M consist of the polyamide; if the polyamide 6 content of the solid material M is less than 100 weight-%, it may be preferred that the solid material M additionally comprises one or more further organic polymeric compounds, more preferably including, but not limited to, one or more of at least one elastanes, at least one polyethylene terephthalate, at least one polytetrahydrofuran, at least one polyamide 6.6, at least one polyurethane, at least one polyester, at least one cellulose material, and at least one rubber material comprising one or more of at least one natural rubber material and at least one synthetic rubber material.

Prior to being provided to the process of the present invention, the collected textile waste material can be suitably sorted. In this regard, it is possible to spread the collected textile waste material on a conveyor, which spreading can be carried out either manually and/or mechanically. Thereafter, the respectively spread textile waste material is subjected to sorting, either by composition and/or by color. Sorting can be carried out either manually and/or optically. If carried out optically, the sorting preferably comprises an infrared sorting, more preferably a near-infrared sorting and/or a mid-infrared sorting. Optionally, prior to sorting, the textile waste material can be subjected to a suitable metal removing step. If a metal removing step is carried out, ferrous elements are preferably separated, for example by suitable magnetic means, and/or non-ferrous elements are preferably separated, for example by suitable eddy current separating means. After said sorting, the respectively obtained textile waste material can be subjected to a further treatment, such as cutting and/or milling.

Generally, the solid material M can be provided according to any suitable method. Preferably according to the present invention, providing the solid material M according to (i.1) comprises

- (i.1.1) providing the solid material M in a delivering unit U_{MD} , wherein U_{MD} preferably comprises one or more of at least one big bag station and at least one a bulk container station;
- (i.1.2) passing the solid material M provided according to (i.1.1) via a first connecting line from the unit U_{MD} to a material collecting unit U_{MC} , preferably a collecting drum, wherein the first connecting line preferably comprises one or more of at least one material receiving and discharge unit U_{MRD} , at least one first material feeding unit U_{FMF} , and at least one first particle separation unit U_{FMPS} ;
- (i.1.3) passing the solid material M from the unit U_{MC} via a second connecting line to the unit U_M , wherein the second connecting line preferably comprises one or more of at least one second material feeding unit U_{SMF} , at least one second particle separation unit U_{SMPS} , and at least one metal detector.

Preferably, according to (i.1), the solid material M is provided in the form of granules, wherein the particle size distribution of said granules is preferably characterized by one or more of the following pairs of values, preferably by two or more of the following pairs of values, more

5 preferably by the following three pairs of values:

- a D10 value of the particle width in the range of from 0.1 to 15 mm and a D10 value of the particle length in the range of from 0.3 to 15 mm;
- a D50 value of the particle width in the range of from 0.2 to 20 mm and a D50 value of the particle length in the range of from 0.5 to 20 mm;
- 10 - a D90 value of the particle width in the range of from 0.3 to 30 mm and a D90 value of the particle length in the range of from 0.8 to 30 mm.

As far as the hydrolytic depolymerization according to the present invention is concerned, it is preferred that the pressure p_D is in the range of from 40 to 140 bar, more preferably in the range of from 40 to 125 bar, more preferably in the range of from 40 to 110 bar; and the temperature T_D is in the range of from 230 to 335 °C, more preferably in the range of from 250 to 320 °C, more preferably in the range of from 270 to 310 °C.

Generally, the aqueous depolymerisation mixture can be prepared according to any method comprised by step (i.3). Preferably, preparing the aqueous depolymerization mixture according to (i.3) comprises

- (i.3.1) melting in a melting unit U_M the solid material M provided according to (i.1), obtaining a liquid stream S_M having a temperature T_{SM} at a pressure p_{SM} ;
- (i.3.2) admixing in a pre-reaction unit U_{PR} the stream S_M obtained according to (i.3.1) with the stream S_W provided according to (i.2) and having a temperature T_{SW} at a pressure p_{SW} , obtaining a liquid reaction feed stream S_F having a temperature T_{SF} at a pressure p_{SF} ;
- 25 (i.3.3) feeding the stream S_F obtained according to (i.3.2) as the depolymerization mixture into the chemical reaction unit U_R .

30 As far as this process design is concerned, it is preferred that

$$0.8 \leq T_{SF}/T_D \leq 1.05 \text{ and } 0.9 \leq p_{SF}/p_D \leq 1.05;$$

$$0.6 \leq T_{SM}/T_{SF} \leq 1.2 \text{ and } 0.9 \leq p_{SM}/p_{SF} \leq 1.05; \text{ and}$$

$$0.8 \leq T_{SW}/T_{SF} \leq 1.2 \text{ and } 0.9 \leq p_{SW}/p_{SF} \leq 1.05.$$

35 The pre-reaction unit U_{PR} according to (i.3.2) preferably comprises, more preferably consists of, a mixing unit, preferably a static mixing unit, and wherein the melting unit U_M comprises, preferably consists of an extruder, preferably a single-screw extruder or a twin-screw extruder. Further according to (i.3.2), it is preferred that S_W and S_M are admixed in U_{PR} at a mixing ratio $(m_W/\text{kg}) / (m_P/\text{kg})$ in the range of from 1:1 to 20:1, more preferably in the range of from 2:1 to 40 15:1, more preferably in the range of from 5:1 to 10:1, wherein m_W is the amount of water comprised in S_W and m_P is the amount of polyamide 6 comprised in S_M .

Preferably, the reaction unit U_R according to (i.4) comprises z chemical reactors R_i , $i=1\dots z$,

- wherein z is in the range of from 1 to 10, preferably in the range of from 1 to 8, more preferably in the range of from 1 to 6, more preferably in the range of from 1 to 5, more preferably in the range of from 1 to 4, more preferably in the range of from 1 to 3. If $z > 1$, is preferred that at least 2 reactors R_i , more preferably all z reactors R_i , are serially coupled, wherein
- 5 - the stream S_F is fed into R_i , with $i = 1$;
 - an aqueous liquid stream S_i containing ϵ -caprolactam dissolved in water is removed from reactor R_i and fed into the reactor R_{i+1} , with $i < z$;
 - the aqueous liquid stream S_z containing ϵ -caprolactam dissolved in water is removed from the reactor R_z as the stream S_R ;
- 10 wherein in every reactor R_i , a depolymerization temperature T_{Di} at a depolymerization pressure p_{Di} is maintained, wherein, independently of each other, T_{Di} is in the range of from 230 to 330 °C and p_{Di} is in the range of from 40 to 140 bar, preferably wherein T_{Di} is in the range of from 250 to 320 °C and p_{Di} is in the range of from 40 to 125 bar, more preferably wherein T_{Di} is in the range of from 270 to 310 °C and p_{Di} is in the range of from 40 to 110 bar. For $z > 1$, it is preferred that the
- 15 z reactors R_i are vertically arranged, with R_1 being the top-most reactor and R_z being the bottom-most reactor, wherein S_i obtained from R_i is transferred to R_{i+1} by gravity, preferably by gravity only. More preferably, at least 1, preferably all z reactors R_i , are continuous stirred tank reactors (CSTR). Preferably, every continuous stirred tank reactor R_i has, independently from each other, from 2 to 6 compartments, more preferably from 2 to 5 compartments, more preferably from 2 to
- 20 4 compartments, said compartments preferably being serially, more preferably being serially and vertically arranged, wherein 2 adjacent compartments are separated by a divider which comprises at least one flow-through opening. Preferably at least one compartment comprised in a reactor R_i comprises at least one agitator, wherein more preferably every compartment of every reactor R_i comprises at least one agitator, wherein more preferably, every compartment of every
- 25 reactor R_i comprises one agitator, and the process comprises agitating the depolymerization mixture in a given compartment for at least part of the time during subjecting to depolymerization conditions in said compartment. Preferably, the polyamide 6 depolymerization conditions further comprise a total residence time t_D of the aqueous depolymerization mixture in the unit U_R , preferably in the z reactors R_i , more preferably in the z continuous stirred tank reactors, wherein
- 30 at least 85 weight-%, preferably at least 90 weight-%, more preferably at least 95 weight-% of the aqueous depolymerization mixture have a t_D in the range of from 30 to 90 min. More preferably, the residence time of an aqueous depolymerization mixture in a reactor R_i is t_{Di} and $0.90 \leq (t_{Di} / t_{Di+1}) \leq 1.10$, more preferably $0.95 \leq (t_{Di} / t_{Di+1}) \leq 1.05$.
- 35 If the solid material M comprises one or more elastanes, the aqueous liquid stream S_R obtained from the depolymerization reaction usually contains one or more decomposition products which are formed from the one or more elastanes, for example in the course of the depolymerization reaction in U_R . Additionally or alternatively, one or more decomposition products from the one or more elastanes may also be formed in the melting unit U_M which is described above. By way of
- 40 example, said one or more decomposition products from the one or more elastanes preferably include at least one of aniline, butanediol, butanediol oligomers including, for example, butanediol dimer and butanediol trimer, and 4,4'-methylenedianiline (MDA) and isomers thereof such as 2,4'-methylenedianiline and 2,2'-methylenedianiline.

The process of the present invention is a continuous process, a semicontinuous process or a batch process.

- 5 According to the present invention, and based on the ultimately purified ϵ -caprolactam stream S_{CPL} , a full recycle loop can be realized. In particular, this is due to the excellent color properties and purity of the crystallized ϵ -caprolactam obtained as stream S_{CPL} .

- 10 According to this recycle loop, the stream S_{CPL} is preferably passed to a polyamide 6 production unit, wherein the polyamide 6 produced therein is preferably at least partially provided as a feedstock to a textile material producing unit, wherein the textile material produced in said textile material producing unit is preferably brought onto the market, and wherein, after the life-time of said textile material, it is preferably collected as textile waste material in a textile material collecting unit and preferably suitably provided from said textile material collecting unit to U_R as S_M , preferably via a unit U_{MD} as defined herein. Yet further, it is also possible that in the course of producing the textile material in either the textile material producing unit mentioned above and/or in one or more other production units, remaining material which cannot not be used and which comprises polyamide 6, e.g. in the form of textile cuttings, is obtained; such remaining material is also referred to as "textile waste material" in the context of the present invention, and this textile waste material can also be used as the solid material M or as a part of the solid material M and can be provided to the reaction unit U_R preferably via a unit U_{MD} as defined herein.

- 25 Further to this recycle loop, the stream S_{CPL} may also be preferably passed to a polyamide 6 production unit, wherein the polyamide 6 produced therein is preferably at least partially provided as a feedstock to an engineering plastics producing unit, wherein the engineering plastics produced in said engineering plastics producing unit is preferably brought onto the market, and wherein, after the life-time of said engineering plastics material, it is preferably collected as engineering plastics waste material in an engineering plastics collecting unit and preferably suitably provided from said engineering plastics collecting unit to U_R as S_M , preferably via a unit U_{MD} as defined herein. Yet further, it is also possible that in the course of producing the engineering plastics in either the engineering plastics producing unit mentioned above and/or in one or more other production units, remaining material which cannot not be used and which comprises polyamide 6 is obtained; such remaining material is also referred to as "engineering plastics waste material" in the context of the present invention, and this engineering plastics waste material can also be used as the solid material M or as a part of the solid material M and can be provided to the reaction unit U_R preferably via a unit U_{MD} as defined herein.

- 35 According to a further aspect, the present invention also relates to crystallized ϵ -caprolactam, i.e. the stream S_{CPL} as such, obtainable or obtained by a process as described above.

- 40 Preferably, said crystallized ϵ -caprolactam exhibits an APHA color (sometimes also referred to as Hazen), determined as described Reference Example 1, of at most 5, preferably of at most 4,

more preferably of at most 3, more preferably of at most 2, more preferably of at most 1.5, more preferably of at most 1.

- Preferably, said crystallized ϵ -caprolactam exhibits a purity, determined as described in
5 Reference Example 2, of at least 99.8 weight-%, preferably of at least 99.9 weight-%, more preferably of at least 99.95 weight-%, based on the total weight of S_{CPL} .

It is preferred that the crystallized ϵ -caprolactam obtainable or obtained by the process of the present invention exhibits

- 10 - an ϵ -caprolactam oligomer content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm; and/or
- a 6-aminocaproic acid content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-
15 ppm.

Furthermore, it is preferred that the crystallized ϵ -caprolactam obtainable or obtained by the process of the present invention exhibits

- 20 - a triisopropyl borate content in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm.

- In particular in case the solid material M provided according to (i) comprises one or more
25 elastanes, it is preferred that the crystallized ϵ -caprolactam obtainable or obtained by the process of the present invention exhibits

- a polytetrahydrofuran content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm; and/or
30 - an aniline content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm; and/or
- a methylene diphenyl diamine (MDA), isomers and oligomers content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm; and/or
35 - a butanediol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm; and/or
- an ethylene glycol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-
40 ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm.

In this context of the present invention,

- the term “ ϵ -caprolactam oligomer” encompasses ϵ -caprolactam dimer and higher oligomers, such as ϵ -caprolactam trimer, ϵ -caprolactam tetramer, ϵ -caprolactam pentamer, ϵ -caprolactam hexamer;
- 5 - the term “6-aminocaproic acid” encompasses 6-aminocaproic and oligomers thereof, including 6-aminocaproic acid dimer and higher oligomers such as 6-aminocaproic acid trimer, 6-aminocaproic acid tetramer, 6-aminocaproic acid pentamer, 6-aminocaproic acid hexamer;
- the term “aniline” encompasses aniline as such and further encompasses derivatives
10 thereof, such as aniline containing one or more methyl groups, and/or one or more halogen residues, and/or one or more additional amino groups, and/or one or more benzyl groups, wherein examples of such aniline derivatives may include N-methyl aniline and aminotoulene. Methylene dianiline as described hereinunder is not an aniline derivative according to the present invention:
- 15 - the term “methylene dianiline” encompasses 4,4'-methylenedianiline (MDA) and isomers thereof such as 2,4'-methylenedianiline and 2,2'-methylenedianiline;
- the term “butanediol” encompasses butanediol as such and oligomers thereof, including butanediol dimer and higher oligomers such as butanediol trimer;
- the term “ethylene glycol” encompasses ethylene glycol as such and oligomers thereof,
20 including diethylene glycol and higher oligomers such as triethylene glycol.

In each case, the respective content refers to an individual compound encompassed by the respective general term. For example with respect to the ϵ -caprolactam oligomer content, the term “an ϵ -caprolactam oligomer content in the range of from 0 to 10 weight-ppm” refers to an ϵ -
25 caprolactam dimer content in the range of from 0 to 10 weight-ppm, an ϵ -caprolactam trimer content in the range of from 0 to 10 weight-ppm, an ϵ -caprolactam tetramer content in the range of from 0 to 10 weight-ppm, an ϵ -caprolactam pentamer content in the range of from 0 to 10 weight-ppm, an ϵ -caprolactam hexamer content in the range of from 0 to 10 weight-ppm, etc.

30 According to a further aspect, the present invention also relates to the use of S_{CPL} , obtainable or obtained by a process as described above, for preparing a polymeric material, preferably for preparing polyamide 6, said use preferably further comprising employing said polyamide 6 as a feedstock for preparing one or more of at least one textile material and at least one engineering plastics material, more preferably for preparing at least one textile material.

35 According to a further aspect, the present invention also relates to the use of a process as described above for preparing high-purity ϵ -caprolactam from a solid material M, preferably a waste material comprising polyamide 6 and preferably one or more elastanes, said high-purity ϵ -caprolactam preferably exhibiting one or more of the following properties:

- 40 - an ϵ -caprolactam oligomer content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;

- a 6-aminocaproic acid content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a triisopropyl borate content in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a polytetrahydrofuran content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - an aniline content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a methylenediphenyl diamine (MDA), isomers and oligomers content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a butanediol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm; and/or
 - an ethylene glycol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm.
- According to a further aspect, the present invention relates to the use of S_{CPL}, obtainable or obtained by a process as described above, for preparing one or more of a polymer and a polymer product; or a method for preparing one or more of a polymer and a polymer product, said method comprising employing S_{CPL}, obtainable or obtained by a process as described above, as a starting material. In this respect, it is preferred that the polymer, or the polymer product, or the polymer and the polymer product is or are in the form of at least one of a granulate, a strand, a rod, a plate, a pipe, a foil, a layer, a film, a sheet, a fiber, a filament, a coating, an extruded article, a molded article, a soft foam, a half-rigid foam and a rigid foam. Preferably, the polymer, or the polymer product, or the polymer and the polymer product comprises or comprise polyamide 6 and optionally at least one further polymeric compound, said polyamide 6 being at least partially obtainable or obtained from S_{CPL}, said S_{CPL} being obtainable or obtained by a process as described above, wherein the at least one further polymeric compound preferably comprises one or more of at least one polyamide 6.6, at least one polyethylene terephthalate, at least one polyurethane, at least one polyester, at least one cellulose material, and at least one rubber material comprising one or more of at least one natural rubber material and at least one synthetic rubber material. Further preferably, the polymer, or the polymer product, or the polymer and the polymer product is or are one of the following or a part of one of the following:
- a part of a car, preferably a cylinder head cover, an engine cover, a housing for a charge air cooler, a charge air cooler flap, an intake pipe, an intake manifold, a connector, a gear

- 5 wheel, a fan wheel, a cooling water box, a housing or a housing part for a heat exchanger, a coolant cooler, a charge air cooler, a thermostat, a water pump, a radiator, a fastening part or a part of a battery system for electromobility, a dashboard, a steering column switch, a seat, a headrest, a center console, a transmission component, a door module, a car exterior for an A, a B, a C or a D pillar cover, a spoiler, a door handle, an exterior mirror, a windscreen wiper, a windscreen wiper protection housing, a decorative grill, a cover strip, a roof rail, a window frame, a sunroof frame, an antenna panel, a headlight, a taillight, an airbag, and/or a cushion;
- 10 - a cloth, an apparel, preferably a shirt, trousers, a pullover, a boot, a shoe, a shoe sole, a tight and/or jacket;
- 15 - an electrical part, preferably an electrical component, an electronic passive component, an electronic active component, a printed circuit board, a housing component, a foil, a line, a switch such as a microswitch, a plug, a socket, a distributor, a relay, a resistor, a capacitor, an inductor, a bobbin, a lamp, a diode such as an LED, a transistor, a connector, a regulator, an integrated circuit (IC), a processor, a controller, a memory, a sensor, a microbutton, a semiconductor, a reflector housing for example for light-emitting diodes, a fastener for an electrical and/or an electronic component, a spacer, a bolt, a strip, a slide-in guide, a screw, a nut, a film hinge, a snap hook (snap-in), and/or a spring tongue;
- 20 - a consumer and/or a pharmaceutical product, preferably a tennis string, a climbing rope, a bristle, a brush, an artificial grass, a 3D printing filament, a grass trimmer, a zipper, a hook and loop fastener, a paper machine clothing, an extrusion coating, a fishing line, a fishing net, an offshore line and rope, a vial, a syringe, an ampoule, a bottle, a sliding element, a spindle nut, a chain conveyor, a plain bearing, a roller, a wheel, a gear, a roller, a ring gear, a screw and spring damper, a hose, a pipeline, a cable sheathing, a socket, a switch, a cable tie, a fan wheel, a carpet, a box and/or a bottle for cosmetics, a mattress, a cushion, an insulation;
- 25 - a packaging for the food industry, preferably a mono- and/or multi-layer blown film, a cast film (mono- and/or multi-layer), a biaxially stretched film, a laminating film.
- 30 Preferably according to the use or the method mentioned above, the polymer, or the polymer product, or the polymer and the polymer product contains or contain polyamide 6, obtainable or obtained from S_{CPL} , said S_{CPL} being obtainable or obtained by a process as described above, in an amount of 1 weight-% or more, preferably 2 weight-% or more, more preferably 5 weight-% or more, more preferably 15 weight-% or more, more preferably 30 weight-% or more, more
- 35 preferably 40 weight-% or more, more preferably 60 weight-% or more, more preferably 80 weight-% or more, more preferably 90 weight-% or more, more preferably 95 weight-% or more; and/or in an amount of 100 weight-% or less, preferably 95 weight-% or less, more preferably 90 weight-% or less, more preferably 50 weight-% or less, more preferably 25 weight-% or less, more preferably 10 weight-% or less.
- 40 According to another aspect, the present invention relates to a process as defined herein, comprising the step of converting a chemical material obtainable or obtained by the process as defined herein to obtain a product Ω .

Preferably, the product Ω is selected from:

- building block or monomer; or
- polymer, preferably polymer A, polymer composition, preferably polymer composition A, or
- 5 polymer product, preferably polymer product A; or
- industrial use polymer, industrial use surfactant, descaling compound, industrial use biocide, industrial use solvent, industrial use dispersant, composition thereof or formulation thereof; or
- agrochemical composition, agrochemical formulation auxiliary or agrochemically active
- 10 ingredient; or
- active pharmaceutical ingredient or intermediate thereof, pharmaceutical excipient, animal feed additive, human food additive, dietary supplements, aroma chemical or aroma composition; or
- aqueous polymer dispersion, preferably polyurethane or polyurethane – poly(meth)acrylate
- 15 hybrid polymer dispersion, emulsion, binder for paper and fiber coatings, UV-curable acrylic polymer for hot melts and coatings polyisocyanates, hyperbranched polyester polyol, polymeric dispersant for inorganic binder compositions, unsaturated polyester polyol or 100% curable composition; or
- cosmetic surfactant, emollient, wax, cosmetic polymer, UV filter, further cosmetic ingredient
- 20 or composition or formulation thereof; or
- polymer B, polymer composition B, coating composition, other functional composition, foil, molded body, coating or coated substrate.

- Preferably, the content of the chemical material obtainable or obtained by the process as
- 25 described herein in the product Ω is 1 weight-% or more, preferably 2 weight-% or more, more preferably 5 weight-% or more, more preferably 15 weight-% or more, more preferably 30 weight-% or more, more preferably 40 weight-% or more, more preferably 60 weight-% or more, more preferably 80 weight-% or more, more preferably 90 weight-% or more, more preferably 95 weight-% or more; and/or
- 30 the content of the chemical material obtainable or obtained by the process as described herein in the product Ω is 100 weight-% or less, preferably 95 weight-% or less, more preferably 90 weight-% or less, more preferably 50 weight-% or less, more preferably 25 weight-% or less, more preferably 10 weight-% or less; and preferably wherein the content is determined based on identity preservation and/or segregation and/or mass balance and/or book and claim chain of
- 35 custody models, preferably based on mass balance, preferably the International Sustainability and Carbon Certification (ISCC) standard.

- The publication Prior Art Disclosure; Issue 684; paragraphs [1000] to [8005]; ISSN: 2198-4786; published: February 12, 2024 will be regarded as Reference RF1, which is incorporated herein by
- 40 reference in its entirety. Preferably, the product Ω referred to in the preceding paragraph is a product as described in Reference RF1; paragraphs [1000] to [8005]. Preferably, the process described herein is further a process for the production of a product, preferably product Ω .

The converting step to obtain the product Ω preferably comprises one or more step(s) as described below and can be performed by conventional methods well known to a person skilled in the art. The converting step preferably comprises one or more step(s) selected from: recycling, preferably depolymerizing, gasifying, pyrolyzing, and/or steam cracking; and/or
5 purifying, preferably crystallizing, (solvent) extracting, distilling, evaporating, hydrotreating, absorbing, adsorbing and/or subjecting to ion exchanger; and/or assembling, preferably foaming, synthesizing, chemical conversion, chemically transforming, polymerizing and/or compounding; and/or forming, preferably foaming, extruding and/or molding; and/or
10 finishing, preferably coating and/or smoothing.
In addition, the one or more step(s) are described in detail in Reference RF1; paragraphs [1000] to [8005].

The term “building block”, as used in the context of the product Ω herein, comprises compounds,
15 which are in a gaseous or liquid state under standard conditions of 0°C and 0.1 MPa. Building blocks are typically used in chemical industry to form secondary products, which provide a higher structural complexity and/or higher molecular weight than the building block on which the secondary product is based. The building block is preferably selected from the group consisting of hydrogen, carbon monoxide, carbon dioxide, ethylene oxide, ethylene glycols, syngas
20 comprising a mixture of hydrogen and carbon monoxide, alkanes, alkenes, alkynes and aromatic compounds. The alkanes, alkenes, alkynes and aromatic compounds comprise in particular 1 to 12 carbon atoms, respectively.

The term “monomer”, as used in the context of the product Ω herein, comprises molecules, which
25 can react with each other to form polymer chains by polymerization. The monomer is preferably selected from the group consisting of (meth)acrylic acid, salts of (meth)acrylic acid; in particular sodium, potassium and zinc salts; (meth)acrolein and (meth)acrylates. (Meth)acrylates comprising 1 to 22 carbon atoms are preferred, in particular comprising 1 to 8 carbon atoms. The terms (meth)acrylic acid, (meth)acrolein or (meth)acrylate relate to acrylic acid, acrolein or
30 acrylate and also to methacrylic acid, methacrolein or methacrylate, where applicable. Further, the monomer can be selected from hexamethylenediamine (HMD) and adipic acid.

The building block can further be an intermediate compound. The term “intermediate compound”, as used in the context of the product Ω herein, comprises organic reagents, which are
35 applied for formation of compounds with higher molecular complexity. The intermediate compound can be selected for example from the group consisting of phosgene, polyisocyanates and propylene oxide. The polyisocyanates are in particular aromatic di- and polyisocyanates, preferably toluene diisocyanate (TDI) and/or diphenylmethane diisocyanate (MDI).

40 The building block and the monomer and typical converting step(s) to obtain the building block or monomer are described in more detail in paragraphs [1000] to [1012] of Reference RF1.

The term “polymer A”, as used in the context of the product Ω herein, comprises thermoplastic, e.g., polyamide or thermoplastic polyurethane, thermoset, e.g., polyurethane, elastomer, e.g., polybutadiene, or a copolymer or a mixture thereof and is defined in more detail in paragraphs [2001] to [2007] of Reference RF1.

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The term “polymer composition A”, as used in the context of the product Ω herein, comprises all compositions comprising a polymer as described above and one or more additive(s), e.g. reinforcement, colorant, modifier and/or flame retardant, and is defined in more detail in paragraph [2008] of Reference RF1.

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The term “polymer product A”, as used in the context of the product Ω herein, comprises any product comprising the polymer A and/or polymer composition A as described above and is defined in more detail in paragraphs [2009] and [2010] of Reference RF1.

The step(s) to obtain the polymer, preferably polymer A, polymer composition, preferably polymer composition A or polymer product, preferably polymer product A is/are described in more detail in paragraph [2011] of Reference RF1.

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The term “industrial use polymer”, as used in the context of the product Ω herein, comprises rheology, polycarboxylate, alkoxylated polyalkylenamine, alkoxylated polyalkylenimine, polyether-based, dye inhibition and soil release cleaning polymers defined in more detail in paragraphs [3035] to [3044] of Reference RF1. The term “industrial use surfactant”, as used in the context of the product Ω herein, comprises non-ionic, anionic and amphoteric industrial use surfactants defined in more detail in paragraphs [3008] to [3034] of Reference RF1. The term “industrial use descaling compound”, as used in the context of the product Ω herein, comprises non-phosphate based builders (NPB) and phosphonates (CoP) described in more detail in paragraphs [3001] to [3005] of Reference RF1. The term “industrial use biocide”, as used herein, refers to a chemical compound that kills microorganisms or inhibits their growth or reproduction defined in more detail in paragraphs [3006] to [3007] of Reference RF1. The term “industrial use solvent”, as used in the context of the product Ω herein, comprises alkyl amides, alkyl lactamides, alkyl esters, lactate esters, alkyl diester, cyclic alkyl diester, cyclic carbonates, aromatic aldehydes and aromatic esters defined in more detail in paragraphs [3045] to [3055] of Reference RF1. The term “industrial use dispersant”, as used in the context of the product Ω herein, comprises anionic and non-ionic industrial use dispersants defined in more detail in paragraphs [3056] to [3058] of Reference RF1. The term “composition and/or formulation thereof” with reference to the industrial use polymers, industrial use surfactants, descaling compounds and/or industrial use biocides refers to industrial use compositions and/or institutional use products and/or fabric and home care products and/or personal care products defined in more detail in paragraph [3059] of Reference RF1. The converting step(s) to obtain the industrial use polymer, industrial use surfactant, descaling compound and/or industrial use biocide are defined in more detail in paragraph [3060] of Reference RF1. The converting steps to obtain the industrial use composition or formulation of the industrial use polymer, industrial use surfactant, descaling compound and/or industrial use biocide are defined in more detail in paragraph [3061] of Reference RF1.

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The term “agrochemical composition”, as used in the context of the product Ω herein, typically relates to a composition comprising an agrochemically active ingredient and at least one agrochemical formulation auxiliary. Examples of agrochemical compositions, active ingredients and auxiliaries are described in more detail in Reference RF1, paragraph [4001].

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The agrochemical composition may take the form of any customary formulation. The agrochemical compositions are prepared in a known manner, e.g. described by Mollet and Grubemann, Formulation technology, Wiley VCH, Weinheim, 2001; or Knowles, New developments in crop protection product formulation, Agrow Reports DS243, T&F Informa, London, 2005. The converting step(s) to obtain the agrochemically active ingredients and auxiliaries may be conducted in analogy to the production step(s) of their analogues that are based on petrochemicals or other precursors that are not gained by recycling processes. In addition, conversion to compounds mentioned in sections “Polymer” and “Cosmetic surfactant, emollient, wax, cosmetic polymer, UV filter, further cosmetic ingredient or compositions or formulations thereof” may be performed as described in these sections as well as the respective paragraphs in Reference RF1.

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The term active pharmaceutical ingredients and/or intermediates thereof, as used in the context of the product Ω herein, comprises substances that provide pharmacological activity or other direct effect in the diagnosis, cure, mitigation, treatment, or prevention of disease, or to affect the structure or any function of the body. Intermediates thereof are isolated products that are generated during a multi-step route of synthesis of an active pharmaceutical ingredient. The term pharmaceutical excipients, as used in the context of the product Ω herein, comprises compounds or compound mixtures used in compositions for various pharmaceutical applications, which are not substantially pharmaceutically active on itself. Active pharmaceutical ingredients and/or intermediates thereof and pharmaceutical excipients are defined in more detail in paragraph [5001] of Reference RF1.

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The converting step(s) to obtain the active pharmaceutical ingredients and/or intermediates thereof and pharmaceutical excipients may comprise one or more synthesis steps and can be performed by conventional synthesis and techniques well known to a person skilled in the art.

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The terms animal feed additives, human food additives, dietary supplements, as used in the context of the product Ω herein, comprises Vitamins, Pro-Vitamins and active metabolites thereof including intermediates and precursors, especially Vitamin A, B, E, D, K and esters thereof, like acetate, propionate, palmitate esters or alcohols thereof like retinol or salts thereof and any combinations thereof; Tetraterpenes, especially isoprenoids like carotenoids and xanthophylls including their intermediates and precursors as well as mixtures and derivatives thereof, especially beta carotene, Canthaxanthin, Citranaxanthin, Astaxanthin, Zeaxanthin, Lutein, Lycopene, Apocarotenoids, and any combinations thereof; organic acids, especially formic acid, propionic acid and salts thereof, such as sodium, calcium or ammonium salts, and any combinations thereof, such as but not limited to mixtures of formic acid and sodium formate, propionic acid and ammonium propionate, formic acid and propionic acid, formic acid and sodium formate and propionic acid, propionic acid and sodium propionate and formic acid and sodium formate;

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glycerides of carboxylic acids and short and medium chain fatty acids, conjugated linoleic acids, such as omega-6 fatty acid (C18:2) methyl ester and 1,2-propandiol and beverage stabilizers, such as polyvinylpyrrolidone-polymer or polyvinylimidazole/polyvinylpyrrolidone-copolymer. Animal feed additives, human food additives and dietary supplements are defined in more detail in paragraph [5002] of Reference RF1.

The converting step(s) to obtain the animal feed additives, human food additives, dietary supplements may comprise one or more synthesis steps and can be performed by conventional synthesis and techniques well known to a person skilled in the art.

The terms aroma chemical and aroma composition as used in the context of the product Ω herein, comprise a volatile organic substance with a molecular weight between 70-250 g/mol comprising a functional group with a carbon skeleton of C5-C16 carbon atoms comprising linear, branched, cyclic, for example with a ring size of C5-C18, bicyclic or tricyclic aliphatic chains and but not necessarily one or more unsaturated structural elements like double bonds, triple bonds, aromatics or heteroaromatics and preferably the one or more additional functional groups are selected from alcohol, ether, ester, ketone, aldehyde, acetal, carboxylic acid, nitrile, thiol, amine. In one aspect, the aroma chemical is a terpene-based aroma chemical, for example selected from monoterpenes and monoterpenoids, sesquiterpenes and sesquiterpenoids, diterpenes, triterpenes or tetraterpenes. Aroma chemicals can be combined with further aroma chemicals to give an aroma composition. Aroma chemicals and aroma compositions are defined in more detail in paragraph [5003] of Reference RF1.

The converting step(s) to obtain the aroma chemical and aroma composition may comprise one or more synthesis steps and can be performed by conventional synthesis and techniques well known to a person skilled in the art.

The term "aqueous polymer dispersion", as used in the context of the product Ω herein, comprises aqueous composition(s) comprising dispersed polymer(s) and is defined in more detail in the section [6001] entitled "aqueous polymer dispersion" of Reference RF1. The dispersed polymer(s) may be selected from acrylic emulsion polymer(s), styrene acrylic emulsion polymer(s), styrene butadiene dispersion(s), aqueous dispersion(s) comprising composite particles, acrylate alkyd hybrid dispersion(s), polyurethane(s) (including UV-curable polyurethanes) and polyurethane - poly(meth)acrylate hybrid polymer(s). The term "emulsion polymer", as used herein, comprises polymer(s) made by free-radical emulsion polymerization. Aqueous polyurethane dispersion(s) are defined in more detail in the section [6002] entitled "Polyurethane dispersions" of Reference RF1. UV-curable polyurethane(s) is/are defined in more detail in the section [6017] of Reference RF1. Polyurethane - poly(meth)acrylate hybrid polymer(s) is/are defined in more detail in the section [6016] of Reference RF1.

The term "polymeric dispersant", as used in the context of the product Ω herein, comprises preferably polymer(s) comprising polyether side chain, in particular polycarboxylate ether

polymer(s) and polycondensation product(s) defined in more detail in paragraph [6020] entitled "Polymeric dispersant" of Reference RF1.

5 The converting (polymerization) step(s) to obtain the aqueous polymer dispersion(s) comprising emulsion polymer(s) is/are defined in more detail in the section [6003] entitled "Emulsion polymerization" of Reference RF1.

10 The converting (polymerization) step(s) to obtain the aqueous polyurethane dispersion(s) is/are defined in more detail in the section [6014] entitled "Process for the preparation of aqueous polyurethane dispersions" and section [6017]) entitled "Aqueous UV-curable polyurethane dispersions, their preparation and use and compositions containing them" of Reference RF1.

Composition(s) and uses of aqueous polymer dispersion(s) and of polymeric dispersant(s) are defined in more detail in the following sections of Reference RF1:

15 section [6004] entitled "Uses of aqueous polymer dispersions",
section [6005] entitled "Binders for architectural and construction coatings"
section [6006] entitled "Binders for paper coating"
section [6007] entitled "Binders for fiber bonding"
section [6008] entitled "Adhesive polymers and adhesive compositions"

20 section [6015] entitled "Aqueous polyurethane dispersions suitable for use in coating compositions"
section [6016] entitled "Aqueous polyurethane - poly(meth)acrylate hybride polymer dispersions suitable for use in coating compositions"
section [6017] entitled "Aqueous UV-curable polyurethane dispersions, their preparation and use

25 and compositions containing them"
section [6018] entitled "Inorganic binder compositions comprising polymeric dispersants and their use" [6019] 100% curable coating compositions

30 UV-crosslinkable poly(meth)acrylate(s) and its/their uses are defined in more detail in section [6009] entitled "UV-crosslinkable poly(meth)acrylates for use in UV-curable solvent-free hot melt adhesives and their use for making pressure-sensitive self-adhesive articles" of Reference RF1.

Polyisocyanate(s), composition(s) comprising them and their uses are defined in more detail in section [6010] entitled "Polyisocyanates" of Reference RF1.

35 Hyperbranched polyester polyol(s) and its/their uses are defined in more detail in section [6011] entitled "Organic solvent based hyperbranched polyester polyols suitable for use in coating compositions" of Reference RF1. The converting step(s) to obtain the hyperbranched polyester polyols is/are defined in more detail in the section [6012] entitled "Preparation of organic solvent based hyperbranched polyester polyols" of Reference RF1. Coating composition(s) comprising

40 hyperbranched polyester polyol(s), polyisocyanate(s) and additive(s) and substrate(s) coated therewith are defined in more detail in section [6013] entitled "Organic solvent based two

component coating compositions comprising hyperbranched polyester polyols and polyisocyanates” of Reference RF1.

5 Unsaturated polyester polyol(s), solvent-based coating composition(s) comprising said unsaturated polyester polyol(s) and substrate(s) for coating with said coating composition(s) are defined in more detail in section [6018] entitled “Organic solvent based coating composition comprising unsaturated polyester polyols” of Reference RF1.
100% curable coating composition(s) is/are defined in more detail in section [6019] of Reference RF1.

10 Polymeric dispersant(s) for inorganic binder compositions is/are defined in more detail in section [6020] of Reference RF1. The inorganic binder composition(s) comprising the polymeric dispersants and their use are defined in more detail in section [6021] of Reference RF1. The converting step(s) to obtain the polymeric dispersant(s) are defined in more detail in section
15 [6020] of Reference RF1. The term “inorganic binder composition” comprising the polymeric dispersant(s), as used herein, comprises preferably in particular hydraulically setting compositions and compositions comprising calcium sulfate and is defined in more detail in section [6021] of Reference RF1 entitled “Inorganic binder compositions comprising the polymeric dispersant and their use”. Specific building material formulation(s) comprising polymeric
20 dispersant(s) or building product(s) produced by a building material formulation comprising a polymeric dispersant are disclosed in more detail in section [6021] of Reference RF1.

The term “cosmetic surfactant”, as used in the context of the product Ω herein, comprises non-ionic, anionic, cationic and amphoteric surfactants and is defined in more detail in paragraph
25 [7002] of Reference RF1. The term “emollient”, as used in the context of the product Ω herein, refers to a chemical compound used for protecting, moisturizing, and/or lubricating the skin and is defined in more detail in paragraph [7003] of Reference RF1. The term “wax”, as used in the context of the product Ω herein, comprises pearlzers and opacifiers and is defined in more detail in paragraph [7004] of Reference RF1. The term “cosmetic polymer”, as used in the context of
30 the product Ω herein, comprises any polymer that can be used as an ingredient in a cosmetic formulation and is defined in more detail in paragraph [7005] of Reference RF1. The term “UV filter”, as used in the context of the product Ω herein, refers to a chemical compound that blocks or absorbs ultraviolet light and is defined in more detail in paragraph [7006] of Reference RF1. The term “further cosmetic ingredient”, as used in the context of the product Ω herein, comprises
35 any ingredient suitable for making a cosmetic formulation. Several sources disclose cosmetically acceptable ingredients. E. g. the database Cosing on the internet pages of the European Commission discloses cosmetic ingredients and the International Cosmetic Ingredient Dictionary and Handbook, edited by the Personal Care Products Council (PCPC), discloses cosmetic ingredients. The term “composition and/or formulation thereof” with reference to the cosmetic
40 surfactant, emollient, wax, cosmetic polymer, UV filter and/or further cosmetic ingredient refers to personal care and/or cosmetic compositions or formulations defined in more detail in paragraph [7007] of Reference RF1. The converting step(s) to obtain the cosmetic surfactant, emollient,

wax, cosmetic polymer, UV filter or further cosmetic ingredient is/are defined in more detail in paragraph [7008] of Reference RF1.

5 The terms “polymer B”, “polymer composition B”, “coating composition”, “other functional composition”, “foil”, “molded body”, “coating” and “coated substrate” are well known to the person skilled in the art and are defined in more detail from paragraph [8000] to [8005] of Reference RF1.

10 The present invention is further illustrated by the following set of embodiments and combinations of embodiments resulting from the dependencies and back-references as indicated. In particular, it is noted that in each instance where a range of embodiments is mentioned, for example in the context of a term such as “The process of any one of embodiments 1 to 4”, every embodiment in this range is meant to be explicitly disclosed for the skilled person, i.e. the wording of this term is to be understood by the skilled person as being synonymous to “The process of any one of
15 embodiments 1, 2, 3 and 4”. Further, it is explicitly noted that the following set of embodiments represents a suitably structured part of the general description directed to preferred aspects of the present invention, and, thus, suitably supports, but does not represent the claims of the present invention.

- 20 1. A process for preparing purified ϵ -caprolactam from polyamide 6 comprised in a solid material M, the process comprising
- (i) preparing an aqueous liquid stream S_R comprising ϵ -caprolactam dissolved in water, comprising
 - (i.1) providing the solid material M comprising polyamide 6;
 - 25 (i.2) preparing an aqueous liquid stream S_W exhibiting a water mass flow μ_W , the stream S_W comprising an aqueous recycle stream S_{WR} exhibiting a water mass flow μ_{WR} and an aqueous makeup stream S_{WF} exhibiting a water mass flow μ_{WF} , wherein $\mu_{WR} + \mu_{WF} = \mu_W$;
 - (i.3) preparing an aqueous depolymerization mixture based on the solid material M provided according to (i.1) and the aqueous liquid stream S_W provided according to (i.2);
 - 30 (i.4) subjecting in a chemical reaction unit U_R the aqueous depolymerization mixture prepared according to (i.3) to depolymerization conditions comprising a depolymerization temperature T_D at a depolymerization pressure p_D , obtaining in U_R a liquid aqueous reaction mixture M_R comprising ϵ -caprolactam dissolved in water;
 - 35 (i.5) removing from U_R the aqueous liquid stream S_R exhibiting a water mass flow μ_R ;
 - (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E at least one aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$;
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- (iii) reprocessing the stream S_L obtained according to (ii) in a heat-consuming purification and recycle unit U_{PR} , the reprocessing comprising
- (iii.1) subjecting the aqueous liquid stream S_L to ϵ -caprolactam purification in the unit U_{PR} , obtaining from U_{PR} a stream S_{CPL} comprising purified ϵ -caprolactam, and further obtaining from U_{PR} at least one separated aqueous stream S_{WS} exhibiting a total water mass flow μ_{WS} ;
- (iii.2) providing at least part of the heat consumed in U_{PR} by the at least one aqueous vapor stream S_{EV} obtained according to (ii), obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL} exhibiting a total water mass flow μ_{EL} ;
- (iii.3) recycling the at least one aqueous stream S_{WS} obtained according to (iii.1) and the at least one aqueous stream S_{EL} obtained according to (iii.2) as aqueous recycle stream S_{WR} to (i.2), wherein $\mu_{WS} + \mu_{EL} = \mu_{WR}$;
- wherein
- μ_{EV} / μ_L is in the range of from 0.50 to 0.9;
- μ_{WR} / μ_W is in the range of from 0.02 to 0.3.
2. The process of embodiment 1, wherein μ_{EV} / μ_L is in the range of from 0.5 to 0.8, preferably in the range of from 0.5 to 0.7, more preferably in the range of from 0.5 to 0.65.
 3. The process of embodiment 1 or 2, wherein μ_{WR} / μ_W is in the range of from 0.03 to 0.3, preferably in the range of from 0.04 to 0.25 more preferably in the range of from 0.05 to 0.2.
 4. The process of any one of embodiments 1 to 3, wherein μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9, preferably in the range of from 0.6 to 0.85, more preferably in the range of from 0.65 to 0.8.
 5. The process of any one of embodiments 1 to 4, wherein the stream S_R obtained according to (i.5) exhibits an ϵ -caprolactam concentration c_{SR} , the stream S_L obtained according to (ii) exhibits an ϵ -caprolactam concentration c_{SL} , and the stream S_{CPL} obtained according to (iii.1) exhibits an ϵ -caprolactam concentration c_{SCPL} , with $c_{SCPL} \gg c_{SL} > c_{SR}$.
 6. The process of any one of embodiments 1 to 5, preferably of embodiment 5, wherein the heat-consuming purification and recycle unit U_{PR} comprises a heat-consuming water separation unit U_{WS} comprising two heat-consuming water separation sub-units $U_{WS}(1)$ and $U_{WS}(2)$.
 7. The process of embodiment 6, wherein (iii.1) comprises subjecting the aqueous liquid stream S_L to water separation in $U_{WS}(1)$, obtaining a separated aqueous stream $S_{WS}(1)$ and an aqueous stream S_{UWS1} exhibiting an ϵ -caprolactam concentration c_{SUWS1} with $c_{SUWS1} > c_{SL}$, and further comprises subjecting the aqueous stream S_{UWS1} , optionally after an intermediate treatment in a high boiler separation unit U_{HS} , to further water separation in

$U_{WS}(2)$, obtaining a separated aqueous stream $S_{WS}(2)$ and an aqueous stream S_{UWS2} exhibiting an ϵ -caprolactam concentration c_{SUWS2} with $c_{SUWS2} > c_{SUWS1}$.

- 5 8. The process of embodiment 7, wherein the stream $S_{WS}(1)$ exhibits a water mass flow μ_{WS1} and the stream $S_{WS}(2)$ exhibits a water mass flow μ_{WS2} , wherein $\mu_{WS1} + \mu_{WS2} = \mu_{WS}$ and wherein μ_{WS1} / μ_{WS2} is preferably in the range of from 10 to 32.5, more preferably in the range of from 11 to 30, more preferably in the range of from 12 to 27.5.
- 10 9. The process of embodiment 7 or 8, wherein at least part of the heat consumed in the unit $U_{WS}(1)$ is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii).
- 15 10. The process of embodiment 9, wherein the at least one aqueous vapor stream S_{EV} has a pressure in the range of from 0.95 to 1.5 bar, preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and a temperature in the range of from 90 to 140 °C, preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C.
- 20 11. The process of any one of embodiments 8 to 10, wherein at least part of the heat consumed in the unit $U_{WS}(2)$ is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii).
- 25 12. The process of embodiment 11, wherein the at least one aqueous vapor stream S_{EV} has a pressure in the range of from 5 to 11 bar, preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and a temperature in the range of from 150 to 210 °C, preferably in the range of from 160 to 200 °C, more preferably in the range of from 170 to 190 °C.
- 30 13. The process of any one of embodiments 6 to 12, wherein the sub-unit $U_{WS}(1)$ comprises one or more of a falling film evaporator, a flash tank, a forced circulation evaporator, and a distillation column, preferably one or more of a falling film evaporator and a flash tank, more preferably a falling film evaporator and a flash tank, and wherein the sub-unit $U_{WS}(2)$ comprises one or more of a falling film evaporator, a flash tank and a distillation column, preferably a distillation column.
- 35 14. The process of any one of embodiments 6 to 13, wherein the heat-consuming purification and recycle unit U_{PR} further comprises one or more of a heat-consuming water distillation unit U_{DI} and a heat consuming crystallization unit U_{CR} , preferably a heat-consuming water distillation unit U_{DI} and a heat-consuming crystallization unit U_{CR} .
- 40 15. The process of embodiment 14, wherein (iii.1) further comprises subjecting the aqueous liquid stream S_{UWS2} to distillation in U_{DI} , obtaining a stream S_{UDI} exhibiting an ϵ -caprolactam concentration c_{SUDI} with $c_{SUDI} > c_{SUWS1}$, and further comprises subjecting the aqueous

stream S_{UDI} to crystallization in U_{CR} , obtaining from U_{CR} the stream S_{CPL} exhibiting an ϵ -caprolactam concentration C_{SCPL} with $C_{SCPL} > C_{SUDI}$.

- 5 16. The process of embodiment 14 or 15, wherein at least part of the heat consumed in the unit U_{DI} is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii).
- 10 17. The process of embodiment 16, wherein the at least one aqueous vapor stream S_{EV} has a pressure in the range of from 5 to 11 bar, preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and a temperature in the range of from 150 to 210 °C, preferably in the range of from 160 to 200 °C, more preferably in the range of from 170 to 190 °C.
- 15 18. The process of any one of embodiments 14 to 17, wherein at least part of the heat consumed in the unit U_{CR} is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii).
- 20 19. The process of embodiment 18, wherein the at least one aqueous vapor stream S_{EV} has a pressure in the range of from 0.95 to 1.5 bar, preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and a temperature in the range of from 90 to 140 °C, preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C.
- 25 20. The process of any one of embodiments 6 to 19, wherein the heat-consuming purification and recycle unit U_{PR} further comprises at least one heat-consuming heating unit U_H .
- 30 21. The process of embodiment 20, wherein recycling according to (iii.3) further comprises passing one or more of the at least one stream S_{WS} and the at least one stream S_{EL} and the stream S_{WF} , or one or more combined streams thereof, through the at least one heating unit U_H , obtaining a respectively heated stream or heated streams.
- 35 22. The process of embodiment 20 or 21, wherein at least part of the heat consumed in at least one of the units U_H is provided by at least one aqueous vapor stream S_{EV} obtained according to (ii).
- 40 23. The process of any one of embodiments 20 to 22, wherein the stream S_{WF} is passed through a unit $U_H(2)$, obtaining a heated stream S_{WF} , wherein at least part of the heat consumed in $U_H(2)$ is provided by an aqueous vapor stream S_{EV} obtained according to (ii).
24. The process of embodiment 23, wherein the vapor stream S_{EV} has a pressure in the range of from 0.95 to 1.5 bar, preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and a temperature in the range of from 90 to 140 °C, preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C.

25. The process of any one of embodiments 20 to 24, wherein a combined stream of the at least one stream S_{WS} and the at least one stream S_{EL} is passed through a unit $U_H(1)$, obtaining a heated combined stream, wherein at least part of the heat consumed in $U_H(1)$ is provided by an aqueous vapor stream S_{EV} obtained according to (ii).
26. The process of embodiment 25, wherein the vapor stream S_{EV} has a pressure in the range of from 13 to 19 bar, preferably in the range of from 14 to 18 bar, more preferably in the range of from 15 to 17 bar; and a temperature in the range of from 170 to 230 °C, preferably in the range of from 180 to 220 °C, more preferably in the range of from 190 to 210 °C.
27. The process of embodiment 25 or 26 insofar as embodiments 25 and 26 are dependent on embodiment 24, wherein the combined stream passed through the unit $U_H(1)$ further comprises the heated stream S_{WF} obtained as defined in embodiment 24.
28. The process of any one of embodiments 1 to 27, wherein (ii) comprises
- (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E three aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$, wherein a first stream S_{EV1} has a pressure p_{EV1} and a temperature T_{EV1} , a second stream S_{EV2} has a pressure p_{EV2} and a temperature T_{EV2} , and a third stream S_{EV3} has a pressure p_{EV3} and a temperature T_{EV3} , wherein $p_{EV1} > p_{EV2} > p_{EV3}$;
- wherein
- p_{EV1} is preferably in the range of from 13 to 19 bar, more preferably in the range of from 14 to 18 bar, more preferably in the range of from 15 to 17 bar; and T_{EV1} is preferably in the range of from 170 to 230 °C, more preferably in the range of from 180 to 220 °C, more preferably in the range of from 190 to 210 °C;
 - p_{EV2} is preferably in the range of from 5 to 11 bar, more preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and T_{EV2} is preferably in the range of from 150 to 210 °C, more preferably in the range of from 160 to 200 °C, more preferably in the range of from 170 to 190 °C;
 - p_{EV3} is preferably in the range of from 0.95 to 1.5 bar, more preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and T_{EV3} is preferably in the range of from 90 to 140 °C, more preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C;
- wherein the stream S_{EV1} exhibits a mass flow μ_{EV1} , the stream S_{EV2} exhibits a mass flow μ_{EV2} and the stream S_{EV3} exhibits a mass flow μ_{EV3} , wherein $\mu_{EV1} + \mu_{EV2} + \mu_{EV3} = \mu_{EV}$.
29. The process of embodiment 28, wherein

- μ_{EV1} / μ_{EV} is in the range of from 0.01 to 0.55, preferably in the range of from 0.02 to 0.5, more preferably in the range of from 0.03 to 0.45;
- μ_{EV2} / μ_{EV} is in the range of from 0.1 to 0.75, preferably in the range of from 0.15 to 0.7, more preferably in the range of from 0.2 to 0.65;
- 5 μ_{EV3} / μ_{EV} is in the range of from 0.2 to 0.55, preferably in the range of from 0.25 to 0.45, more preferably in the range of from 0.3 to 0.4.
30. The process of embodiment 28 or 29, wherein (iii.2) comprises
- 10 (iii.2) providing at least part of the heat consumed in U_{PR} by the streams S_{EV1} , S_{EV2} and S_{EV3} obtained according to (ii) or one or more part streams thereof, obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL1} , at least one at least partially condensed aqueous stream S_{EL2} and at least one at least partially condensed aqueous stream S_{EL3} , said at least one at least partially condensed aqueous stream S_{EL1} , said at least one at least partially condensed aqueous stream S_{EL2} and said at least one at least partially condensed aqueous stream S_{EL2} together exhibiting a total water mass flow μ_{EL} .
- 15
31. The process of embodiment 30, wherein the reprocessing according to (iii) comprises
- 20 (iii.1) subjecting the aqueous liquid stream S_L to ϵ -caprolactam purification in the unit U_{PR} , obtaining from U_{PR} a stream S_{CPL} comprising purified ϵ -caprolactam, and further obtaining from U_{PR} at least one separated aqueous stream S_{WS} exhibiting a total water mass flow μ_{WS} , comprising
- (iii.1.1) subjecting the aqueous liquid stream S_L to water separation in a first water separation unit $U_{WS}(1)$, obtaining a separated aqueous stream $S_{WS}(1)$ and an aqueous stream S_{UWS1} exhibiting an ϵ -caprolactam concentration C_{SUWS1} with $C_{SUWS1} > C_{SL}$, and further comprises subjecting the aqueous stream S_{UWS1} , optionally after an intermediate treatment in a high boiler separation unit U_{HS} , to further water separation in a second water separation unit $U_{WS}(2)$, obtaining a separated aqueous stream $S_{WS}(2)$ and an aqueous stream S_{UWS2} exhibiting an ϵ -caprolactam concentration C_{SUWS2} with $C_{SUWS2} > C_{SUWS1}$;
- 25
- 30 (iii.1.2) subjecting the aqueous liquid stream S_{UWS2} to distillation in a distillation unit U_{DI} , obtaining a stream S_{UDI} exhibiting an ϵ -caprolactam concentration C_{SUDI} with $C_{SUDI} > C_{SUWS1}$, and further comprises subjecting the aqueous stream S_{UDI} to crystallization in a crystallization unit U_{CR} , obtaining from U_{CR} the stream S_{CPL} exhibiting an ϵ -caprolactam concentration C_{SCPL} with $C_{SCPL} > C_{SUDI}$;
- 35
- (iii.2) providing at least part of the heat consumed in U_{PR} by the streams S_{EV1} , S_{EV2} and S_{EV3} obtained according to (ii) or one or more part streams thereof, obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL1} , at least one at least partially condensed aqueous stream S_{EL2} and at least one at least partially condensed aqueous stream S_{EL3} , said at least one at least partially condensed aqueous stream S_{EL1} , said at least one at least partially condensed aqueous stream S_{EL2} and said at least one at least partially condensed aqueous stream S_{EL2} together exhibiting a total water mass flow μ_{EL} , said providing comprising
- 40

- (iii.2.1) providing at least part of the heat consumed in $U_{WS}(1)$ by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- 5 (iii.2.2) providing at least part of the heat consumed in $U_{WS}(2)$ by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} ;
- (iii.2.3) providing at least part of the heat consumed in U_{DI} by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} ;
- 10 (iii.2.4) providing at least part of the heat consumed in U_{CR} by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- (iii.2.5) providing at least part of the heat consumed in $U_H(1)$ as defined in (iii.3) by at least one part stream of the stream S_{EV1} , obtaining at least one at least partially condensed stream S_{EL1} , each having a pressure p_{EL1} and a temperature T_{EL1} ;
- 15 (iii.2.6) providing at least part of the heat consumed in $U_H(2)$ as defined in (iii.3) by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- 20 (iii.3) recycling the aqueous stream $S_{WS}(1)$, the aqueous stream $S_{WS}(2)$ obtained according to (iii.1.1) and the aqueous streams S_{EL1} , S_{EL2} , S_{EL2} obtained according to (iii.2) as aqueous recycle stream S_{WR} to (i.2), wherein $\mu_{WS} + \mu_{EL} = \mu_{WR}$.
- 25 32. The process of embodiment 31, comprising
- (iii.2.1) providing at least part of the heat consumed in $U_{WS}(1)$ by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{WS1})$;
- 30 (iii.2.2) providing at least part of the heat consumed in $U_{WS}(2)$ by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} , said at least one part stream of the stream S_{EV2} exhibiting a total mass flow $\mu_{EV2}(U_{WS2})$;
- (iii.2.3) providing at least part of the heat consumed in U_{DI} by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} , said at least one part stream of the stream S_{EV2} exhibiting a total mass flow $\mu_{EV2}(U_{DI})$;
- 35 (iii.2.4) providing at least part of the heat consumed in U_{CR} by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{CR})$;
- 40 (iii.2.5) providing at least part of the heat consumed in $U_H(1)$ as defined in (iii.3) by at least one part stream of the stream S_{EV1} , obtaining at least one at least partially

- condensed stream S_{EL1} , each having a pressure p_{EL1} and a temperature T_{EL1} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV1}(U_{H1})$;
- (iii.2.6) providing at least part of the heat consumed in $U_H(2)$ as defined in (iii.3) by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{H2})$;

wherein

$\mu_{EV1}(U_{H1}) / \mu_{EV1}$ is in the range of from 0.85 to 1, preferably in the range of from 0.9 to 1, more preferably in the range of from 0.95 to 1;

$\mu_{EV2}(U_{WS2}) / \mu_{EV2}$ is in the range of from 0.03 to 0.2, preferably in the range of from 0.04 to 0.15, more preferably in the range of from 0.05 to 0.1;

$\mu_{EV2}(U_{DI}) / \mu_{EV2}$ is in the range of from 0.8 to 0.97, preferably in the range of from 0.85 to 0.96, more preferably in the range of from 0.9 to 0.95;

$\mu_{EV3}(U_{WS1}) / \mu_{EV3}$ is in the range of from 0.1 to 0.9, preferably in the range of from 0.2 to 0.85, more preferably in the range of from 0.3 to 0.8;

$\mu_{EV3}(U_{CR}) / \mu_{EV3}$ is in the range of from 0.1 to 0.9, preferably in the range of from 0.2 to 0.85, more preferably in the range of from 0.3 to 0.8;

$\mu_{EV3}(U_{H2}) / \mu_{E3}$ is in the range of from 0.01 to 0.04, preferably in the range of from 0.01 to 0.03, more preferably in the range of from 0.01 to 0.02.

33. The process of embodiment 31 or 32, wherein

- $0.95 p_{EV1} \leq p_{EL1} \leq p_{EV1}$; and

$\Delta T_{VL1} = T_{EV1} - T_{EL1}$ is in the range of from 2 to 10 °C, preferably in the range of from 3 to 8 °C, more preferably in the range of from 4 to 6 °C;

- $0.95 p_{EV2} \leq p_{EL2} \leq p_{EV2}$; and

$\Delta T_{VL2} = T_{EV2} - T_{EL2}$ is in the range of from 15 to 40 °C, preferably in the range of from 18 to 32 °C, more preferably in the range of from 20 to 30 °C;

- $0.95 p_{EV3} \leq p_{EL3} \leq p_{EV3}$; and

$\Delta T_{VL3} = T_{EV3} - T_{EL3}$ is in the range of from 10 to 30 °C, preferably in the range of from 12.5 to 27.5 °C, more preferably in the range of from 15 to 25 °C.

34. The process of any one of embodiments 28 to 33, wherein (ii) comprises

(ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E three aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$, wherein a first stream S_{EV1} has a pressure p_{EV1} and a temperature T_{EV1} , a second stream S_{EV2} has a pressure p_{EV2} and a temperature T_{EV2} , and a third stream S_{EV3} has a pressure p_{EV3} and a temperature T_{EV3} , wherein $p_{EV1} > p_{EV2} > p_{EV3}$, wherein obtaining from U_E three aqueous vapor stream S_{EV} comprises

(ii.1) subjecting the liquid aqueous stream S_R obtained according to (i.5) to depressurization in a first evaporation sub-unit U_{E1} , obtaining from U_{E1} an

- aqueous vapor stream S_{EV1A} having the pressure p_{EV1} , and further obtaining an at least partially aqueous liquid stream S_{LU1} ;
- (ii.2) dividing the stream S_{EV1A} , obtaining the stream S_{EV1} and a stream S_{EV1B} having the pressure p_{EV1} ;
- 5 (ii.3) subjecting the stream S_{EV1B} to depressurization in a unit U_{V1} , U_{V1} preferably comprising a valve, more preferably a pressure relief valve, obtaining the stream S_{EV2} ;
- (ii.4) subjecting the stream S_{LU1} obtained according to (ii.1) to depressurization in a second evaporation sub-unit U_{E2} , obtaining from U_{E2} an aqueous vapor stream S_{EV3A} and the liquid stream S_L , wherein the aqueous vapor stream S_{EV3A} is the aqueous vapor stream S_{EV3} .
- 10
35. The process of embodiment 34, wherein obtaining the stream S_{EV3} further comprises one or more of (ii.5.1) and (ii.5.2):
- 15 (ii.5.1) separating a stream S_{EV1C} from the stream S_{EV1A} , obtained according to (ii.1), the stream S_{EV1C} having the pressure p_{EV1} ; subjecting the stream S_{EV1C} to depressurization in a unit U_{V2} , U_{V2} preferably comprising a valve, more preferably a pressure relief valve, obtaining a stream S_{EV3B} having the pressure p_{EV3} ;
- 20 (ii.5.2) separating a stream S_{EV2A} from the stream S_{EV2} obtained according to (ii.3), the stream S_{EV2A} having the pressure p_{EV2} ; subjecting the stream S_{EV2A} to depressurization in a unit U_{V3} , U_{V3} preferably comprising a valve, more preferably a pressure relief valve, obtaining a stream S_{EV3C} having the pressure p_{EV3} ;
- and further comprises
- (ii.6) admixing one or more of the streams S_{EV3B} obtained according to (ii.5.1) and the stream S_{EV3C} obtained according to (ii.5.2) to the stream S_{EV3A} obtained according to (ii.4), obtaining the stream S_{EV3} .
- 25
36. The process of any one of embodiments 1 to 35, wherein the solid material M provided according to (i.1) comprises, preferably consists of, a waste material, preferably one or more of a textile waste material and an engineering plastics waste material, more preferably of a textile waste material.
- 30
37. The process of any one of embodiments 1 to 36, wherein from 10 to 100 weight-%, preferably from 30 to 100 weight-%, more preferably from 50 to 100 weight-%, more preferably from 80 to 100 weight-%, of the solid material M consist of the polyamide 6.
- 35
38. The process of any one of embodiments 1 to 37, wherein providing the solid material M according to (i.1) comprises
- (i.1.1) providing the solid material M in a delivering unit U_{MD} , wherein U_{MD} preferably comprises one or more of at least one big bag station and at least one a bulk container station;
- 40 (i.1.2) passing the solid material M provided according to (i.1.1) via a first connecting line from the unit U_{MD} to a material collecting unit U_{MC} , preferably a collecting drum,

- wherein the first connecting line preferably comprises one or more of at least one material receiving and discharge unit U_{MRD} , at least one first material feeding unit U_{FMF} , and at least one first particle separation unit U_{FMPS} ;
- 5 (i.1.3) passing the solid material M from the unit U_{MC} via a second connecting line to the unit U_M , wherein the second connecting line preferably comprises one or more of at least one second material feeding unit U_{SMF} , at least one second particle separation unit U_{SMPS} , and at least one metal detector.
- 10 39. The process of any one of embodiments 1 to 38, wherein according to (i.1), the solid material M is provided in the form of granules, wherein the particle size distribution of said granules is preferably characterized by one or more of the following pairs of values, preferably by two or more of the following pairs of values, more preferably by the following three pairs of values:
- 15 - a D10 value of the particle width in the range of from 0.1 to 15 mm and a D10 value of the particle length in the range of from 0.3 to 15 mm;
- a D50 value of the particle width in the range of from 0.2 to 20 mm and a D50 value of the particle length in the range of from 0.5 to 20 mm;
- 20 - a D90 value of the particle width in the range of from 0.3 to 30 mm and a D90 value of the particle length in the range of from 0.8 to 30 mm.
40. The process of any one of embodiments 1 to 39, wherein p_D is in the range of from 40 to 140 bar, preferably in the range of from 40 to 125 bar, more preferably in the range of from 40 to 110 bar; and T_D is in the range of from 230 to 335 °C, preferably in the range of from 250 to 320 °C, more preferably in the range of from 270 to 310 °C.
- 25 41. The process of any one of embodiments 1 to 40, wherein preparing the aqueous depolymerization mixture according to (i.3) comprises
- (i.3.1) melting in a melting unit U_M the solid material M provided according to (i.1), obtaining a liquid stream S_M having a temperature T_{SM} at a pressure p_{SM} ;
- 30 (i.3.2) admixing in a pre-reaction unit U_{PR} the stream S_M obtained according to (i.3.1) with the stream S_W provided according to (i.2) and having a temperature T_{SW} at a pressure p_{SW} , obtaining a liquid reaction feed stream S_F having a temperature T_{SF} at a pressure p_{SF} ;
- 35 (i.3.3) feeding the stream S_F obtained according to (i.3.2) as the depolymerization mixture into the chemical reaction unit U_R ;
- wherein
- $0.8 \leq T_{SF}/T_D \leq 1.05$ and $0.9 \leq p_{SF}/p_D \leq 1.05$;
- $0.6 \leq T_{SM}/T_{SF} \leq 1.2$ and $0.9 \leq p_{SM}/p_{SF} \leq 1.05$; and
- 40 $0.8 \leq T_{SW}/T_{SF} \leq 1.2$ and $0.9 \leq p_{SW}/p_{SF} \leq 1.05$.
42. The process of embodiment 41, wherein the pre-reaction unit U_{PR} according to (i.3.2) comprises, preferably consists of, a mixing unit, preferably a static mixing unit, and wherein

the melting unit U_M comprises, preferably consists of an extruder, preferably a single-screw extruder or a twin-screw extruder.

43. The process of embodiment 41 or 42, wherein according to (i.3.2), S_W and S_M are admixed in U_{PR} at a mixing ratio $(m_W/kg) / (m_P/kg)$ in the range of from 1:1 to 20:1, preferably in the range of from 2:1 to 15:1, more preferably in the range of from 5:1 to 10:1, wherein m_W is the amount of water comprised in S_W and m_P is the amount of polyamide 6 comprised in S_M .
44. The process of any one of embodiments 1 to 43, wherein the reaction unit U_R according to (i.4) comprises z chemical reactors R_i , $i=1\dots z$, wherein z is in the range of from 1 to 10, preferably in the range of from 1 to 8, more preferably in the range of from 1 to 6, more preferably in the range of from 1 to 5, more preferably in the range of from 1 to 4, more preferably in the range of from 1 to 3.
45. The process of embodiment 44, wherein if $z > 1$, at least 2 reactors R_i , preferably z reactors R_i are serially coupled, wherein
- the stream S_F is fed into R_i , with $i = 1$;
 - an aqueous liquid stream S_i containing ϵ -caprolactam dissolved in water is removed from reactor R_i and fed into the reactor R_{i+1} , with $i < z$;
 - the aqueous liquid stream S_z containing ϵ -caprolactam dissolved in water is removed from the reactor R_z as the stream S_R ;
- wherein in every reactor R_i , a depolymerization temperature T_{Di} at a depolymerization pressure p_{Di} is maintained, wherein, independently of each other, T_{Di} is in the range of from 230 to 330 °C and p_{Di} is in the range of from 40 to 140 bar, preferably wherein T_{Di} is in the range of from 250 to 320 °C and p_{Di} is in the range of from 40 to 125 bar, more preferably wherein T_{Di} is in the range of from 270 to 310 °C and p_{Di} is in the range of from 40 to 110 bar.
46. The process of embodiment 45, wherein for $z > 1$, the z reactors R_i are vertically arranged, with R_1 being the top-most reactor and R_z being the bottom-most reactor, wherein S_i obtained from R_i is transferred to R_{i+1} by gravity, preferably by gravity only.
47. The process of any one of embodiments 44 to 46, wherein at least 1, preferably z reactors R_i , are continuous stirred tank reactors (CSTR).
48. Crystallized ϵ -caprolactam, obtainable or obtained as stream S_{CPL} by a process according to any one of embodiments 1 to 47, exhibiting one or more of the following properties:
- an APHA color, determined as described in Reference Example 1, of at most 5, preferably of at most 4, more preferably of at most 3, more preferably of at most 2, more preferably of at most 1.5, more preferably of at most 1;
 - a purity, determined as described in Reference Example 2, of at least 99.8 weight-%, preferably of at least 99.9 %, more preferably of at least 99.95 %.

49. The crystallized ϵ -caprolactam of embodiment 48, exhibiting one or more of the following properties:
- an ϵ -caprolactam oligomer content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a 6-aminocaproic acid content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm.
50. The crystallized ϵ -caprolactam of embodiment 48 or 49, exhibiting the following property:
- a triisopropyl borate content in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm.
51. The crystallized ϵ -caprolactam of any one of embodiments 48 to 50, preferably wherein the solid material M as defined in embodiment 2 comprises one or more elastanes, said crystallized ϵ -caprolactam exhibiting one or more of the following properties:
- a polytetrahydrofuran content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - an aniline content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a methylenediphenyl diamine (MDA), isomers and oligomers content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a butanediol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm; and/or
 - an ethylene glycol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm.
52. Use of S_{CPL} , obtainable or obtained by a process according to any one of embodiments 1 to 47, preferably of S_{CPL} according to any one of embodiments 48 to 51, for preparing polyamide 6, said use preferably further comprising employing said polyamide 6 as a feedstock for preparing one or more of at least one textile material and at least one engineering plastics material, more preferably for preparing at least one textile material.

53. Use of a process according to any one of embodiments 1 to 47 for preparing high-purity ϵ -caprolactam from a solid material M, preferably a waste material comprising polyamide 6 and preferably one or more elastanes, said high-purity ϵ -caprolactam exhibiting one or more of the following properties:
- an ϵ -caprolactam oligomer content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a 6-aminocaproic acid content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a triisopropyl borate content in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a polytetrahydrofuran content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - an aniline content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a methylenediphenyl diamine (MDA), isomers and oligomers content in the range of from 0 to 10 weight-ppm, more preferably in the range of from 0 to 5 weight-ppm, more preferably in the range of from 0 to 1 weight-ppm;
 - a butanediol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm; and/or
 - an ethylene glycol content in the range of from 0 to 500 weight-ppm, more preferably in the range of from 0 to 300 weight-ppm, more preferably in the range of from 0 to 100 weight-ppm, more preferably in the range of from 0 to 50 weight-ppm, more preferably in the range of from 0 to 10 weight-ppm.
54. Use of S_{CPL} , obtainable or obtained by a process according to any one of embodiments 1 to 47, preferably of S_{CPL} according to any one of embodiments 48 to 51, for preparing one or more of a polymer and a polymer product; or a method for preparing one or more of a polymer and a polymer product, said method comprising employing S_{CPL} , obtainable or obtained by a process according to any one of embodiments 1 to 47, preferably of S_{CPL} according to any one of embodiments 48 to 51, as a starting material.
55. The use or the method of embodiment 54, wherein the polymer, or the polymer product, or the polymer and the polymer product is or are in the form of at least one of a granulate, a

strand, a rod, a plate, a pipe, a foil, a layer, a film, a sheet, a fiber, a filament, a coating, an extruded article, a molded article, a soft foam, a half-rigid foam and a rigid foam.

56. The use or the method of embodiment 54 or 55, wherein the polymer, or the polymer product, or the polymer and the polymer product comprises or comprise polyamide 6 and optionally at least one further polymeric compound, said polyamide 6 being at least partially obtainable or obtained from S_{CPL}, said S_{CPL} being obtainable or obtained by a process according to any one of embodiments 1 to 47, preferably being S_{CPL} according to any one of embodiments 48 to 51, wherein the at least one further polymeric compound preferably comprises one or more of at least one polyamide 6.6, at least one polyethylene terephthalate, at least one polyurethane, at least one polyester, at least one cellulose material, and at least one rubber material comprising one or more of at least one natural rubber material and at least one synthetic rubber material.
57. The use or the method of any one of embodiments 54 to 56, wherein the polymer, or the polymer product, or the polymer and the polymer product is or are one of the following or a part of one of the following:
- a part of a car, preferably a cylinder head cover, an engine cover, a housing for a charge air cooler, a charge air cooler flap, an intake pipe, an intake manifold, a connector, a gear wheel, a fan wheel, a cooling water box, a housing or a housing part for a heat exchanger, a coolant cooler, a charge air cooler, a thermostat, a water pump, a radiator, a fastening part or a part of a battery system for electromobility, a dashboard, a steering column switch, a seat, a headrest, a center console, a transmission component, a door module, a car exterior for an A, a B, a C or a D pillar cover, a spoiler, a door handle, an exterior mirror, a windscreen wiper, a windscreen wiper protection housing, a decorative grill, a cover strip, a roof rail, a window frame, a sunroof frame, an antenna panel, a headlight, a taillight, an airbag, and/or a cushion;
 - a cloth, an apparel, preferably a shirt, trousers, a pullover, a boot, a shoe, a shoe sole, a tight and/or or jacket;
 - an electrical part, preferably an electrical component, an electronic passive component, an electronic active component, a printed circuit board, a housing component, a foil, a line, a switch such as a microswitch, a plug, a socket, a distributor, a relay, a resistor, a capacitor, an inductor, a bobbin, a lamp, a diode such as an LED, a transistor, a connector, a regulator, an integrated circuit (IC), a processor, a controller, a memory, a sensor, a microbutton, a semiconductor, a reflector housing for example for light-emitting diodes, a fastener for an electrical and/or an electronic component, a spacer, a bolt, a strip, a slide-in guide, a screw, a nut, a film hinge, a snap hook (snap-in), and/or a spring tongue;
 - a consumer and/or a pharmaceutical product, preferably a tennis string, a climbing rope, a bristle, a brush, an artificial grass, a 3D printing filament, a grass trimmer, a zipper, a hook and loop fastener, a paper machine clothing, an extrusion coating, a fishing line, a fishing net, an offshore line and rope, a vial, a syringe, an ampoule, a

- bottle, a sliding element, a spindle nut, a chain conveyor, a plain bearing, a roller, a wheel, a gear, a roller, a ring gear, a screw and spring damper, a hose, a pipeline, a cable sheathing, a socket, a switch, a cable tie, a fan wheel, a carpet, a box and/or a bottle for cosmetics, a mattress, a cushion, an insulation;
- 5 - a packaging for the food industry, preferably a mono- and/or multi-layer blown film, a cast film (mono- and/or multi-layer), a biaxially stretched film, a laminating film.
58. The use or the method of any one of embodiments 54 to 57, wherein the polymer, or the polymer product, or the polymer and the polymer product contains or contain polyamide 6,
- 10 obtainable or obtained from S_{CPL} , said S_{CPL} being obtainable or obtained by a process according to any one of embodiments 1 to 47 or preferably being the S_{CPL} according to any one of embodiments 48 to 51, in an amount of 1 weight-% or more, preferably 2 weight-% or more, more preferably 5 weight-% or more, more preferably 15 weight-% or more, more preferably 30 weight-% or more, more preferably 40 weight-% or more, more preferably 60
- 15 weight-% or more, more preferably 80 weight-% or more, more preferably 90 weight-% or more, more preferably 95 weight-% or more; and/or in an amount of 100 weight-% or less, preferably 95 weight-% or less, more preferably 90 weight-% or less, more preferably 50 weight-% or less, more preferably 25 weight-% or less, more preferably 10 weight-% or less.
- 20 59. A process, preferably according to any one of embodiments 1 to 47, comprising the step of converting a chemical material obtainable or obtained by the process according to any one of embodiments 1 to 47 to obtain a product Ω .
- 25 60. The process of embodiment 59, wherein the product Ω is selected from:
- building block or monomer; or
 - polymer, preferably polymer A, polymer composition, preferably polymer composition A, or polymer product, preferably polymer product A; or
 - industrial use polymer, industrial use surfactant, descaling compound, industrial use

30 biocide, industrial use solvent, industrial use dispersant, composition thereof or formulation thereof; or

 - agrochemical composition, agrochemical formulation auxiliary or agrochemically active ingredient; or
 - active pharmaceutical ingredient or intermediate thereof, pharmaceutical excipient,

35 animal feed additive, human food additive, dietary supplements, aroma chemical or aroma composition; or

 - aqueous polymer dispersion, preferably polyurethane or polyurethane –

40 poly(meth)acrylate hybrid polymer dispersion, emulsion, binder for paper and fiber coatings, UV-curable acrylic polymer for hot melts and coatings polyisocyanates, hyperbranched polyester polyol, polymeric dispersant for inorganic binder compositions, unsaturated polyester polyol or 100% curable composition; or

 - cosmetic surfactant, emollient, wax, cosmetic polymer, UV filter, further cosmetic ingredient or composition or formulation thereof; or

- polymer B, polymer composition B, coating composition, other functional composition, foil, molded body, coating or coated substrate.

61. The process of embodiment 59 or 60,
- 5 wherein the content of the chemical material obtainable or obtained by the process according to any one of embodiments 1 to 47 in the product Ω is 1 weight-% or more, preferably 2 weight-% or more, more preferably 5 weight-% or more, more preferably 15 weight-% or more, more preferably 30 weight-% or more, more preferably 40 weight-% or more, more preferably 60 weight-% or more, more preferably 80 weight-% or more, more preferably 90 weight-% or more, more preferably 95 weight-% or more; and/or
- 10 wherein the content of the chemical material obtainable or obtained by the process according to any one of embodiments 1 to 47 in the product Ω is 100 weight-% or less, preferably 95 weight-% or less, more preferably 90 weight-% or less, more preferably 50 weight-% or less, more preferably 25 weight-% or less, more preferably 10 weight-% or less; and preferably wherein the content is determined based on identity preservation and/or segregation and/or mass balance and/or book and claim chain of custody models, preferably based on mass balance, preferably the International Sustainability and Carbon Certification (ISCC) standard.
- 15
- 20 As far as the embodiment 58 is concerned, the respective amounts are preferably determined based on identity preservation and/or segregation and/or mass balance and/or book and claim chain of custody models, more preferably based on mass balance, more preferably the International Sustainability and Carbon Certification (ISCC) standard. As far as the embodiments 54 to 58 are concerned, preparing the polymer, the polymer product, or the polymer and the
- 25 polymer product may comprise one or more synthesis steps and can be performed by conventional synthesis and technics well known to the person skilled in the art. Examples of the synthesis steps are described in "Industrial Organic Chemistry", 3rd volume, Wiley-VCH, 1997; ISBN: 978-3-527-28838-0; „Kunststoffhandbuch“, 11 volumes in 17 sub-volumes, Carl Hanser Verlag, especially volume 6, „Polyamide“, 1st edition, 1966; "Injection Molding Reference Guide, 4th edition, CreateSpace Independent Publishing Platform, 2011, ISBN: 978-1466407824; WO 2008/155271 A1 and WO 2013/139827 A1, each of which is incorporated herein by reference.
- 30

The term „bar“ as used in the context of the present invention refers to „bar(abs)“, i.e. bar (absolute), sometimes also referred to as „bara“.

35

The term "elastane" as used herein is also referred to as "spandex", and common brand names for spandex include Lycra, Elasthan, Acepora, Creora, Inviya, Roica, Dorlastan, Linel or ESPA.

40 The term "textile material" covers textile raw materials and non-textile raw materials that are processed by various methods into linear, planar and spatial structures. It concerns the linear textile structures produced from them, such as yarns, twisted yarns and ropes, the sheet-like textile structures, such as woven fabrics, knitted fabrics, braids, stitch-bonded fabrics, nonwovens and felts, and the three-dimensional textile structures, i.e. body structures, such as textile hoses,

stockings or textile semi-finished products; and it further concerns those finished products which, using the aforementioned products, are brought into a saleable condition by making up, opening up and/or other operations for onward transmission to the processor, the trade or the end consumer. The term “textile waste material” covers a textile material as defined above, the
5 inherent value of which has been consumed from the perspective of its current holder and, thus, is an end-of-life material for said holder.

The term “engineering plastics” as used herein refers to high-performance plastics grades which possess physical properties enabling them to perform for prolonged use in structural applications,
10 over a wide temperature range, under mechanical stress, and in difficult chemical and physical environments used for example to fabricate plastic parts replacing traditional engineering materials like metals and ceramics. Engineering plastics specifically apply in the fabrication of mechanical parts across several industries such as automotive, medical, electrical and electronics, aerospace, construction and consumer products. The term “engineering plastics
15 waste material” as used herein covers an engineering plastics material as defined above, the inherent value of which has been consumed from the perspective of its current holder and, thus, is an end-of-life material for said holder.

The present invention is further illustrated in the following reference examples and figure.
20

Reference Examples

Reference Example 1: Determination of the APHA color of crystallized ϵ -caprolactam

25 The APHA color was determined by according to ISO 8112. In principal, the extinction E of a 50 % by weight aqueous ϵ -caprolactam solution is determined in a cuvette of length $l = 5$ cm at a wavelength $\lambda = 390$ nm and expressed in Hazen units (platinum-cobalt scale). For doing this, the measured extinction E is multiplied by the factor $f = 150$. The Hazen units (platinum-cobalt scale) are defined as the color of a solution containing, in 1 l water, 1 mg platinum in the form of
30 hexachloroplatinum(IV) acid in the presence of 2 mg cobalt(II) chloride hexahydrate. The Hazen units correspond to the APHA units. A standard solution of 500 Hazen units as prepared as follows: 1.000 g cobalt(II) chloride hexahydrate ($\text{CoCl}_2 \cdot 6 \text{H}_2\text{O}$) and 1.245 g potassium hexachloroplatinate(IV) (K_2PtCl_6) are dissolved in 100 ml hydrochloric acid having a ρ of 1.19 g/ml. The solution is transferred into a 1000 ml volumetric flask which is filled to the calibration mark.
35 This solution contains 500 mg platinum and corresponds to 500 Hazen units. 50 ± 0.1 g ϵ -caprolactam are dissolved in a 250 Erlenmeyer flask in 50 ml distilled water. The solution is mixed and left until the air bubbles have disappeared. The 2 cuvettes of the spectrophotometer (which is suitable for measurements at a wavelength $\lambda = 390$ nm) are filled with distilled water, placed in the beam path, and the spectrophotometer is adjusted at $\lambda = 390$ nm to $E = 0$. Then, the
40 distilled water is removed from the sample cuvette, followed by filling this cuvette with the ϵ -caprolactam solution. Then, the extinction E of this solution is determined at $\lambda = 390$ nm (E_{390}) against the comparative cuvette containing distilled water. The color number X (Hazen units, platinum-cobalt scale) is calculated as $X = E \cdot f = 150 \cdot E_{390}$. X is rounded to the next integer.

Reference Example 2: Determination of the purity of crystallized ϵ -caprolactam

For GC analysis on purity of the crystallized ϵ -caprolactam, samples were prepared in deionized water at concentration of approx. 200 mg/mL. Analysis was performed on a standard GC instrument equipped with a split/splitless injector and an FID. The injection volume was 1 μ L (microL) at a split ratio of 15:1. The injector temperature was 250 °C. The instrument was operated in constant pressure mode at 14.5 psi ($\sim$ 1 bar), and nitrogen was used as carrier gas. Separation was performed on a Wax 52 CB column, 50 m x 0.32 mm, 1.2 μ m from Agilent Technologies. The temperature program started with a ramp from 80 °C to 185 °C at a heating rate of 7 °C/min, and a hold time at 185 °C for 30 min. A second ramp was from 185 °C to 200 °C at a heating rate of 7 °C/min, and a hold time at 200 °C for 5 min. The detector (Flame Ionization Detector, FID) temperature was 250 °C. Evaluation of purity values was based on area-% distribution, corrected by the content of water determined by Carl Fisher Method.

According to the present invention, it was found that, if impurities are present in S_{CPL} , and in particular in case one or more elastanes are contained in the solid material M, diol compounds such as butanediol and ethylene glycol, and optionally oligomers thereof, are the predominant impurities.

20

Brief description of the figure

Fig. 1 illustrates a process according to the present invention. In a reaction unit U_R , an aqueous depolymerization mixture (providing the solid material M according to step (i.1) is not shown) is subjected to depolymerization conditions comprising a depolymerization temperature T_D at a depolymerization pressure p_D , wherein in U_R , a liquid aqueous reaction mixture M_R comprising ϵ -caprolactam dissolved in water is obtained (step (i.4)). From the unit U_R , the aqueous liquid stream S_R is removed exhibiting a water mass flow μ_R (step (i.5)). This stream S_R is then subjected to depressurization in the evaporation unit U_E , and from the unit U_E , the aqueous liquid stream S_L exhibiting a water mass flow μ_L and at least one aqueous vapor stream S_{EV} (only one stream S_{EV} is shown in Fig. 1) exhibiting a total water mass flow μ_{EV} (step (ii)). The streams S_L and S_{EV} are then passed to the heat-consuming purification and recycle unit U_{PR} for reprocessing purposes (step (iii)). In the unit U_{PR} , the aqueous liquid stream S_L is purified with respect to ϵ -caprolactam, and a respectively purified stream S_{CPL} is obtained (step (iii.1)). From said purification in U_{PR} , at least one (separated) aqueous stream S_{WS} is obtained (only one stream S_{WS} is shown in Fig. 1) exhibiting a total water mass flow μ_{WS} . The stream S_{WS} is then recycled to the unit U_R (step (iii.3)), as a combined stream S_W prepared from the stream S_{WS} , an aqueous makeup stream S_{WF} exhibiting a water mass flow μ_{WF} , and at least one at least partially condensed aqueous stream S_{EL} (only one stream S_{EL} is shown) exhibiting a total water mass flow μ_{EL} . This stream S_{EL} is obtained from the unit U_{PR} , specifically from providing at least part of the heat consumed in U_{PR} by the at least one aqueous vapor stream S_{EV} (step (iii.2)) wherein in the course of providing heat, S_{EV} is at least partially condensed to obtain S_{EL} .

Claims

1. A process for preparing purified ϵ -caprolactam from polyamide 6 comprised in a solid material M, the process comprising
 - 5 (i) preparing an aqueous liquid stream S_R comprising ϵ -caprolactam dissolved in water, comprising
 - (i.1) providing the solid material M comprising polyamide 6;
 - (i.2) preparing an aqueous liquid stream S_W exhibiting a water mass flow μ_W , the stream S_W comprising an aqueous recycle stream S_{WR} exhibiting a water mass flow μ_{WR} and an aqueous makeup stream S_{WF} exhibiting a water mass flow μ_{WF} ,
 10 wherein $\mu_{WR} + \mu_{WF} = \mu_W$;
 - (i.3) preparing an aqueous depolymerization mixture based on the solid material M provided according to (i.1) and the aqueous liquid stream S_W provided according to (i.2);
 - 15 (i.4) subjecting in a chemical reaction unit U_R the aqueous depolymerization mixture prepared according to (i.3) to depolymerization conditions comprising a depolymerization temperature T_D at a depolymerization pressure p_D , obtaining in U_R a liquid aqueous reaction mixture M_R comprising ϵ -caprolactam dissolved in water;
 - 20 (i.5) removing from U_R the aqueous liquid stream S_R exhibiting a water mass flow μ_R ;
 - (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E at least one aqueous vapor stream S_{EV} exhibiting a
 25 total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$;
 - (iii) reprocessing the stream S_L obtained according to (ii) in a heat-consuming purification and recycle unit U_{PR} , the reprocessing comprising
 - (iii.1) subjecting the aqueous liquid stream S_L to ϵ -caprolactam purification in the unit U_{PR} , obtaining from U_{PR} a stream S_{CPL} comprising purified ϵ -caprolactam, and
 30 further obtaining from U_{PR} at least one separated aqueous stream S_{WS} exhibiting a total water mass flow μ_{WS} ;
 - (iii.2) providing at least part of the heat consumed in U_{PR} by the at least one aqueous vapor stream S_{EV} obtained according to (ii), obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL} exhibiting a total water mass flow
 35 μ_{EL} ;
 - (iii.3) recycling the at least one aqueous stream S_{WS} obtained according to (iii.1) and the at least one aqueous stream S_{EL} obtained according to (iii.2) as aqueous recycle stream S_{WR} to (i.2), wherein $\mu_{WS} + \mu_{EL} = \mu_{WR}$;
- wherein
- 40 μ_{EV} / μ_L is in the range of from 0.50 to 0.9;
 - μ_{WR} / μ_W is in the range of from 0.02 to 0.3.

2. The process of claim 1, wherein μ_{EV} / μ_L is in the range of from 0.5 to 0.8, preferably in the range of from 0.5 to 0.7, more preferably in the range of from 0.5 to 0.65.
3. The process of claim 1 or 2, wherein μ_{WR} / μ_W is in the range of from 0.03 to 0.3, preferably in the range of from 0.04 to 0.25 more preferably in the range of from 0.05 to 0.2.
4. The process of any one of claims 1 to 3, wherein μ_{EL} / μ_{WS} is in the range of from 0.55 to 0.9, preferably in the range of from 0.6 to 0.85, more preferably in the range of from 0.65 to 0.8.
5. The process of any one of claims 1 to 4, wherein the stream S_R obtained according to (i.5) exhibits an ϵ -caprolactam concentration C_{SR} , the stream S_L obtained according to (ii) exhibits an ϵ -caprolactam concentration C_{SL} , and the stream S_{CPL} obtained according to (iii.1) exhibits an ϵ -caprolactam concentration C_{SCPL} , with $C_{SCPL} \gg C_{SL} > C_{SR}$.
6. The process of any one of claims 1 to 5, wherein the heat-consuming purification and recycle unit U_{PR} comprises a heat-consuming water separation unit U_{WS} comprising two heat-consuming water separation sub-units $U_{WS}(1)$ and $U_{WS}(2)$, wherein (iii.1) comprises subjecting the aqueous liquid stream S_L to water separation in $U_{WS}(1)$, obtaining a separated aqueous stream $S_{WS}(1)$ and an aqueous stream S_{UWS1} exhibiting an ϵ -caprolactam concentration C_{SUWS1} with $C_{SUWS1} > C_{SL}$, and further comprises subjecting the aqueous stream S_{UWS1} , optionally after an intermediate treatment in a high boiler separation unit U_{HS} , to further water separation in $U_{WS}(2)$, obtaining a separated aqueous stream $S_{WS}(2)$ and an aqueous stream S_{UWS2} exhibiting an ϵ -caprolactam concentration C_{SUWS2} with $C_{SUWS2} > C_{SUWS1}$, and wherein the stream $S_{WS}(1)$ exhibits a water mass flow μ_{WS1} and the stream $S_{WS}(2)$ exhibits a water mass flow μ_{WS2} , wherein $\mu_{WS1} + \mu_{WS2} = \mu_{WS}$ and wherein μ_{WS1} / μ_{WS2} is preferably in the range of from 10 to 32.5, more preferably in the range of from 11 to 30, more preferably in the range of from 12 to 27.5.
7. The process of claim 6, wherein the heat-consuming purification and recycle unit U_{PR} further comprises one or more of a heat-consuming water distillation unit U_{DI} and a heat consuming crystallization unit U_{CR} , preferably a heat-consuming water distillation unit U_{DI} and a heat-consuming crystallization unit U_{CR} , wherein (iii.1) further comprises subjecting the aqueous liquid stream S_{UWS2} to distillation in U_{DI} , obtaining a stream S_{UDI} exhibiting an ϵ -caprolactam concentration C_{SUDI} with $C_{SUDI} > C_{SUWS1}$, and further comprises subjecting the aqueous stream S_{UDI} to crystallization in U_{CR} , obtaining from U_{CR} the stream S_{CPL} exhibiting an ϵ -caprolactam concentration C_{SCPL} with $C_{SCPL} > C_{SUDI}$.
8. The process of any one of claims 1 to 7, wherein (ii) comprises
 - (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E three aqueous vapor stream S_{EV} exhibiting a total

water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$, wherein a first stream S_{EV1} has a pressure p_{EV1} and a temperature T_{EV1} , a second stream S_{EV2} has a pressure p_{EV2} and a temperature T_{EV2} , and a third stream S_{EV3} has a pressure p_{EV3} and a temperature T_{EV3} , wherein $p_{EV1} > p_{EV2} > p_{EV3}$;

5 wherein

- p_{EV1} is preferably in the range of from 13 to 19 bar, more preferably in the range of from 14 to 18 bar, more preferably in the range of from 15 to 17 bar; and T_{EV1} is preferably in the range of from 170 to 230 °C, more preferably in the range of from 180 to 220 °C, more preferably in the range of from 190 to 210 °C;
- 10 - p_{EV2} is preferably in the range of from 5 to 11 bar, more preferably in the range of from 6 to 10 bar, more preferably in the range of from 7 to 9 bar; and T_{EV2} is preferably in the range of from 150 to 210 °C, more preferably in the range of from 160 to 200 °C, more preferably in the range of from 170 to 190 °C;
- 15 - p_{EV3} is preferably in the range of from 0.95 to 1.5 bar, more preferably in the range of from 1.0 to 1.4 bar, more preferably in the range of from 1.1 to 1.3 bar; and T_{EV3} is preferably in the range of from 90 to 140 °C, more preferably in the range of from 100 to 130 °C, more preferably in the range of from 110 to 120 °C;

wherein the stream S_{EV1} exhibits a mass flow μ_{EV1} , the stream S_{EV2} exhibits a mass flow μ_{EV2} and the stream S_{EV3} exhibits a mass flow μ_{EV3} , wherein $\mu_{EV1} + \mu_{EV2} + \mu_{EV3} = \mu_{EV}$;

20 wherein

- μ_{EV1} / μ_{EV} is preferably in the range of from 0.01 to 0.55, more preferably in the range of from 0.02 to 0.5, more preferably in the range of from 0.03 to 0.45;
- μ_{EV2} / μ_{EV} is preferably in the range of from 0.1 to 0.75, more preferably in the range of from 0.15 to 0.7, more preferably in the range of from 0.2 to 0.65;
- 25 μ_{EV3} / μ_{EV} is preferably in the range of from 0.2 to 0.55, more preferably in the range of from 0.25 to 0.45, more preferably in the range of from 0.3 to 0.4.

9. The process of claim 8, wherein (iii.2) comprises

(iii.2) providing at least part of the heat consumed in U_{PR} by the streams S_{EV1} , S_{EV2} and S_{EV3} obtained according to (ii) or one or more part streams thereof, obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL1} , at least one at least partially condensed aqueous stream S_{EL2} and at least one at least partially condensed aqueous stream S_{EL3} , said at least one at least partially condensed aqueous stream S_{EL1} , said at least one at least partially condensed aqueous stream S_{EL2} and said at least one at least partially condensed aqueous stream S_{EL2} together exhibiting a total water mass flow μ_{EL} .

10. The process of claim 9, wherein the reprocessing according to (iii) comprises

(iii.1) subjecting the aqueous liquid stream S_L to ϵ -caprolactam purification in the unit U_{PR} , obtaining from U_{PR} a stream S_{CPL} comprising purified ϵ -caprolactam, and further obtaining from U_{PR} at least one separated aqueous stream S_{WS} exhibiting a total water mass flow μ_{WS} , comprising

- (iii.1.1) subjecting the aqueous liquid stream S_L to water separation in a first water separation unit $U_{WS}(1)$, obtaining a separated aqueous stream $S_{WS}(1)$ and an aqueous stream S_{UWS1} exhibiting an ϵ -caprolactam concentration C_{SUWS1} with $C_{SUWS1} > C_{SL}$, and further comprises subjecting the aqueous stream S_{UWS1} , optionally after an intermediate treatment in a high boiler separation unit U_{HS} , to further water separation in a second water separation unit $U_{WS}(2)$, obtaining a separated aqueous stream $S_{WS}(2)$ and an aqueous stream S_{UWS2} exhibiting an ϵ -caprolactam concentration C_{SUWS2} with $C_{SUWS2} > C_{SUWS1}$;
- (iii.1.2) subjecting the aqueous liquid stream S_{UWS2} to distillation in a distillation unit U_{DI} , obtaining a stream S_{UDI} exhibiting an ϵ -caprolactam concentration C_{SUDI} with $C_{SUDI} > C_{SUWS1}$, and further comprises subjecting the aqueous stream S_{UDI} to crystallization in a crystallization unit U_{CR} , obtaining from U_{CR} the stream S_{CPL} exhibiting an ϵ -caprolactam concentration C_{SCPL} with $C_{SCPL} > C_{SUDI}$;
- (iii.2) providing at least part of the heat consumed in U_{PR} by the streams S_{EV1} , S_{EV2} and S_{EV3} obtained according to (ii) or one or more part streams thereof, obtaining from U_{PR} at least one at least partially condensed aqueous stream S_{EL1} , at least one at least partially condensed aqueous stream S_{EL2} and at least one at least partially condensed aqueous stream S_{EL3} , said at least one at least partially condensed aqueous stream S_{EL1} , said at least one at least partially condensed aqueous stream S_{EL2} and said at least one at least partially condensed aqueous stream S_{EL2} together exhibiting a total water mass flow μ_{EL} , said providing comprising
- (iii.2.1) providing at least part of the heat consumed in $U_{WS}(1)$ by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- (iii.2.2) providing at least part of the heat consumed in $U_{WS}(2)$ by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} ;
- (iii.2.3) providing at least part of the heat consumed in U_{DI} by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} ;
- (iii.2.4) providing at least part of the heat consumed in U_{CR} by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;
- (iii.2.5) providing at least part of the heat consumed in $U_H(1)$ as defined in (iii.3) by at least one part stream of the stream S_{EV1} , obtaining at least one at least partially condensed stream S_{EL1} , each having a pressure p_{EL1} and a temperature T_{EL1} ;
- (iii.2.6) providing at least part of the heat consumed in $U_H(2)$ as defined in (iii.3) by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} ;

(iii.3) recycling the aqueous stream $S_{WS}(1)$, the aqueous stream $S_{WS}(2)$ obtained according to (iii.1.1) and the aqueous streams S_{EL1} , S_{EL2} , S_{EL3} obtained according to (iii.2) as aqueous recycle stream S_{WR} to (i.2), wherein $\mu_{WS} + \mu_{EL} = \mu_{WR}$.

5 11. The process of claim 10, comprising

(iii.2.1) providing at least part of the heat consumed in $U_{WS}(1)$ by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{WS1})$;

10 (iii.2.2) providing at least part of the heat consumed in $U_{WS}(2)$ by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} , said at least one part stream of the stream S_{EV2} exhibiting a total mass flow $\mu_{EV2}(U_{WS2})$;

15 (iii.2.3) providing at least part of the heat consumed in U_{DI} by at least one part stream of the stream S_{EV2} , obtaining at least one at least partially condensed stream S_{EL2} , each having a pressure p_{EL2} and a temperature T_{EL2} , said at least one part stream of the stream S_{EV2} exhibiting a total mass flow $\mu_{EV2}(U_{DI})$;

20 (iii.2.4) providing at least part of the heat consumed in U_{CR} by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{CR})$;

25 (iii.2.5) providing at least part of the heat consumed in $U_H(1)$ as defined in (iii.3) by at least one part stream of the stream S_{EV1} , obtaining at least one at least partially condensed stream S_{EL1} , each having a pressure p_{EL1} and a temperature T_{EL1} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV1}(U_{H1})$;

(iii.2.6) providing at least part of the heat consumed in $U_H(2)$ as defined in (iii.3) by at least one part stream of the stream S_{EV3} , obtaining at least one at least partially condensed stream S_{EL3} , each having a pressure p_{EL3} and a temperature T_{EL3} , said at least one part stream of the stream S_{EV3} exhibiting a total mass flow $\mu_{EV3}(U_{H2})$;

30 wherein

$\mu_{EV1}(U_{H1}) / \mu_{EV1}$ is in the range of from 0.85 to 1, preferably in the range of from 0.9 to 1, more preferably in the range of from 0.95 to 1;

$\mu_{EV2}(U_{WS2}) / \mu_{EV2}$ is in the range of from 0.03 to 0.2, preferably in the range of from 0.04 to 0.15, more preferably in the range of from 0.05 to 0.1;

35 $\mu_{EV2}(U_{DI}) / \mu_{EV2}$ is in the range of from 0.8 to 0.97, preferably in the range of from 0.85 to 0.96, more preferably in the range of from 0.9 to 0.95;

$\mu_{EV3}(U_{WS1}) / \mu_{EV3}$ is in the range of from 0.1 to 0.9, preferably in the range of from 0.2 to 0.85, more preferably in the range of from 0.3 to 0.8;

40 $\mu_{EV3}(U_{CR}) / \mu_{EV3}$ is in the range of from 0.1 to 0.9, preferably in the range of from 0.2 to 0.85, more preferably in the range of from 0.3 to 0.8;

$\mu_{EV3}(U_{H2}) / \mu_{E3}$ is in the range of from 0.01 to 0.04, preferably in the range of from 0.01 to 0.03, more preferably in the range of from 0.01 to 0.02.

12. The process of any one of claims 8 to 11, wherein (ii) comprises
- (ii) subjecting the aqueous liquid stream S_R obtained according to (i.5) to depressurization in an evaporation unit U_E , obtaining from U_E an aqueous liquid stream S_L comprising ϵ -caprolactam dissolved in water exhibiting a water mass flow μ_L , and further obtaining from U_E three aqueous vapor stream S_{EV} exhibiting a total water mass flow μ_{EV} , wherein $\mu_L + \mu_{EV} = \mu_R$, wherein a first stream S_{EV1} has a pressure p_{EV1} and a temperature T_{EV1} , a second stream S_{EV2} has a pressure p_{EV2} and a temperature T_{EV2} , and a third stream S_{EV3} has a pressure p_{EV3} and a temperature T_{EV3} , wherein $p_{EV1} > p_{EV2} > p_{EV3}$, wherein obtaining from U_E three aqueous vapor stream S_{EV} comprises
- (ii.1) subjecting the liquid aqueous stream S_R obtained according to (i.5) to depressurization in a first evaporation sub-unit U_{E1} , obtaining from U_{E1} an aqueous vapor stream S_{EV1A} having the pressure p_{EV1} , and further obtaining an at least partially aqueous liquid stream S_{LU1} ;
- (ii.2) dividing the stream S_{EV1A} , obtaining the stream S_{EV1} and a stream S_{EV1B} having the pressure p_{EV1} ;
- (ii.3) subjecting the stream S_{EV1B} to depressurization in a unit U_{V1} , U_{V1} preferably comprising a valve, more preferably a pressure relief valve, obtaining the stream S_{EV2} ;
- (ii.4) subjecting the stream S_{LU1} obtained according to (ii.1) to depressurization in a second evaporation sub-unit U_{E2} , obtaining from U_{E2} an aqueous vapor stream S_{EV3A} and the liquid stream S_L , wherein the aqueous vapor stream S_{EV3A} is the aqueous vapor stream S_{EV3} ;
- wherein obtaining the stream S_{EV3} preferably further comprises one or more of (ii.5.1) and (ii.5.2):
- (ii.5.1) separating a stream S_{EV1C} from the stream S_{EV1A} , obtained according to (ii.1), the stream S_{EV1C} having the pressure p_{EV1} ; subjecting the stream S_{EV1C} to depressurization in a unit U_{V2} , U_{V2} preferably comprising a valve, more preferably a pressure relief valve, obtaining a stream S_{EV3B} having the pressure p_{EV3} ;
- (ii.5.2) separating a stream S_{EV2A} from the stream S_{EV2} obtained according to (ii.3), the stream S_{EV2A} having the pressure p_{EV2} ; subjecting the stream S_{EV2A} to depressurization in a unit U_{V3} , U_{V3} preferably comprising a valve, more preferably a pressure relief valve, obtaining a stream S_{EV3C} having the pressure p_{EV3} ;
- and preferably further comprises
- (ii.6) admixing one or more of the streams S_{EV3B} obtained according to (ii.5.1) and the stream S_{EV3C} obtained according to (ii.5.2) to the stream S_{EV3A} obtained according to (ii.4), obtaining the stream S_{EV3} .
13. The process of any one of claims 1 to 12, wherein the solid material M provided according to (i.1) comprises, preferably consists of, a waste material, preferably one or more of a textile waste material and an engineering plastics waste material, more preferably of a textile waste material, wherein preferably from 10 to 100 weight-%, more preferably from 30

to 100 weight-%, more preferably from 50 to 100 weight-%, more preferably from 80 to 100 weight-%, of the solid material M consist of the polyamide 6.

- 5 14. Crystallized ϵ -caprolactam, obtainable or obtained as stream S_{CPL} by a process according to any one of claims 1 to 13, exhibiting one or more of the following properties:
- an APHA color of at most 5, preferably of at most 4, more preferably of at most 3, more preferably of at most 2, more preferably of at most 1.5, more preferably of at most 1;
 - 10 - a purity of at least 99.8 weight-%, preferably of at least 99.9 %, more preferably of at least 99.95 %.
- 15 15. A process, preferably according to any one of claims 1 to 13, comprising the step of converting a chemical material obtainable or obtained by the process according to any one of claims 1 to 13 to obtain a product Ω .