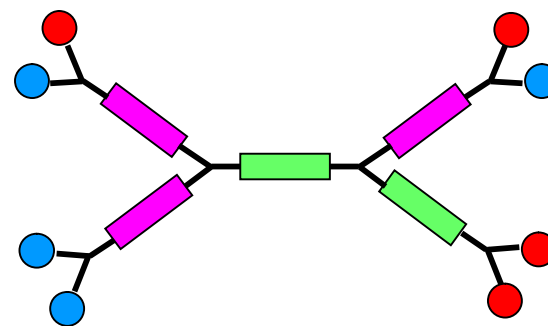


HYBRANE®

**DSM's hyperbranched
polymer platform**

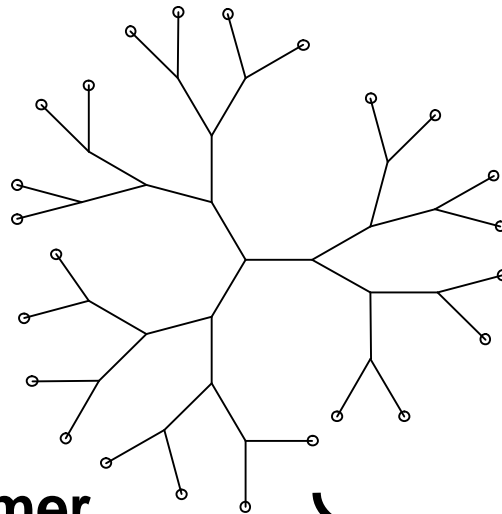
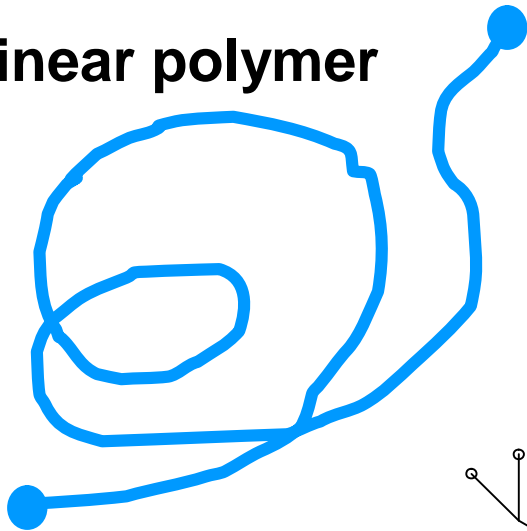


**hyperbranched polyesteramides
- properties**

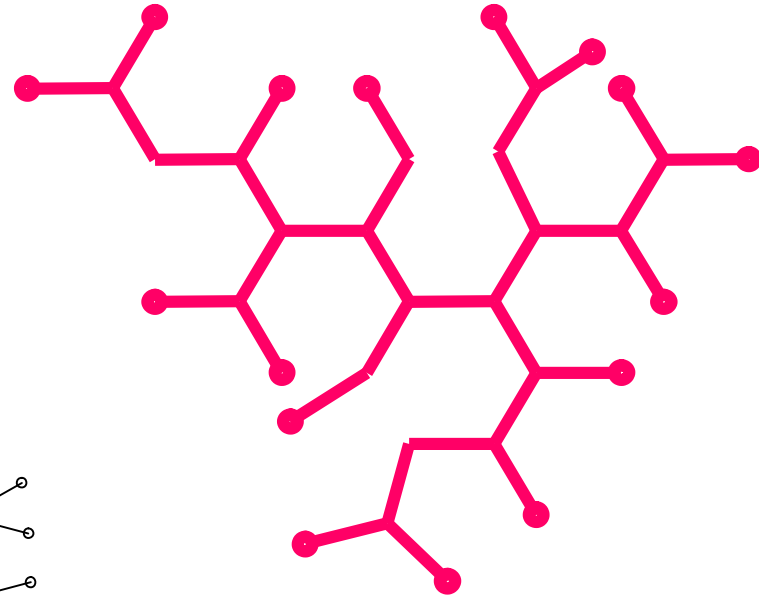
Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

linear polymer



dendrimer



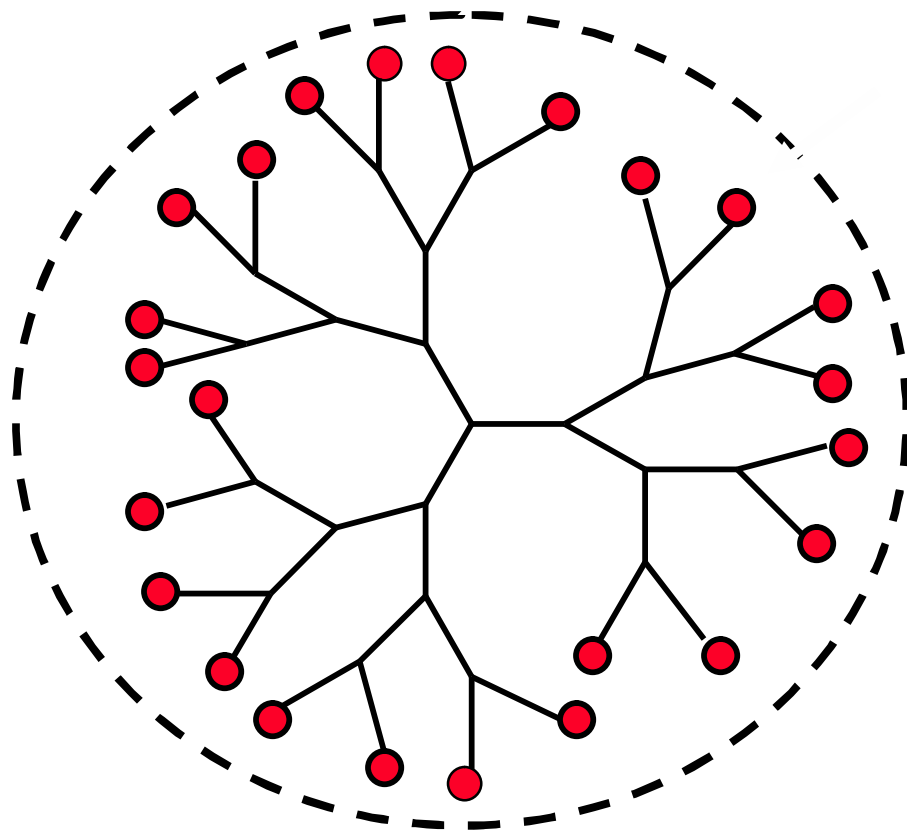
hyperbranched polymer

dendritic polymers

Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

CHARACTERISTICS OF DENDRITIC MACROMOLECULES 3

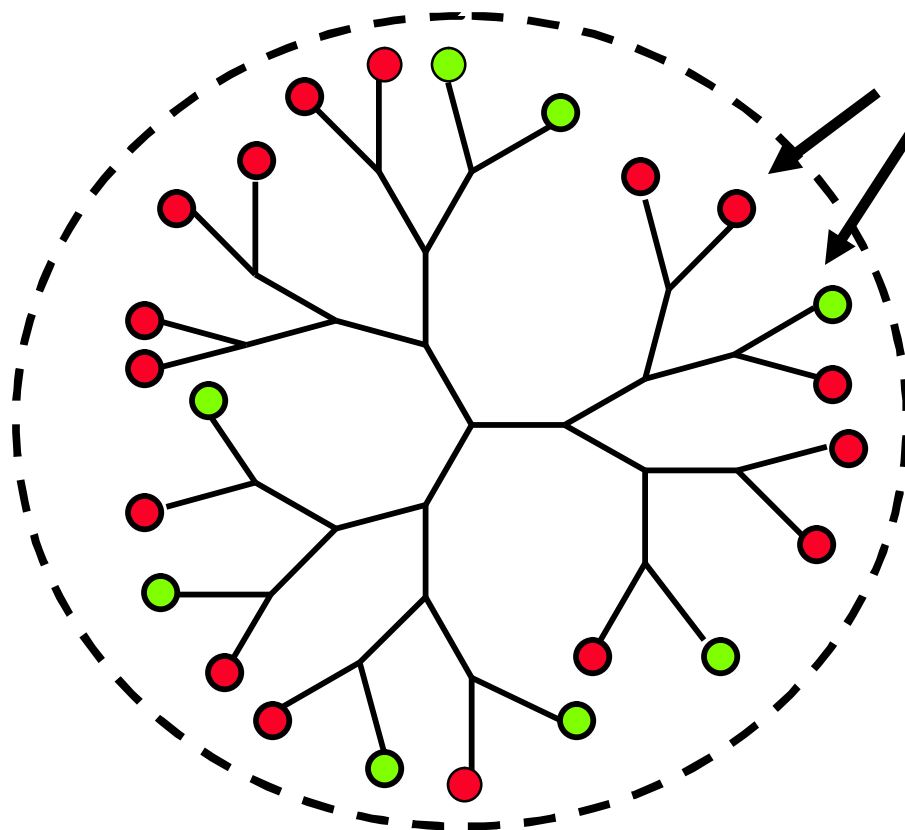


many reactive
end groups

Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

CHARACTERISTICS OF DENDRITIC MACROMOLECULES 4



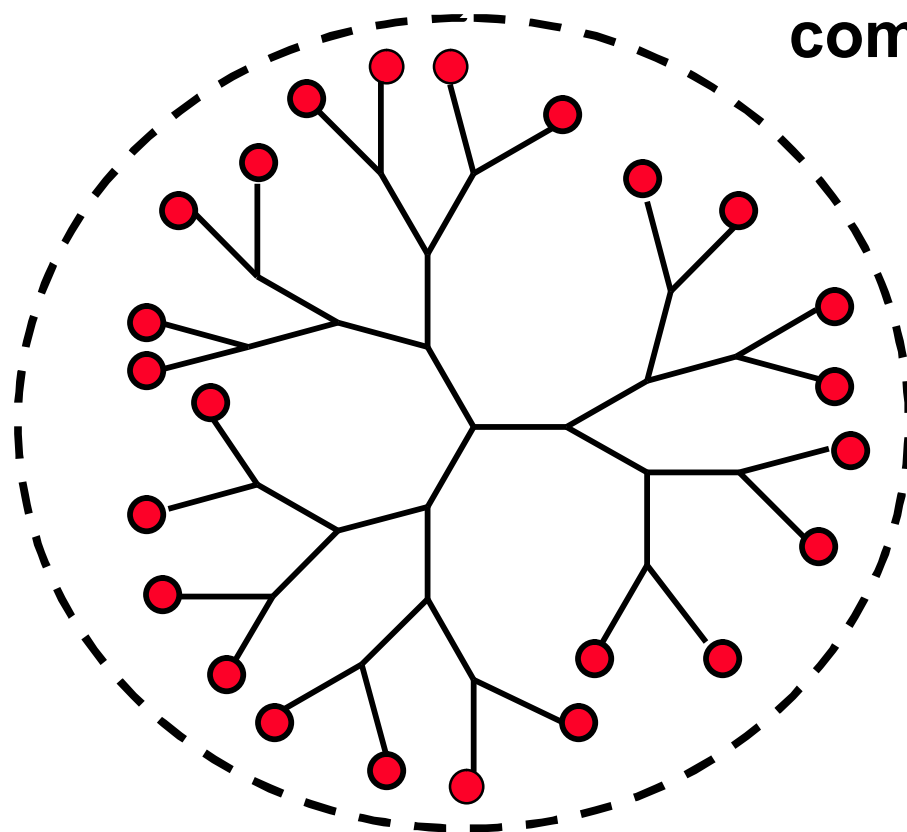
many reactive
end groups:
(partial) functionalization

control over (e.g.)
- solubility
- interfacial properties

Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

CHARACTERISTICS OF DENDRITIC MACROMOLECULES 5

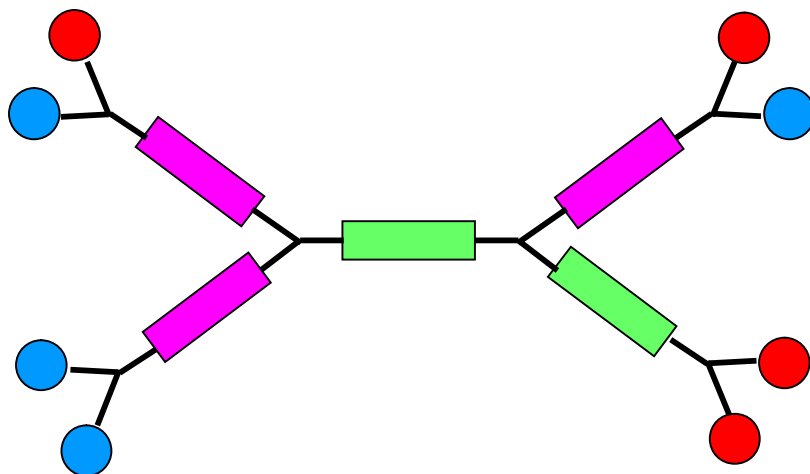


compact spherical shape

- low bulk viscosity
- low solution viscosity

Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**



- broad variation of structures
- control over properties

Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

- number-average molecular weight: 1000-5000
- broad molecular weight distribution

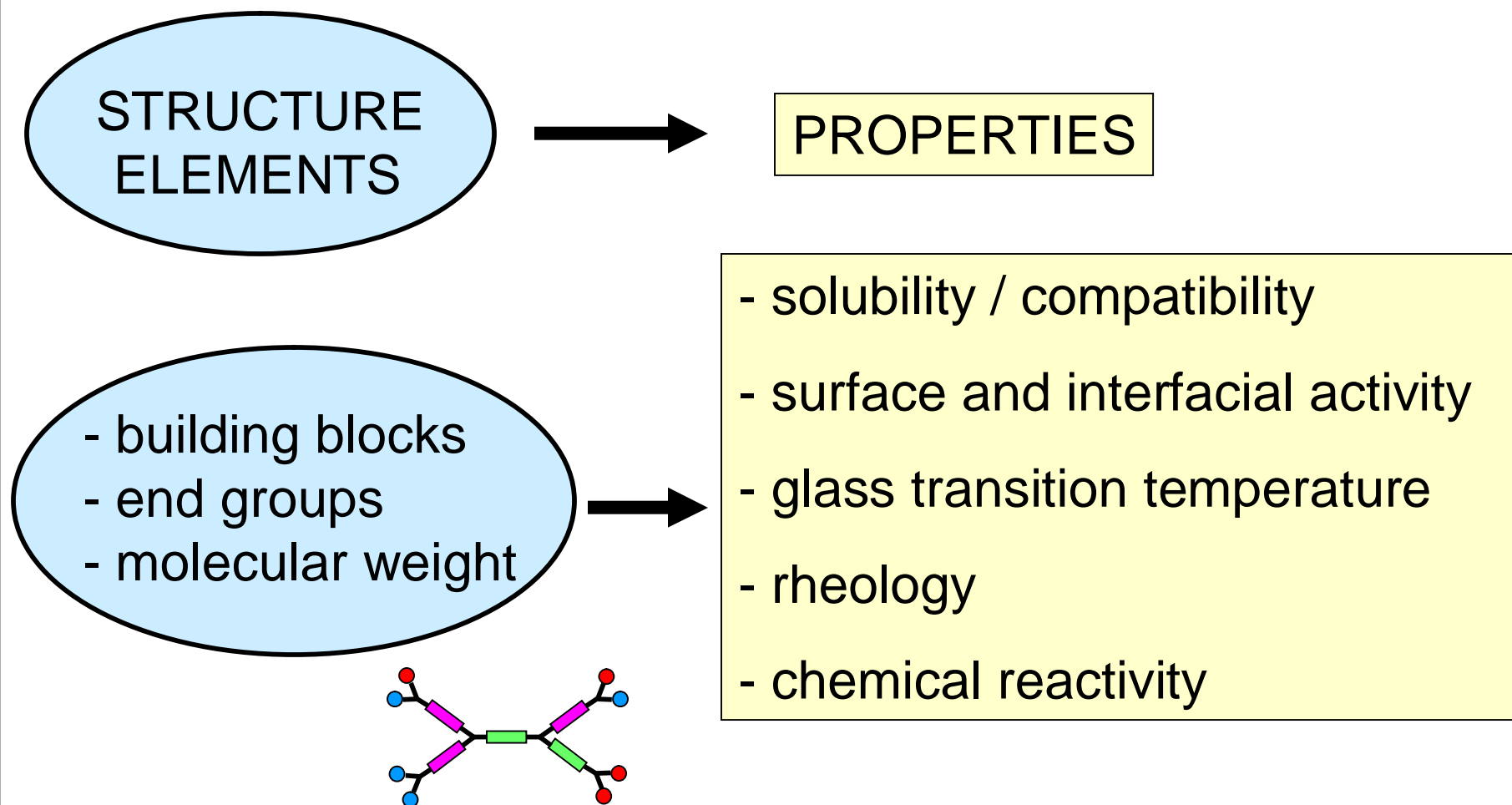
- appearance: viscous liquids to solid resins

- solubility:
 - soluble in most organic solvents
 - hydrocarbons: depending on components
 - water: depending on components

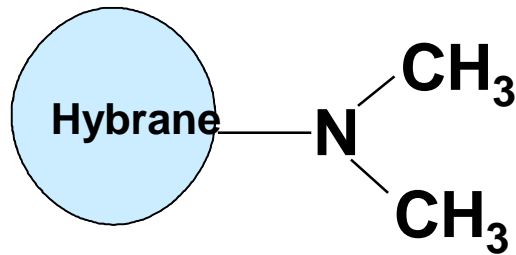
- stability:
 - thermal: up to 220 °C
 - hydrolysis: stable in water at pH 5-9
 - intrinsically biodegradable

Hybrane, DSM's hyperbranched polymer platform

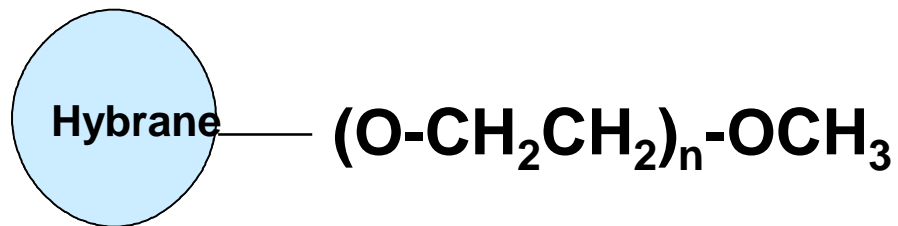
Unlimited. **DSM**



Hybrane, DSM's hyperbranched polymer platform



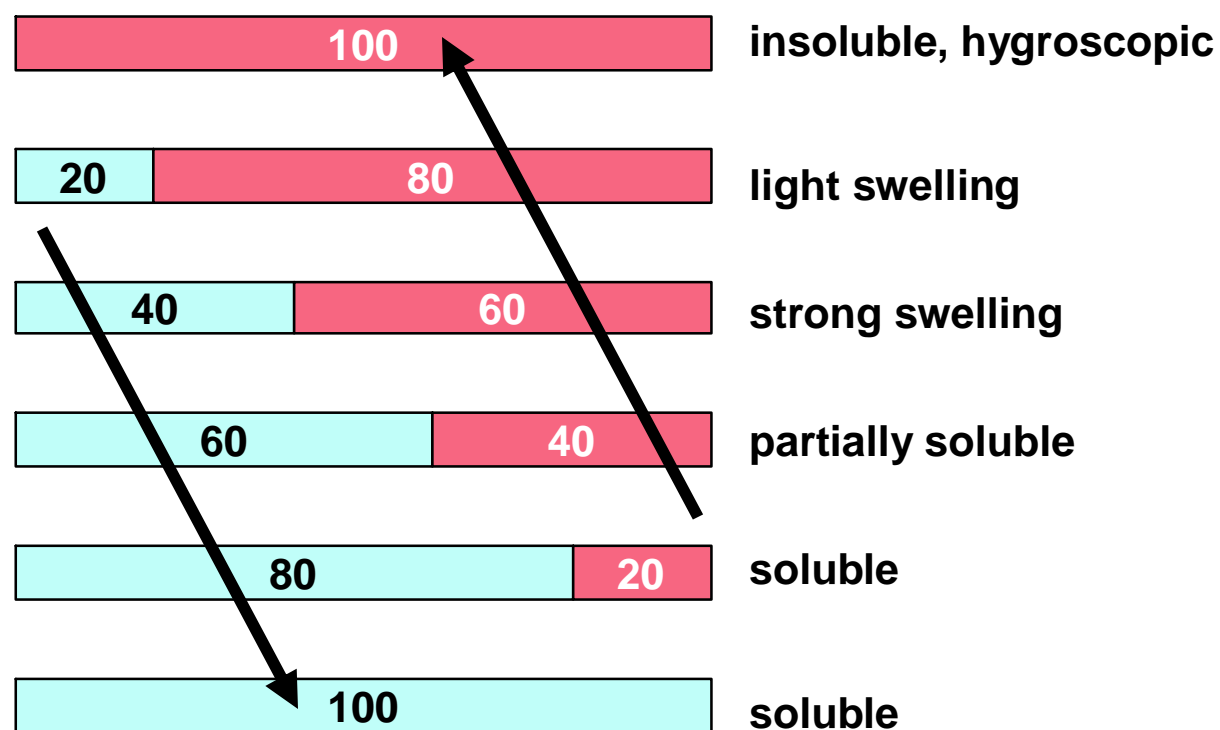
water soluble through
end groups



Hybrane, DSM's hyperbranched polymer platform

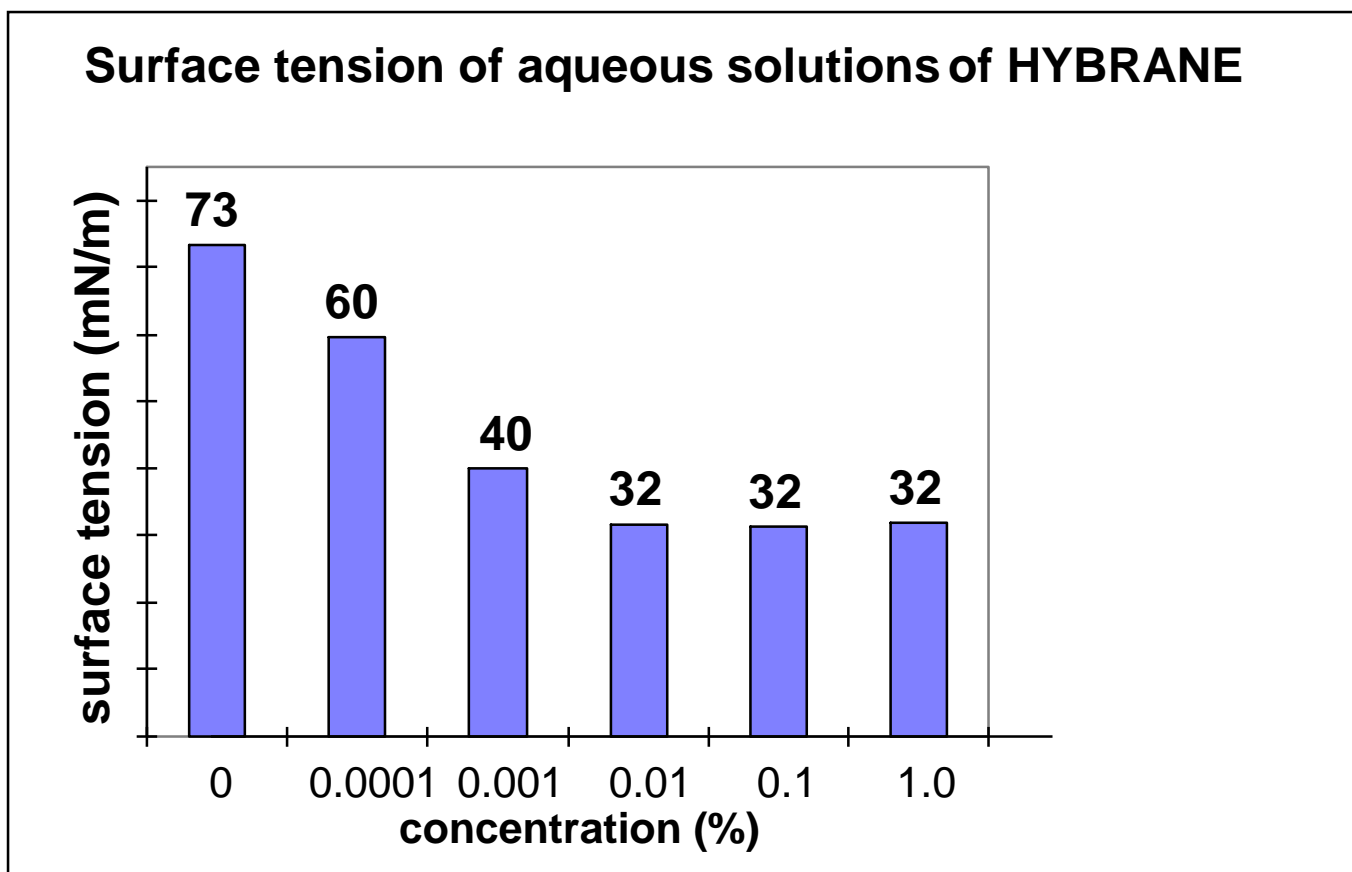
Unlimited. **DSM**

WATER SOLUBILITY DEPENDING ON BUILDING BLOCK 10



Hybrane, DSM's hyperbranched polymer platform

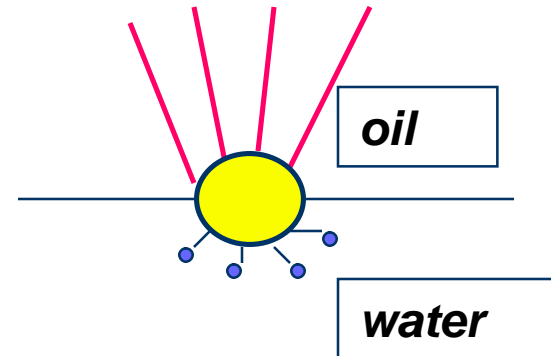
Unlimited. **DSM**



Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

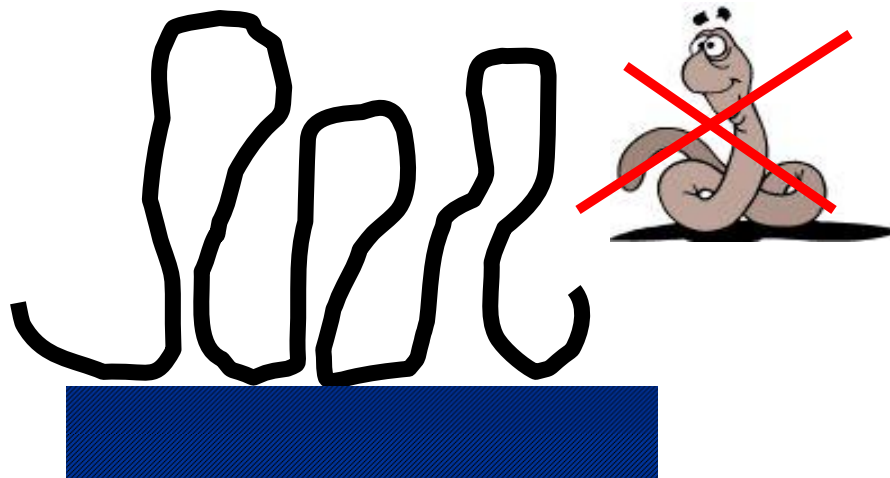
- many polar heads
- many apolar tails



- tailoring of hydrophilic/lipophilic balance
- active at low concentrations
- low critical micelle concentration

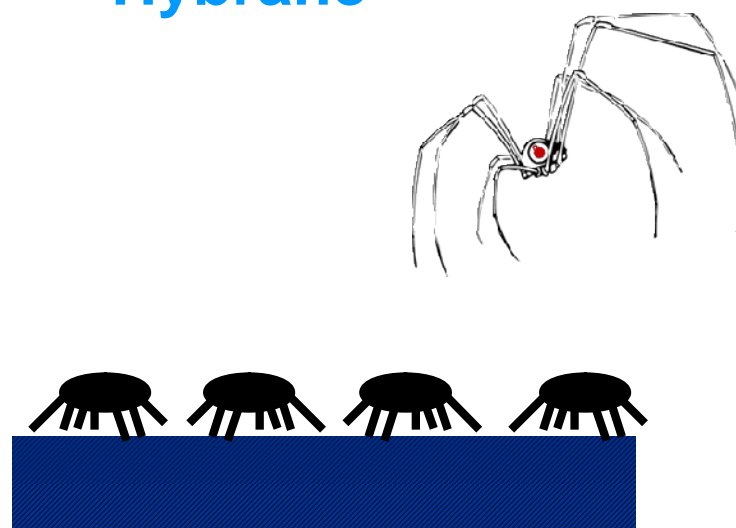
Comparable to “gemini surfactants”

linear polymer



- free "loops"
- adsorbed "trains"
- small fraction of molecule takes part
- **loss of entropy**

Hybrane



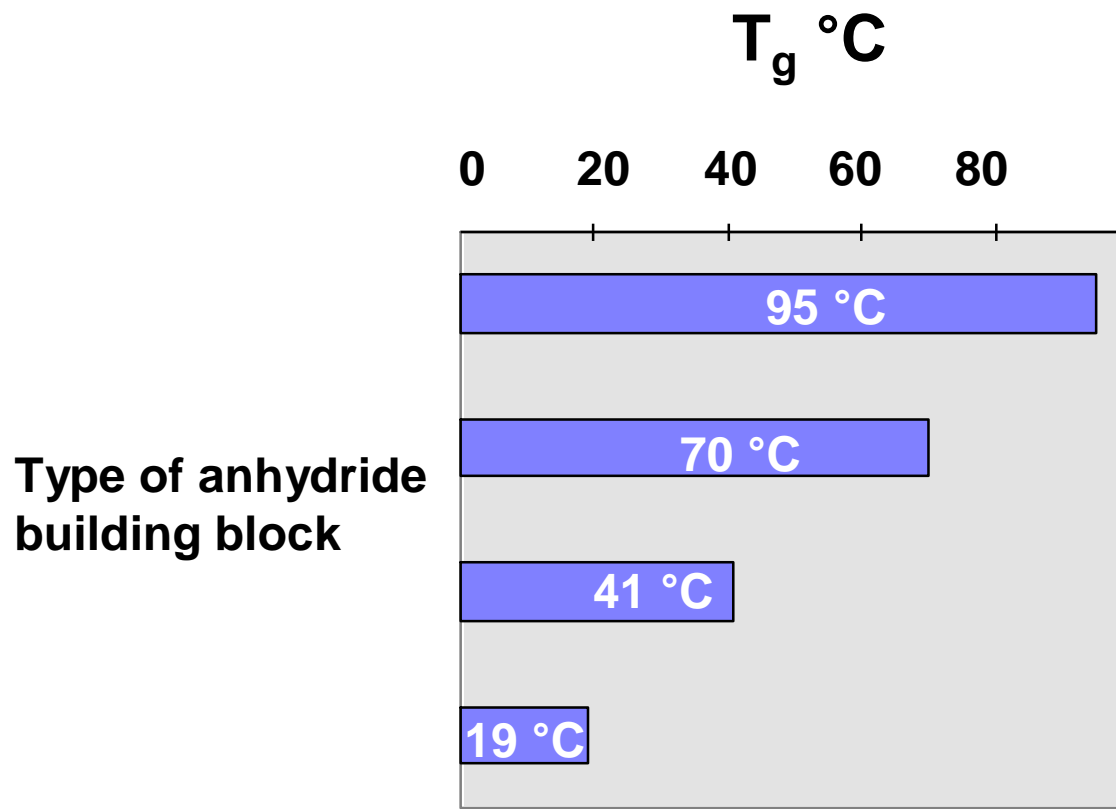
- no loops
- molecules flatten
- whole molecule takes part, more efficient use
- **limited loss of entropy**

Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

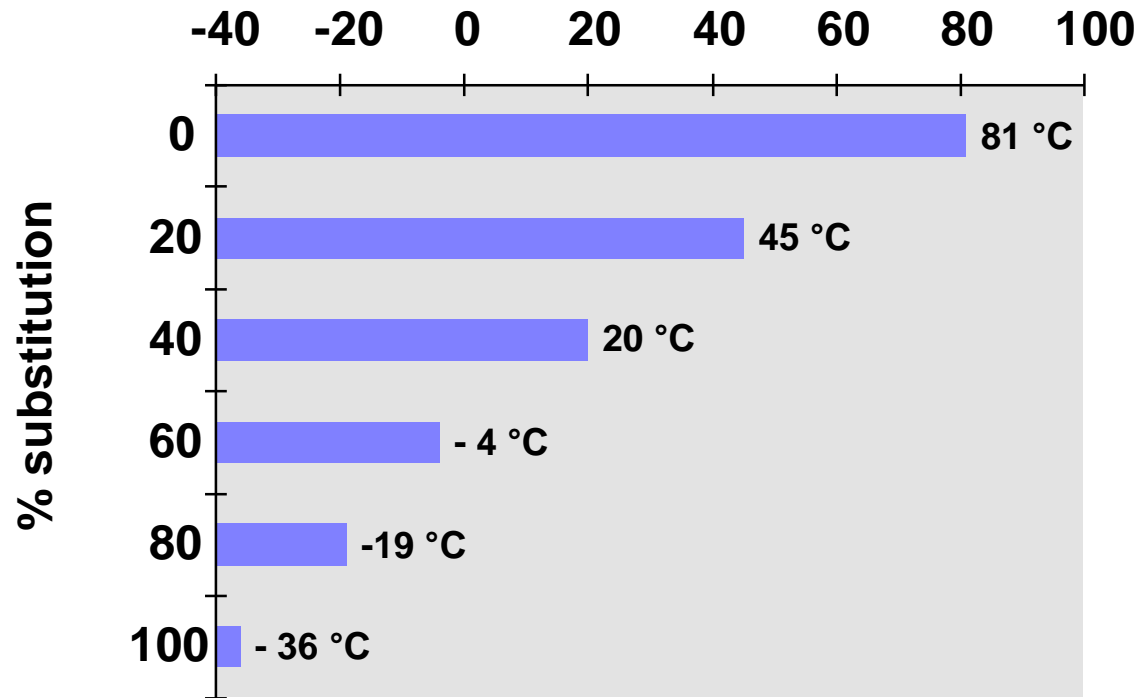
T_g of HYBRANE determined by

- building blocks**
- end groups**
- molecular weight**



Hybrane, DSM's hyperbranched polymer platform

Influence of end groups

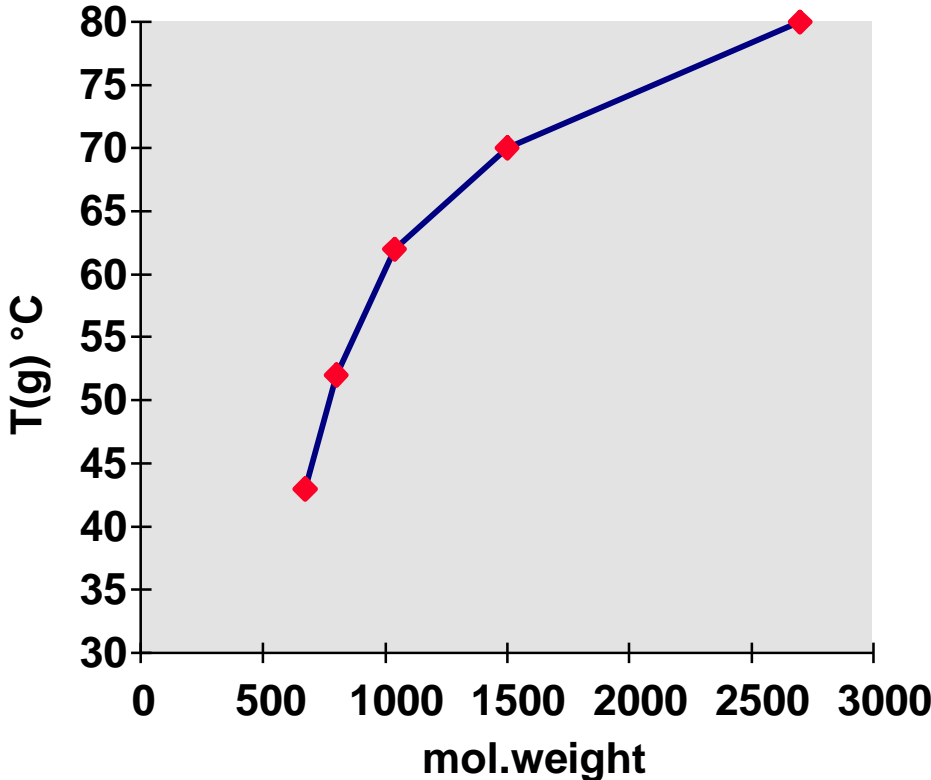


Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

Influence of molecular weight

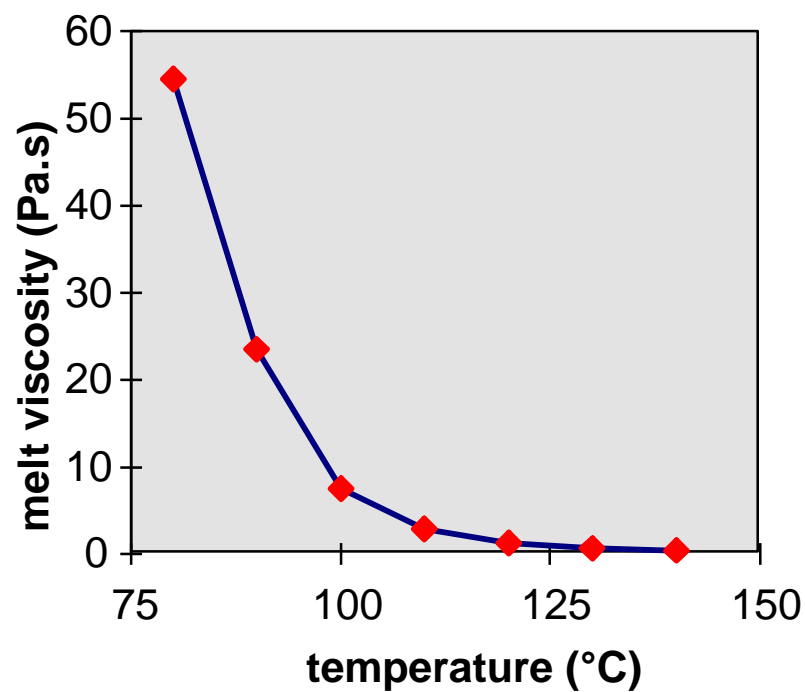
T_g of base resin



Hybrane, DSM's hyperbranched polymer platform



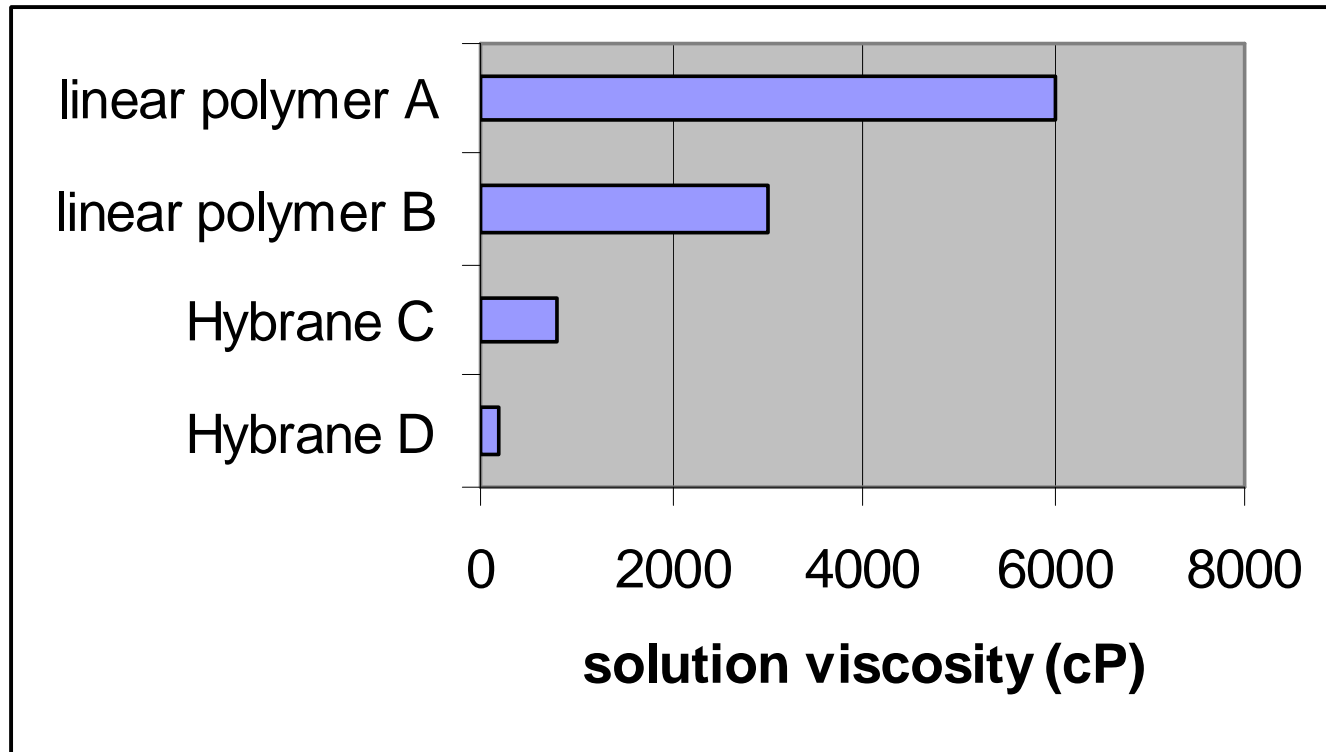
HYBRANE PS2550



Hybrane, DSM's hyperbranched polymer platform

Unlimited. **DSM**

Viscosity of 50 % solutions



Straightforward synthesis and modification



Broad variety of structural elements



Tailoring of properties



Performance additive in many applications