Chemically bonded Nonwovens

Vorteile und Grenzen verschiedener Dispersionsbindemittel

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CONTENT

Chemically bonded Nonwovens - Vorteile und Grenzen verschiedener Dispersionsbindemittel

SYNTHOMER AT GLANCE

Leading in specialty polymers

Top 5
Global supplier of emulsion and speciality polymers

FTSE250
Listed company
Focused on organic growth and M&A

£ 1.61 Bn
Group revenue

25
Production sites

2900
Employees

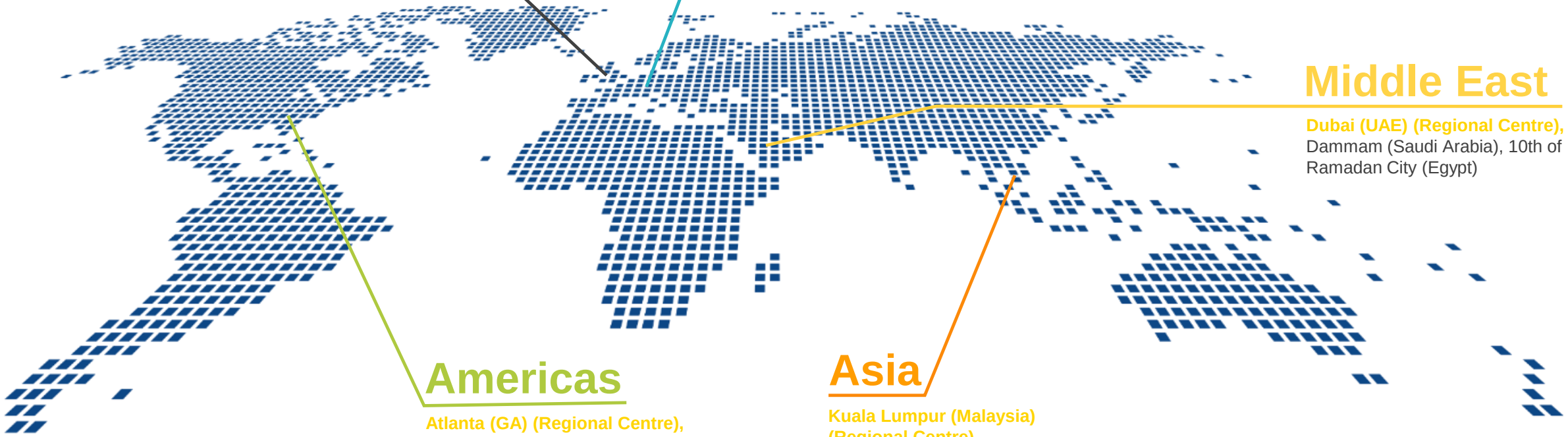
>100
Countries

>10
Polymer classes
xSBR, HS-SBR, SA, PA, NBR, CR, VP, VAc, VA-Co, NR

>20%
Turnover with products younger then 5 years

SYNTHOMER AT GLANCE

Your global partner



Synthomer Headquarters

London (UK)
(Synthomer Headquarters)

Europe

Marl (Germany) (Regional Centre),
Accrington (UK), Asua (Spain), Evergem (Belgium), Filago (Italy), Hasselt (Netherlands), Harlow (UK), Langelsheim (Germany), Pischelsdorf (Austria), Oss (Netherlands), Oulu (Finland), Ribecourt (France), Sant' Albano (Italy), Sokolov (Czech Republic), Stallingborough (UK), Worms (Germany)

Middle East

Dubai (UAE) (Regional Centre),
Dammam (Saudi Arabia), 10th of Ramadan City (Egypt)

Americas

Atlanta (GA) (Regional Centre),
Roebuck (SC)

Asia

Kuala Lumpur (Malaysia)
(Regional Centre),
Chonburi (Thailand), Ho Chi Minh City (Vietnam), Kluang (Malaysia), Pasir Gudang (Malaysia), Shanghai (China)

GENERAL INFORMATION

Woven vs. Nonwoven production process

- Woven fabric production process

Fibers

Spinning

Yarn formation

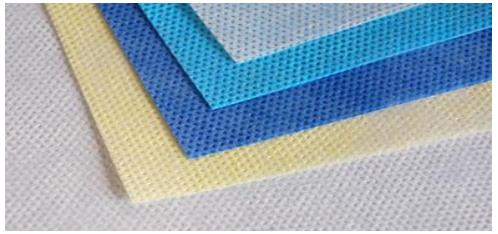
Weaving

Woven fabric

- Nonwoven fabric production process

Fibers

Web forming & bonding

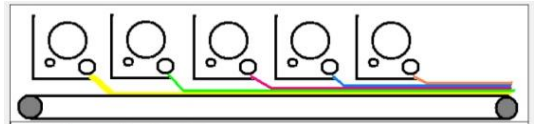


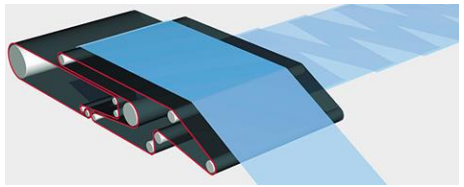
Nonwoven fabric

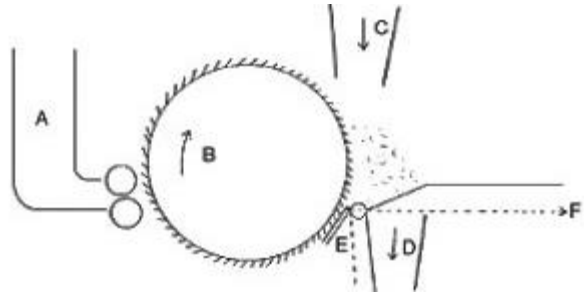
GENERAL INFORMATION

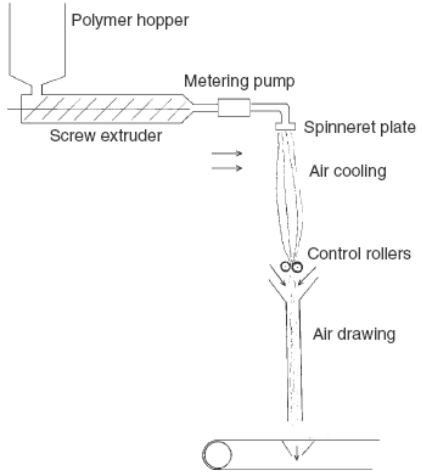
Different methods of web formation

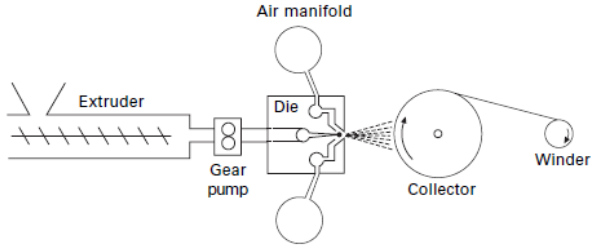
- Parallel Laying
- Cross Laying
- Air Laying
- Spun Laying
- Melt Blown
- Wet Laying
- …

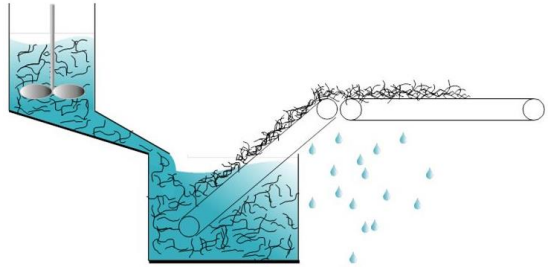








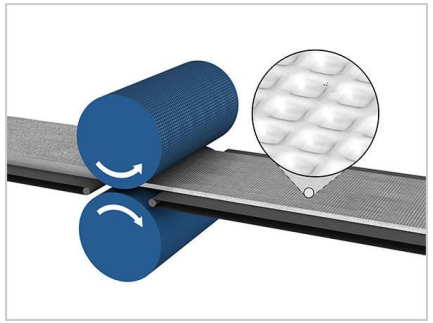


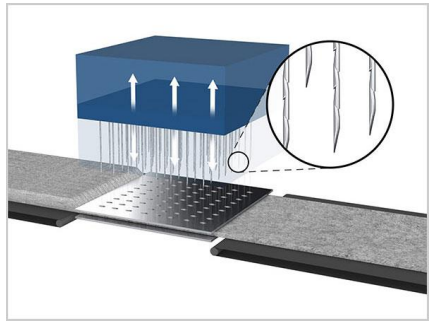


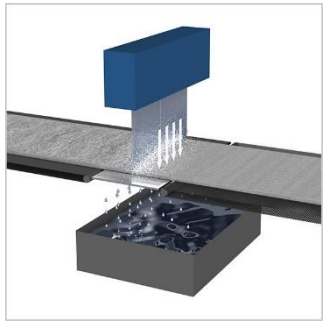
GENERAL INFORMATION

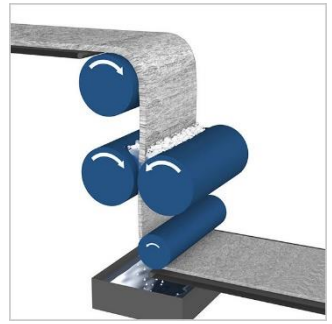
Different methods of web bonding

- Thermal bonding
- Needle punching
- Hydro entanglement
- Stitch bonding
- Solvent bonding
- Chemical bonding









Pictures copied from https://www.freudenberg-pm.com/Materialien/Verfestigung

CHEMICAL BONDING PROCESS

Why do we need chemical bonding?

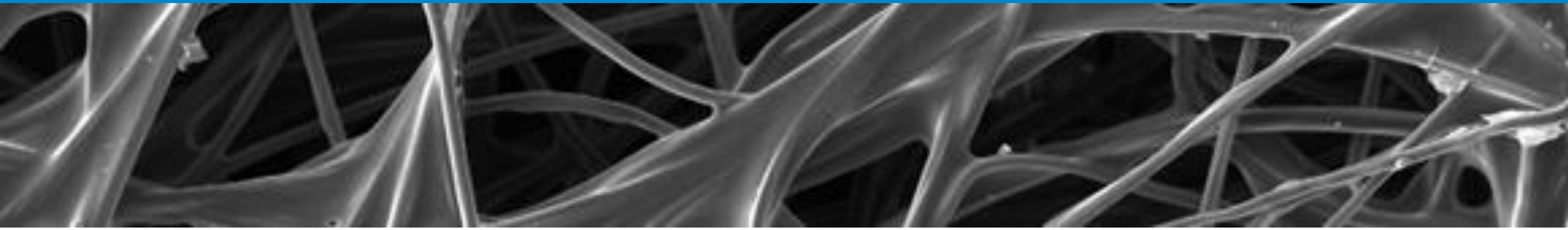
Improve characteristics such as:

- Strength
- Softness / Stiffness
- Adhesion
- Firmness
- Durability
- Abrasion resistance
- Hydrophilicity / Hydrophobicity
- Reduced surface tension
- Improved dimension stability
- Solvent, wash & acid resistance
- …

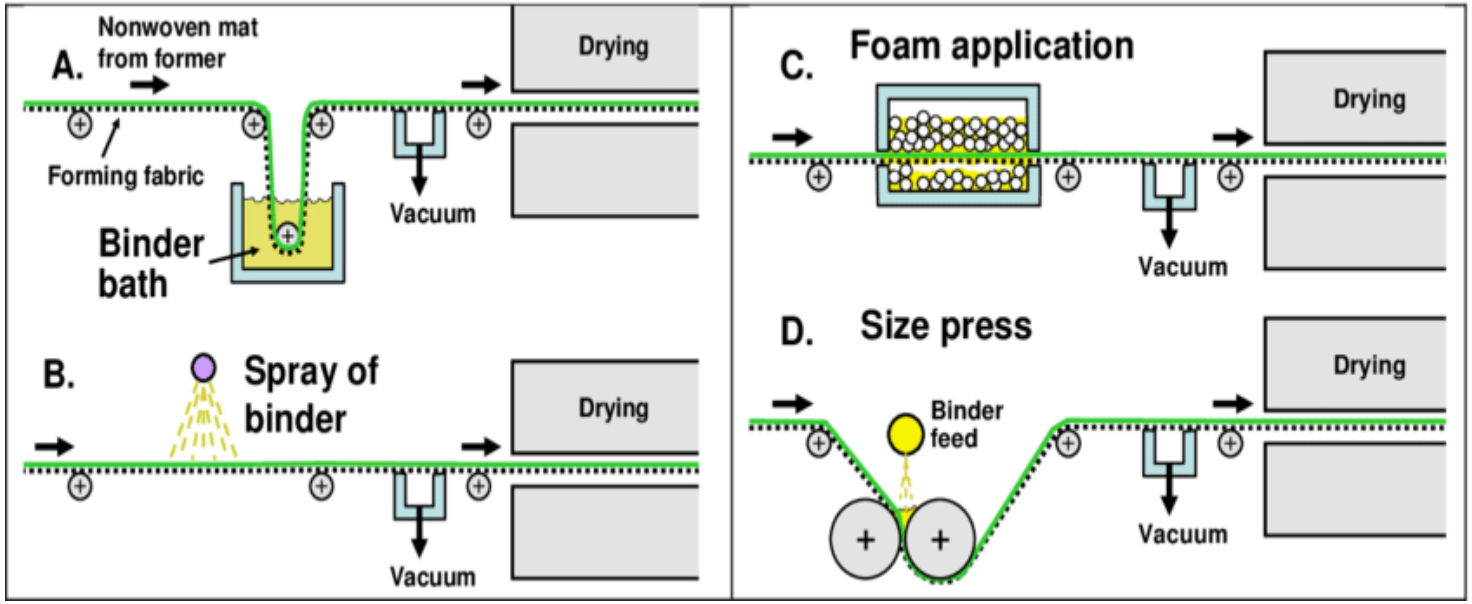
- Create added value products
- Achieve desired products requirements

CHEMICAL BONDING PROCESS

Types of chemical bonding



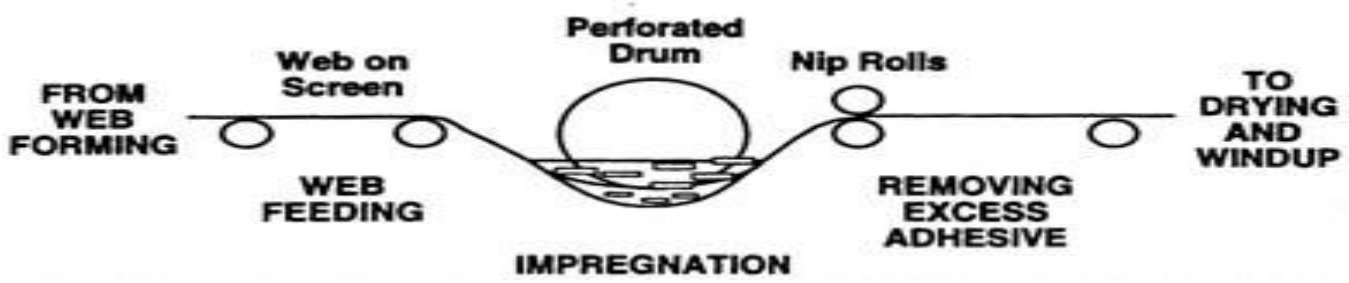
- Saturation
- Spray bonding
- Foam bonding
- Print bonding



CHEMICAL BONDING PROCESS

Saturation

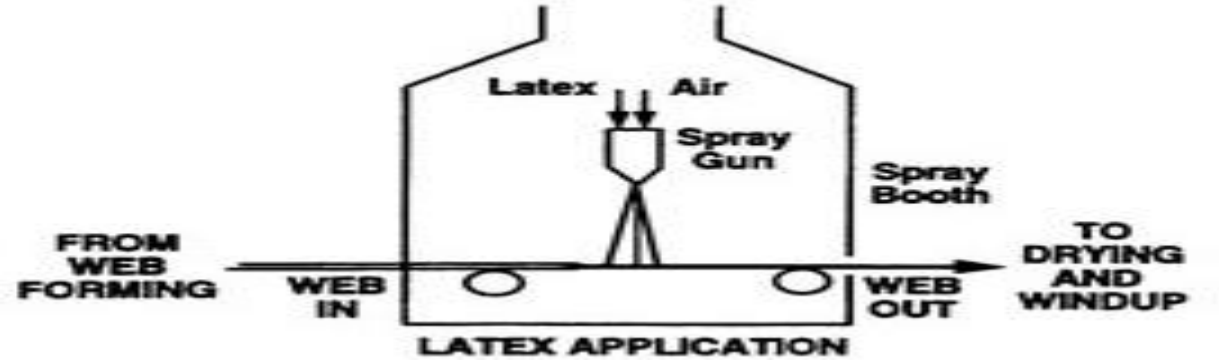
- Complete immersion of the nonwoven web in a bath containing binder
- Excess binder is removed by vacuum or roll press
- For fabric application which require strength, stiffness and maximum fiber encapsulation
- Amount of binder uptake depends on
  - basis weight of nonwoven
  - time spent in bath
  - wettability of fiber
  - nip pressure



CHEMICAL BONDING PROCESS

Spray bonding

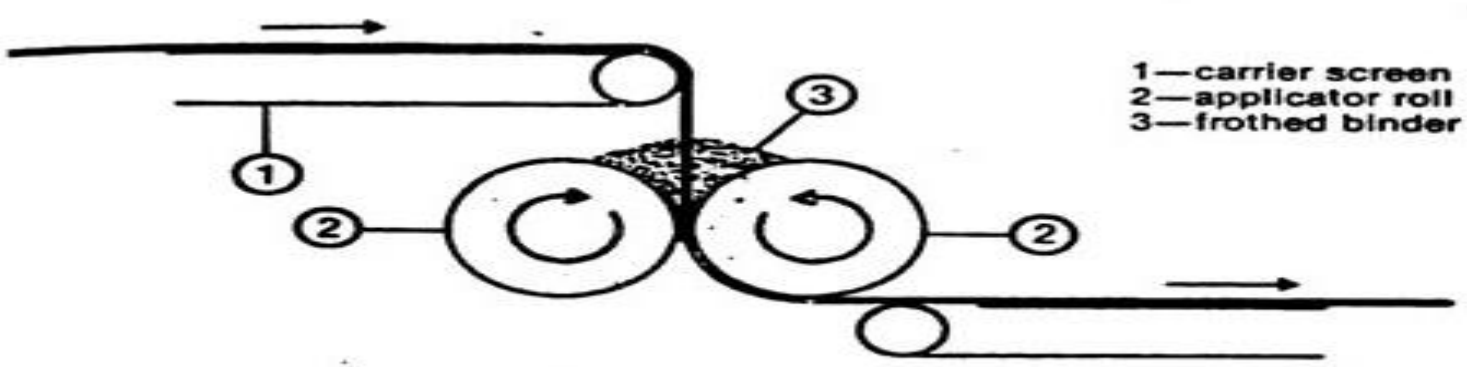
- Binder is sprayed onto moving web
- used for fabric applications which require the maintenance of high loft or bulk



CHEMICAL BONDING PROCESS

Foam bonding

- Means to apply at low water and high binder-solids concentration levels
- Require less energy in drying, since less water is used compared to saturation

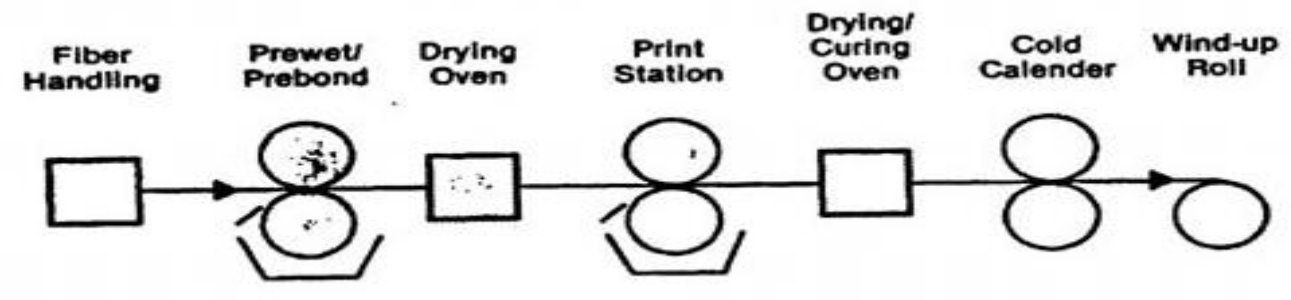


Binder frothed with air (unstable foam) — one of many application techniques

CHEMICAL BONDING PROCESS

Print bonding

- Applies binder only in the predetermine areas
- Is used for fabric applications which require binder free area on the fabric

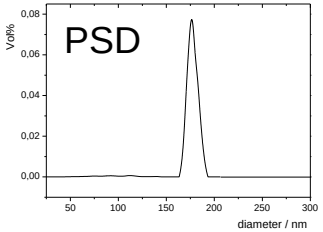


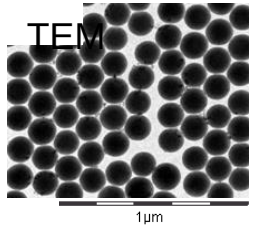
ALL ABOUT POLYMERISATION

Definition of Latex and Dispersion / Emulsion

- Latex: liquid (Latin), droplet (Greek)
  - ➔ naturally occurring rubber milk

- <u>Definition (Latex)</u>: A colloidal dispersion of polymer particles in an aqueous medium. The polymer may be organic or inorganic.
  - ➔ aqueous synthetic organic polymer colloids, esp. for butadiene-styrene copopolymer emulsions



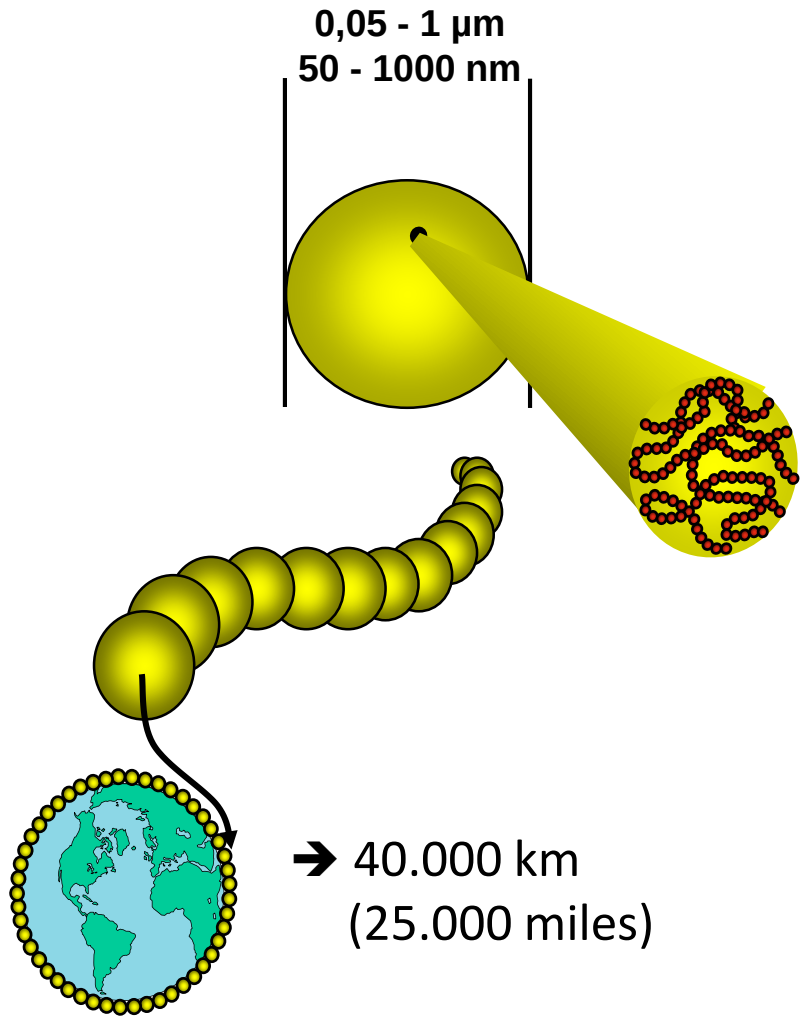


- <u>Definition (Polymer dispersion)</u>: A dispersion in which the disperse phase consists of polymer particles.

ALL ABOUT POLYMERISATION

Latex in number and size

- Specification of “typical” Latex
  - Solid content 50%
  - Particel Ø 150nm
  - 1ml of dispersion
    contains 2,6 × 10^{14} particles
  - 1 particle
    contains app. 10 - 10.000 macromolecular chains
  - 1 macromolecular chain
    contains app. 100 – 1.000.000 monomer units



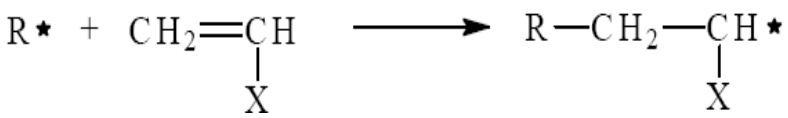
ALL ABOUT POLYMERISATION

Free radical chain polymerisation mechanisms

- Initiation
  - decomposition of initiator I (formation of free radicals R•)

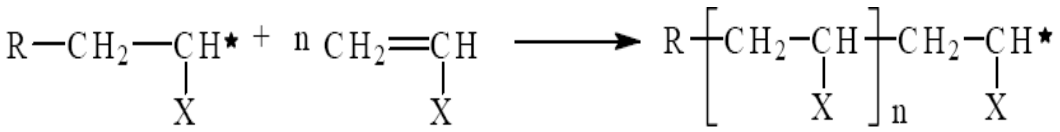
    $I \rightarrow 2\,R^{\bullet}$
  - initiation of chain

    $R^{\bullet} + M \rightarrow RM_1^{\bullet}$

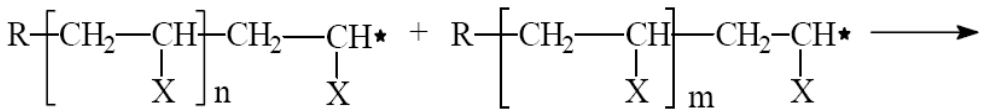


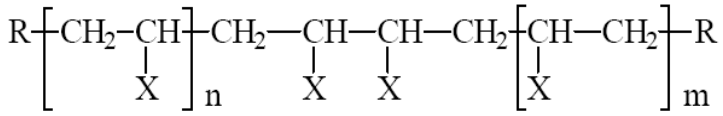
- Propagation

$RM_n^{\bullet} + M \rightarrow RM_{n+1}^{\bullet}$

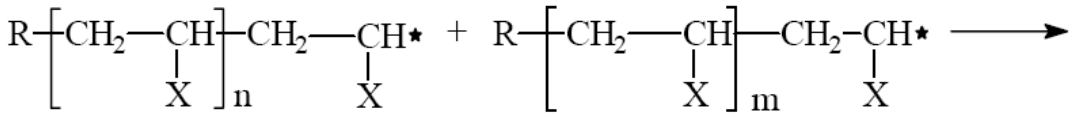


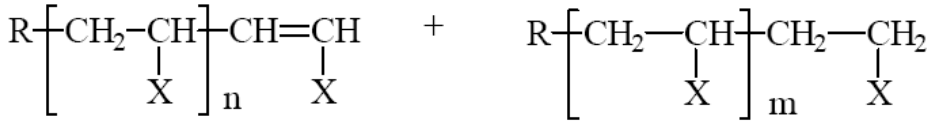
- Termination
  - combination





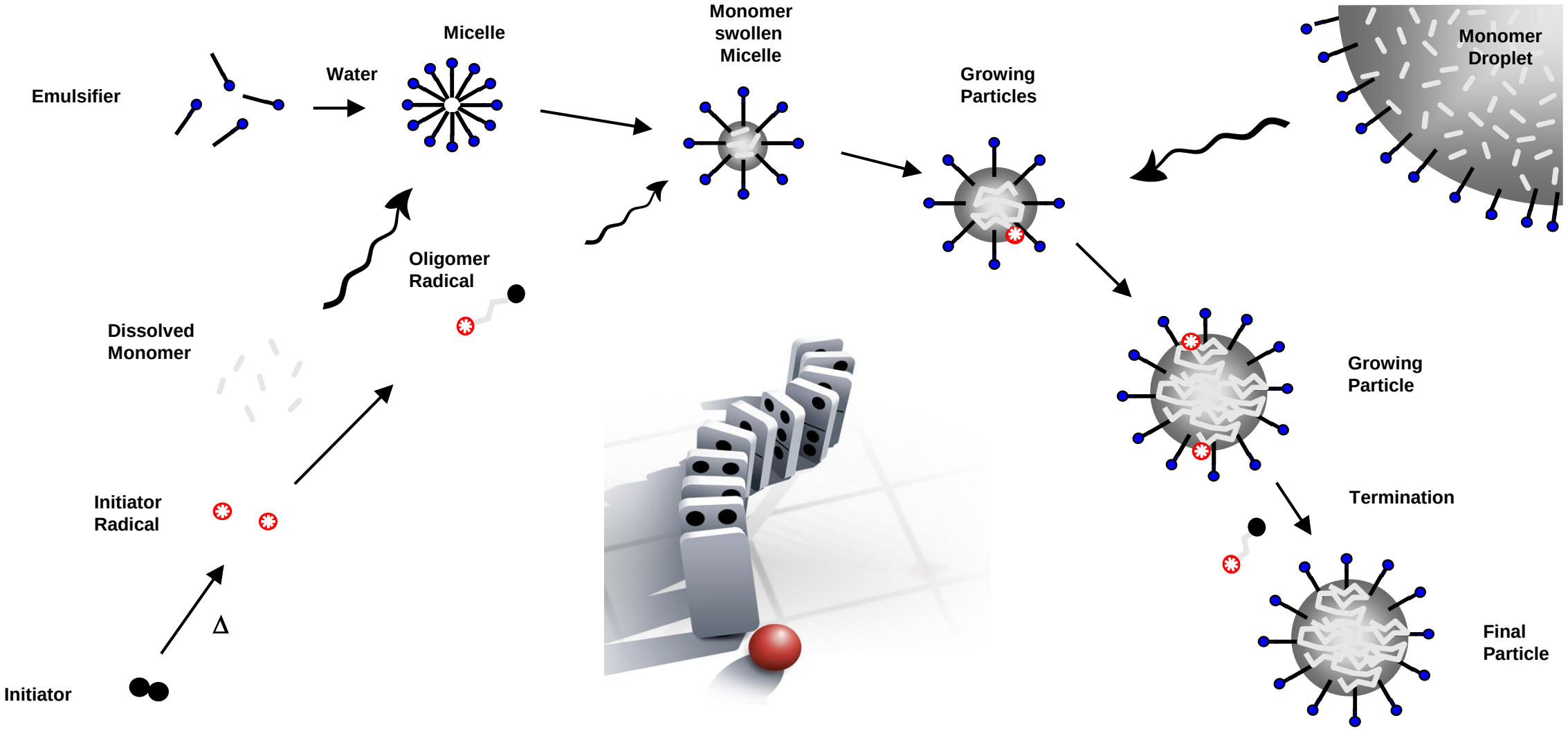
  - Disproportionation





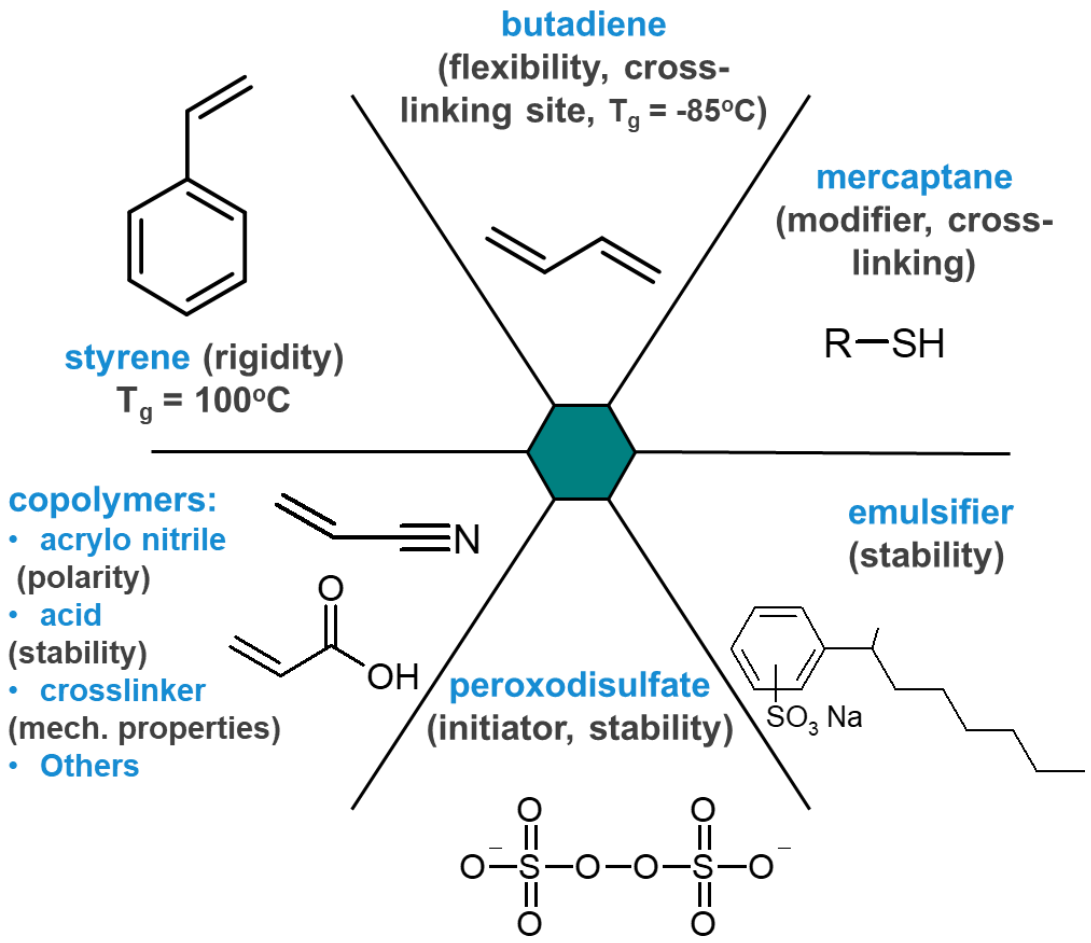
ALL ABOUT POLYMERISATION

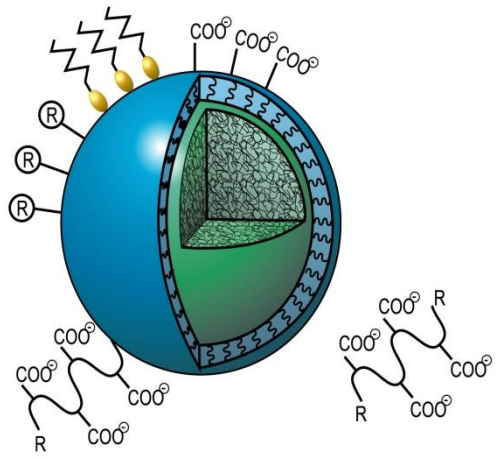
Emulsion polymerisation principle

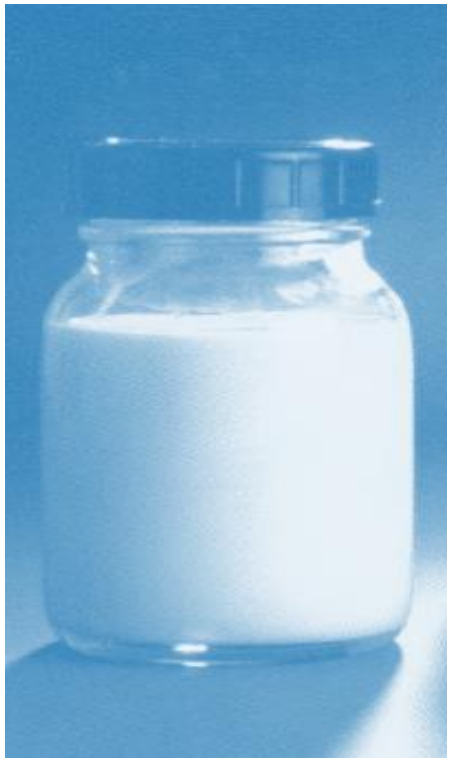


ALL ABOUT POLYMERISATION

Main components for XSBR latices polymerisation







ALL ABOUT POLYMERISATION

Crosslinking concept – building high polymer network

Concept of crosslinking

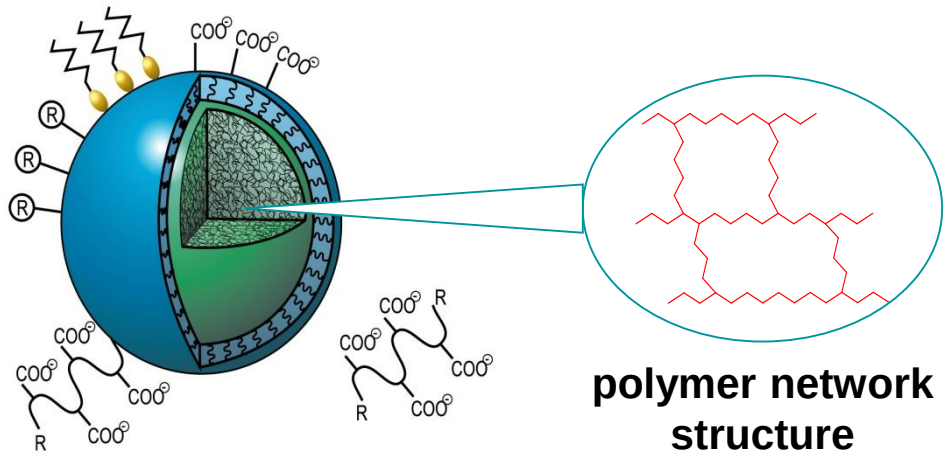
Creation of chemical bonds leads to increase of molecular weight and formation of polymer network

I. Crosslinking during the polymer synthesis

- monomers with 2 or more double bonds
- Process conditions

II. Crosslinking after polymer film formation

- By functional group within the polymer backbone
- More sophisticated the I.
- Allows ideal wetting and bonding to substrate



ALL ABOUT POLYMERISATION

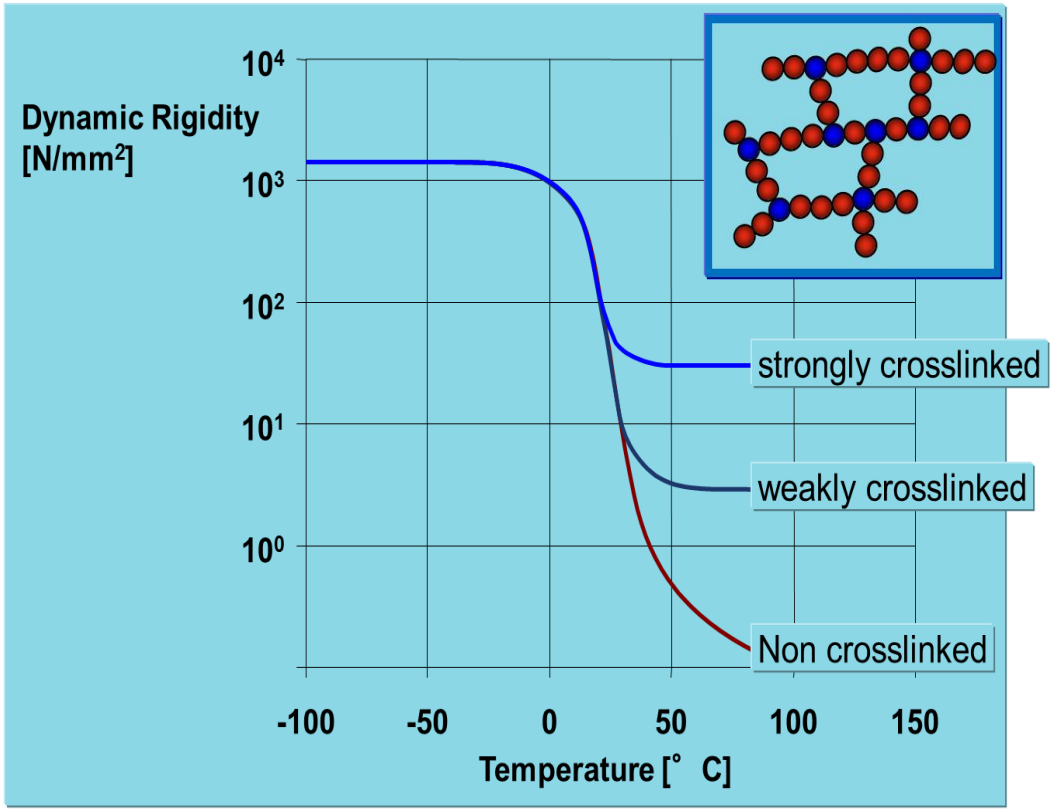
Crosslinking – Key for high performance Latices

Crosslinking leads to high performance on

- elasticity and resilience
- heat resistance
- tensile- / bonding strength
- resistance against solvents, acids, chemicals
- combination of soft handle & non blocking features
- better abrasion resistance

Crosslinking

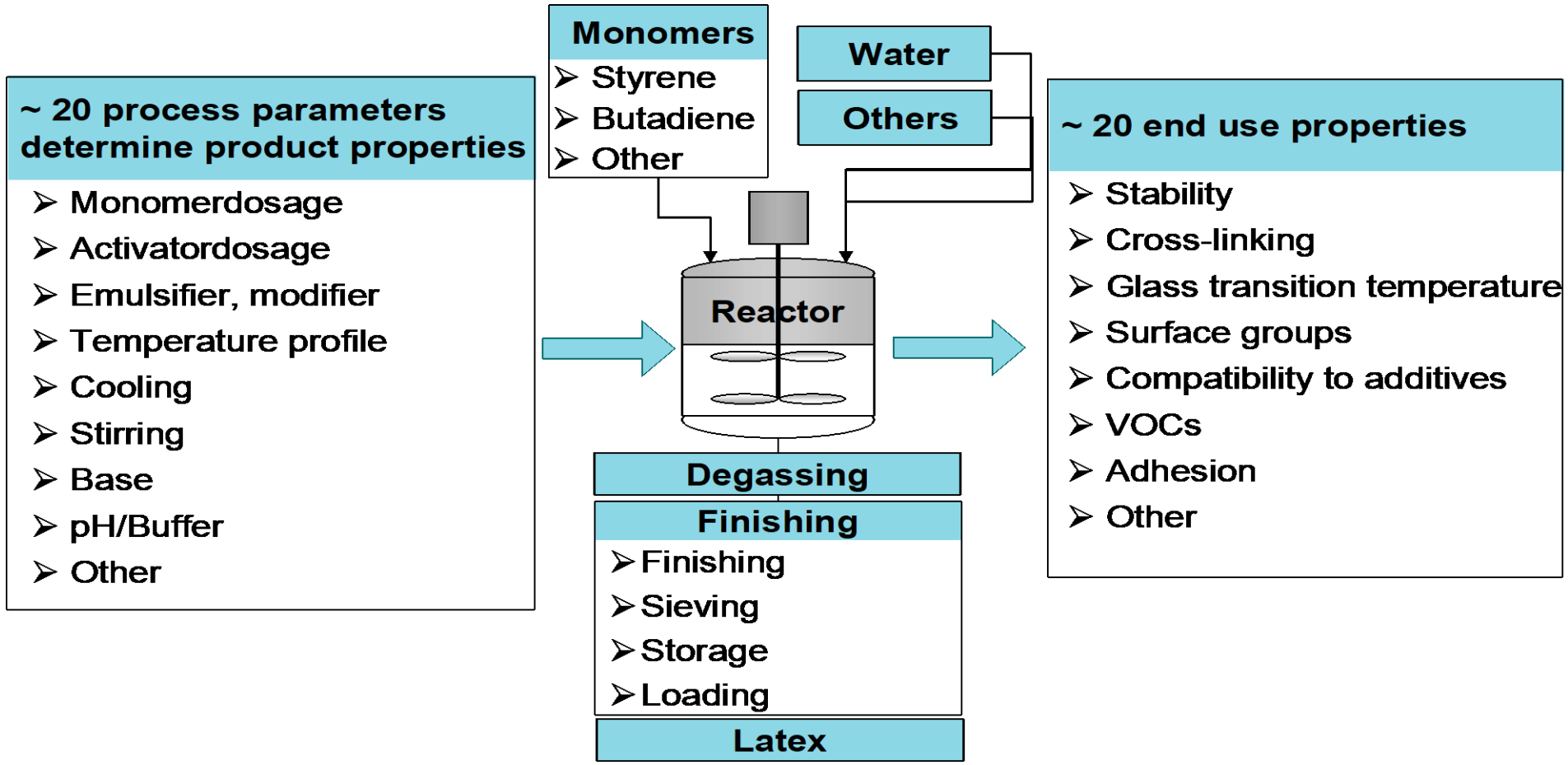
Impact on elasticity and resilience by DMA



ALL ABOUT POLYMERISATION

Emulsion polymerisation - Product development & process know-how

Emulsion polymerisation process is very flexible ➔ billions of combinations of process parameter



DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

Synthomers broad product portfolio

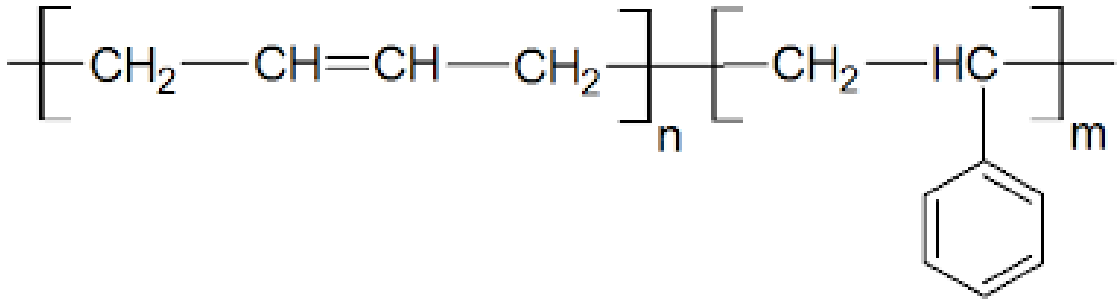
- xSBR - carboxylated styrene-butadiene-rubber
- HS-SBR - high-solid styrene-butadiene-rubber
- SA - styrene acrylics
- PA - pure acrylics
- NBR - nitrile-butadiene-rubber
- VP-SBR – vinyl-pyridine-styrene-butadiene-rubber
- CR – chloroprene latex
- VAc – Vinyl-acetate homopolymer
- VA-Co – Vinyl-acetate co-polymers
- NR – natural rubber

Apart from Synthomer portfolio

- EVA – Ethylene-vinyl-acetate
- PUD – Polyurethane-dispersion

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

xSBR - carboxylated styrene-butadiene-rubber



Key-Properties

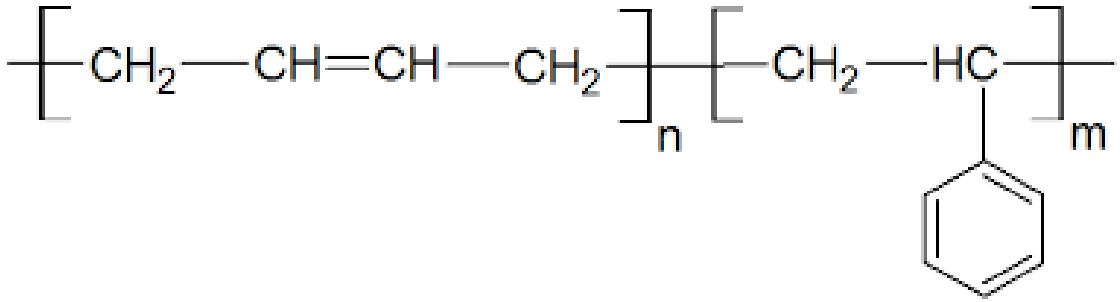
- Hydrophobic
- Temperature resistant
- Alkaline resistant
- Good resilience
- Durability
- internal and external crosslink-able, vulcanizable
- Excellent combination flexibility and toughness

Application used for

- Finishing of glass fibres (EIFS)
- Hygiene Nonwovens (ADL)
- PES Nonwoven for roofing
- Footwear
- Abrasives

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

HS-SBR – high-solid styrene-butadiene-rubber



Key-Properties

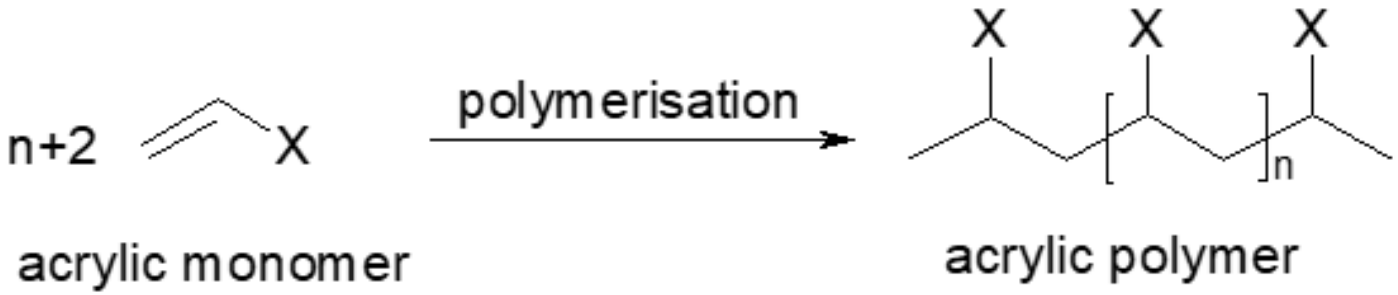
- Alternative for natural rubber
- very soft and elastic
- vulcanizable

Application used for

- Mattresses
- Clutches
- footwear
- friction papers
- sealants

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

Pure acrylics & styrene acrylics



Key-Properties

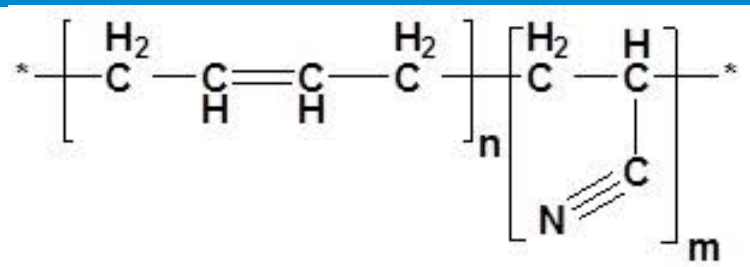
- Excellent UV resistance
- Very good weathering resistance
- acid resistant
- solvent resistant
- internal and external crosslink-able

Application used for

- Filter
- Tents
- Awnings
- Blinds
- Battery separators
- Technical paper
- Deco laminates

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

NBR - nitrile-butadiene-rubber



Key-Properties

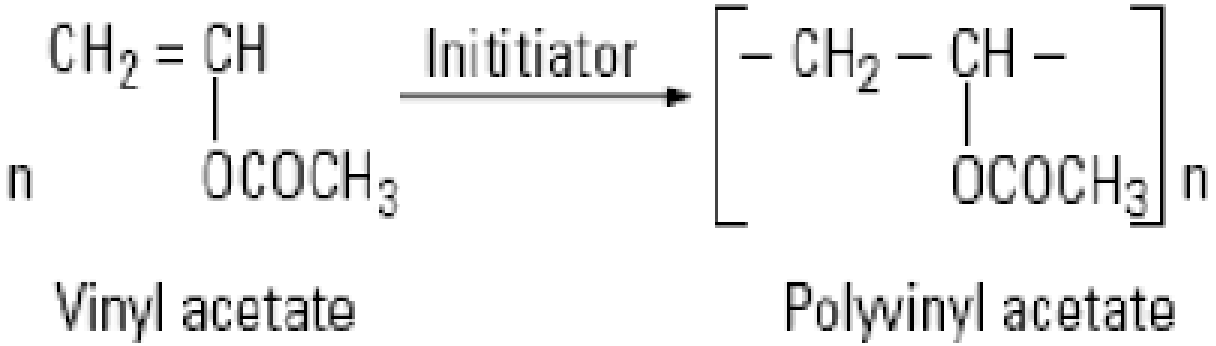
- Excellent Oil, fat & grease resistance
- chemical resistance
- wash resistance
- Very soft haptic, dry and tack free coatings
- internal and external crosslink-able, vulcanizable,
- adhesion promoter

Application used for

- Sealants
- Gaskets
- Clutches
- Abrasives
- Artificial leather
- Wipes

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

VAc – Vinyl-acetate homopolymer & VA-Co – Vinyl-acetate co-polymers



Key-Properties

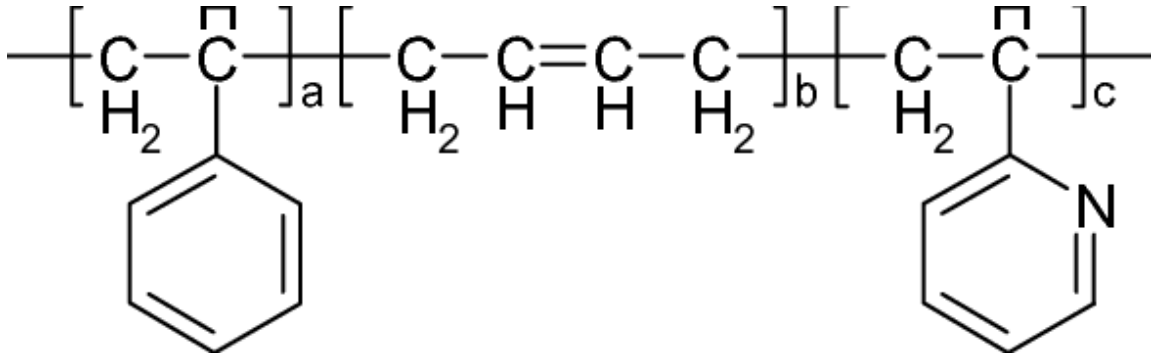
- Hydrophobic
- Temperature resistant
- Alkaline resistant
- Good resilience
- Durability
- internal and external crosslink-able, vulcanizable
- Excellent combination flexibility and toughness

Application used for

- Finishing of glass fibres mats
- Hygiene Nonwovens
- Footwear
- Abrasives

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

VP-SBR – vinyl-pyridine-styrene-butadiene-rubber



Key-Properties

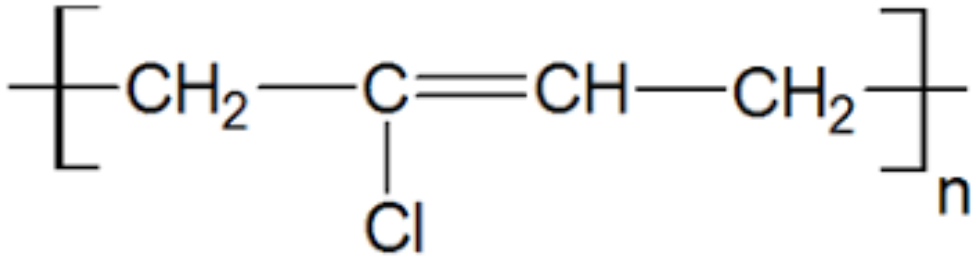
- Excellent adhesion to Polyamide, PES, Aramide
- Hydrophobic
- Temperature resistant
- Durability
- internal and external crosslink-able, vulcanizable
- Excellent combination flexibility and toughness
- Adhesion promoter

Application used for

- Adhesion promoter for rubber materials
- tire cord
- conveyor belts
- hoses

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

CR – chloroprene latex



Key-Properties

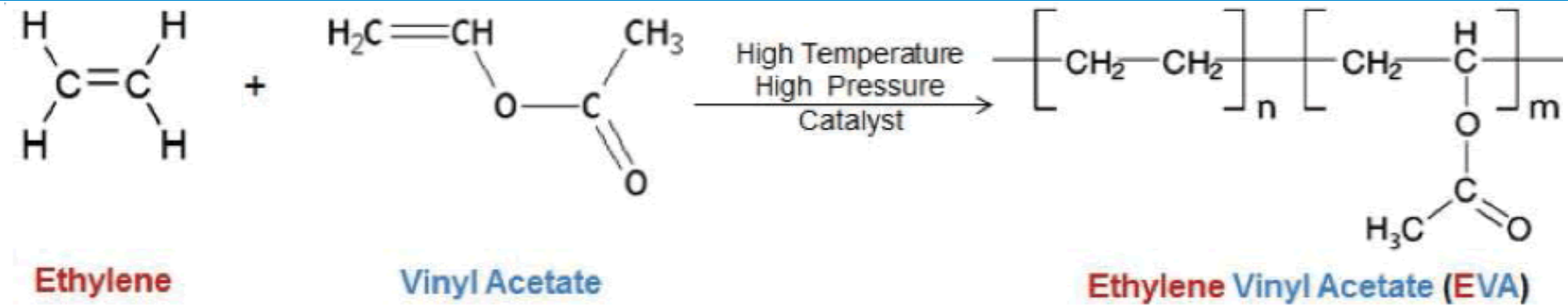
- Excellent Oil, fat & grease resistance
- chemical resistance
- flame retardant
- wash resistance
- very soft
- vulcanizable

Application used for

- Protection clothes
- Sealants
- Footwear

DIFFERENT CHEMISTRIES, DIFFERENT PROPERTIES

EVA – Ethylene-vinyl-acetate



Key-Properties

- High wet-strength
- Different hands possible
- More odor then other binders
- Excellent absorbency
- Cheap

Application used for

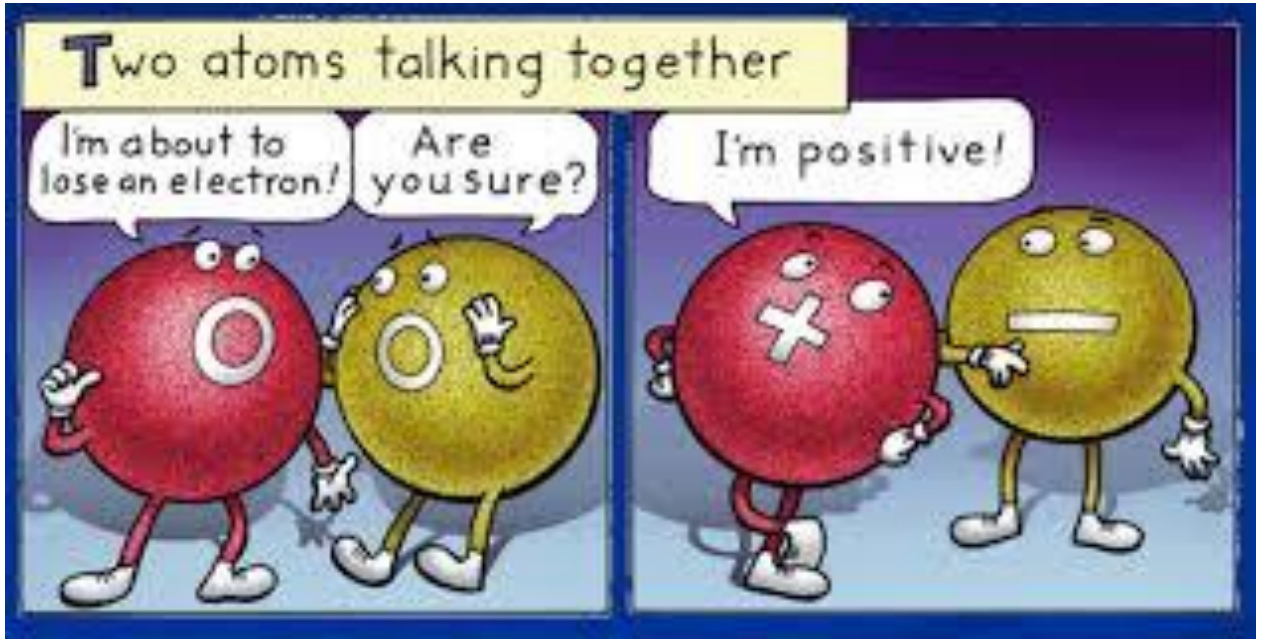
- Wet wipes
- Air-laid pulp fabrics

SUMMARY

Chemically bonded Nonwovens – adding value to the industry

- Different ways of web formation
- Different methods of web bonding
- Chemical bonding creates added value
- Emulsion polymerisation process very flexible
- Different chemistries deliver different properties

➔ Synthomer as reliable & innovative supplier



How

Can We Improve Your Nonwoven?

Chemically bonded Nonwovens

Vorteile und Grenzen verschiedener Dispersionsbindemittel

Matthias Renka

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34. Hofer Vliesstofftage, Hof - Germany