Capa™ Caprolactone intermediates for radiation curable applications

{add value}

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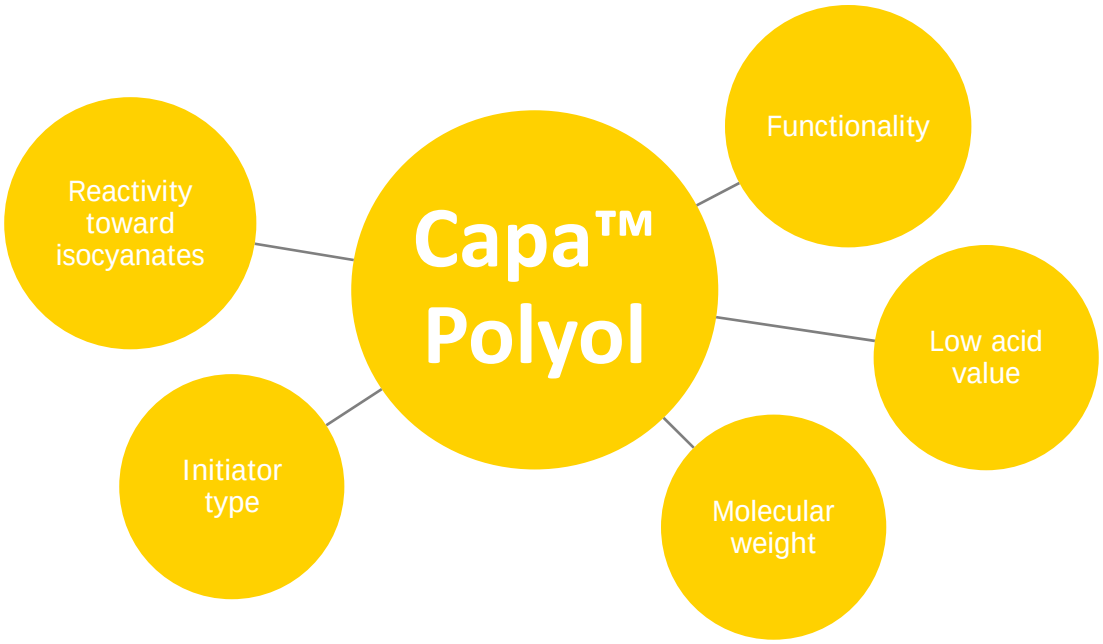
Perstorp Focus

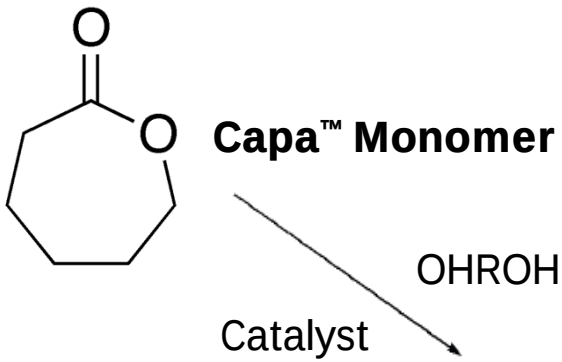
- Caprolactone derivatives are marketed by Perstorp as Capa™
- Production of monomer, polyols and thermoplastics takes place in Warrington, UK
- Intermediates for Radcure applications are a key market for Capa™ Polyols
- Perstorp is committed to support growing demand for Capa™ and has recently invested in greatly increased capacity to meet customers' expectations.

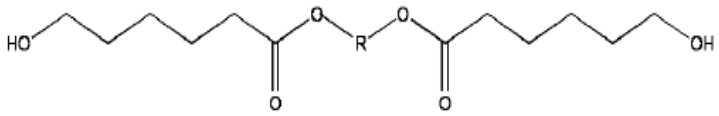
Caprolactone Polyols

- Unique aliphatic polyester polyols
- Made via ring opening polymerisation – no by-products
- This gives a tighter manufacturing specification than most other polyols
- Very low acid values with premium grades having a negligible acid content
- Controlled poly-dispersity
- Relevant molecular weight ranges and functionalities for maximum versatility



Capa™



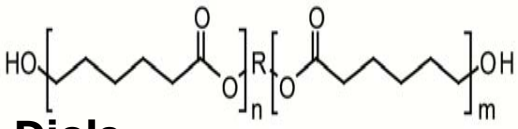


Capa™ Polyol

- Wide range of products – In excess of 30 commercial grades, with more under development.
- The reaction is “ring opening”, so there are low temperatures, less catalyst and no water, resulting in clean product with a narrow mwt distribution and clearly defined functionality.

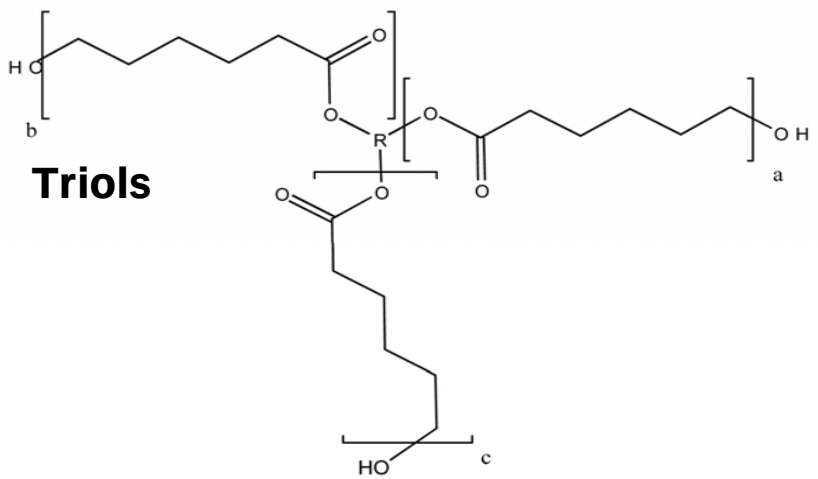
Capa™ Polyols

- Grades can be tailored depending on type of “initiator”.
- “Initiator” represents only 4-6% by weight of a 2,000Mwt polycaprolactone, but has significant effect on final properties.
- The functionality of the “initiator” is repeated exactly in the resultant polymer, so di-, tri- and multi functional polyols can be produced.



Diols

Capa 2 series – 200 – 8,000Mw



Triols

Capa 3 series – 300 – 3,000Mw

Why use Capa™?

Characteristics associated with Oligomers based on Capa™

(Capa™ Polyols can be used to produce polyester or urethane acrylate oligomers)

Advantages

- Flexibility
  - Oligomers are flexible and tough.
- Low Viscosity
  - Oligomers typically show lower viscosity for equivalent Mwt.
- Durability
  - Exterior durability.
  - High abrasion resistance.
- Control of Tg.
  - Possibility for “soft feel”

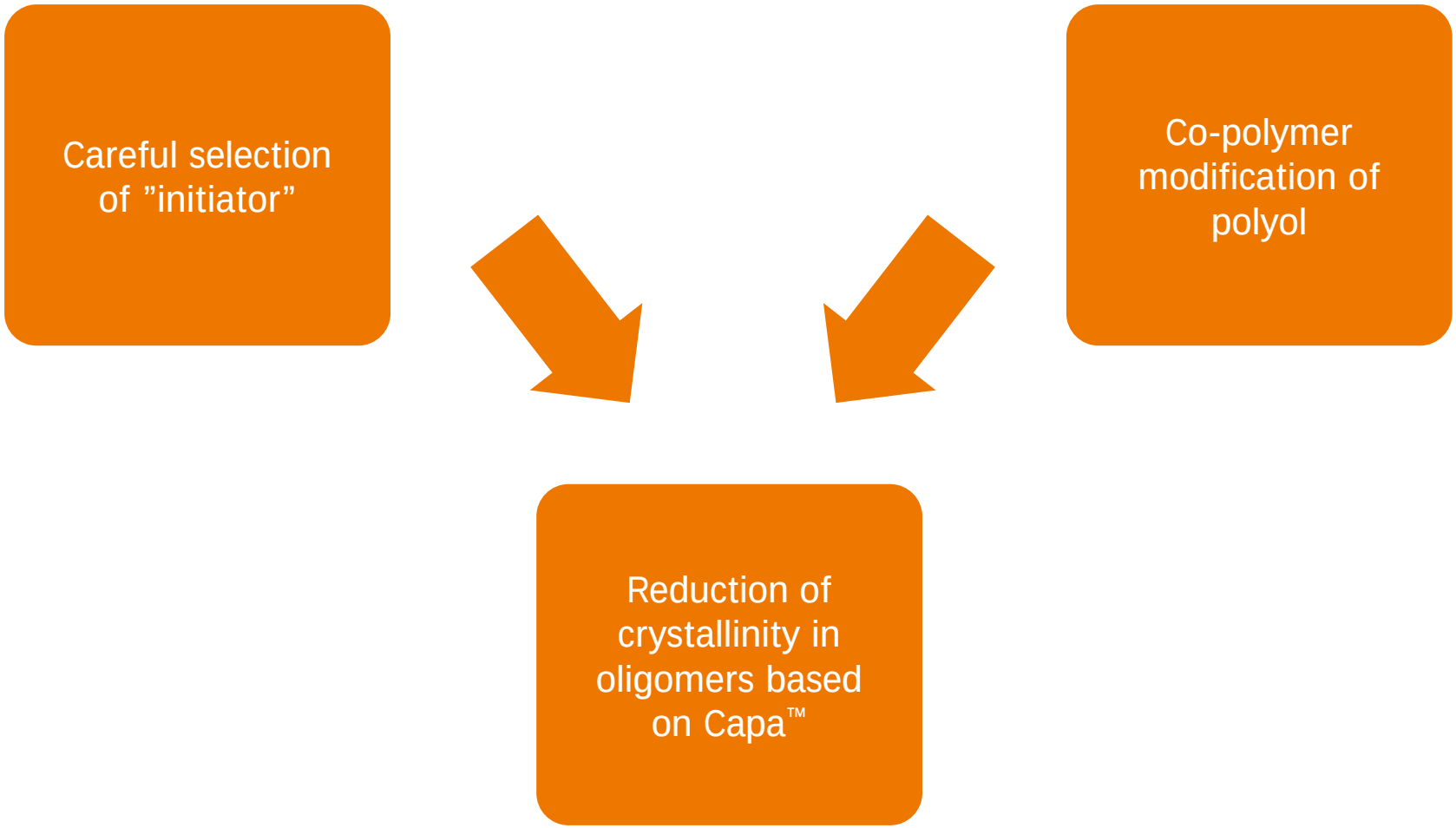
Disadvantages

- Availability
  - Problem is now solved.
- Crystallinity
  - Urethane acrylates have a tendency to crystalline nature...

Capa™ based urethane acrylate

Basic design

Control of Crystallinity



Experimental

Viscosity comparison (20% TPGDA)

Sample 1. = 1.1 Pas
Sample 2. = 1.2 Pas

Two samples were prepared for comparison;
Both use 2,000 mwt caprolactone

1. Based on 2,000 mwt (Capa™ 2200A)

2. Based on modified Caprolactone co-polymer (Capa™ 612065).

In each case the polyol was made into a polyurethane acrylate, using IPDI and HEA.

Both samples appeared similar immediately after preparation.

Experimental
(cont.)

2 hours	“Unmodified” sample starts to look “opaque”.
2,5 hours	It begins to look white.
3 hours	It is completely white, really high viscours but still not solid.
> 3 hours	It has become solid.

The “modified” sample remains clear throughout

Nb. After 2 hours stored at 60C, both samples are liquid once more.

Conclusions

High value applications

- Urethane acrylates have long been favoured for cured film properties, but high viscosity has been a problem.
- Caprolactones have been shown to add technical benefit (such as resistance and flexibility), but there have been barriers (such as crystallinity) to addoption.
- Maximum oligomer design flexibility can be achieved by use of Caprolactone based urethane acrylates.
- Our work has demonstrated the control which can be achieved by tailor made Capa™ polyol design, resulting in low viscosity, high performance urethane acrylates.
- Recent plant expansion means that availability is no longer a problem.

Going Forward

- Increased interest in low viscosity applications such as digital printing and 3-D modelling demands versatile, high performance oligomers.
- Perstorp is dedicated to research to develop intermediates for new high tech applications. We are currently running projects to investigate;
  - Highly functional Capa™ based low viscosity acrylates, utilising existing Perstorp Boltorn technology – aimed at requirements for low viscosity, resistance, wetting properties and high functionality.
  - Capa™ already has very good “green credentials”, but Perstorp is investigating renewable sourced raw materials for polyol modifications.
  - The possibility to control Tg and hardness by use of alternative “initiators”, gives the possibility to design polyols for “soft feel” applications or anti-abrasion coatings.

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Thank You!