Polygels and Tempoxy-LO in NaClO based formulations

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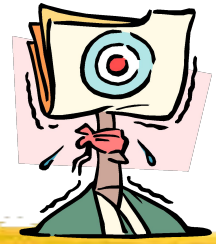
Agenda

- Project Objectives
- Polygel CA and CK
- Technical Data for Polygels
- Tempoxy-LO
- Technical Data for Tempoxy-LO
- Conclusions
- Appendix 1: NaClO formulations with Polygel
- Appendix 2: Raw Material

Project Objective



- Develop NaClO based formulations with
  - good **rheological behaviour**,
  - good **on-storage stability** for **viscosity** and **NaClO content**,

Conclusions

- **Polygel CA and CK** deliver a good **rheological behaviour** and **stability profile** for NaClO based formulations
- **Tempoxy-LO** improves even further the on-storage **rheological stability**.

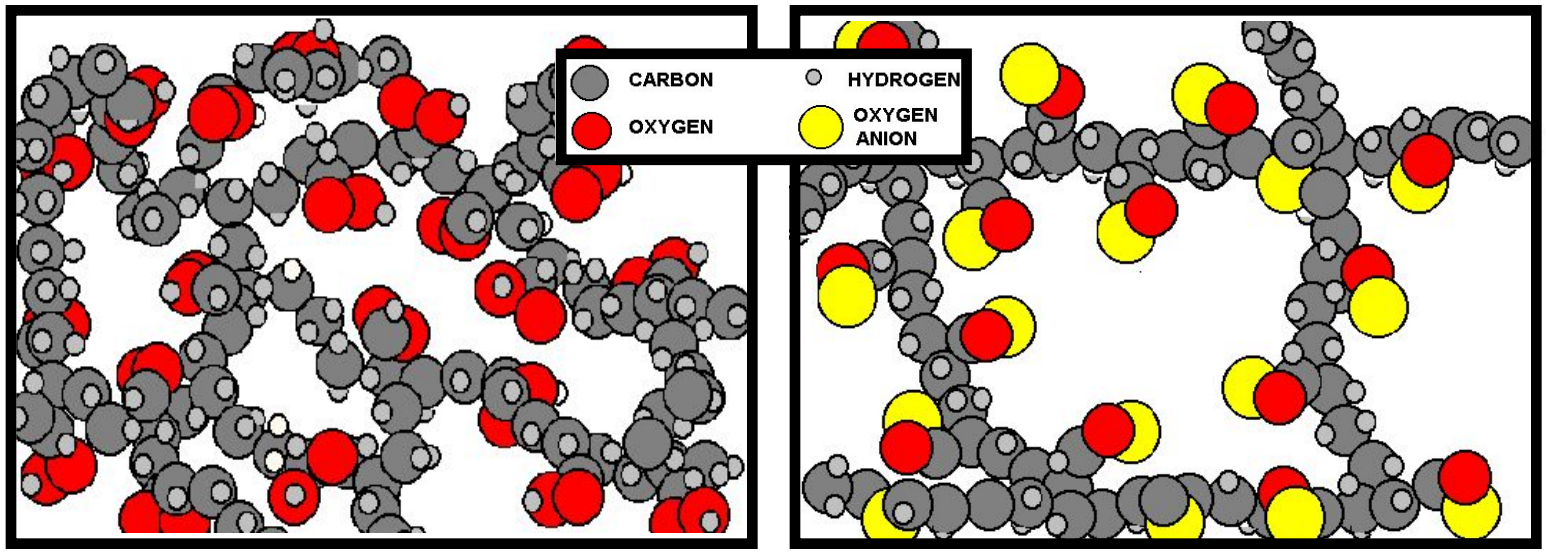
Polygel CA and Polygel CK

- Polygel CA and Polygel CK are powdered cross-linked Polyacrylates.
- They are capable to impart visco-elastic behaviours.

Thickening Mechanism

" The electrostatic repulsion between adjacent carboxylic groups is the main factor influencing the polymer swelling degree and then the thickening capability of carbomer's dispersion."

Acidic Medium ***Alkaline Medium***



Neutralizers

- Polygel CK shows better result in term of viscosity/stability using KOH solution to adjust the pH.

- Potassium ion has a bigger diameter compared to Sodium, maximizing the polymer swelling mechanism.

Polygel Properties

- Polygel CA and CK deliver:
  - Shear thinning rheology
    - Improvement of easiness in application
    - Spray-ability
  - Plastic behaviour
    - Yield Value
    - Reduction in mist pattern
    - Vertical cleaning
    - Splashing reduction

Polygel and Bleach

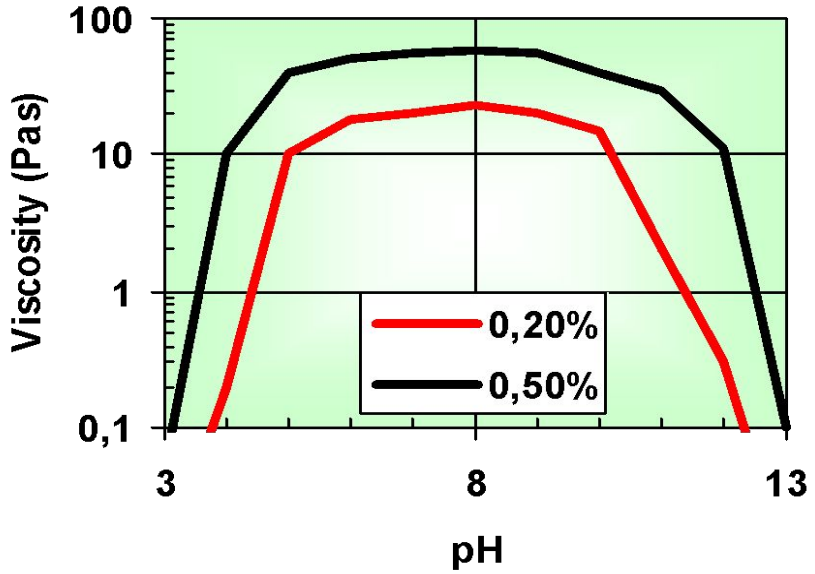
- **Polygel CA and Polygel CK show excellent stability in bleach formulation.**
- Depending from different formulations, they show good overall stability with an $AvCl_2$ between 1% and 4%.
- A viscosity improvement is evident within the first 10 days of storage.
- they are stable for 10-12 weeks at 40°C.

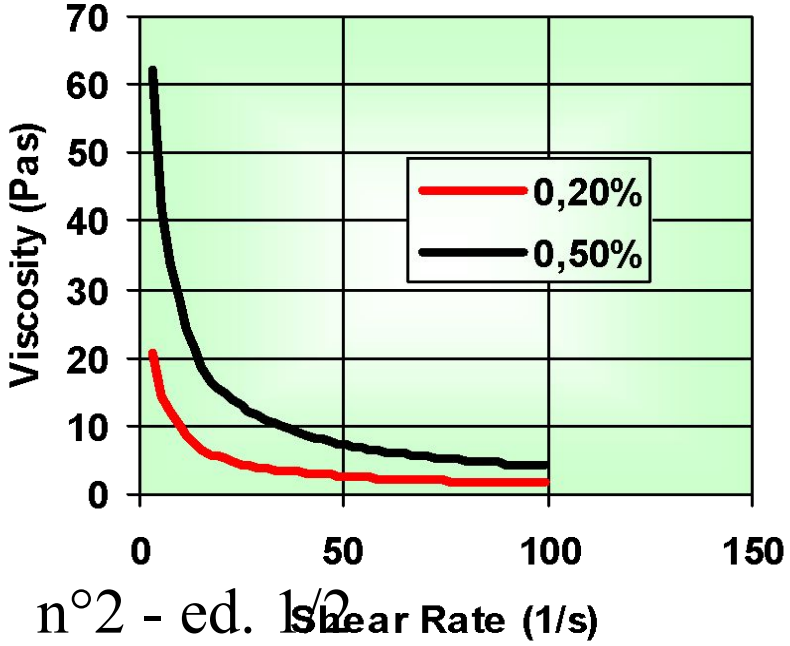
Polygel and Bleach

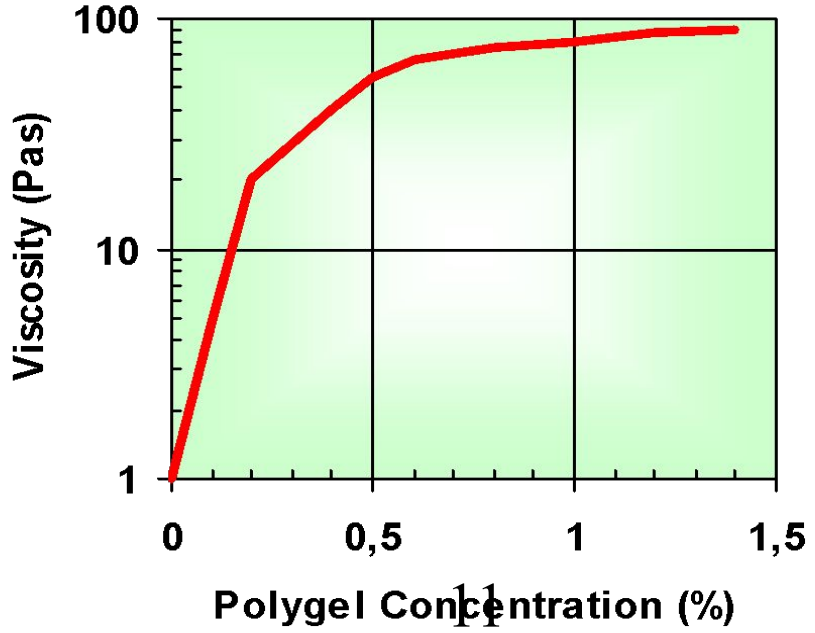
- Polygel CA and CK start to thicken close to pH 4 up to a plateau. Viscosity will decrease from pH 11 till 14.

- Comparing Polygel rheological profile vs. bleach overall stability, there is an overlap area between pH 12 and 13.

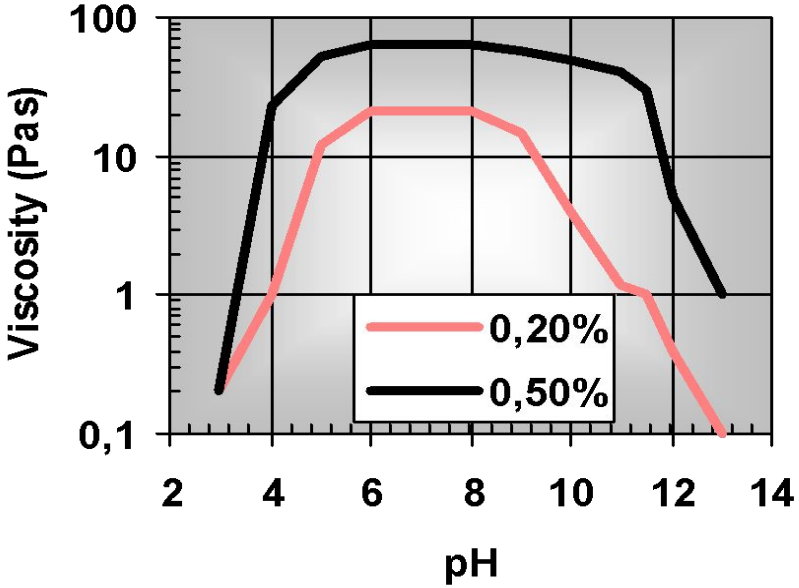
Polygel CA

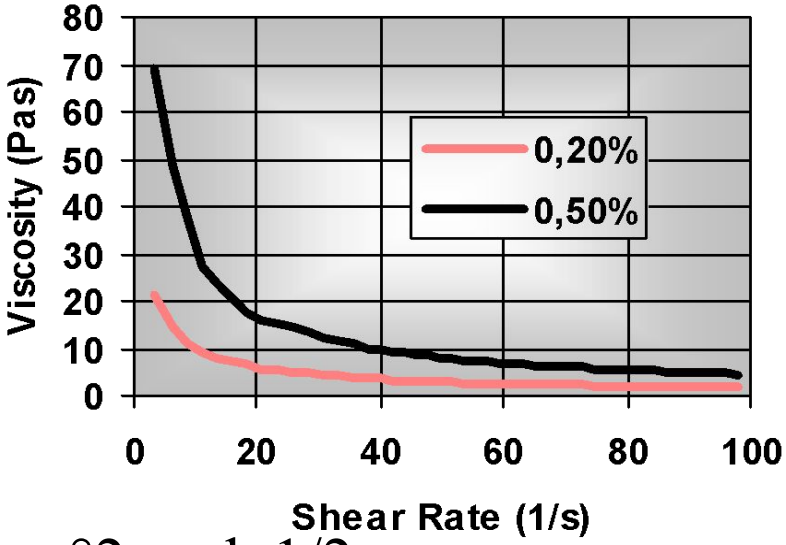

100
10
1
0,1
Viscosity (Pas)
0,20%
0,50%
3
8
13
pH

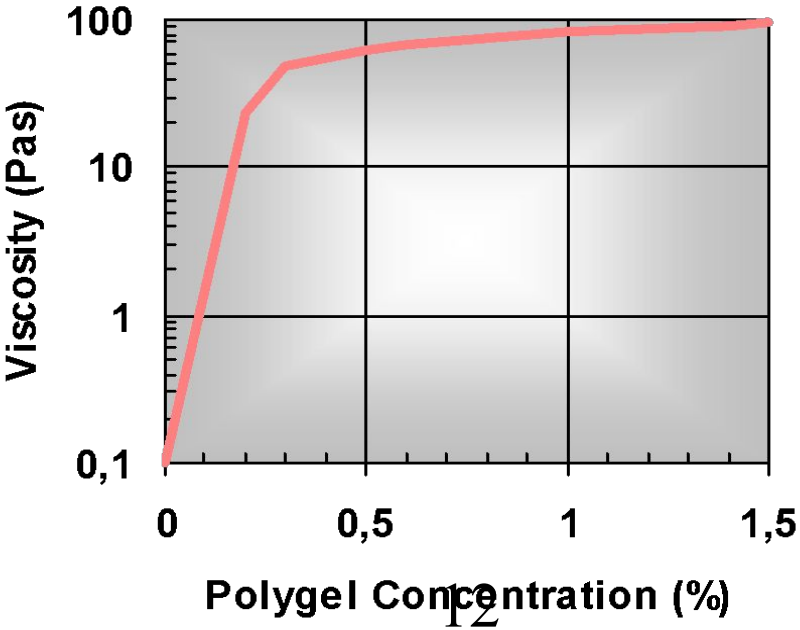

70
60
50
40
30
20
10
0
Viscosity (Pas)
0,20%
0,50%
0
50
100
150
Shear Rate (1/s)


100
10
1
Viscosity (Pas)
0
0,5
1
1,5
Polygel Concentration (%)

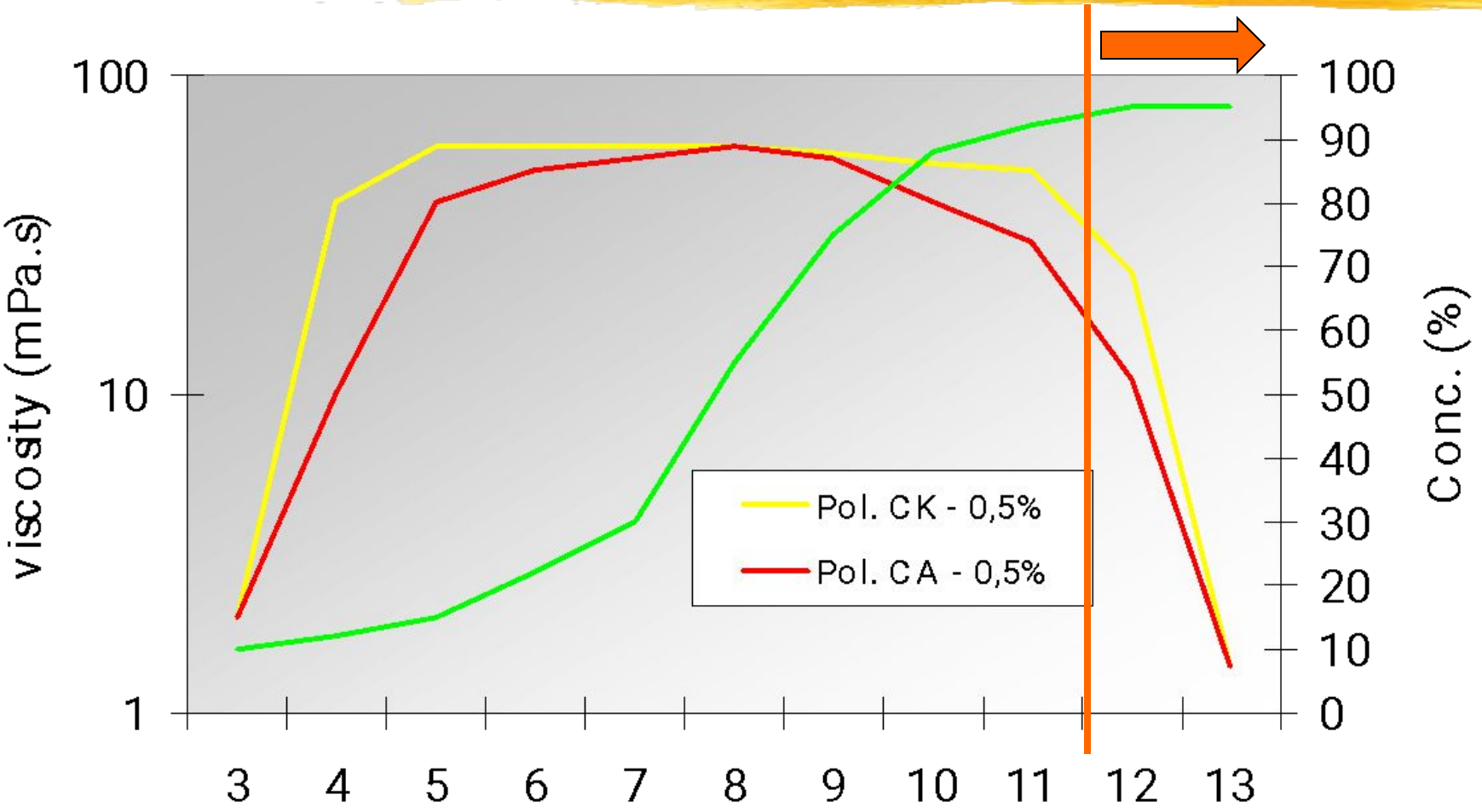
Polygel CK


100
10
1
0,1
Viscosity (Pas)
0,20%
0,50%
2
4
6
8
10
12
14
pH


80
70
60
50
40
30
20
10
0
Viscosity (Pas)
0,20%
0,50%
0
20
40
60
80
100
Shear Rate (1/s)


100
10
1
0,1
Viscosity (Pas)
0
0,5
1
1,5
Polygel Concentration (%)

pH Importance in the NaClO Formulations



Stability highlights- Polygel CA

Raw materials	Percentage w/w
Polygel CA	1
NaClO	1
KOH	Up to 12.5
Dem Water	Up to 100

Brookfield viscosity, 20 rpm, 25°C (cps)	
Initial	3500
After 1 month at room T	3550
After 1 month at 40°C	3425
$AvCl_2$	
Initial	1
After 1 month at room T	0.97
After 1 month at 40°C	0.92

Stability highlights – Polygel CK

Raw materials	Percentage w/w
Polygel CK	1.5
NaClO	1.9
NaOH	Up to 12.5
Dem Water	Up to 100

Brookfield viscosity, 20 rpm, 25°C (cps)	
Initial	1600
After 1 month at room T	1350
After 1 month at 40°C	1500
$AvCl_2$	
Initial	1.9
After 1 month at room T	1.7
After 1 month at 40°C	1.3

Polygel CK: KOH vs. NaOH

	Ref % w/w	1 % w/w	2 % w/w
Polygel CK	÷	2.0	2.0
NaOCl (as active chlorine)	4.9	4.9	5.0
Ethyl hexyl sulphate	1.0	1.0	1.0
NaOH	to pH 12.5	to pH 12.5	÷
KOH	÷	÷	to pH 12.5
H_2O	Up to 100	Up to 100	Up to 100
Brookfield viscosity, 20 rpm, 25°C (cps)			
Initial	÷	1200	2600
After 1 month at 40°C	÷	1000	2300
$AvCl_2$			
Initial	4.9	4.9	5.0
After 1 month at 40°C	3,3	3,4	3,4

Tempoxy-LO: Radical Scavenger

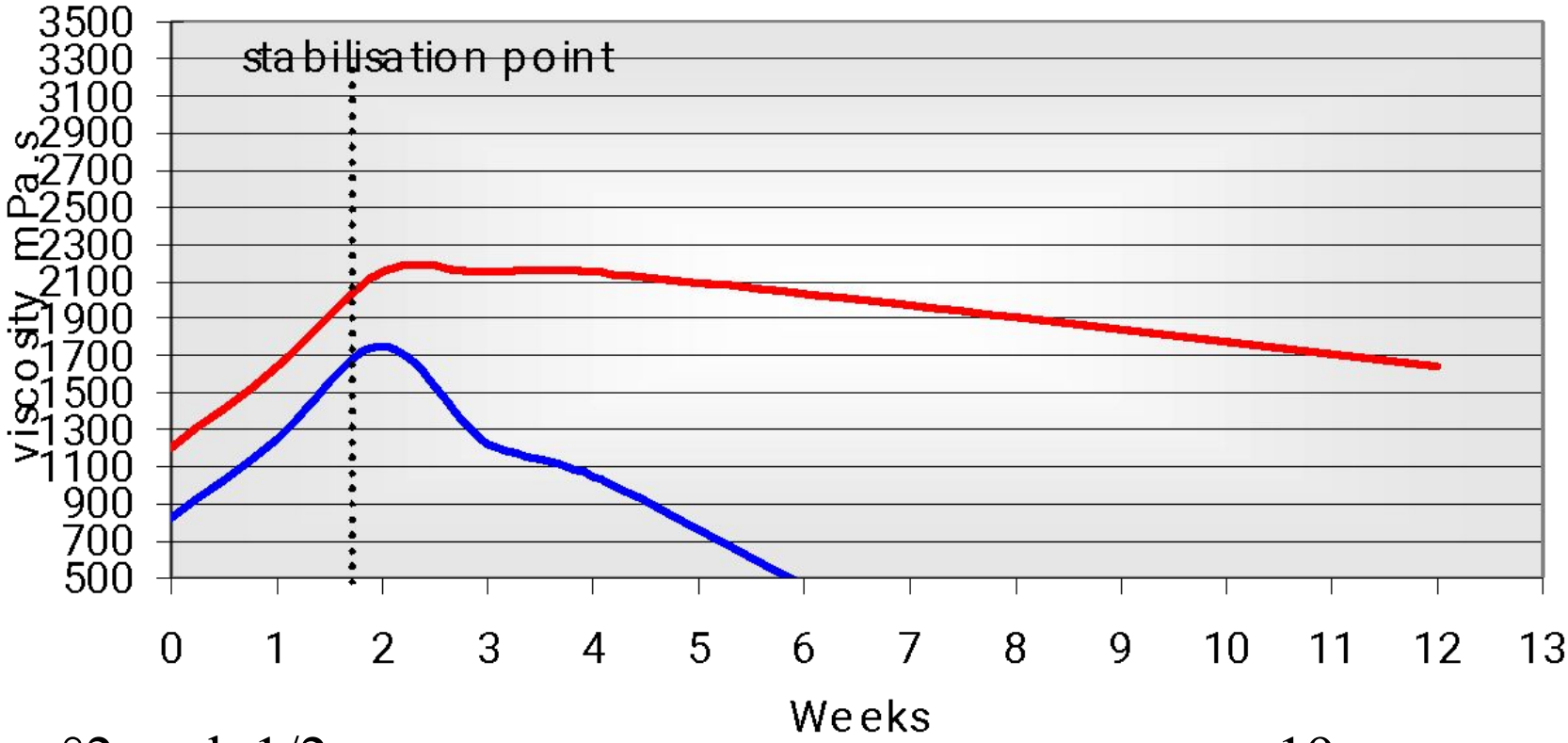
- 3V Sigma has developed Tempoxy-LO to increase Polygel performances in bleaches.
  - Tempoxy-LO is a patented additive, capable to improve Polygel stability.
  - Working sinergically with Polygel, it stabilises viscosity at high $AvCl_2$ content

Tempoxy-LO Stabilization Data

	with Tempoxy-LO	without Tempoxy LO
POLYGEL CK	2,0	2,0
tempoxy LO	0,3	÷
NaOCl (AvCl2)	5%	5%
KOH (50%)	a pH 13	a pH 13
Dem Water	to 100%	to 100%

T: 40°C		**with Tempoxy LO**		**without Tempoxy-LO**		
formula:						
weeks	*viscosity*	*pH*	*% Cl*	*viscosity*	*pH*	*% Cl*
0	1200	13	5	820	13	5
1	1640	13	3,8	1250	13	4,5
2	2150	13	3,58	1750	13	4,36
3	2150	13	3,23	1225	13	3,97
4	2150	13	3	1050	13	3,68
8	1900	13	2,24	0	13	2,6
12	1640	13	1,87	0	13	2

Viscosity Profile



Conclusions

- In NaClO based formulations **Polygel CA** and **Polygel CK** deliver:
  - Good storage stability
  - Yield Value
  - Cling effect on vertical surfaces
  - Cup retention
- **Tempoxy-LO** enhances even further the rheological stability on storage for such thickened formulations

Appendix 1
Market Status & Formulations

- NaClO is used in the following applications:
  - Hard Surface Cleaners
  - Drain openers
  - Toilet bowl cleaners
  - Kitchen triggers
  - Automatic Dish Washing Liquid and Gels

Appendix 1
Formulation key drivers:

- These compositions have increased viscosity to enhance residence time on non-horizontal surfaces.

- pH: 12.5
- Oxidizing system: NaClO (usually $AvCl_2$<4.5%);
- Thickening system: Carbomer (Polygel CA, CK);
- Target viscosity: 300 – 700 mPa.s (Brookfield RV, 25° C).

Appendix 1
Cream Cleanser with Bleach

Polygel CA	**1%**
Laueth-3 Sulphate (27%)[1]	4%
Fatty Alcohol EO/PO terminally blocked[2]	1%
Sodium Phosphonate[3]	0.5%
$CaCO_3$	20%
NaOH (50%)	Up to pH
$AvCl_2$	**1%**
Dem Water	Up to 100%

~~η = 2500-3200 mPa.s pH: 12-12.5~~

Appendix 1
Cream Cleanser with Bleach

Polygel CK	**0.8%**
Laueth-3 Sulphate (27%)[1]	4%
Lauryl dimethylamine oxide (30%)[4]	1%
Phytic acid	0.2%
$CaCO_3$	20%
NaOH (50%)	Up to pH
$AvCl_2$	**1%**
Dem Water	Up to 100%

η = 2500-3500 mPa.s pH: 12-12.5

Appendix 1
HSC: Bleach Gel

Polygel CA	**1%**
Laureth-3 Sulphate [1]	4%
KOH (50%)	Up to pH
$AvCl_2$	**1%**
Dem Water	Up to 100%

η = 3000-3500 mPa.s pH: 12.5

Appendix 1
HSC: Bleach Gel

Polygel CK	**1.4%**
Ethyl Hexyl Sulphate (40%)[5]	1%
Fatty Alcohol EO/PO terminally blocked [2]	1%
KOH (50%)	Up to pH
$AvCl_2$	**3%**
Dem Water	Up to 100%

η = 1200-2000 mPa.s pH: 12-12.5

Appendix 1
Toilet Bowl: Bleach Gel

Polygel CK	**1.5%**
Alkyl (C12-C18) dimethylamine oxide(30%)[7]	3%
KOH (50%)	Up to pH
$AvCl_2$	**4.5%**
Dem Water	Up to 100%

η = 700-1500 mPa.s pH: 12.5

Appendix 1
HSC: Bleach Gel

Polygel CK	**1.5%**
Lauryc Acid [8]	1%
Alkyl (C12-C18) dimethylamine oxide(30%)[7]	3%
KOH (50%)	Up to pH
$AvCl_2$	**3%**
Dem Water	Up to 100%

η = 5000-7000 mPa.s pH: 12-12.5

Appendix 1
Automatic Dish Washing Gel

Polygel CA	**0.8%**
Sodium Silicate (R=2,4)	20%
Sodium Tripolyphosphate	15%
Sodium n-decyldiphenyloxide disulphonate (45%)[6]	3%
$NaCO_3$	5%
KOH (50%)	Up to pH
$AvCl_2$	**1%**
Dem Water	Up to 100%

η = 3500-4500 mPa.s pH: 12.5-13

Appendix 1
Automatic Dish Washing Gel

Polygel CK	**0.8%**
Sodium Silicate (R=2,4)	20%
Sodium Tripolyphosphate	15%
Sodium n-decyldiphenyloxide disulphonate (45%)[6]	4%
$NaCO_3$	5%
KOH (50%)	Up to pH
$AvCl_2$	**1%**
Dem Water	Up to 100%

η = 5000-6000 mPa.s pH: 12.5-13

Appendix 2
Raw Materials

- 1: Empicol ESB 3M (from Huntsman)
- 2: Plurafac LF 403 (from BASF)
- 3: Sequion CLR (from Bozzetto)
- 4: Empigen OB (from Huntsman)
- 5: Empicol 0585/A (from Huntsman)
- 6: Dowfax 3B2 (from Dow)
- 7: Aromox BW270 (from Akzo Nobel)