AFLatex technologies

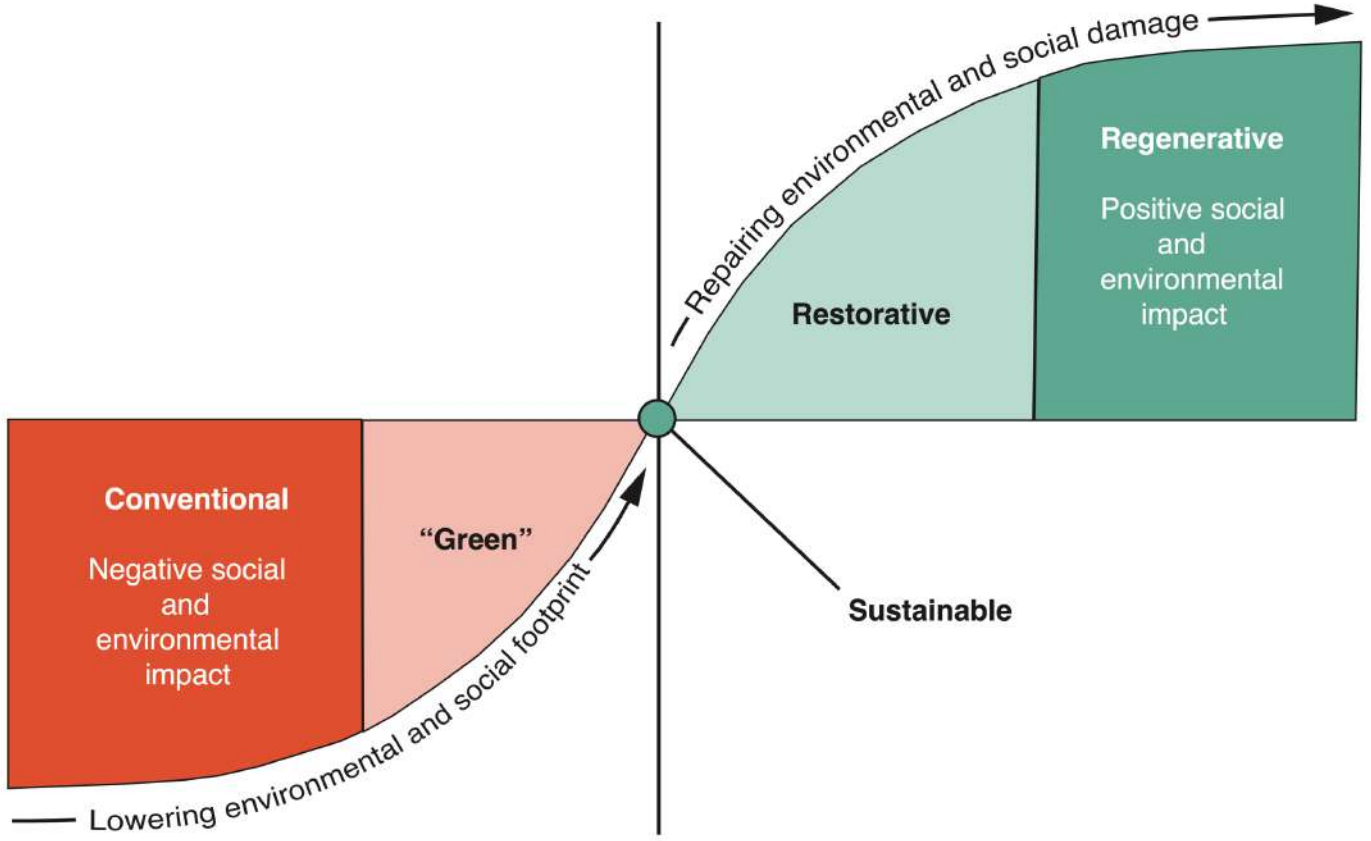
REINVENTADO CAUCHO
- LIBRE DE AMONIACO -

AFLatex technologies

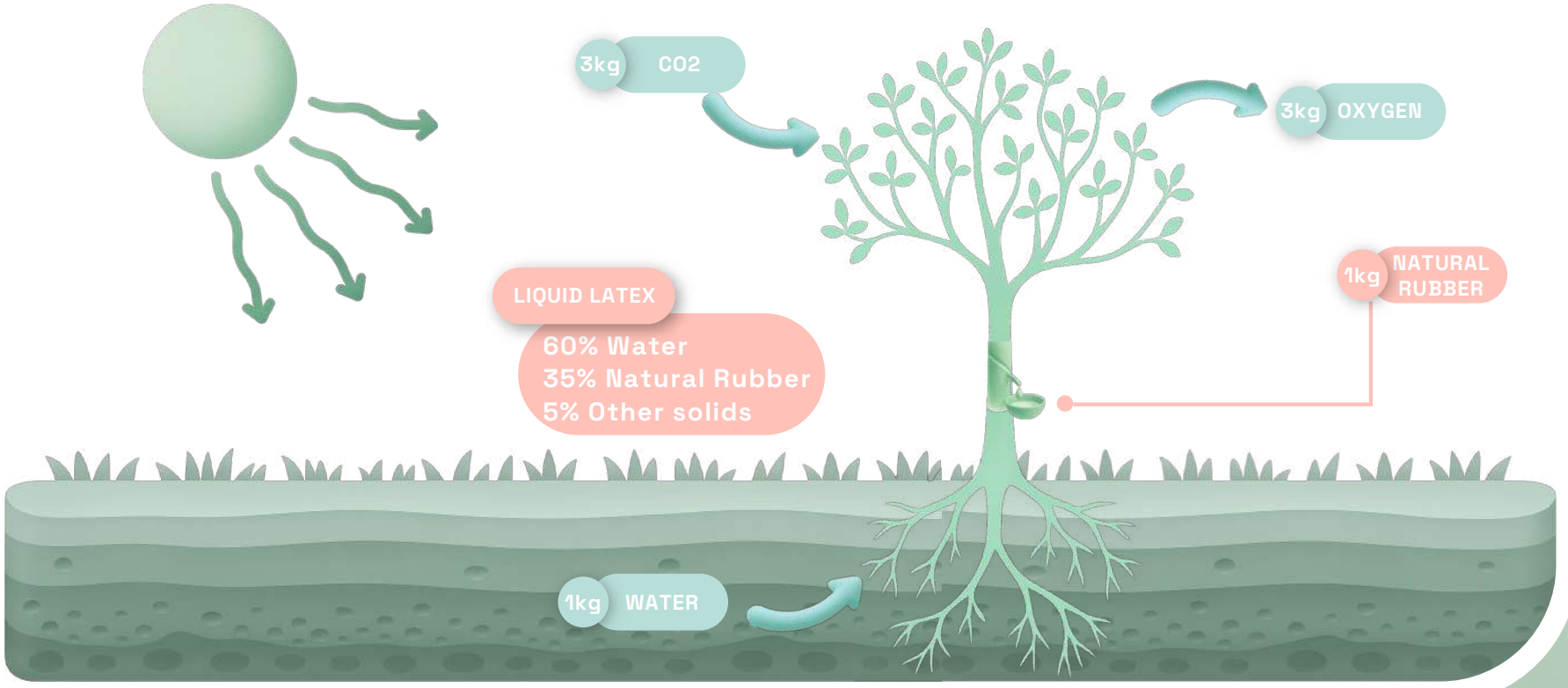
UN FUTURO MAS LIMPIO

Restaurando el Medio Ambiente con Látex de Caucho Natural sin Amoniaco

Prof. Tim A. Osswald Eric Adler Julio César Rodríguez Prof. Allen J. Román

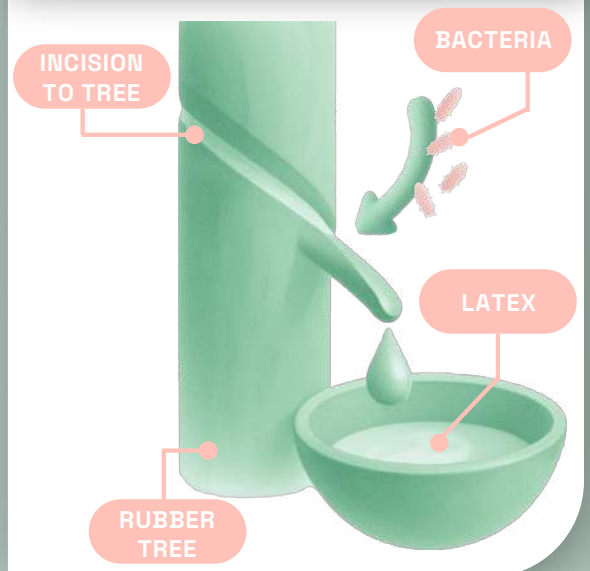

Repairing environmental and social damage
Regenerative
Positive social and environmental impact
Restorative
Conventional
Negative social and environmental impact
"Green"
Sustainable
Lowering environmental and social footprint

1 kg of natural rubber sequesters 3 kg of CO_2



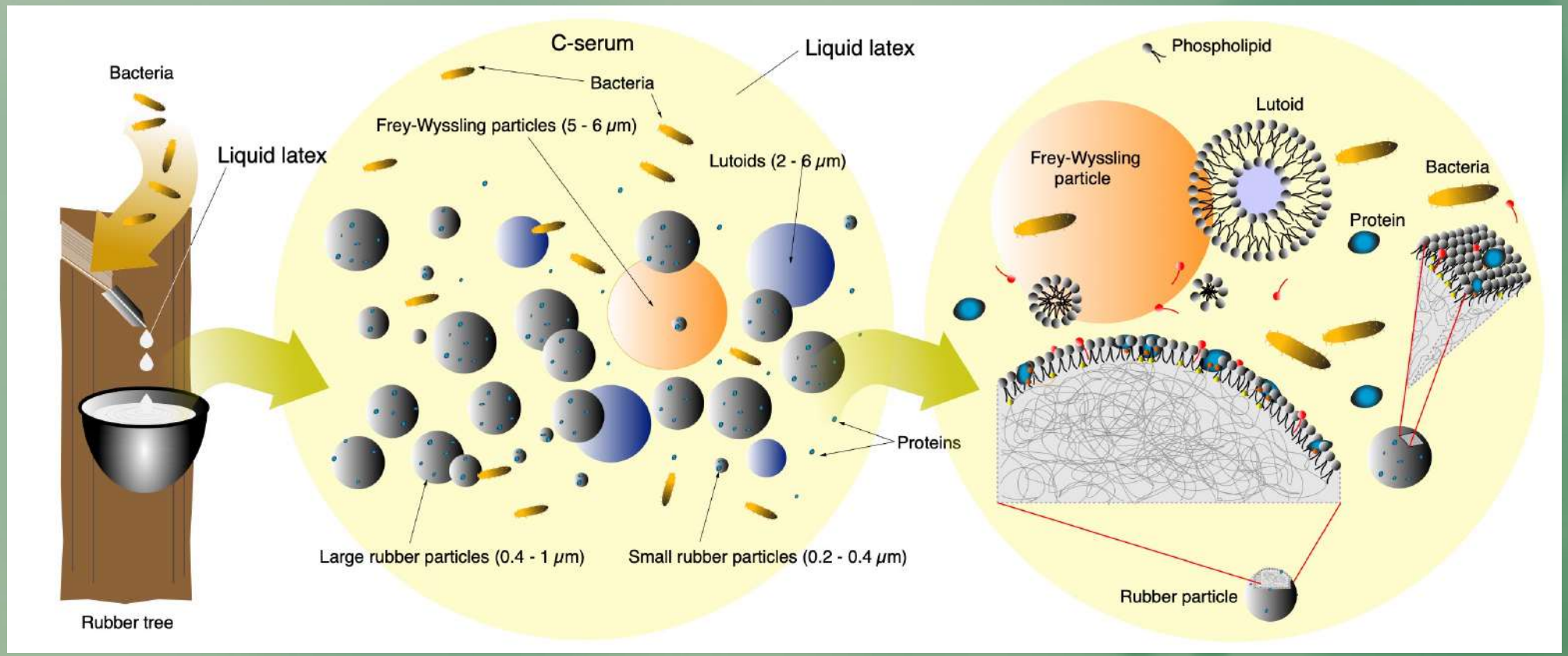
Natural rubber latex **tree tapping process**

LIQUID LATEX COLLECTION



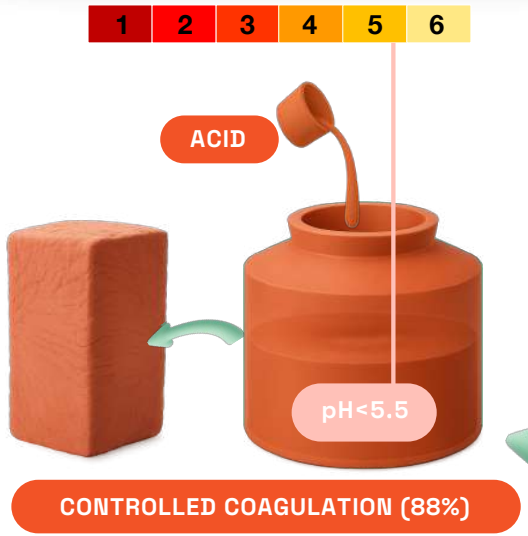
STABILIZATION-PRESERVATION

PRODUCT DEVELOPMENT


Bacteria
Liquid latex
Rubber tree
C-serum
Liquid latex
Bacteria
Frey-Wyssling particles (5 - 6 μm)
Lutoids (2 - 6 μm)
Proteins
Large rubber particles (0.4 - 1 μm)
Small rubber particles (0.2 - 0.4 μm)
Phospholipid
Lutoid
Frey-Wyssling particle
Bacteria
Protein
Rubber particle

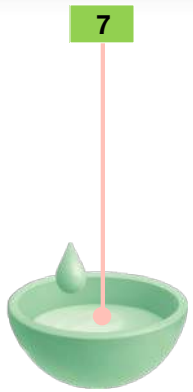
Natural rubber latex **and pH**

ACIDIC



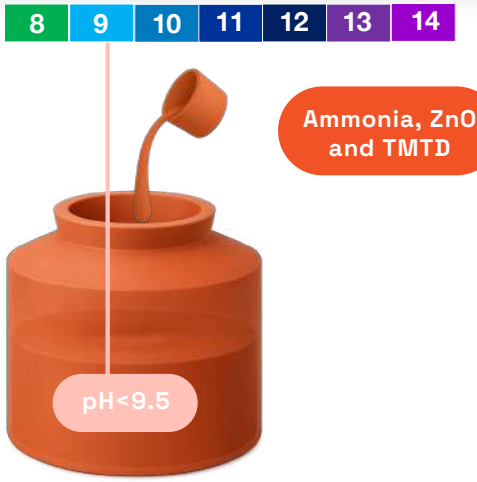
CONTROLLED COAGULATION (88%)

NEUTRAL



NATURAL RUBBER LATEX

ALKALINE



PRESERVATION AND STABILIZATION (12%)

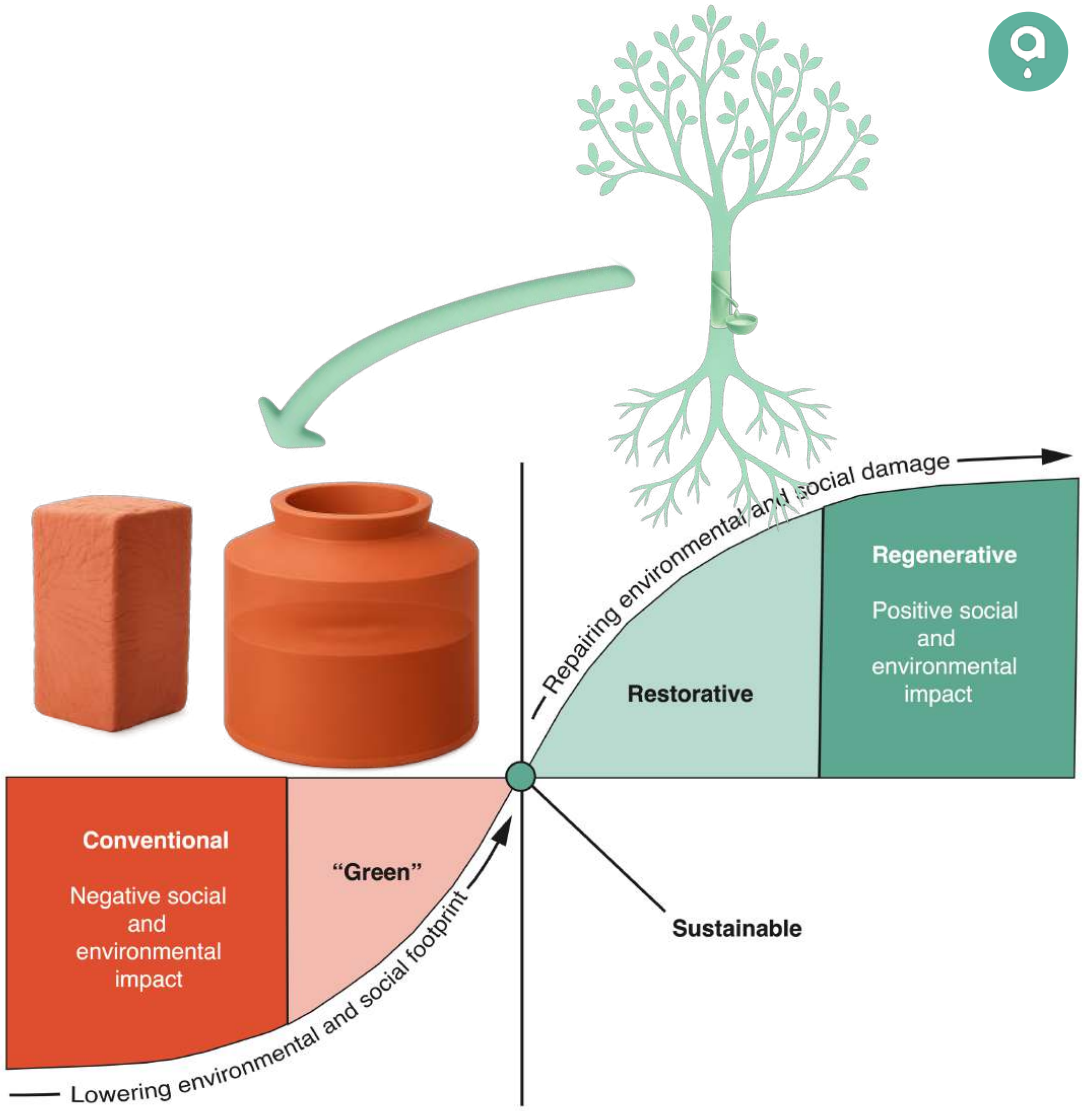
THE PROBLEM

Ammonia is a common preservative and stabilizer

AMMONIATED RUBBER

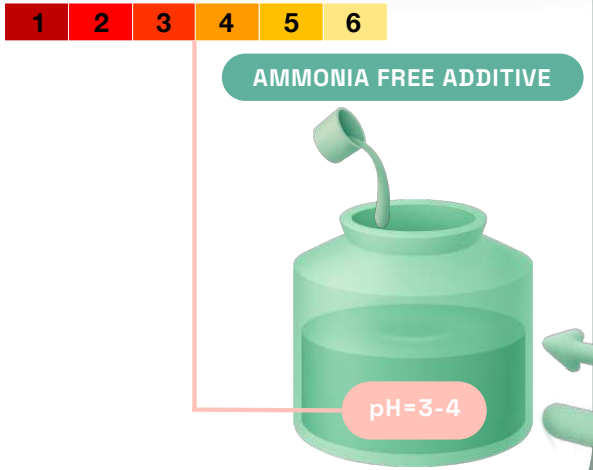
ZnO and TMTD

- Hazardous to health of workers
- Environmentally damaging
- Effluents promote unwanted algae growth
- Contains carcinogenic nitrosamines



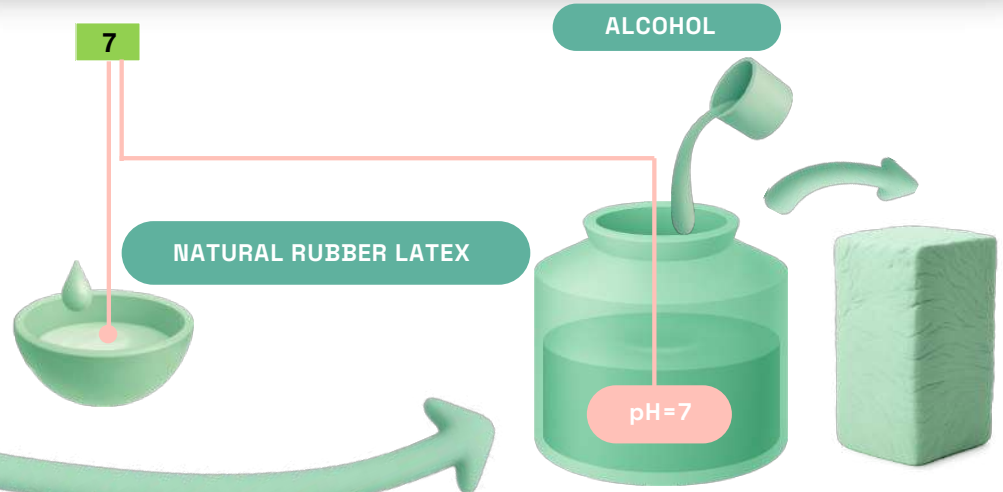
Natural rubber latex **and pH**

ACIDIC



PRESERVATION AND STABILIZATION (12%)

NEUTRAL



COAGULATION (88%)

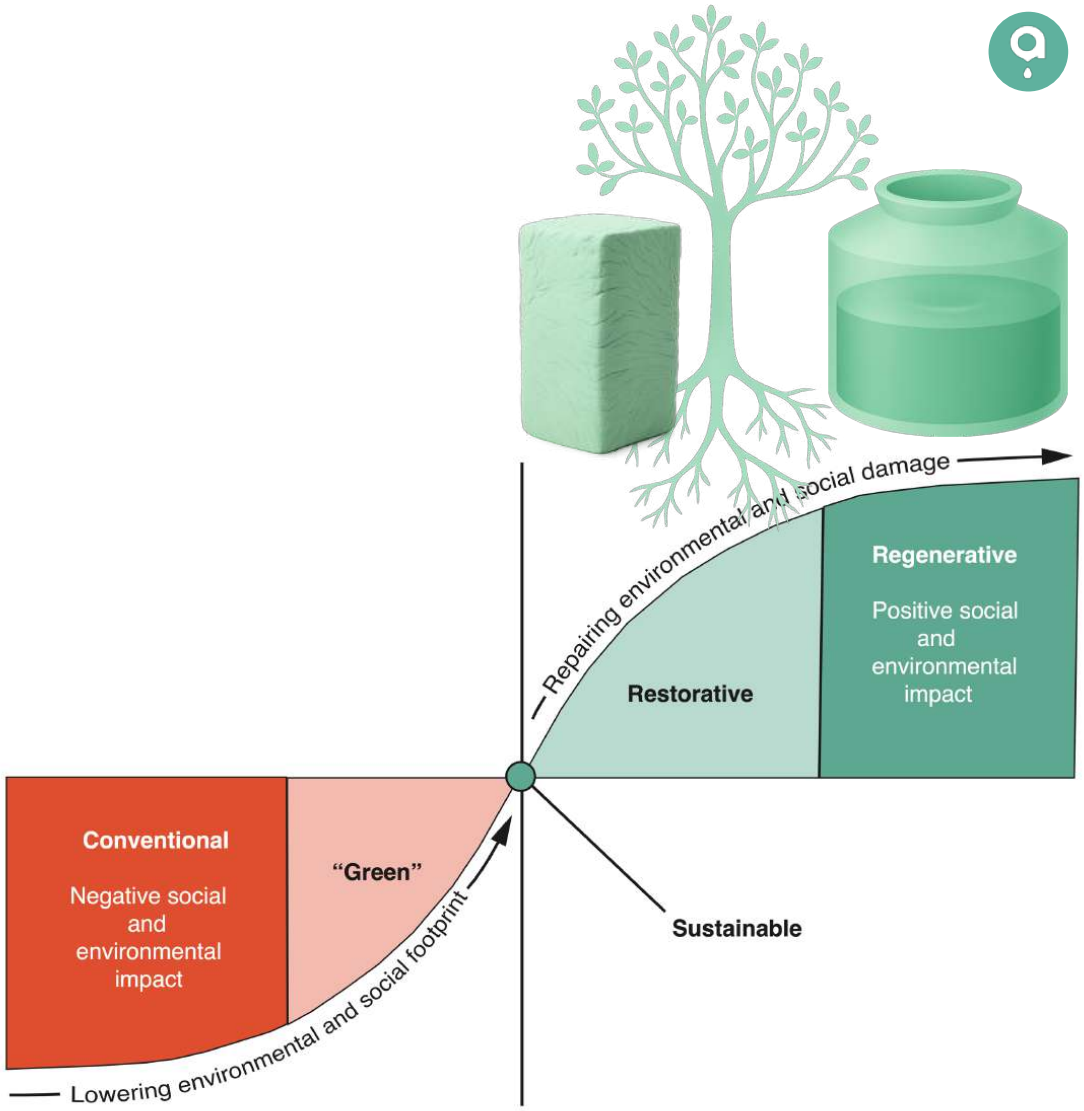
THE BREAKTHROUGH

Environmentally friendly additives
stabilize and preserve the liquid latex

AFLatex technologies

35%-100% dry natural rubber

- Superior strength
- Odorless and non-toxic
- No water treatment facilities required
- No negative health consequences to workers and users



AFLATEX STABILIZATION FORMULATIONS

BETA

Formulation (by volume):
98% Natural rubber field latex
2% Linear DBS (**CAS: 85536-14-7**)

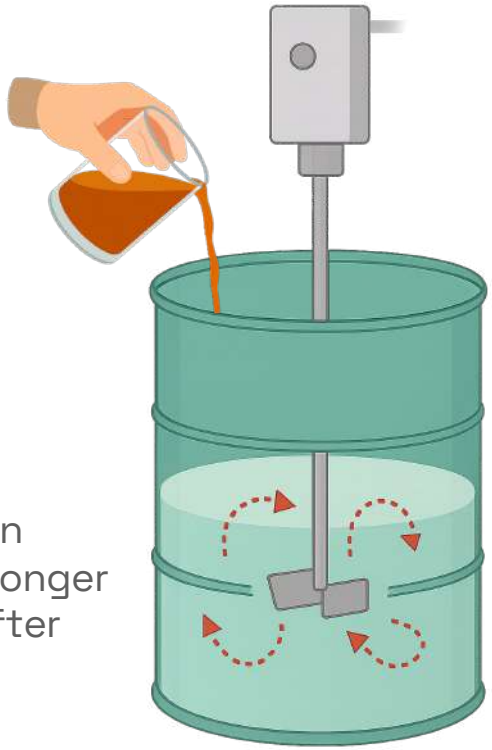
DBS = Dodecylbenzene sulfonic acid

Important note

Some chemical suppliers may offer CAS: 27176-87-0 which is the most expensive option for DBS as it's the purest form of the chemical.

Mixing:

Beta requires intense mixing, such as a drill-powered mixer

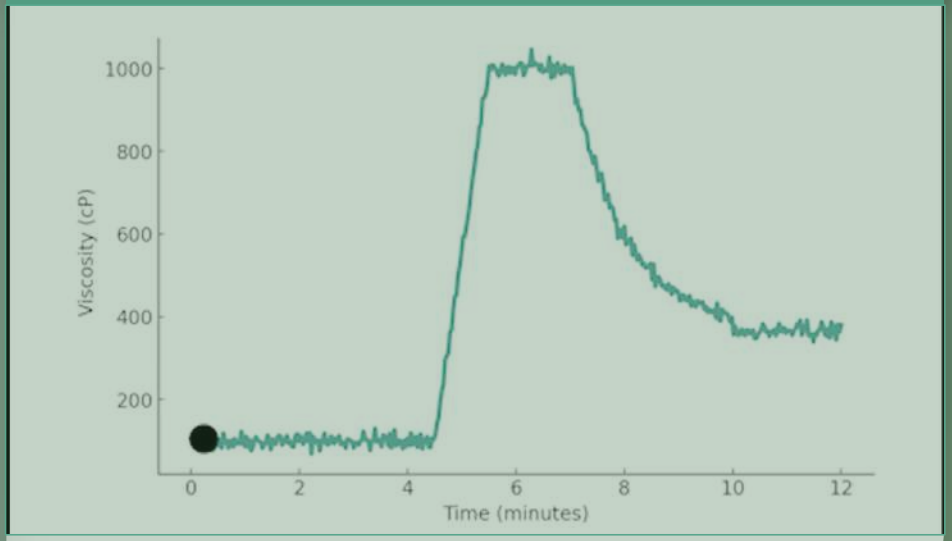


Note: Stabilization should occur no longer than 3 ½ hours after collection

Mixing of 2% dodecylbenzene sulfonic acid and field latex

BETA STABILIZATION PROCESS

VISCOSITY DURING STABILIZATION



AFLATEX STABILIZATION FORMULATIONS

ALFA

Formulation (by volume):
98.6% Natural rubber field latex
1.4% volume of chemical premixture

Chemical premixture formulation (by volume):

29% hydrofluoric acid (50% concentration) (**CAS:7664-39-3**)

71% Ethoxylated alcohol (7 moles) (**CAS: 68551-12-2**)

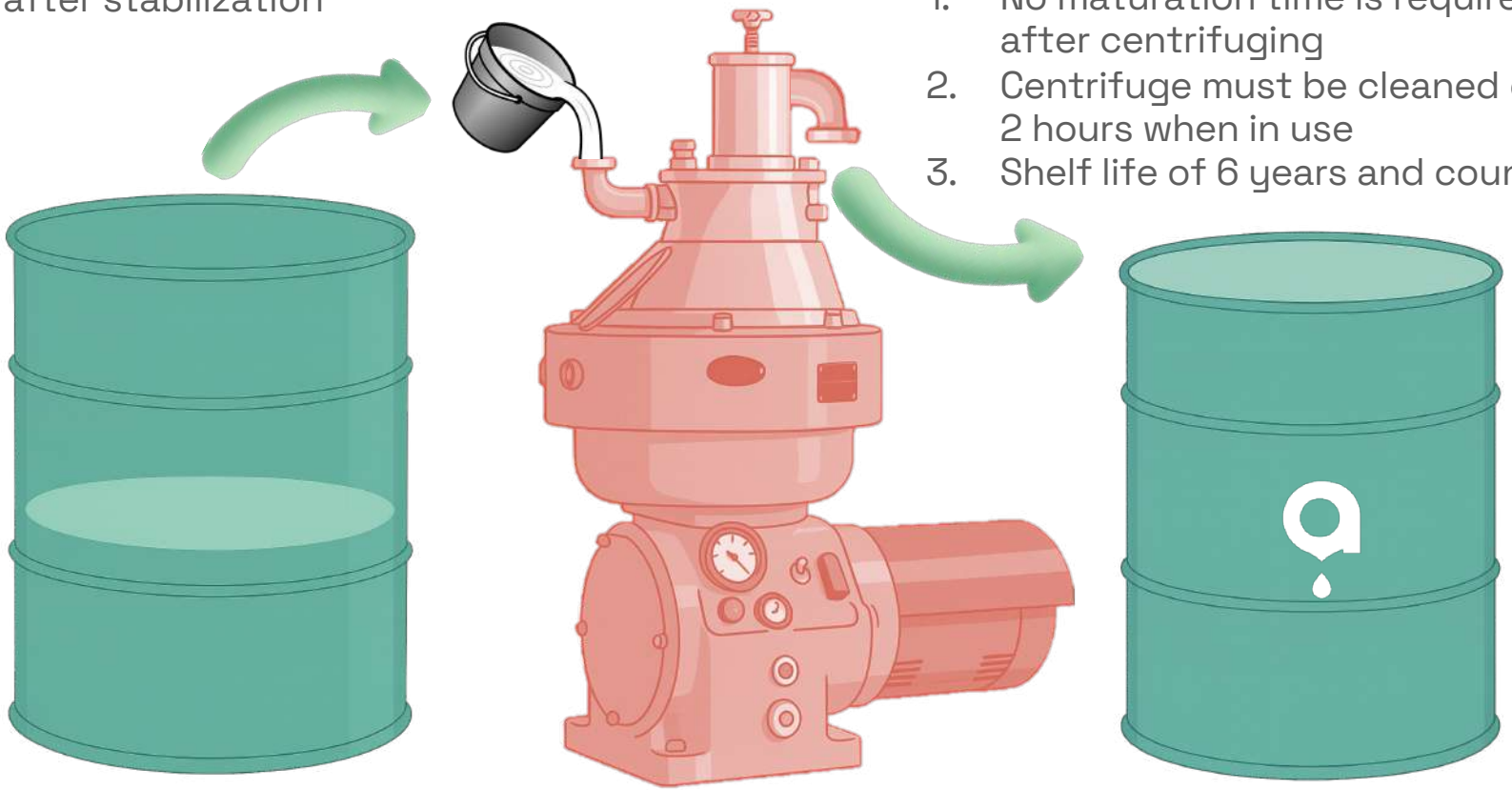
Mixing:

Alfa can be mixed by hand

Note: Stabilization should occur no longer than 3 ½ hours after collection

AFLATEX CENTRIFUGING PROCESS

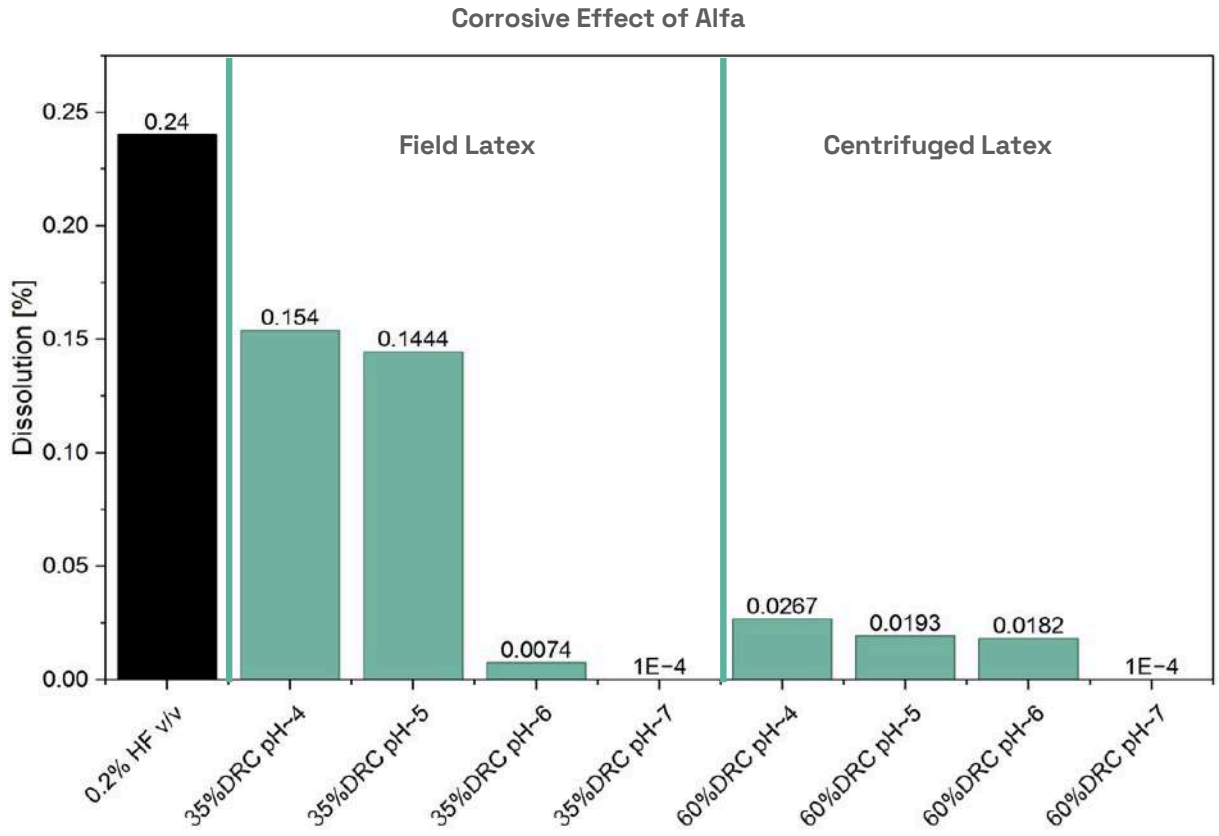
Notes: Latex can be centrifuged anytime after stabilization



Notes:

1. No maturation time is required after centrifuging
2. Centrifuge must be cleaned every 2 hours when in use
3. Shelf life of 6 years and counting

EFFECT OF HF IN ALFA



NITROSAMINE TESTING

TABLE 1: NITROSAMINES TESTING

AFLatex Alfa Field Latex	
PARAMETER	**RESULTS, ug/kg**
N-Nitroso-di-n-propylamine	<10
N-Nitrosomethylethylamine	<10
N-Nitrosodi-n-butylamine	<10
N-Nitrosodimethylamine	<10
N-Nitrosodiethylamine	<10
N-Nitrosopyrrolidine	<10
N-Nitrosopiperidine	<10
N-Nitrosomorpholine	<10
N-Nitrosodiethylphenylamine	<10
N-Nitrosomethylphenylamine	<10
N-Nitrosodiisononylamine	<10
N-Nitrosodibenzylamine	<10

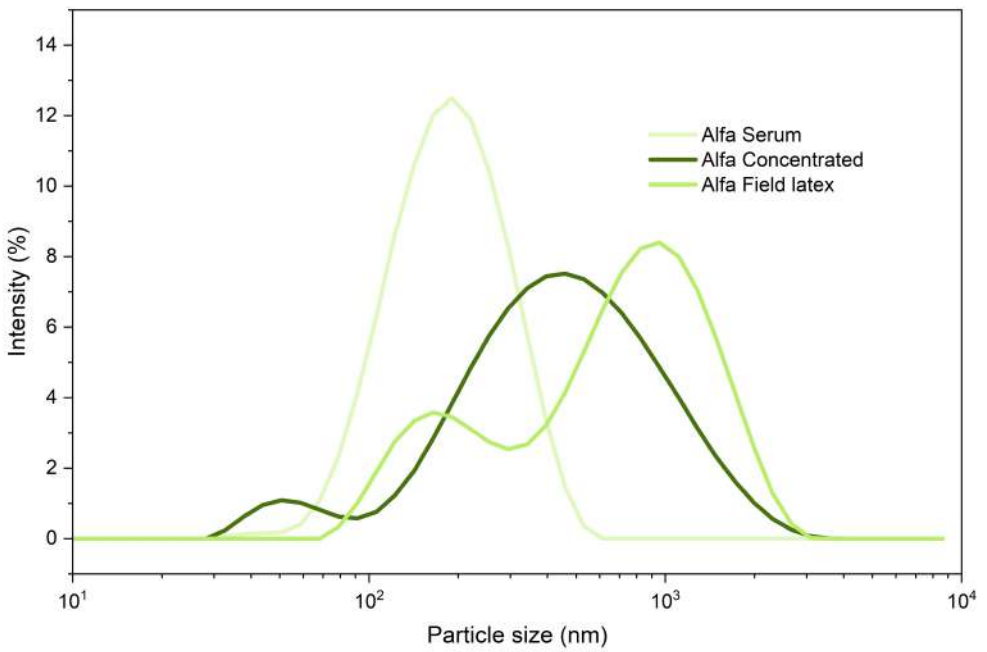
TABLE 2: NITROSAMINES TESTING

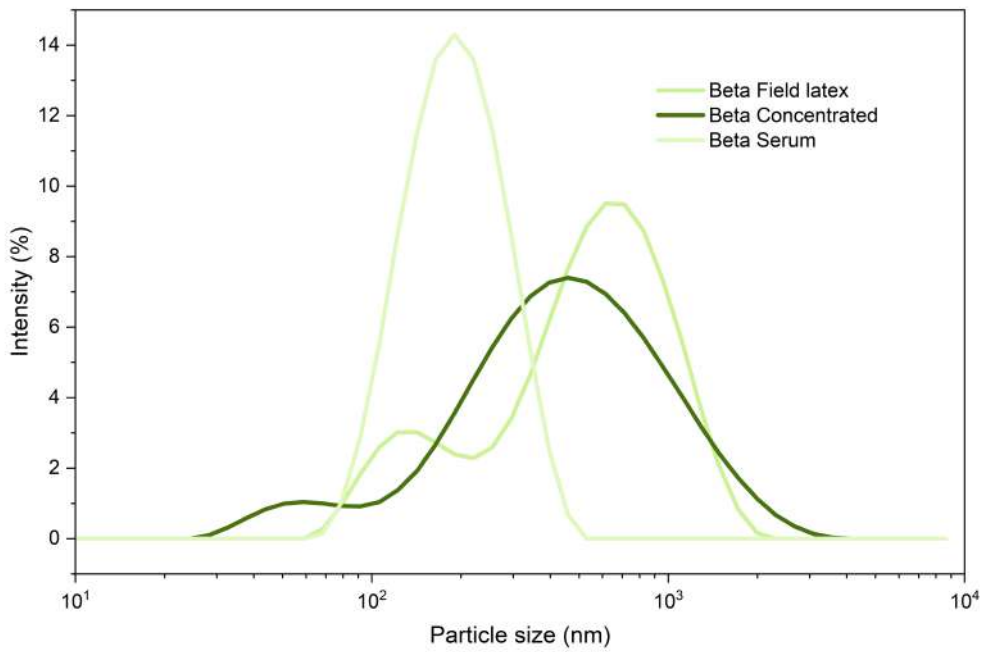
AFLatex Alfa Concentrated Latex	
PARAMETER	**RESULTS, ug/kg**
N-Nitroso-di-n-propylamine	<10
N-Nitrosomethylethylamine	<10
N-Nitrosodi-n-butylamine	<10
N-Nitrosodimethylamine	<10
N-Nitrosodiethylamine	<10
N-Nitrosopyrrolidine	<10
N-Nitrosopiperidine	<10
N-Nitrosomorpholine	<10
N-Nitrosodiethylphenylamine	<10
N-Nitrosomethylphenylamine	<10
N-Nitrosodiisononylamine	<10
N-Nitrosodibenzylamine	<10

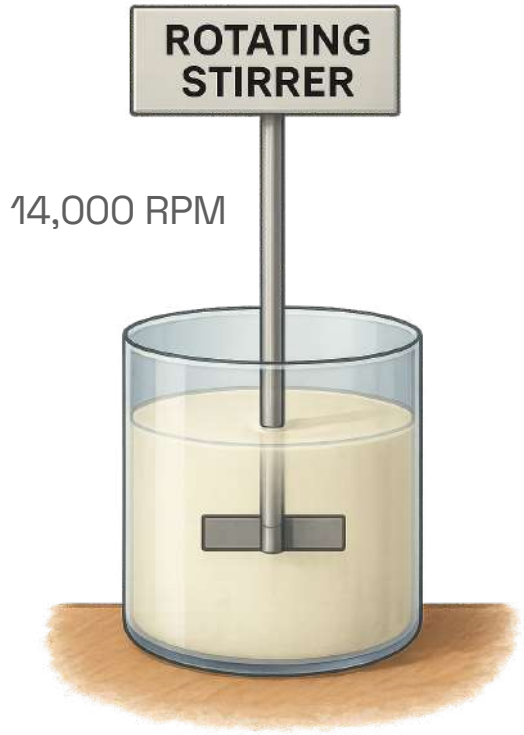
ALL NITROSAMINES WERE UNDETECTED

EPA 8270-SIM Testing: Performed at ARDL

PARTICLE SIZE DISTRIBUTION







Adapted from ASTM 1076-15

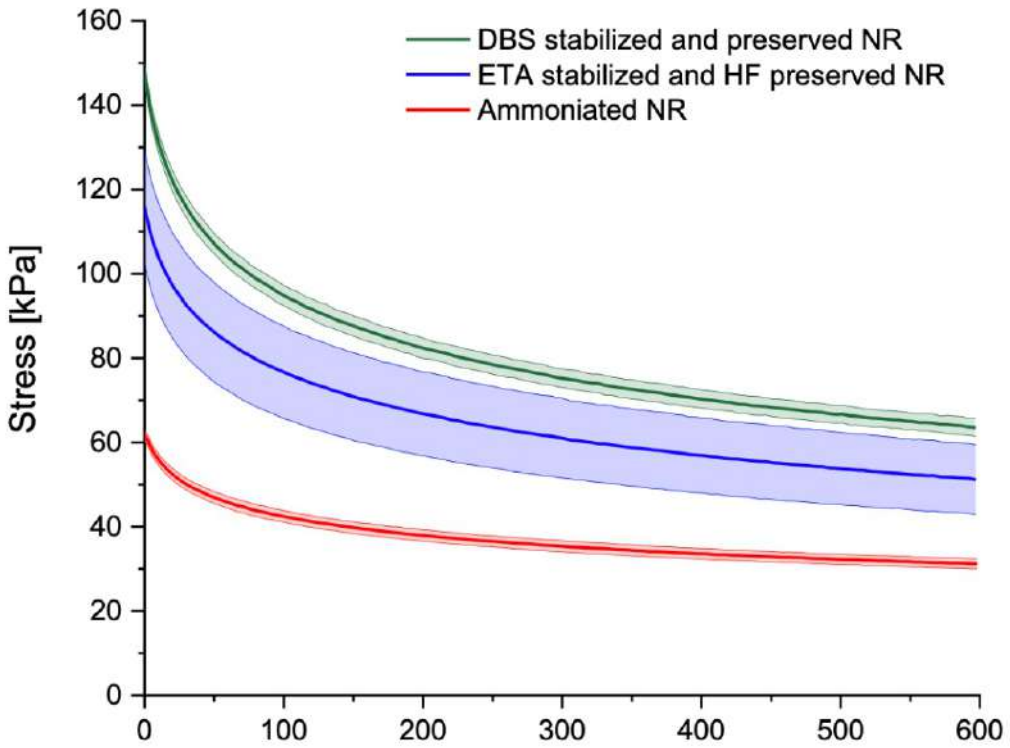
Note:

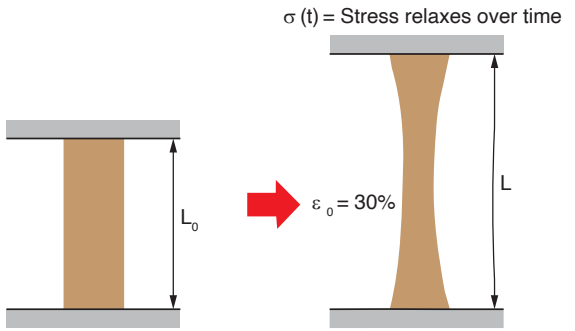
Centrifuged ammoniated latex is
diluted to 55% DRC with 1.6% ammonia solution

AFLatex is diluted to 55% DRC with distilled water

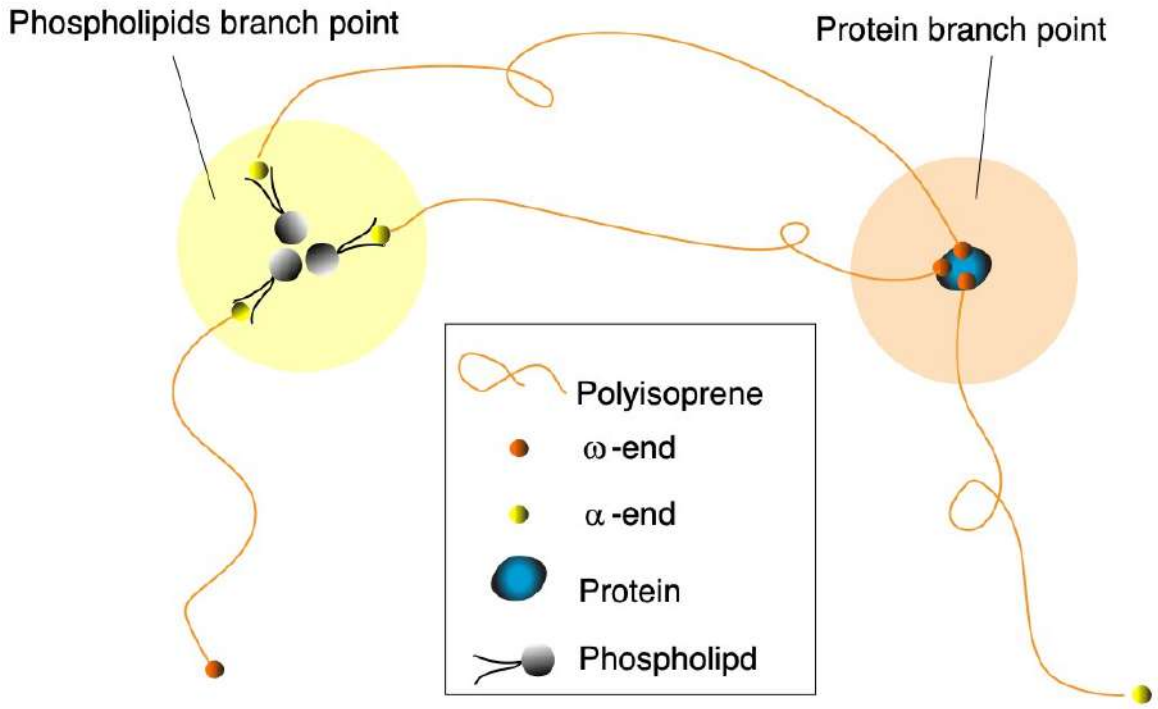
ALFA: MST between 800 and 1000 seconds
BETA: MST between 800 and 1200 seconds

AFLatex VS Ammoniated Natural Rubber





Protein and Phospholipids Branch Points

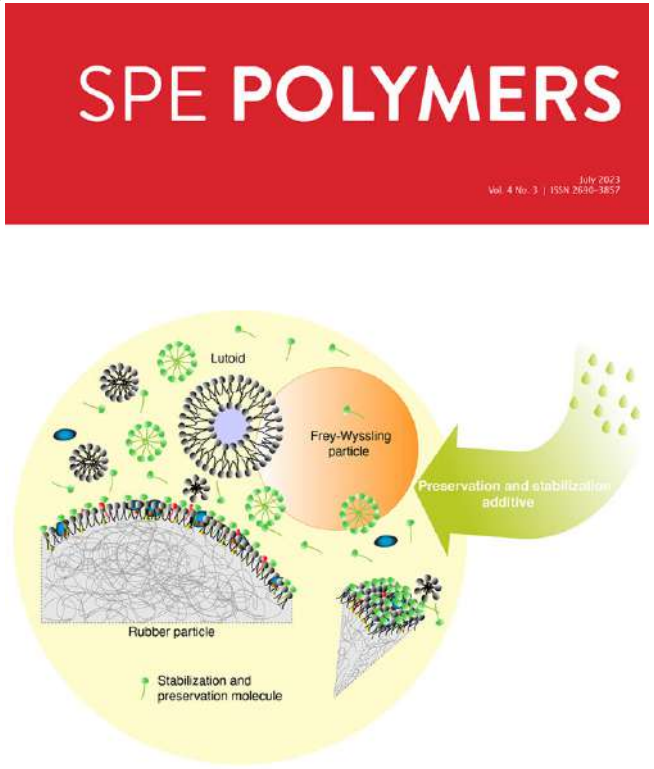


SUMMARY

AFLatex technologies

Environmentally friendly natural rubber & latex eliminates toxic additives

- Odorless and non-toxic Nitrosamine free
- Superior mechanical properties
- No water treatment facilities required
- Eliminates health risks to rubber industry workers
- Lower allegenic protein content
- Extended latex shelf life to over 6 years
- In-house R&D and patented technologies
- Working in partnership with multiple companies



Rodriguez Urbina, J.C., Osswald, T.A., Estela Garcia, J.E., and Román, A.J., "Environmentally safe preservation and stabilization of natural rubber latex in an acidic environment," *SPE-Polymers*,93–104, DOI: 10.1002/pls2.10089 (2023)

Román, A, Dibisa, O., Pardo, G., Rodríguez Urbina, J., Osswald, T., "Evaluation of an ammonia-free natural rubber latex adhesive," *SPE Polymers,5*, 11-19, DOI: 10.1002/pls2.10103 (2024)

Osswald, T.A., Rodríguez, J.C., Adler, E.P., Estela Garcia, J.E., Pardo Morales, G. and Román, A.J., "A Novel Ammonia-Free Preservation and Stabilization Process for Natural Rubber Liquid Latex in an Acidic Environment," Latex Handbook, Chapter, TechnoBiz (2024)

Osswald, T.A., Rodríguez, J.C., Adler, E.P., Arroyave, H.A., J.E., Dibisa, O., Pardo Morales, G., and Román, A.J., "Applications of an Environmentally Friendly Natural Rubber Liquid Latex ," Latex Handbook, Chapter, TechnoBiz (2024)

Dibisa, O., Arroyave, H., Rodríguez, J.C., Román, A.J.,and Osswald, T.A., "Comparative Rheology and Microstructure Analysis of Natural Rubber Latex with Conventional and Eco-Friendly Preservatives," *Physics of Fluids,* 37 DOI: 10.1063/To be Published, (2025)

Dibisa, O., J.C., Román, A.J.,Cabush, H., O'Brien, G., Kuang, X. and Osswald, T.A.,"Ammonia-Free Natural Rubber Latex Photo-Resin for Sustainable 3D Printing of Highly Stretchable and Tough Elastomers," *SPE-Polymers*,1-16, DOI: 10.1002/pls2.70011 (2025)

ALSO PUBLICATIONS IN RESEARCH OUTLOOK, RUBBER NEWS, RUBBER WORLD AND SLTCAUCHO

AFLatex technologies

REINVENTEMOS EL CAUCHO NATURAL PARA UN FUTURO MAS SOSTENIBLE