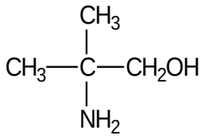
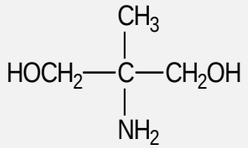
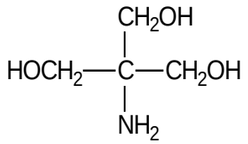
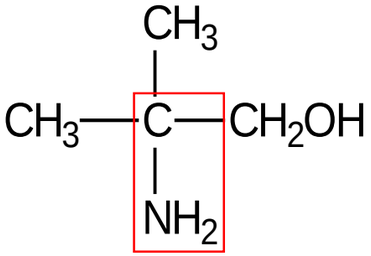

ANGUS®
CHEMICAL COMPANY

Product & Chemistry Overview

Product & Chemistry Overview

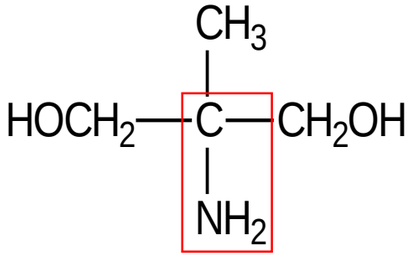
Chemistry	Structure	Mw	pKa	Product	Appearance	FP/MP, ^{0}C
AMP™ **INCI:** Aminomethyl propanol **CAS:** 124-68-5 **EiNECs:** 204-709-8	 Primary amine Tertiary carbon	89.14	9.72	AMP-ULTRA™ PC 1000	Anhydrous solid	30
				AMP-ULTRA™ PC 2000	Low viscositiy liquid (5% water)	13
				AMP-ULTRA™ PC 3000	Low viscosity liquid (11% water)	-3
AMPD™ **INCI:** Aminomethyl propanediol **CAS:** 115-69-5 **EiNECS:** 204-100-7	 Primary amine Tertiary carbon	105.14	8.76	AMPD™ ULTRA PC	Crystalline solid	100
TRIS AMINO™ **INCI:** Tromethamine **CAS:** 77-86-1 **EiNECS:** 201-064-4	 Primary amine Tertiary carbon	121.14	8.03	TRIS AMINO™ ULTRA PC	Crystalline solid	165

Key Functionalities At A Glance



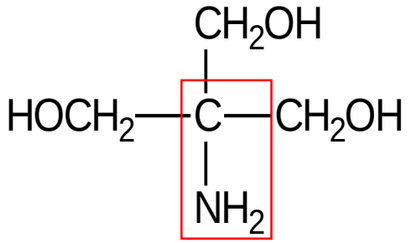
AMP-ULTRA™ PC

INCI: aminomethyl propanol
CAS: 124-68-5
EiNECS: 204-709-8



AMPD™ ULTRA PC

INCI: aminomethyl propanediol
CAS: 115-69-5
EiNECS: 204-100-7



TRIS AMINO™ ULTRA PC

INCI: Tromethamine
CAS: 77-86-1
EiNECS: 201-064-4

- Tertiary carbon linked to N atom → chemical & colour stability → prevent nitrosamine formation
- High pKa value→ quick neutralization + formulation stability at desired pH
- Wide range of base strength (with pH buffering)
- Confers stability to formulations – regardless of high salt / high ethanol systems
- Enhances preservative systems

Globally Compliant

- Minimum Purity 99%
- Maximum secondary amine content 0.5%
- Maximum nitrosamine content 50 µg/kg (50 ppb)
- Stored in nitrite-free containers
- Certified on COA

Globally Compliant

- European Cosmetics Regulation 1223/2009 (replacing European Cosmetics Directive 76/768/EEC and its latest amendments)
- Brazil ANVISA Mercosur Resolution on Cosmetics and Personal Care Products
- The Ministry of Health (MOH) of the People's Republic of China Hygienic Standards for Cosmetics (2007 version)
- KOREA: A KFDA revision of the regulations on cosmetic raw materials (2010-99)
- The 2008 ASEAN Cosmetics Directive (Annex updated Feb-2011)

Globally Compliant

- REACH-registered
- Compliant with global chemical control inventories

✓ USA - TSCA
✓ Canada - DSL
✓ EU - EINECS
✓ China - IECSC
✓ Taiwan
✓ Japan - ENCS
✓ Korea - KECI
✓ Philippines - PICCS
✓ Australia - AICS
✓ New Zealand - NZIOC

Consumer Friendly Chemistry

- Reduces risk of nitrosamine formation
- Globally compliant
- Stringent quality control and certification process
- Compliant chemistry to help formulate products for worldwide distribution

AMP-ULTRA™ PC

Target	Applications	Benefits
Hair styling	Hair styling gels / Creams / Sprays / Mousses	• Very low dosage requirement (w/w) • Efficient fatty acid and resin • Good buffering capacity • Odourless in formulations • Improves product performances such as stability, clarity, and washability • Does not contribute to nitrosamine formation • Excellent safety profile • Globally compliant • Corrosion inhibitor • Improves soap base stability at lower pH • Enables rich, dense, and stable foam in cleansing products
Cleansers	Soap-based cleansing products Shampoos / Facial cleansers / Body cleansers/ Hand sanitizers	
Skin Care	Skin creams / lotions	

AMPD™ ULTRA PC

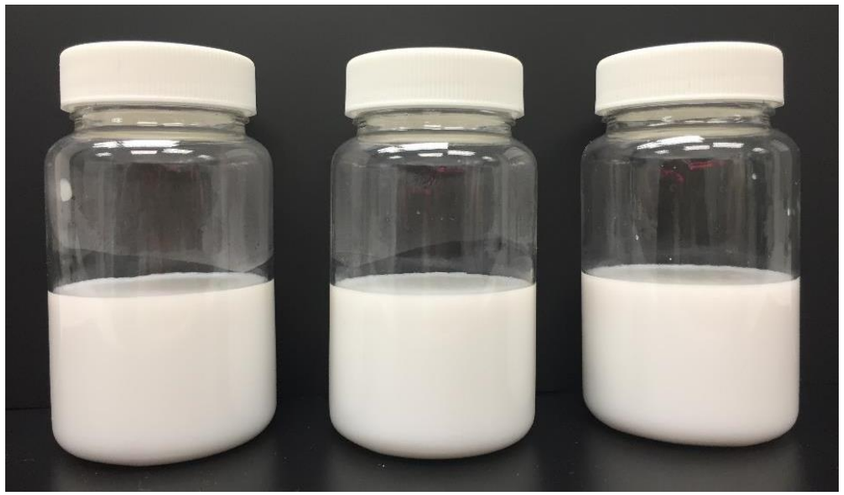
Target	Applications	Benefits
Hypoallergenic products	Facecream / Eyecream	• Low dosage requirement (w/w) • Efficient fatty acid and resin neutralisation • Good buffering capacity • Odourless in formulations • Improves product performances such as stability and clarity • Does not contribute to nitrosamine formation • Excellent safety profile • Globally compliant • Aids in pigment dispersion to enhance coverage • Improves product shelf life, e.g., mascara
Colour cosmetics	Face area : Makeup bases / BB, CC creams / Foundation Eye area : Mascaras / Eye liners	

TRIS AMINO™ ULTRA PC

Target	Applications	Benefits
Suncare	Sunscreen lotions / Creams / Gels / Sprays	• Low dosage requirement (w/w) • Efficient fatty acid, resin, and sunscreen active neutralisation • Good buffering capacity at physiological pH • Odourless in formulations • Improves product performances such as stability • Enhances efficacy of preservative systems • Does not contribute to nitrosamine formation • Excellent safety profile • Globally compliant • Aids in pigment dispersion at pH ≤ 7 to enhance coverage • Efficient odour scavenging at neutral pH
Sensitive skin	Facial creams / Eye care creams / Gels / Skin creams and lotions	
Odour Control	Deodorant sticks / Roll-ons / Wipes / Sprays	

Sunscreen Application

Aids Nano TiO2 Dispersion

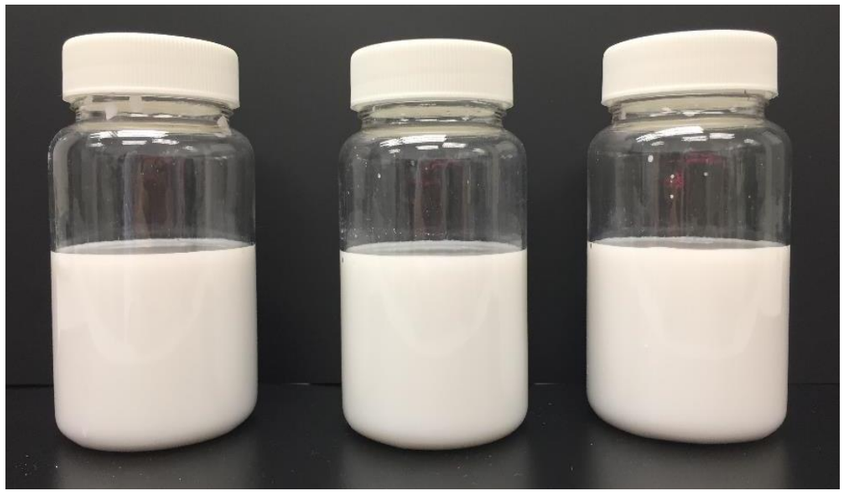


TRIS AMINO UPC pH 10.4	TEA pH 10.2	AMP UPC 2000 pH 11.5

Max pH

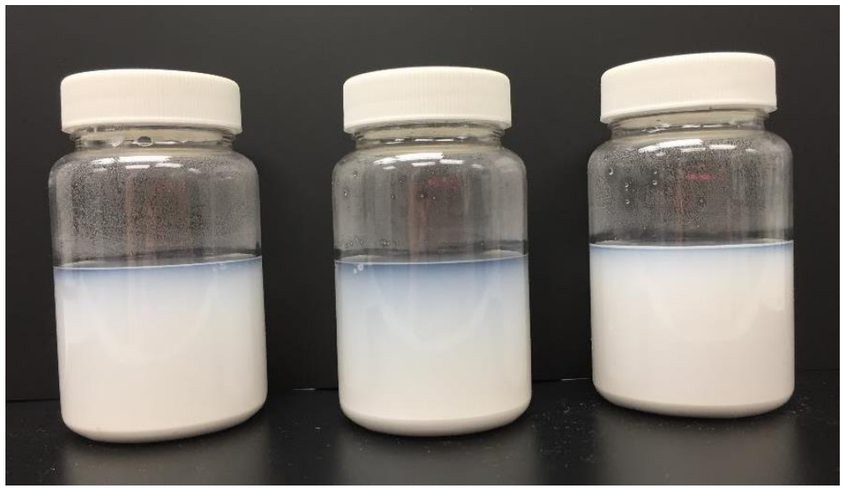
After 24 hours

Aids Nano TiO2 Dispersion



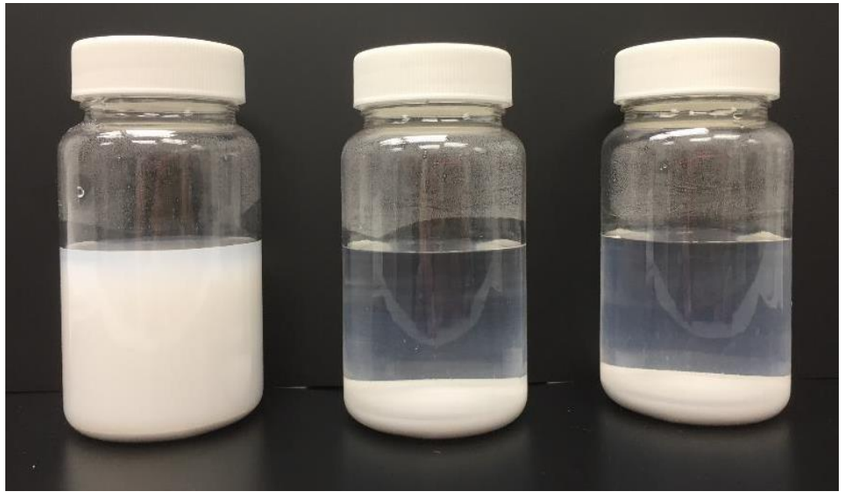
TRIS AMINO UPC | TEA | AMP UPC 2000

pH 7
After 24 hours

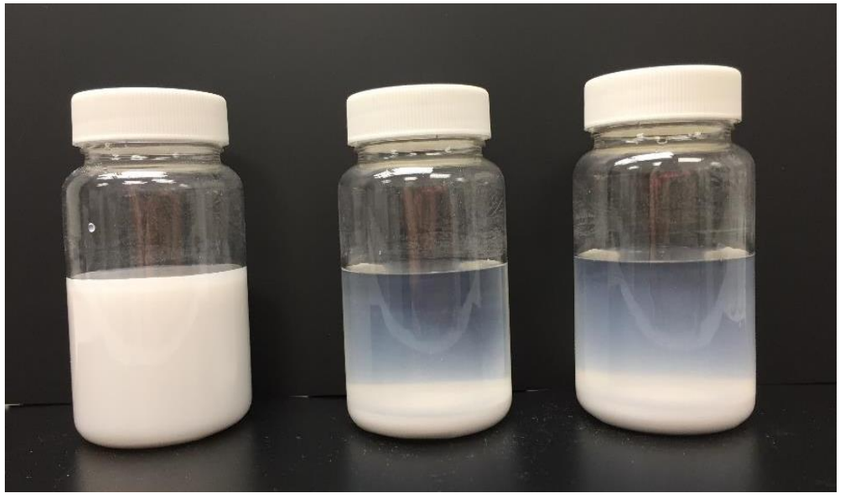


Aids Nano TiO_2 Dispersion

TRIS AMINO UPC | TEA | AMP UPC 2000



pH 5
After 3 hours



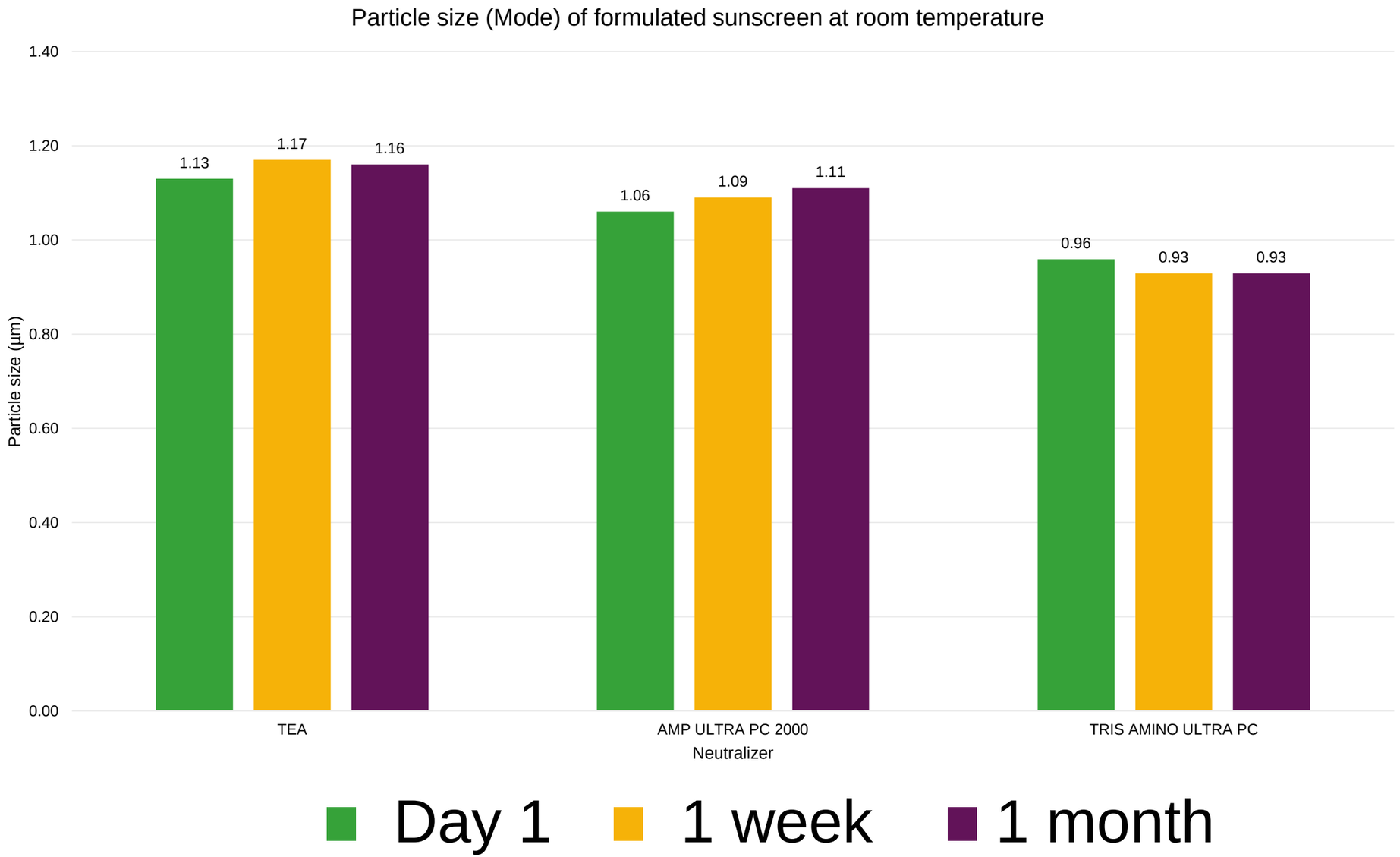
TRIS AMINO UPC | TEA | AMP UPC 2000

After 24 hours

Basic Sunscreen @ pH 7

Phase	Trade Name	INCI Name	TEA %, w/w	AMP UPC 2000 % w/w	TRIS AMINO UPC % w/w
A	DI-Water	Water	58.21	58.33	58.18
	Disodium EDTA	Disodium EDTA	0.05	0.05	0.05
	Carbopol Ultrez 30	Carbomer	0.20	0.20	0.20
	Propylene Glycol	Propylene Glycol	3.00	3.00	3.00
	Chemonic OE-20 Ethoxylated Alcohol	Oleth-20	3.00	3.00	3.00
	Isopropyl myristate	Isopropyl myristate	11.00	11.00	11.00
B	Tween 80	Polysorbate 80	1.50	1.50	1.50
	TRIsatin	Glyceryl Stearate	1.50	1.50	1.50
	Stearic Acid	Stearic Acid	2.00	2.00	2.00
	Element 14 PDMS 100	Dimethicone	6.00	6.00	6.00
	MT-100WP (15nm)	Titanium Dioxide (Hydrophilic)	8.00	8.00	8.00
C	SFE 839	Cyclopentasiloxane (and) Dimethicone/Vinyl Dimethicone Crosspolymer	5.00	5.00	5.00
D	Neutralizer	-	0.44	0.32	0.47
E	Preservative		0.10	0.10	0.10
		Total	**100.00**	**100.00**	**100.00**

Sunscreen Formulated at pH 7 – Particle Size



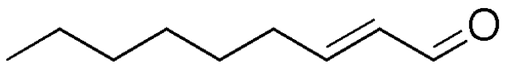
Value for Sunscreen

- Reduce risk of nitrosamine formation
- High safety profile
- Nano TiO_2 dispersion is aided by TRIS AMINO at pH < 7
  - Enables mild pH sunscreen that is ideal for skin care products
  - Enhanced dispersion can help with skin coverage
- Sunblock formulated with TRIS AMINO at pH 7 showed particle sizes smaller than TEA
  - Expected better coverage and UV absorption
- TRIS AMINO is the best choice to enable PBSA to be incorporated into formulations
  - Balances pH and dosage requirements
  - PBSA is a water-based chemical UV absorber of choice due to superior safety profile versus other organic filters

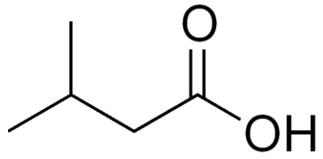
Odour Control Application

Typical Unpleasant Odors

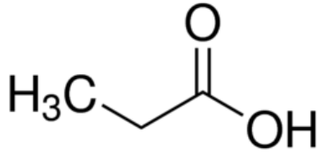
- 2-nonenal
  - Unsaturated aldehyde
  - Associated with human body odour alterations



- 3-methylbutanoic acid (isovaleric acid)
  - Major component of unpleasant foot odour
  - Produced by skin bacteria metabolising leucine

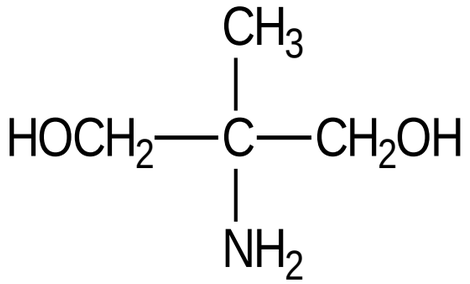


- Propionic acid
  - Present in many sweat samples.
  - Breakdown product of some amino acids by propionibacteria which thrive in the ducts of adolescent and adult sebaceous glands.
  - Chemically similar to acetic acid - vinegar-like smell



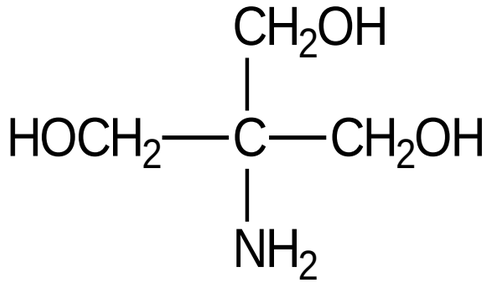
ANGUS Aminoalcohols as Actives

- High performance
- Only multifunctional primary aminoalcohols to capture aldehydes and fatty acids
- New opportunities for home care and personal care markets



AMPD™ ULTRA PC

2-amino-2-methyl-1,3-propanediol
CAS: 115-69-5



TRIS AMINO™ ULTRA PC

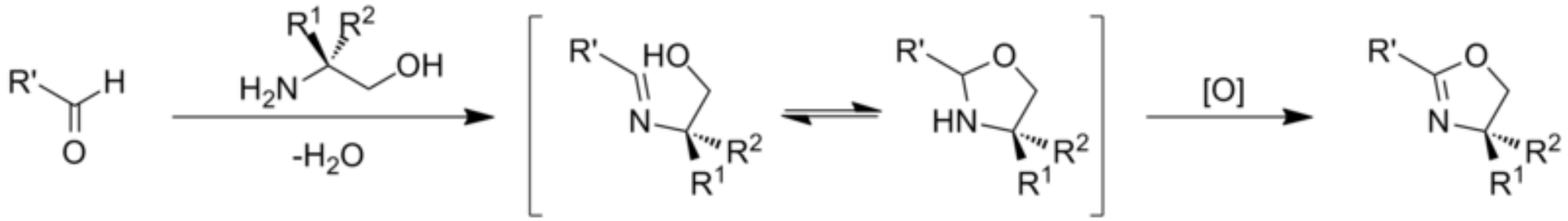
Tris(hydroxymethyl)aminomethane
CAS: 77-86-1

Proposed Reaction Mechanisms

- Weak acid – weak base reaction

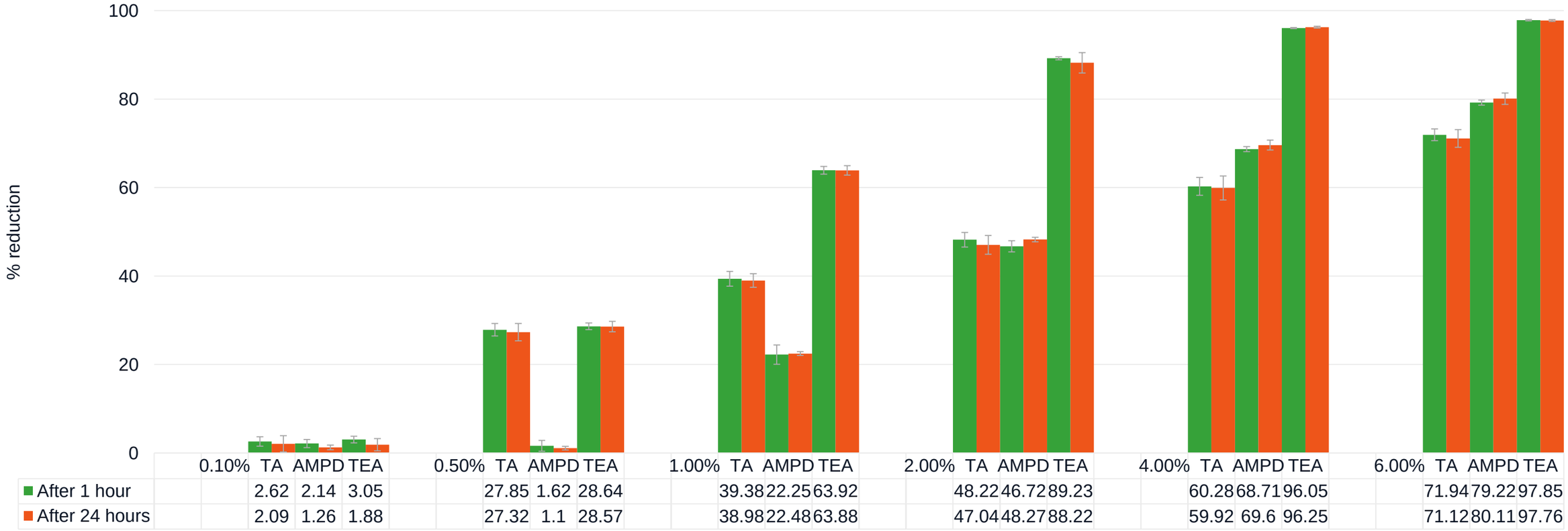
$$RNH_2 + RCOOH \rightleftharpoons RNH_3^+ + RCOO^-$$

- Reacting with an aldehyde to form imines or oxazolidines



Neutralisation of Isovaleric Acid

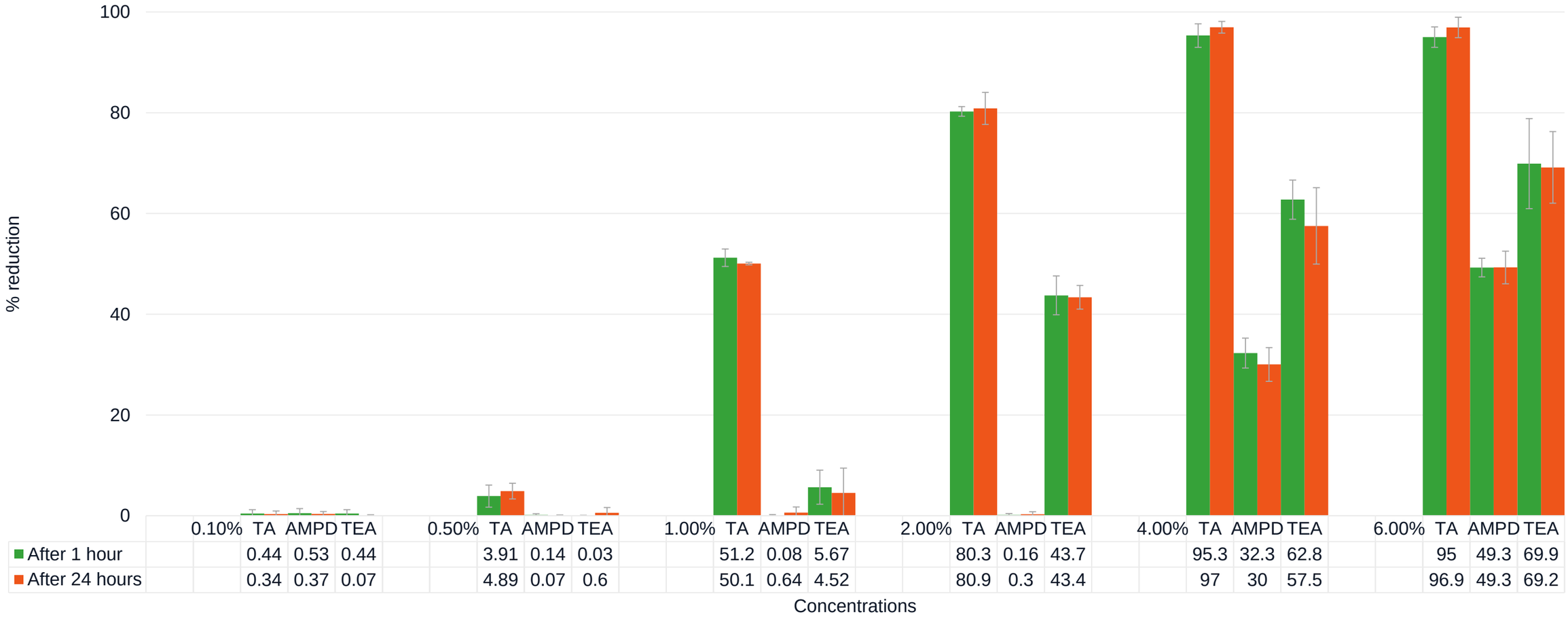
% reduction of 500ppm isovaleric acid peak areas with different concentrations of TA, AMPD and TEA (adjusted to pH 7) at room temperature.



	0.10% TA	AMPD	TEA	0.50% TA	AMPD	TEA	1.00% TA	AMPD	TEA	2.00% TA	AMPD	TEA	4.00% TA	AMPD	TEA	6.00% TA	AMPD	TEA
After 1 hour	2.62	2.14	3.05	27.85	1.62	28.64	39.38	22.25	63.92	48.22	46.72	89.23	60.28	68.71	96.05	71.94	79.22	97.85
After 24 hours	2.09	1.26	1.88	27.32	1.1	28.57	38.98	22.48	63.88	47.04	48.27	88.22	59.92	69.6	96.25	71.12	80.11	97.76

Neutralisation of Propionic Acid

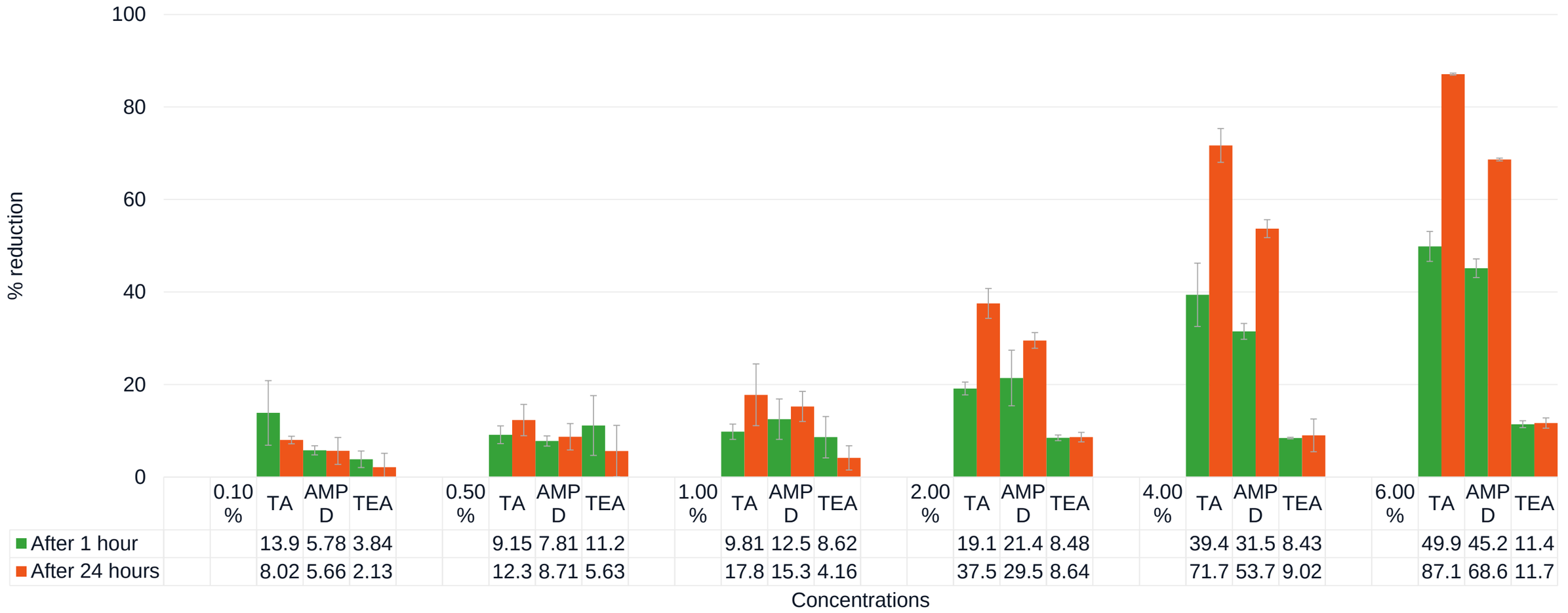
% reduction of 500ppm propionic acid peak areas with different concentrations of TA, AMPD and TEA (adjusted to pH 7) at room temperature.



	0.10% TA	AMPD	TEA	0.50% TA	AMPD	TEA	1.00% TA	AMPD	TEA	2.00% TA	AMPD	TEA	4.00% TA	AMPD	TEA	6.00% TA	AMPD	TEA
After 1 hour	0.44	0.53	0.44	3.91	0.14	0.03	51.2	0.08	5.67	80.3	0.16	43.7	95.3	32.3	62.8	95	49.3	69.9
After 24 hours	0.34	0.37	0.07	4.89	0.07	0.6	50.1	0.64	4.52	80.9	0.3	43.4	97	30	57.5	96.9	49.3	69.2

Neutralisation of 2-Nonenal

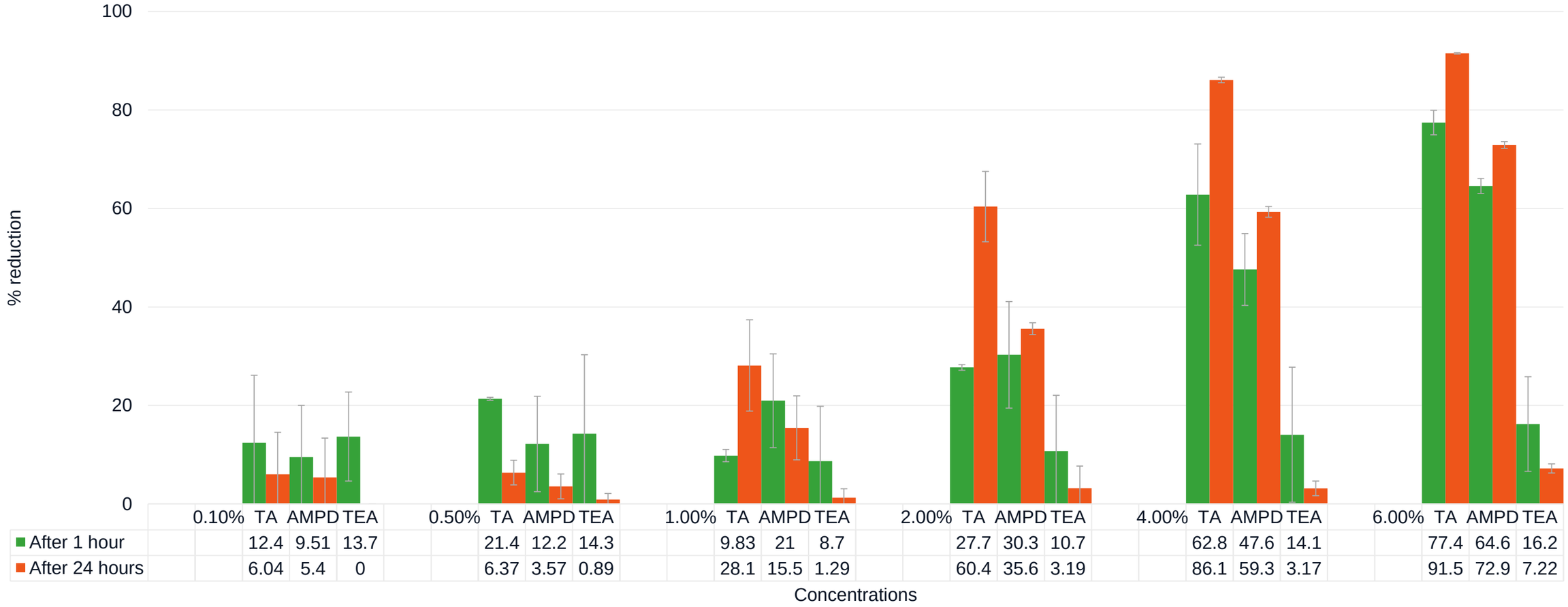
% reduction of 10ppm Nonenal peak areas with different concentrations of TA, AMPD and TEA (adjusted to pH 7) at room temperature.



	0.10 %	TA	AMPD	TEA	0.50 %	TA	AMPD	TEA	1.00 %	TA	AMPD	TEA	2.00 %	TA	AMPD	TEA	4.00 %	TA	AMPD	TEA	6.00 %	TA	AMPD	TEA
After 1 hour		13.9	5.78	3.84		9.15	7.81	11.2		9.81	12.5	8.62		19.1	21.4	8.48		39.4	31.5	8.43		49.9	45.2	11.4
After 24 hours		8.02	5.66	2.13		12.3	8.71	5.63		17.8	15.3	4.16		37.5	29.5	8.64		71.7	53.7	9.02		87.1	68.6	11.7

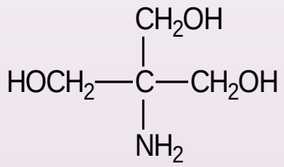
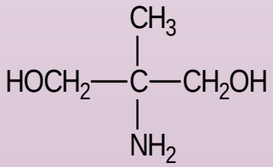
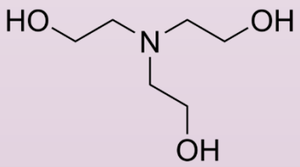
Neutralisation of 2-Nonenal

% reduction of 10ppm Nonenal peak areas with different concentrations of TA, AMPD and TEA (adjusted to pH 7) at 37 degree Celcius.



	0.10% TA	0.10% AMPD	0.10% TEA	0.50% TA	0.50% AMPD	0.50% TEA	1.00% TA	1.00% AMPD	1.00% TEA	2.00% TA	2.00% AMPD	2.00% TEA	4.00% TA	4.00% AMPD	4.00% TEA	6.00% TA	6.00% AMPD	6.00% TEA
After 1 hour	12.4	9.51	13.7	21.4	12.2	14.3	9.83	21	8.7	27.7	30.3	10.7	62.8	47.6	14.1	77.4	64.6	16.2
After 24 hours	6.04	5.4	0	6.37	3.57	0.89	28.1	15.5	1.29	60.4	35.6	3.19	86.1	59.3	3.17	91.5	72.9	7.22

Overview

Chemistry	Structure	Reaction with Isovaleric Acid	Reaction with Propionic Acid	Reaction with 2-Nonenal	Safety Profile	Score
TRIS AMINO™		√√	√√√	√√√	√√√ **Proven safe** in multiple applications including pharmaceuticals	11
AMPD™		√	√	√√	√√√ **Proven safe** in near mucosal surfaces products	7
TEA		√√√	√√	X	X Possible stable nitrosamine formation	5

Value for Odour Control

- Reduce risk of nitrosamine formation
- High safety profile
- Scavenges odour compounds such as 2-nonenal, propionic acid, and isovaleric acid
- Easy to formulate

Hair Styling Application

Typical Formulations

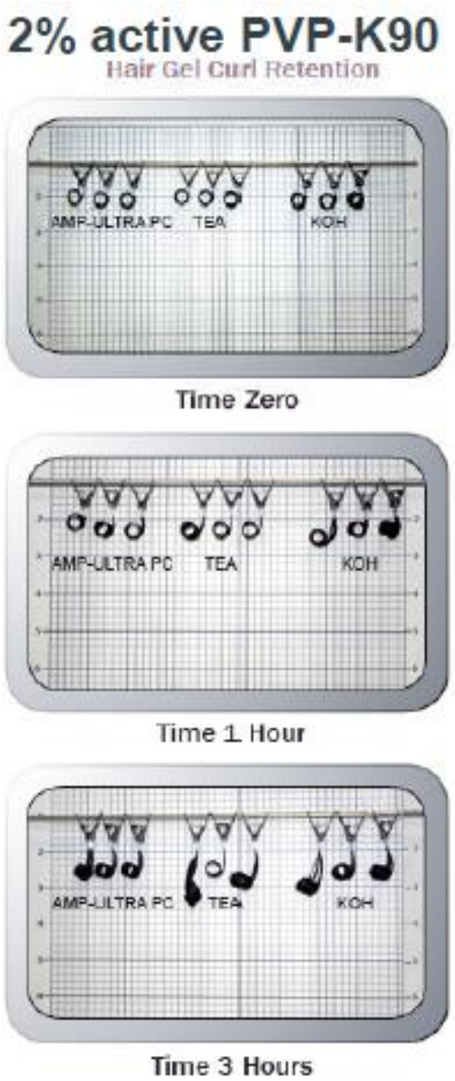
Hair Spray Formulation

Ingredient	wt%
Hair Fixative Polymer	6
AMP-ULTRATM PC 2000	1.126
Ethanol(SDA 40-B)	53-58
Propellant	35-40

Hair Gel Formulation

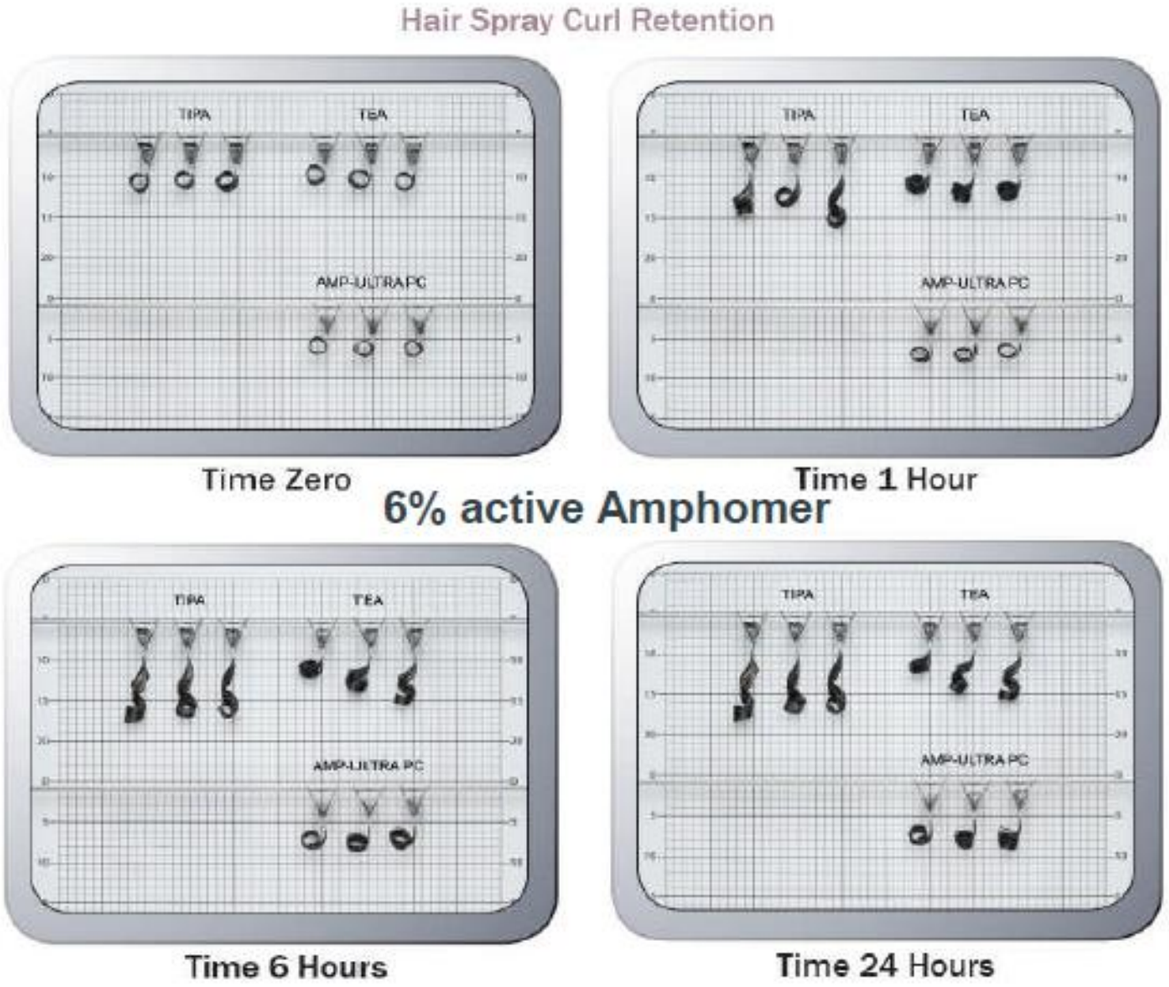
Phase 1	wt%
DI Water	56.45
AMP-ULTRA™ PC 2000	0.5
Phase 2	
DI Water	40
PVP K-90	2
Neolene PE	0.6
AMP-ULTRA™ PC 2000	0.35
Total	100
AMP-ULTRA™ PC 2000	Adjust to reach p H=7

Superior Hair Gel Holding Strength



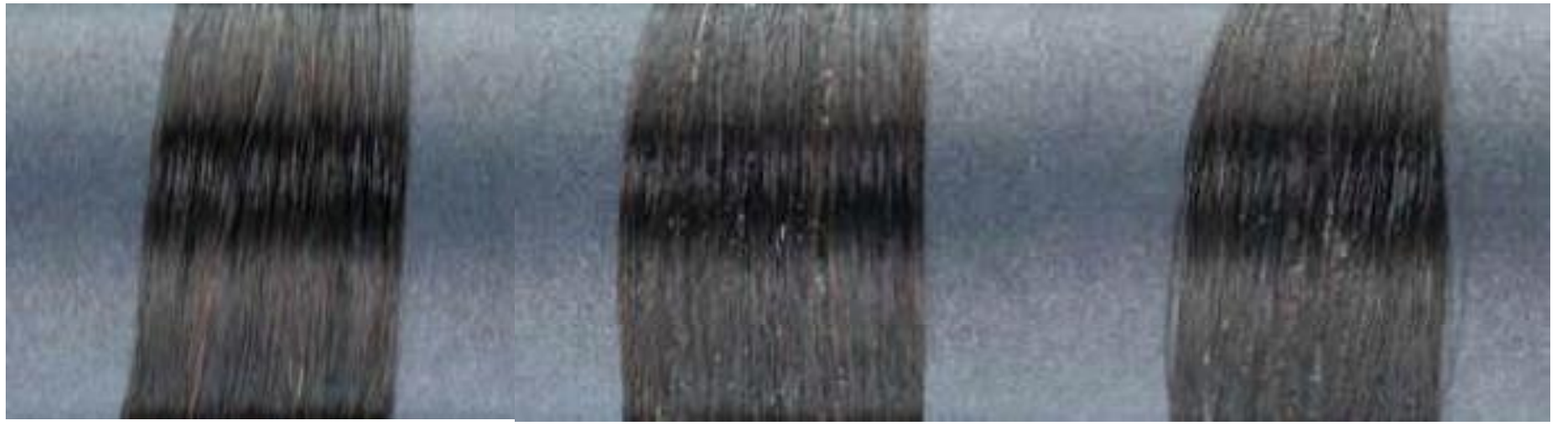
- Tested at 30 °C, 90% relative humidity
- PVP resin neutralized with AMP outperforms PVP resin neutralized with TEA and KOH
- KOH-PVP resin fails after 1 h and TEA-PVP resin fails after 3 h
- Hair curls hold for at least 3 h at high temperature and humidity with AMP-PVP resin

Superior Hair Spray Holding Strength



- Tested at 30 °C, 90% relative humidity
- Amphomer resin neutralized with AMP outperforms amphomer resin neutralized with TEA and TIPA
- Hair curls holds for at least 24 h at high temperature and humidity

Excellent Hair Washability



AMP-ULTRA™ PC | TEA | TIPA

- Hair tresses were treated with 6% neutralized polymer solution (hairspray)
- Dried and washed for 8 cycles to simulate frequent use
- Hair spray with AMP-neutralized resin sample displayed excellent washabililty
- No polymer buildup – optimized neutralization for increased washability
- Hair spray with TIPA and TEA-neutralized resin resulted in white flaky residue on the hair.

Hydrocarbon Compatibility

- Compatible with hydrocarbon propellant
- Good formulation clarity and stability
- Helps in anti-corrosion function in aerosol products – critical for safety of spray cans

Value for Hairstyling

- Reduce risk of nitrosamine formation
- High safety profile
- Provides superior styling and holding strength for hair gels and hair sprays
- Stable neutralisation to enable washability – no residue and tackiness
- Compatible with hydrocarbon propellants
- Prevents corrosion of aerosol cans

Cleansing Application

Cleansing Foam Formulation (100% Fatty Acid Neutralisation)

Phase	Trade Name	CTFA / INCI Name	AMP UPC (95.5%) w/w %	TRIS AMINO UPC w/w %	TEA (99.6%) w/w %	AMPD UPC w/w %	KOH (85.5%) w/w %	NaOH (99.9%) w/w %
A	Stearic acid (98.6%)	Octadecanoic Acid	0.67	0.67	0.67	0.67	0.67	0.67
	Lauric acid (99.3%)	Dodecanoic Acid	2.67	2.67	2.67	2.67	2.67	2.67
	Myristic acid (99.6%)	Tetradecanoic Acid	6.00	6.00	6.00	6.00	6.00	6.00
B	Disodium EDTA	EDTA Na2	0.05	0.05	0.05	0.05	0.05	0.05
	Neutralizer		3.89	5.05	6.25	4.39	2.73	1.50
	Glycerin 99%	1,2,3-Propanetriol	2.00	2.00	2.00	2.00	2.00	2.00
	Butylene Glycol	1,3 Butanediol	6.67	6.67	6.67	6.67	6.67	6.67
	DI Water	Water	72.55	71.39	70.19	72.05	73.71	74.94
C	SOFTAZOLINE CH-R	Sodium Cocoamphoacetate	2.00	2.00	2.00	2.00	2.00	2.00
	SOFTAZOLINE LHL	Sodium Lauroamphoacetate	2.00	2.00	2.00	2.00	2.00	2.00
D	Hydrolite 6	1,2 Hexandiol	1.50	1.50	1.50	1.50	1.50	1.50
		Total	100.00	100.00	100.00	100.00	100.00	100.00

Fatty acids neutralised with neutralisers at ratio 1:1.

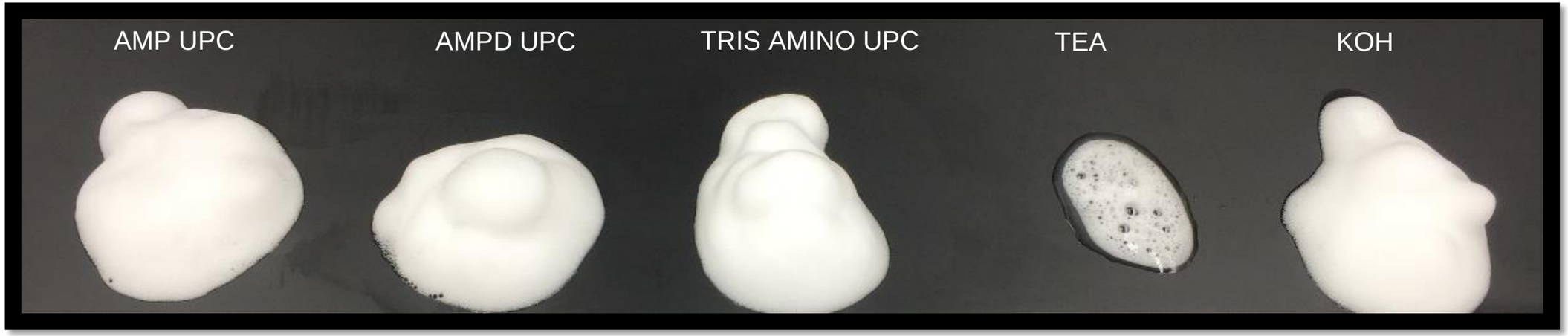
Cleansing Foam (100% Neutralisation)

AMP UPC	AMPD UPC	TRIS AMINO UPC	TEA	KOH	NaOH

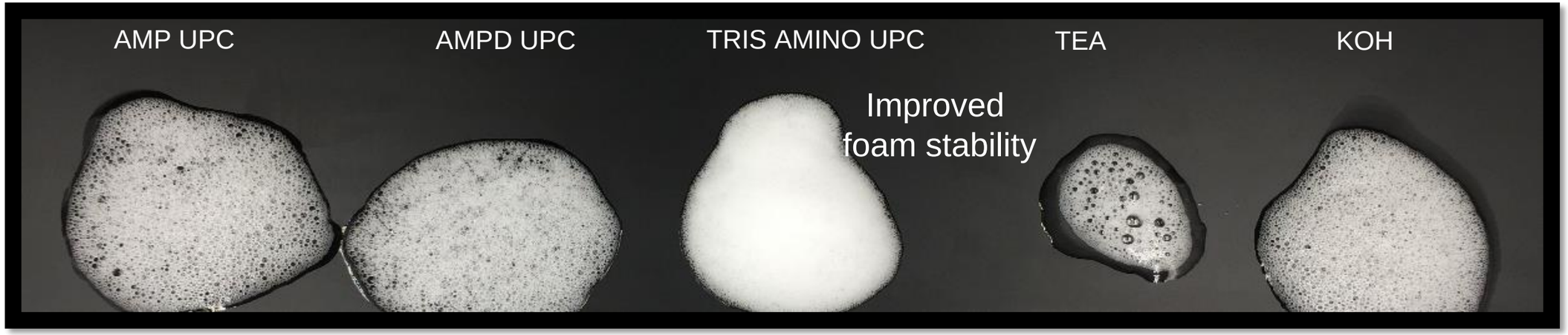
ULTRA PC™ aminoalcohols enable formulation of cleansers with high clarity

Foam Breakability (100% Neutralisation)

Initial



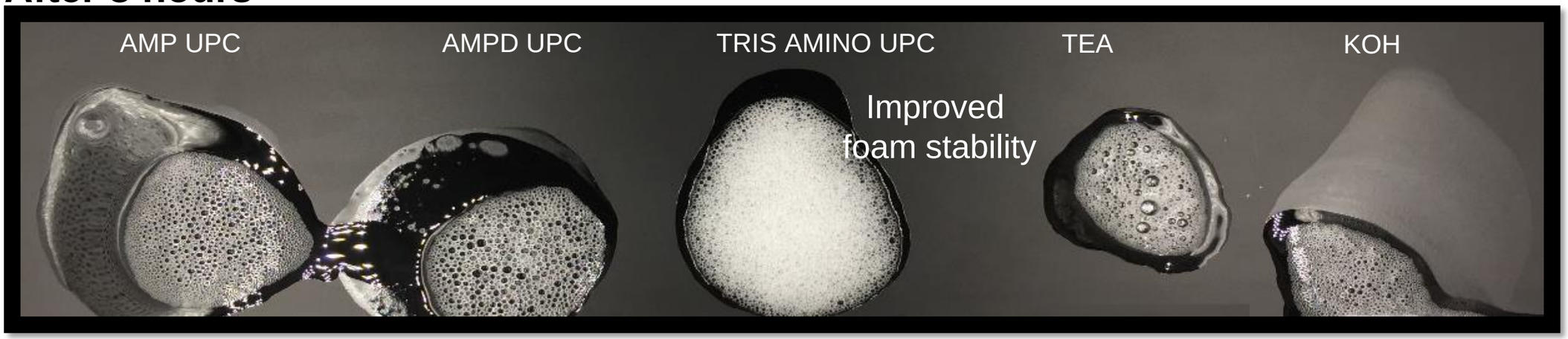
After 1 hour



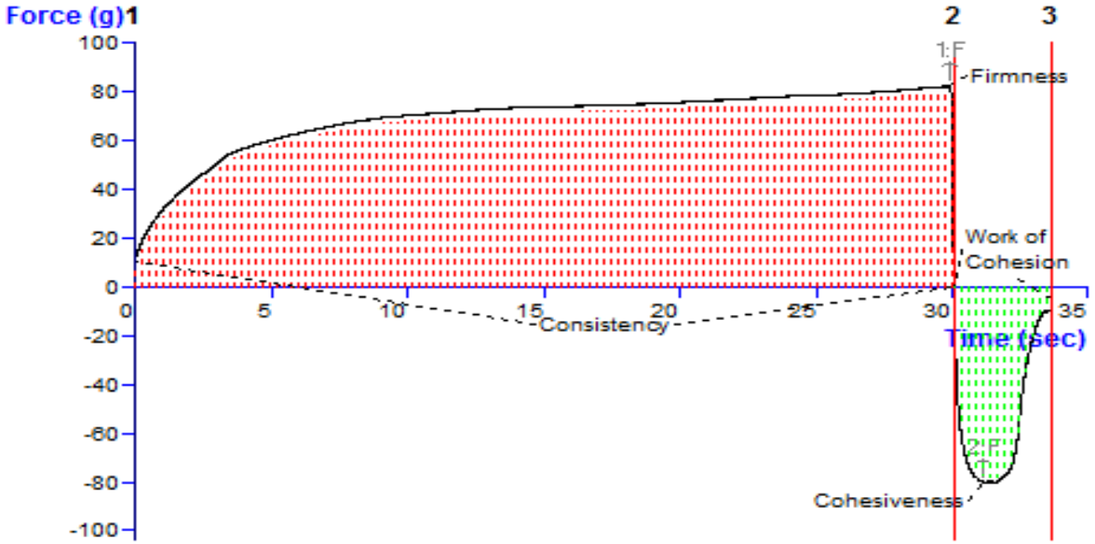
Foam Breakability (100% Neutralisation)

Initial

After 3 hours



Testing Foam Firmness Using Back Extrusion Test

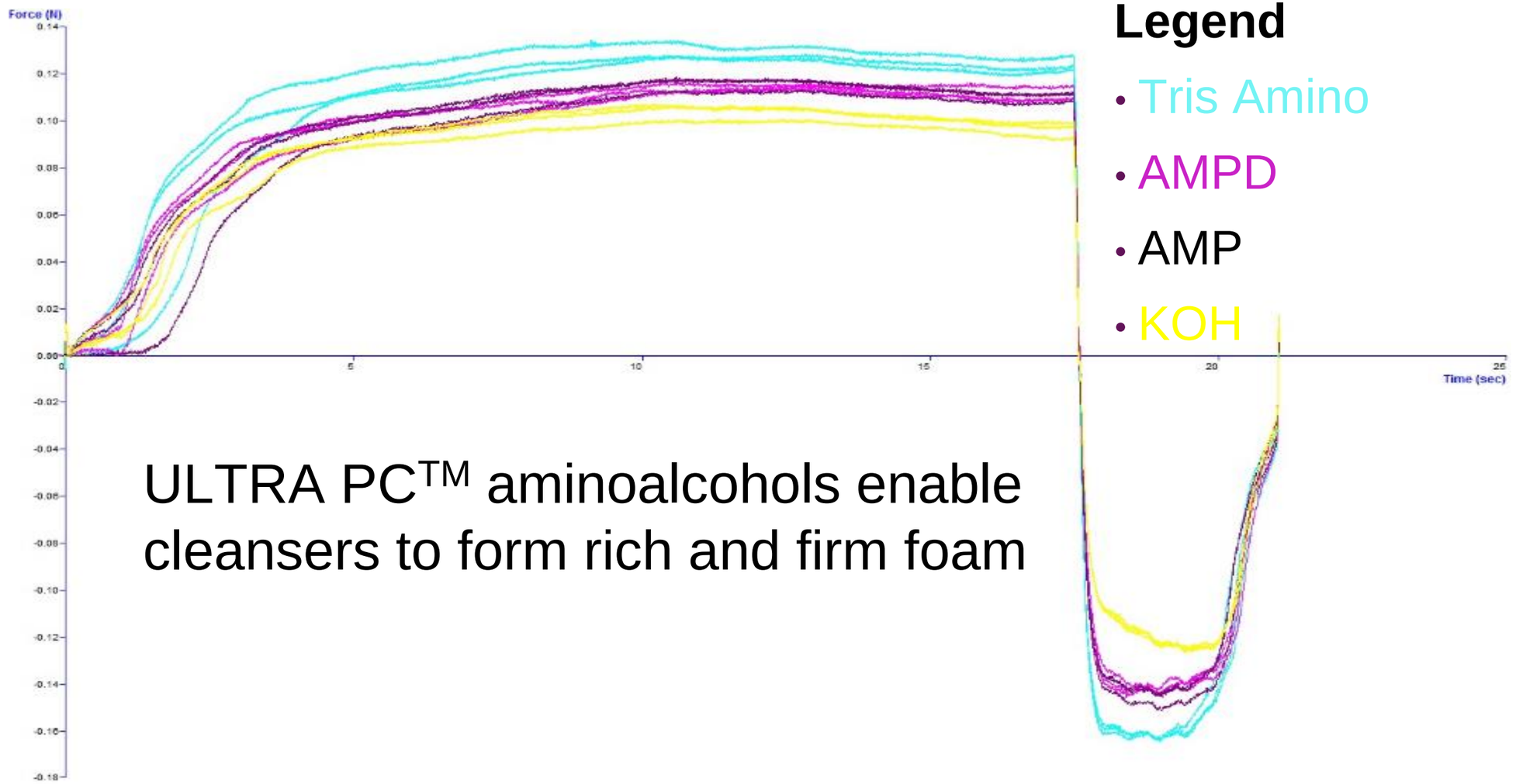


An example of a force-time graph generated by a back extrusion test

This test analyses the firmness of the foams generated by the cleanser formulations.

Textural Parameter	Instrumental Definition	Physical Definition	Sensory Correlation
Firmness / N	Positive Peak Force	Amount of force required to press down the sample	• How soft/hard the sample is when being pressed • The higher the value, the firmer the foam

Foam Firmness (100% Neutralisation)



Legend

- Tris Amino
- AMPD
- AMP
- KOH

ULTRA PC™ aminoalcohols enable cleansers to form rich and firm foam

Summary of Data (100% Neutralisation)

Neutraliser	pH	Viscosity (cPs) LVT-2, 60rpm	Foam Firmness Force (N)	Surface Tension[1] (mN/m)	Hazen / APHA
TEA	7.83	25	NA – Formulation Unstable	NA – Formulation Unstable	247
TRIS AMINO UPC	8.05	11	0.125	26.16	11
AMP UPC	8.70	10	0.111	29.65	10
AMPD UPC	8.32	10	0.112	28.60	11
KOH	9.48	8	0.097	30.19	7
NaOH	NA	NA	NA	NA	NA

[1]Lower surface tension → improved foam formation and cleansing

- ULTRA PC aminoalcohols enable formulation of low pH cleansers that can form rich, dense, and firm foam.

Summary (100% Neutralisation)

Neutralization at 100%	pH	Viscosity	Foam Firmness	Surface Tension	Cleanser appearance/ stability	Foam stability	Hazen/ APHA	Safety & Toxicity Profile	Total score
TEA	✓✓✓	×	×	×	×	×	×	× Possible stable nitrosamine formation	3
TRIS AMINO UPC	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓ **Proven safe** in multiple applications including pharmaceuticals	23
AMP UPC	✓	✓✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	18
AMPD UPC	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓✓ **Proven safe** in near mucosal surfaces products	19
KOH	×	✓✓✓	✓	✓	✓✓✓	✓✓	✓✓✓	✓✓ Moderate hazard as known for organ system toxicity (non-reproductive); Irritation (skin, eyes, or lungs)	15
NaOH	×	×	×	×	×	×	×	✓✓ Moderate hazard as known for organ system toxicity (non-reproductive) ; Irritation (skin, eyes, or lungs)	2

- TRIS AMINO ULTRA PC best overall choice for formulating foaming cleansers
- Balanced pH, good foam strength, feel, and stability.

Cleansing Foam Formulation (90% Fatty Acids Neutralisation)

Phase	Trade Name	CTFA / INCI Name	AMP UPC (95.5%) w/w %	TRIS AMINO UPC w/w %	AMPD UPC w/w %	KOH (85.5%) w/w %
A	Stearic acid (98.6%)	Octadecanoic Acid	0.67	0.67	0.67	0.67
	Lauric acid (99.3%)	Dodecanoic Acid	2.67	2.67	2.67	2.67
	Myristic acid (99.6%)	Tetradecanoic Acid	6.00	6.00	6.00	6.00
B	Disodium EDTA	EDTA Na2	0.05	0.05	0.05	0.05
	Neutralizer		3.50	4.55	3.95	2.46
	Glycerin 99%	1,2,3-Propanetriol	2.00	2.00	2.00	2.00
	Butylene Glycol	1,3 Butanediol	6.67	6.67	6.67	6.67
	DI Water	Water	72.94	71.89	72.49	73.98
C	SOFTAZOLINE CH-R	Sodium Cocoamphoacetate	2.00	2.00	2.00	2.00
	SOFTAZOLINE LHL	Sodium Lauroamphoacetate	2.00	2.00	2.00	2.00
D	Hydrolite 6	1,2 Hexandiol	1.50	1.50	1.50	1.50
		Total	100.00	100.00	100.00	100.00

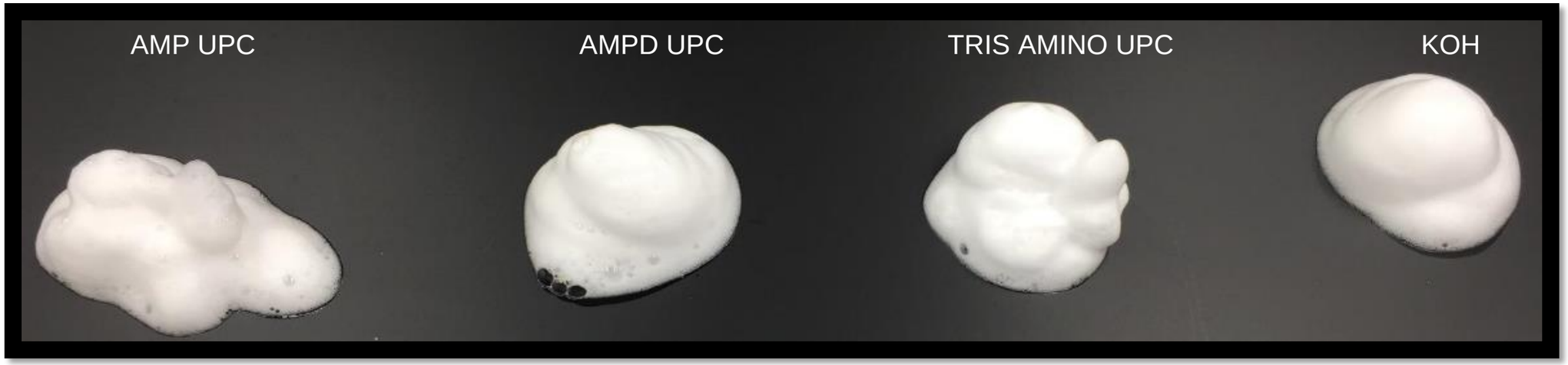
- Fatty acids neutralized with neutralizers at ratio 1:0.9.

Cleansing Foam (90% Neutralised)

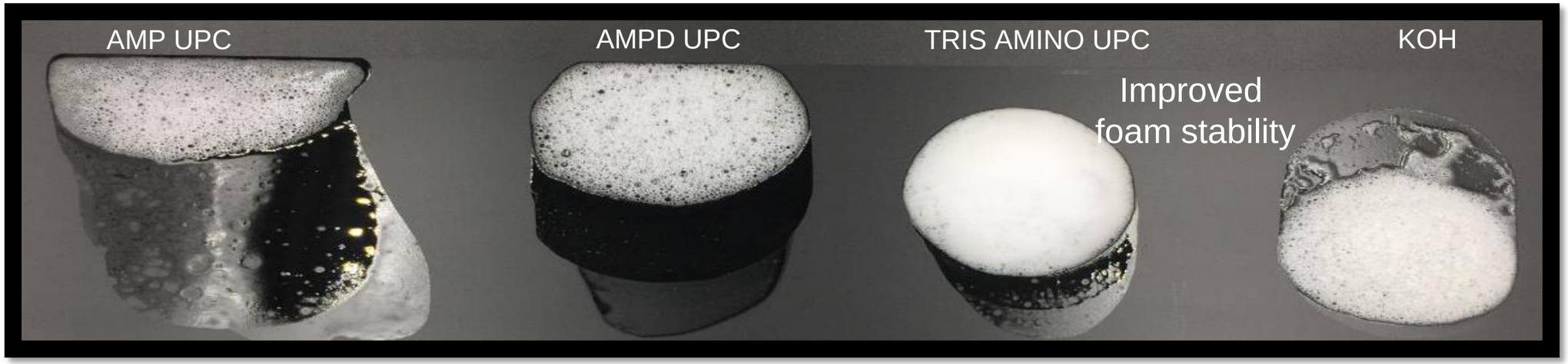
AMP UPC	AMPD UPC	TRIS AMINO UPC	KOH

Foam Breakability (90% Neutralisation)

Initial

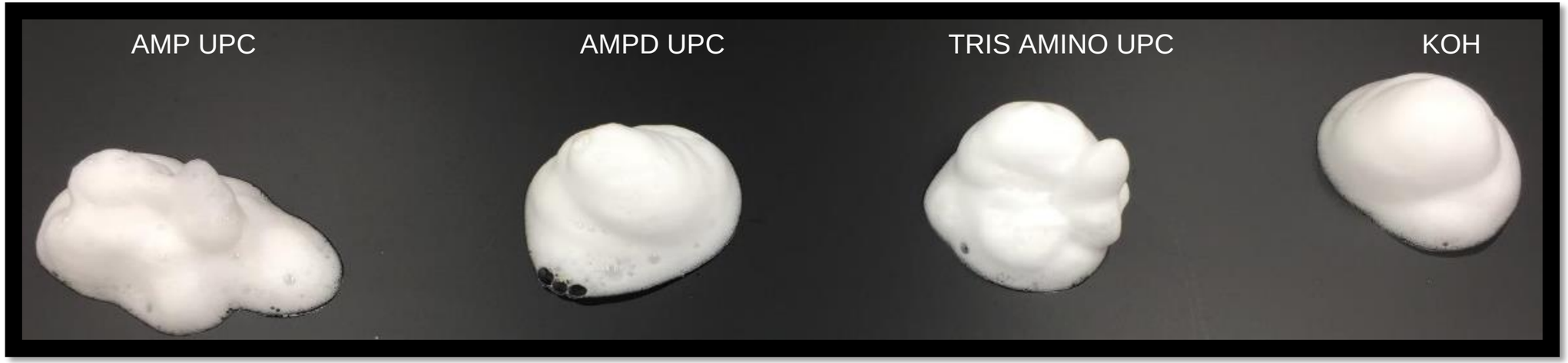


After 1 hour

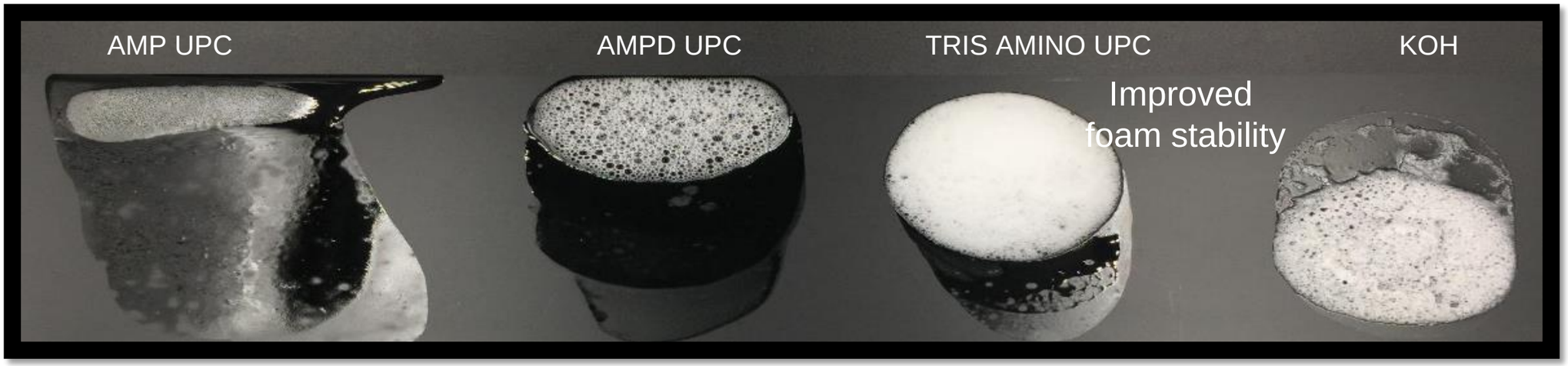


Foam Breakability (90% Neutralisation)

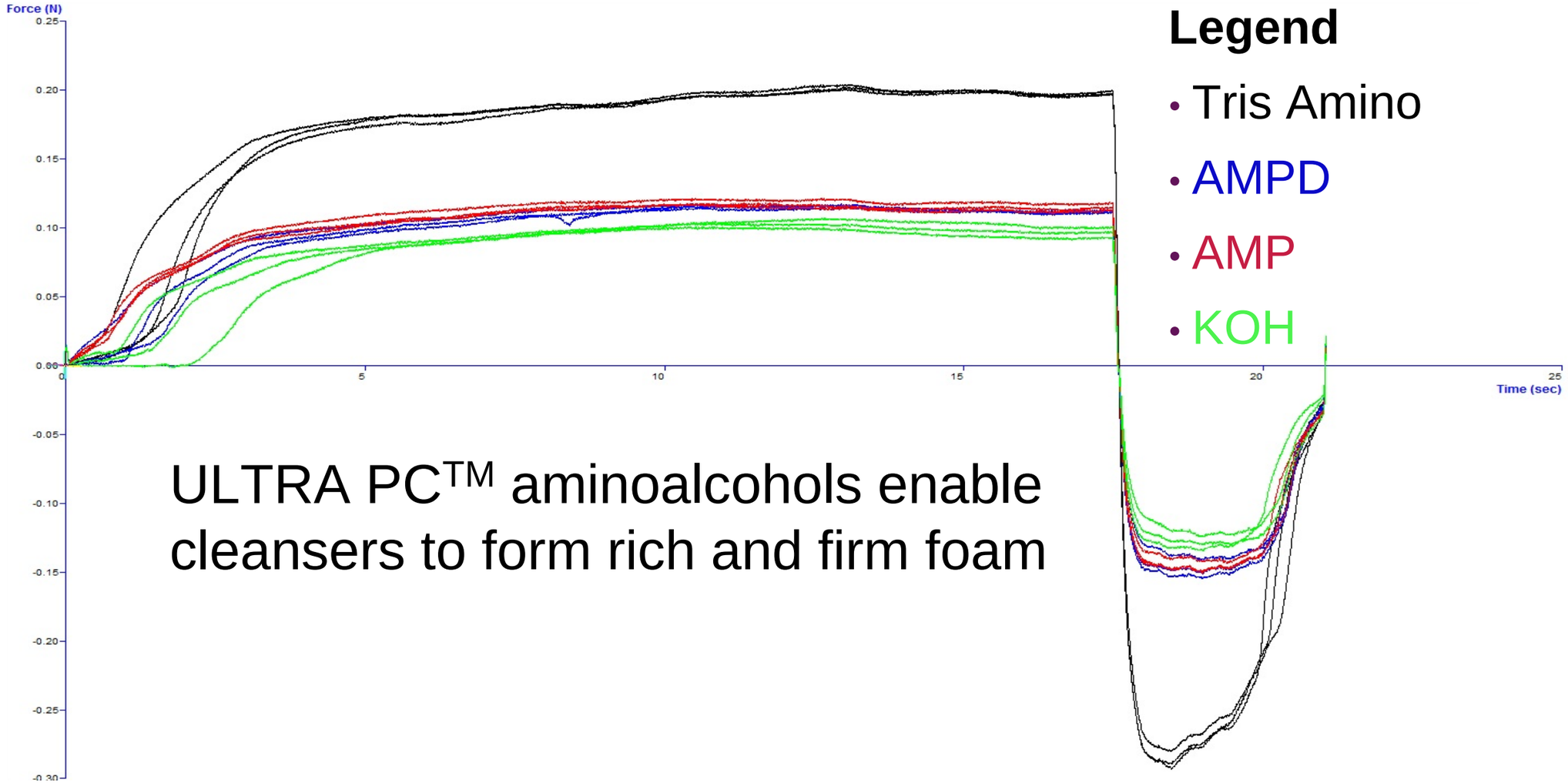
Initial



After 2 hours



Foam Firmness (90% Neutralisation)



Legend

- Tris Amino
- AMPD
- AMP
- KOH

ULTRA PC™ aminoalcohols enable cleansers to form rich and firm foam

Summary of Data (90% Neutralisation)

Neutralizer	pH	Viscosity (cPs) LVT-2, 60rpm	Foam Firmness Force (N)	Surface Tension[1] (mN/m)	Hazen/ APHA
TRIS AMINO UPC	7.95	13	0.199	24.04	11
AMP UPC	8.20	14	0.116	27.90	12
AMPD UPC	8.13	13	0.112	27.12	13
KOH	8.97	13	0.097	28.62	448

[1]Lower surface tension → improved foam and cleansing

- ULTRA PC aminoalcohols enable formulation of low pH cleansers that can form rich, dense, and firm foam.

Summary (90% Neutralisation)

Neutralisation at 90%	pH	Viscosity	Foam Firmness	Surface Tension	Cleanser appearance/ stability	Foam stability	Hazen/ APHA
TRIS AMINO UPC	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
AMP UPC	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓	✓✓✓
AMPD UPC	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓✓
KOH	✗	✓✓✓	✓	✓✓	✗	✗	✗

- TRIS AMINO ULTRA PC best overall choice for formulating foaming cleansers
- Balanced pH, good foam strength, feel, and stability.

Value in Cleansers

- Reduce risk of nitrosamine formation
- High safety profile
- Enable formulation of cleansers with high clarity
- Cleansers have much lower pH – mild on skin
- Foam generated are rich, dense, firm, and stable

Skin & Body Care Application

General Composition of Formulations

Additives

Fragrance(s)
Natural extracts
Vitamins
Functional acids

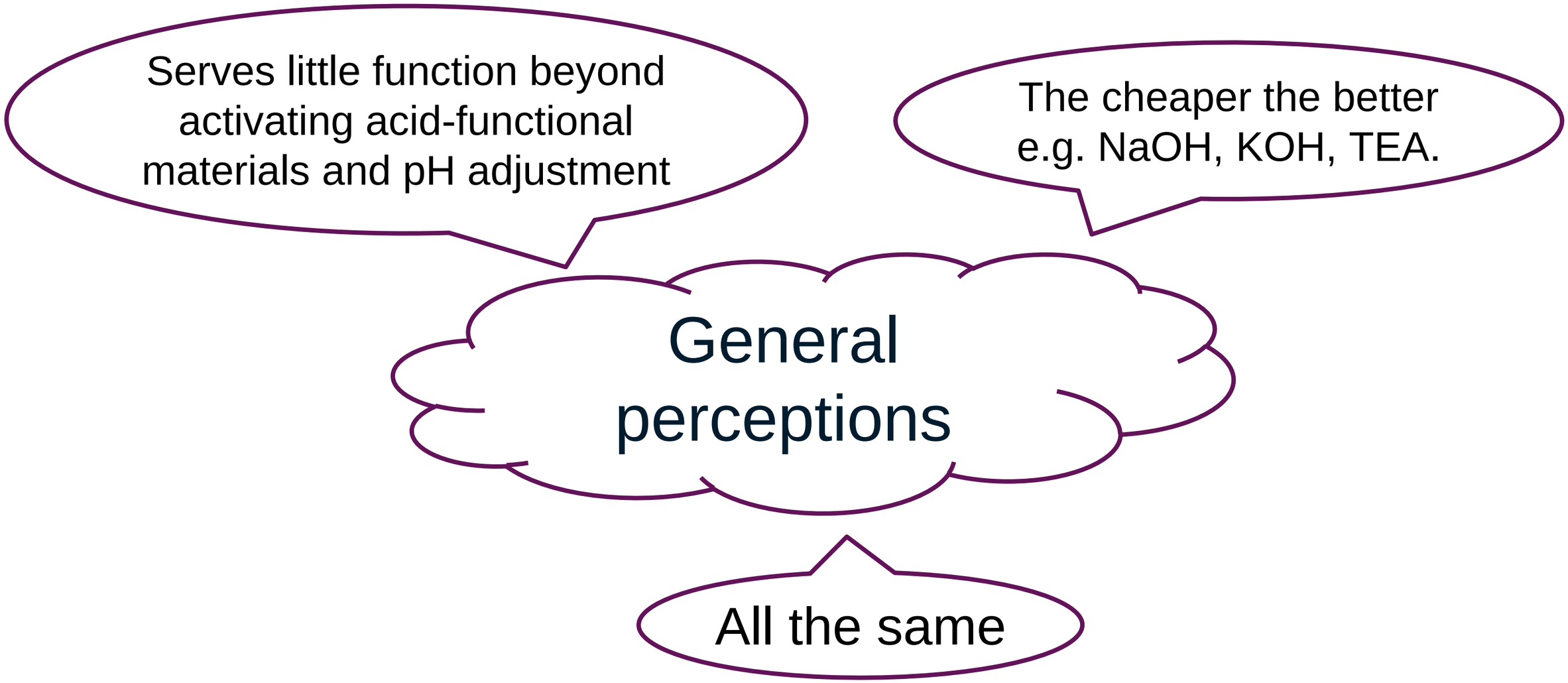
Gives Marketing Claims

Base

Preservative(s)
Neutraliser
Alcohols
Surfactants
Oils
Waxes
Rheology modifier(s)
Water

Ensures Product Stability

Neutraliser



Effect of Neutraliser on Salt Tolerance

Neutralisers Studied

Carbomer		Salt Disruption
0.5%	Triethanolamine (TEA) NaOH KOH Aminomethyl Propanol (AMP) Aminomethyl Propanediol (AMPD) Tromethamine (Tris)	0.5% NaCl

pH Adjusted to pH 7

Storage at room temperature and at 50 °C
Rheological analyses at initial, 1 month, and 3 months

Neutralisation Ratios

Neutraliser	Neutraliser : Carbomer Ratio to Achieve pH 7
Aminomethyl Propanol (AMP)	0.90 : 1.00
Aminomethyl Propanediol (AMPD)	1.00 : 1.00
Tromethamine (Tris)	1.21 : 1.00
Triethanolamine (TEA)	1.50 : 1.00
KOH (18%)	2.97 : 1.00
NaOH (18%)	2.12 : 1.00

Rheological Analysis: Rotational Test

- **Room Temperature Samples**

	K values			N values		
Neutraliser	Day 1	1 Month	3 Months	Day 1	1 Month	3 Months
Aminomethyl Propanol	35.42	34.46	33.25	0.298	0.299	0.301
Aminomethyl Propanediol	33.20	33.25	33.76	0.275	0.286	0.284
Tromethamine	31.93	31.34	32.90	0.259	0.291	0.280
Triethanolamine	41.52	39.73	36.31	0.274	0.277	0.297
KOH	31.07	32.07	28.54	0.250	0.264	0.284
NaOH	37.68	32.11	32.09	0.242	0.284	0.284

Neutraliser	% absolute Δ K Day 1 vs 3 months
Aminomethyl Propanol	6.13 %
Aminomethyl Propanediol	1.69 %
Tromethamine	3.04 %
Triethanolamine	12.55 %
KOH	8.14 %
NaOH	14.84 %

Larger changes in K values for gels formulated with TEA, KOH, and NaOH when salt is present in the system

Rheological Analysis – Rotational Test

- **Heat storage samples (50 °C)**

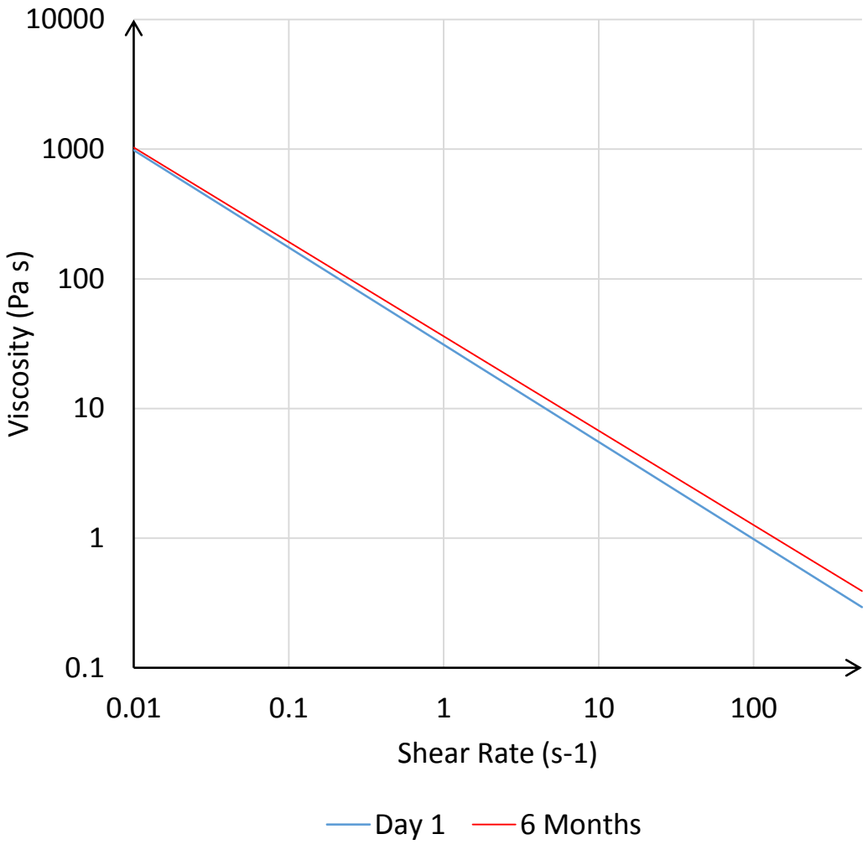
	K values			N values		
Neutraliser	Day 1	1 Month	3 Months	Day 1	1 Month	3 Months
AMP Ultra PC 2000	35.42	32.42	31.19	0.298	0.297	0.301
AMPD Ultra PC	33.20	30.47	31.24	0.275	0.294	0.293
Tris Amino	31.93	35.98	31.02	0.259	0.264	0.288
TEA	41.52	35.27	30.58	0.274	0.288	0.295
KOH	31.07	31.58	35.32	0.250	0.276	0.280
NaOH	37.68	35.08	29.50	0.242	0.247	0.285

Material	% absolute Δ K Day 1 vs 3 months
Aminomethyl Propanol	11.94 %
Aminomethyl Propanediol	5.90 %
Tromethamine	2.85 %
Triethanolamine	26.35 %
KOH	13.68 %
NaOH	21.71 %

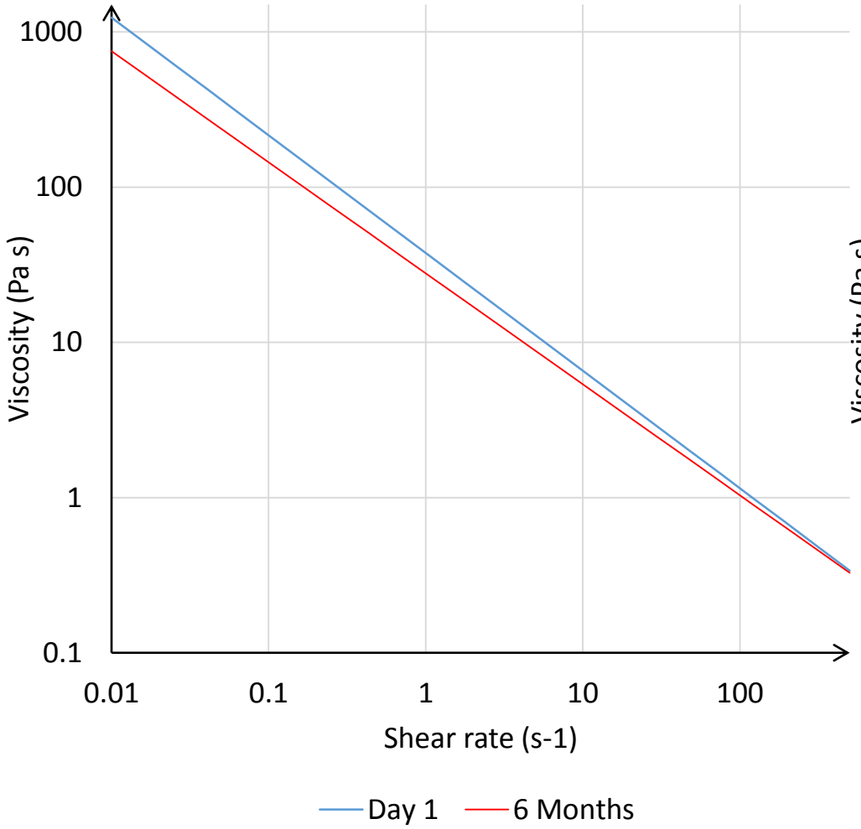
Larger changes in K values for gels formulated with TEA, KOH, and NaOH when salt is present in the system

Viscosity Profile of Heat Storage Samples

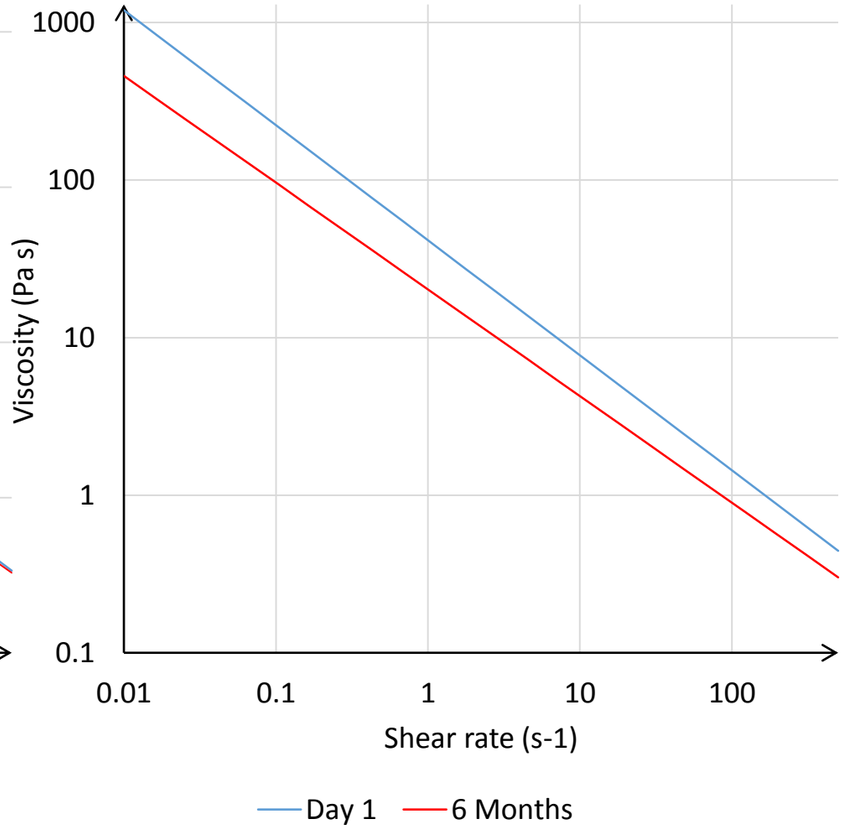
Viscosity of **KOH**-neutralised Carbopol 940 Gel after Heat Storage



Viscosity of **NaOH**-neutralised Carbopol 940 sample after Heat Storage



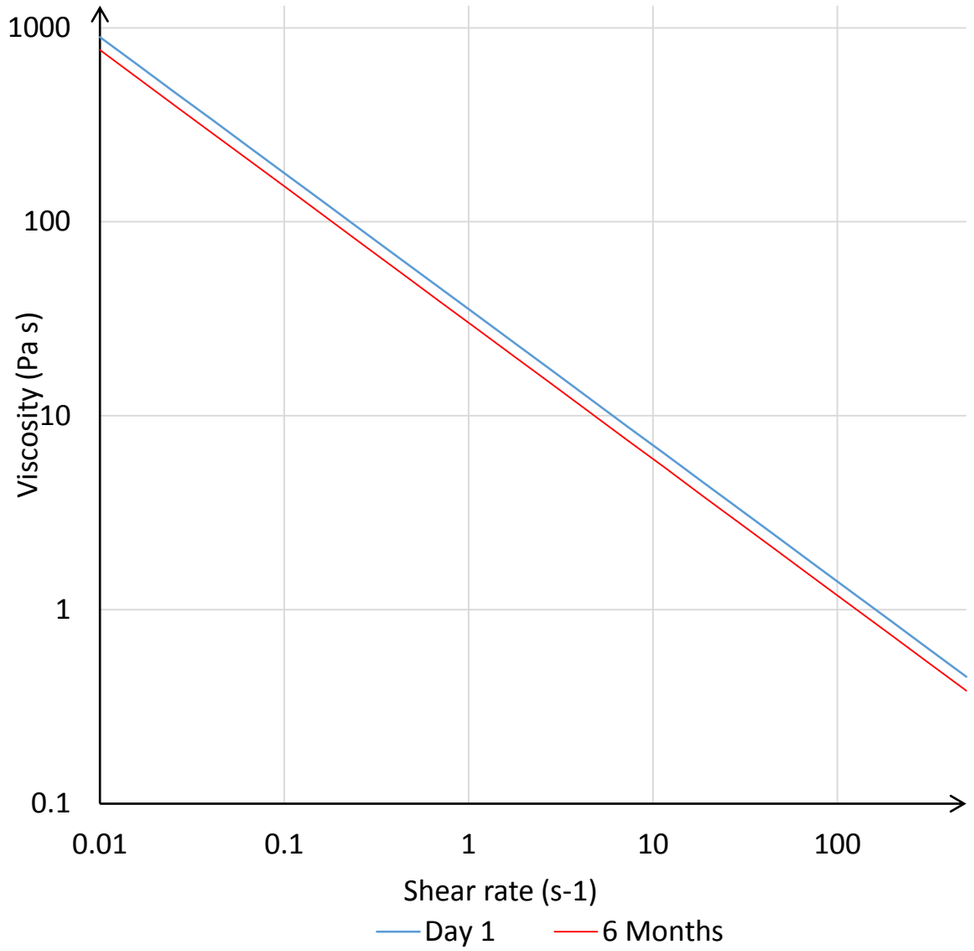
Viscosity of **TEA**-neutralised Carbopol 940 Gel after Heat Storage



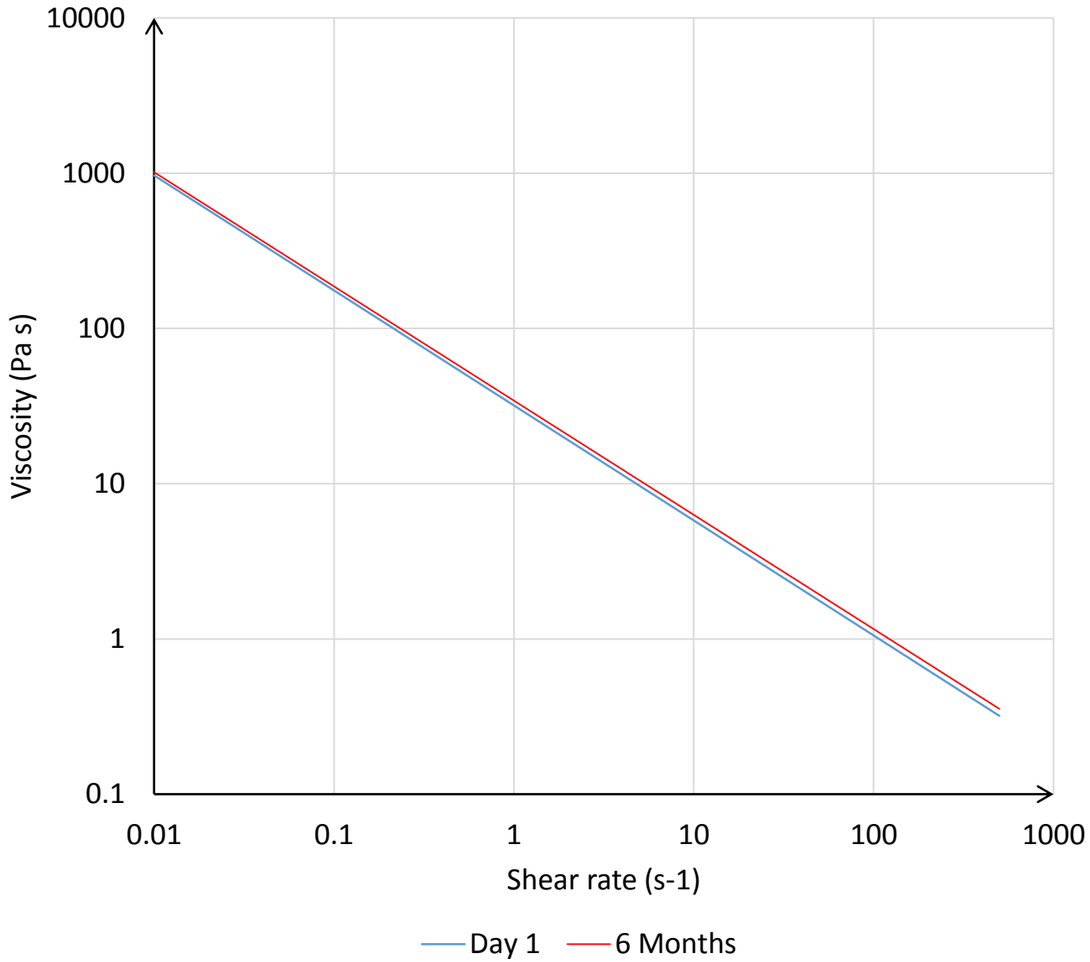
Larger changes in viscosities for gels formulated with TEA, KOH, and NaOH when salt is present in the system

Viscosity Profile of Heat Storage Samples

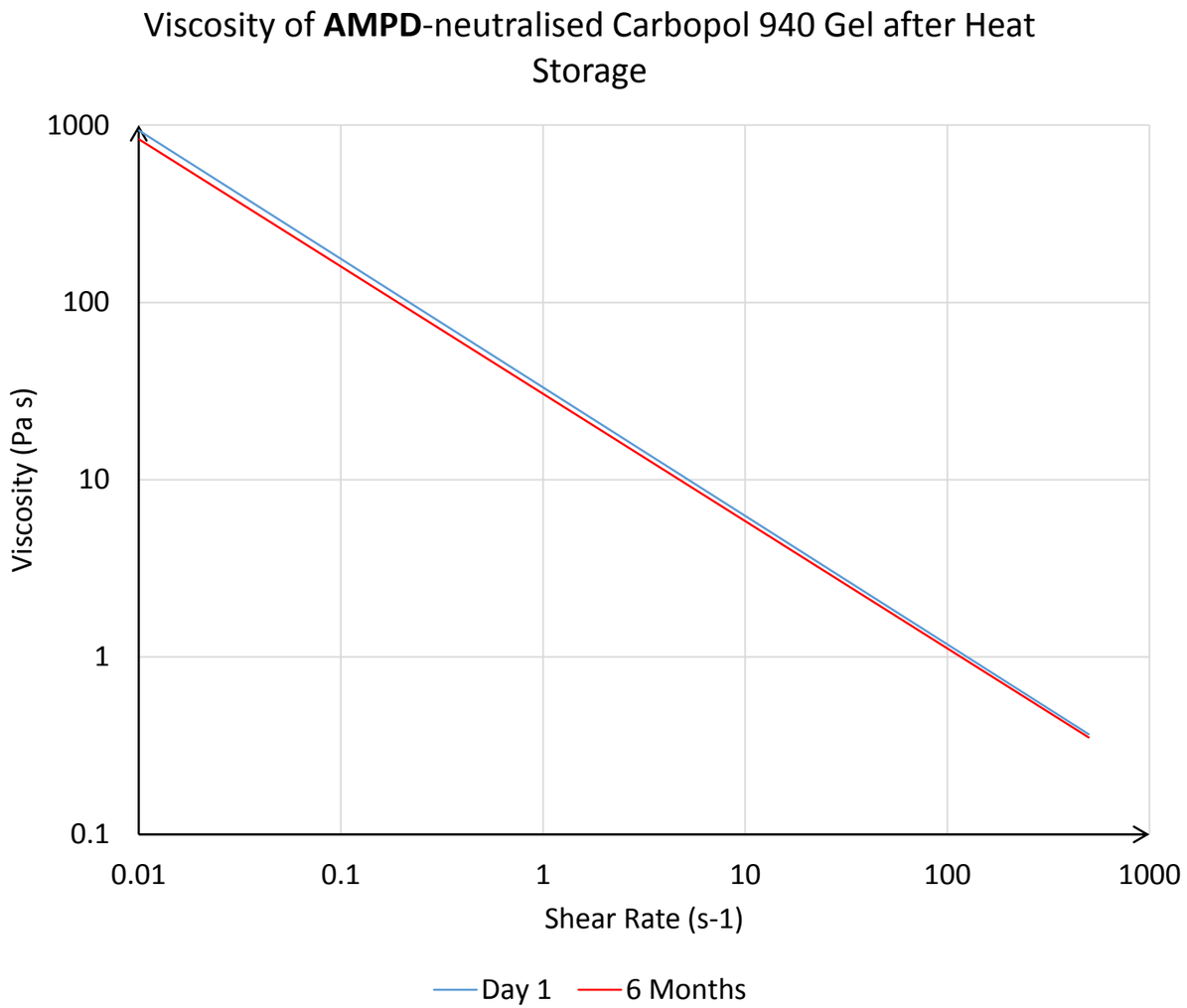
Viscosity of **AMP**-neutralised Carbopol 940 Gel after Heat Storage



Viscosity of **Tris Amino**-neutralised Carbopol 940 Gel after Heat Storage



Viscosity Profile of Heat Storage Samples



- Largest changes in viscosity profiles for gels formulated with NaOH, KOH, or TEA when salt is present
- Highest consistency in viscosity profiles for gels formulated with AMP, Tris Amino, and AMPD when salt is present
- Overall product stability can be improved/enhanced with chemistries like AMP, Tris Amino, and AMPD.

Value for Skin & Body Care

- Reduce risk of nitrosamine formation
- High safety profile
- Good salt tolerance in water-based systems
- Improves / enhances overall product stability

Hand Sanitisers Application

Basic Ethanol Tolerance Test

- 600g of carbomer neutralized by different bases and loaded with 70% ethanol content
- Viscosities and clarities observed over 1 month for samples stored at room temperature or at 50 °C

Effect of Neutraliser on Ethanol Tolerance

- NaOH and KOH based neutralisation have poor ethanol tolerance

Table 1. Observations of the viscosity and clarity of samples immediately upon preparation and after 24 hours

	Neutralizer	Content of ethanol in gel (%, w/w)									
		Immediately after preparation					24 h after preparation				
		20	30	40	50	60	20	30	40	50	60
Inorganic bases	NaOH	-	++	+++	+++	+++	-	-	+++	+++	+++
	KOH	-	-	++	+++	+++	-	-	++	+++	+++
Organic bases	AMP	-	-	-	-	-	-	-	-	-	-
	AMPD	-	-	-	-	-	-	-	-	-	-
	TRIS	-	-	-	-	+	-	-	-	-	-

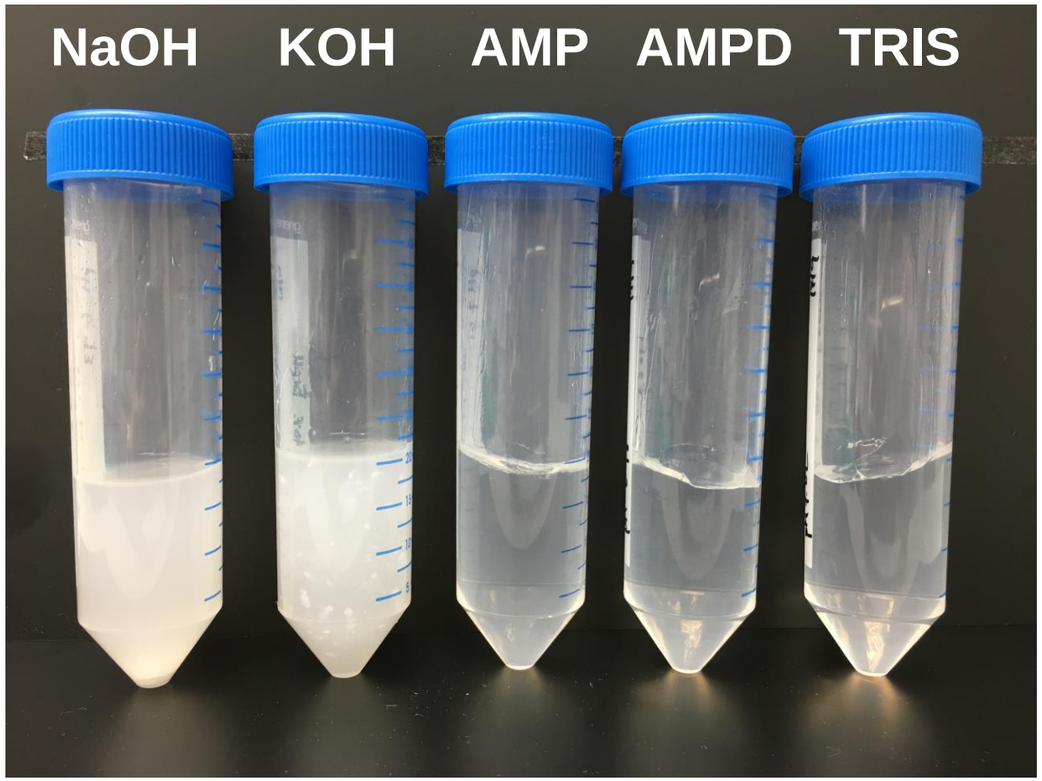
Shaded boxes indicate that samples did not possess satisfactory viscosity (i.e., sample can flow when the container was inverted)

+/- indicates the presence/absence of precipitates in the sample

- **Inorganic bases**
  - Precipitation when EtOH content ≥ 30 %, w/w
  - Poor gelling action
- **Organic bases**
  - No or minimal precipitates up to 60 %, w/w of EtOH
  - Clear, viscous gels formed

Effect of Neutralisers on Ethanol Tolerance

Visual appearances of gels



Carbomer gels containing 40 %, w/w ethanol

Inorganic bases (NaOH, KOH)

- Precipitate formation
- Liquid-like for NaOH based neutralisation
- Gel-like clumps suspended in viscous liquid for KOH based neutralisation

Organic bases (AMP, AMPD and TRIS)

- Clear and viscous gels formed

Viscosity Stability

Neutraliser	<Viscosity> of final sample with 70% Ethanol at Day 1 / cps	<Viscosity> of samples after 1 month / cps		Percentage change in viscosity after 1 month	
		Room temp.	50°C	Room temp.	50°C
AMP Ultra PC 2000	4308	4890	4735	13.51%	9.91%
AMPD Ultra PC	3002	3567	2955	18.82%	1.57%
TEA	1905	3140	2502	64.83%	31.34%

Note: These viscosity readings are measured using the T-spindle (TC).

- AMP and AMPD –based neutralisations had excellent ethanol tolerance
- High initial viscosity achieved
- Stable viscosity over room and heat storage

- TEA – based neutralisation poor at ethanol tolerance
- Poor viscosity building
- Poor stability of viscosity

Clarity Stability

Neutraliser	Turbidity level of sample with 70% Ethanol at Day 1 / NTU	Turbidity level after 1 month / NTU	
		At room temperature	In 50°C oven
AMP Ultra PC 2000	7.95	7.94	6.46
AMPD Ultra PC	21.10	16.70	18.70
TEA	1083.00	21.50	61.00

- AMP – based neutralisation showed the highest clarity and stability over time with 70% ethanol content
- Order of stability in clarity: AMP > AMPD > TEA

Physical Appearances of Gels

Initial

AMP AMPD TEA

After 1 month @ 50 °C

AMP AMPD TEA

- AMP-based neutralisation confers highest stability for viscosity and clarity in the presence of ethanol

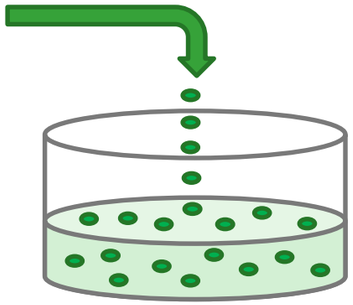
Value for Hand Sanitizers

- Reduce risk of nitrosamine formation
- High safety profile
- Enable formulation of hand sanitizers with high percentage of ethanol
- Rapid and easy processability
- Fully transparent gel
- Stable over long term storage

Enhancement of Preservation System (Lotion Examples)

Challenge Test Methodology

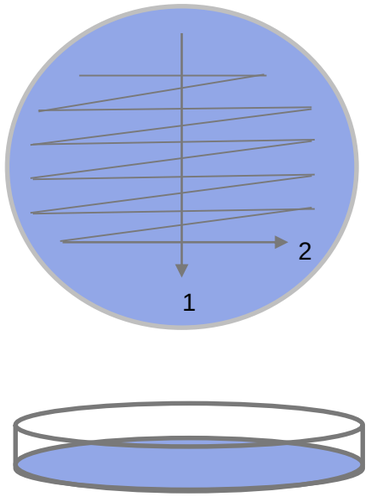
Inoculation on Day 0, 7 and 14
Bacteria: $5x10^6$ - $5x10^7$ CFU/mL
Fungi: $5x10^5$ - $5x10^6$ CFU/mL



Sample formulation to be tested

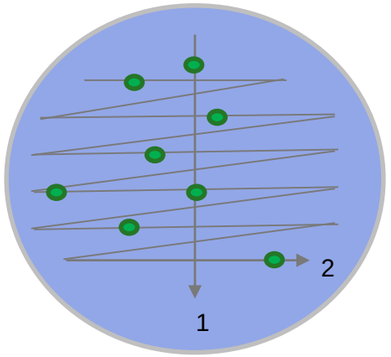
Sample Incubation at 25°C.
Sampling/Streaking on Day 2, 7, 14, 21 and 28.

Bacteria on Tryptone Soya Agar
Fungi on Sabouraud Dextrose Agar



Streaking sample on agar

Streak Plate Incubation
Bacteria: 2 days at 37°C
Fungi: 2 – 7 days at 30°C



Viable organisms form colonies on agar

Plating Results	Score	Approximate CFU/mL Sample
No viable colony detected (✓)	0	$<1 \times 10^2$
1–10 colonies (✓)	1	1×10^2 - 1×10^3
11–20 colonies (×)	2	1.1×10^3 - 2×10^3
21–50 colonies (×)	3	2.1×10^3 - 5×10^3
51–100 colonies (×)	4	5.1×10^3 - 1×10^4
>100 colonies (×)	5	$>1 \times 10^4$

Enhancement of 1,2-hexanediol

Lotion samples were prepared according to the formulation below.

1,2-hexanediol was post-added to the formulation at 1.0%, 1.5% and 2.0% prior to testing.

Phase	INCI Name	Wt%			
		AMP	TA	NaOH	KOH
A	Water	69.62	69.48	69.13	68.70
	EDTA	0.02	0.02	0.02	0.02
	Acrylates/C10-30 Alkyl Acrylate Crosspolymer	0.50	0.50	0.50	0.50
B	Butylene Glycol	3.00	3.00	3.00	3.00
	Glycerin	2.00	2.00	2.00	2.00
	Glyceryl Stearate	3.00	3.00	3.00	3.00
	Cetyl Ethylhexanoate	12.50	12.50	12.50	12.50
	Cyclypentasiloxane, Dimethicone Crosspolymer	4.00	4.00	4.00	4.00
C	Water	5.00	5.00	5.00	5.00
	Aminomethylpropanol (AMP™ Ultra PC 2000)	0.36	-	-	-
	Tromethamine (TRIS AMINO™ ULTRA PC)	-	0.50	-	-
	Sodium Hydroxide	-	-	0.85	-
	Potassium Hydroxide	-	-	-	1.28
	TOTAL	100.00	100.00	100.00	100.00

Enhancement of 1,2-hexanediol

No.	Sample Description	Bacterial Challenge	Fungal Challenge
1	AMP (Blank)	×	×
2	AMP + 1.0% 1,2-hexanediol	×	×
3	AMP + 1.5% 1,2-hexanediol	✓	✓
4	AMP + 2.0% 1,2-hexanediol	✓	✓
5	TRIS AMINO (Blank)	×	×
6	TRIS AMINO + 1.0% 1,2-hexanediol	×	×
7	TRIS AMINO + 1.5% 1,2-hexanediol	✓	✓
8	TRIS AMINO + 2.0% 1,2-hexanediol	✓	✓
9	NaOH (Blank)	×	×
10	NaOH + 1.0% 1,2-hexanediol	×	×
11	NaOH + 1.5% 1,2-hexanediol	×	✓
12	NaOH + 2.0% 1,2-hexanediol	✓	✓
13	KOH (Blank)	×	×
14	KOH + 1.0% 1,2-hexanediol	×	×
15	KOH + 1.5% 1,2-hexanediol	×	✓
16	KOH + 2.0% 1,2-hexanediol	✓	✓

- Lotion samples formulated with AMP and TRIS AMINO were able to withstand both bacterial and fungal challenge with just 1.5% 1,2-hexanediol
- Formulations with NaOH and KOH could not.

Enhancement of Pentylene Glycol

- Lotion samples were prepared according to the formulation below.
- **Pentylene glycol** was post-added to the formulation at 3.0%, 4.0%, 4.5% and 5.0% prior to testing.

Phase	INCI Name	Wt%	
		AMP	KOH
A	Water	69.62	68.70
	EDTA	0.02	0.02
	Acrylates/C10-30 Alkyl Acrylate Crosspolymer	0.50	0.50
B	Butylene Glycol	3.00	3.00
	Glycerin	2.00	2.00
	Glyceryl Stearate	3.00	3.00
	Cetyl Ethylhexanoate	12.50	12.50
	Cyclypentasiloxane, Dimethicone Crosspolymer	4.00	4.00
C	Water	5.00	5.00
	Aminomethylpropanol (AMP™ Ultra PC 2000)	0.36	-
	Potassium Hydroxide	-	1.28
	TOTAL	100.00	100.00

Enhancement of Pentylene Glycol

No.	Sample Description	Bacterial Challenge	Fungal Challenge
1	AMP (Blank)	x	x
2	AMP + 3.0% Pentylene Glycol	x	x
3	AMP + 4.0% Pentylene Glycol	✓	✓
4	AMP + 4.5% Pentylene Glycol	✓	✓
5	AMP + 5.0% Pentylene Glycol	✓	✓
6	KOH (Blank)	x	x
7	KOH + 3.0% Pentylene Glycol	x	x
8	KOH + 4.0% Pentylene Glycol	x	x
9	KOH + 4.5% Pentylene Glycol	✓	✓
10	KOH + 5.0% Pentylene Glycol	✓	✓

- Lotion sample formulated with AMP was able to withstand both bacterial and fungal challenge with just 4.0% pentylene glycol
- Formulation with KOH could not.

Value for Formulations

- Reduce risk of nitrosamine formation
- High safety profile
- Enhancement of preservation systems
- Works well in ‘preservative-free’ systems
- Reduced dosages to achieve similar protection

WE MAKE THE BEST PERFORM BETTER.

Thank You