

# Formula Optimization of Neutralizing Shampoo for Chemical Hair Relaxer Systems

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# The Hair Relaxer Medium

Cream chemical hair relaxers use strong alkali:  
Sodium, lithium, guanidine, potassium hydroxides

All induce lantionization: conversion of disulfide bonds  
in keratin cystine to cysteine sulfhydryls.

All use an o/w emulsion cream base with minimal  
water activity that inverts at body temperature (37°C)  
to w/o, protecting the scalp

# The Process and the Threat

Once applied to hair, process should provide acceptable results within 20 - 25 minutes

Scalp discomfort usually occurs during that span due to nearly unavoidable contact. Always occurs if cream left on too long.

Un-neutralized, hair's keratin would become fully denatured through alkaline hydrolysis.

Client would lose hair, experience acute pain and be **VERY UNHAPPY!**

# Relaxing interval end-state

- Cuticle is swollen, vulnerable, stressed, frayable.
- Cortex is in adsorptive state, good time for uptake of associative molecules (E.g. Arianor dyes)
- Scalp contact points are stinging or burning
- May expect dehydration, coarseness and shedding if inadequately neutralized or reconditioned.

# Neutralization state

Neutralizing shampoo is integral part of the system.

- Neutralizes alkalinity within the hair.
- Ameliorates caustic burning of scalp.
- Completes lanthionine reaction pathway to thiols.
- Removes cream relaxer constituents from hair.
- Functions as vehicle for conditioning, rehydrating.

# Effective cream hair relaxers have pH >12.8

Best medium for neutralization is **a cationic conditioner** at pH 3.0 – 5.0. Better for final healthy state of hair.

Some brands use this technique to good advantage.  
Requires a paradigm shift for stylists and consumers who are accustomed to shampoo as neutralizing medium.  
Too bad.

# Shampoo as chemical tool

The pH of an effective neutralizing shampoo should be at lower end of stable range: 4.0 – 5.5

Citric acid is preferred; doubles as chelator for  $\text{Ca}^{++}$  adsorbed onto hair from guanidine hydroxide systems.

Buffered systems have greater capacity to neutralize.  
Use weak acid-conjugate base pair.

Most formulators ignore this. Don't know why.  
Forgotten their stoichiometry?

# Condition too – why not!

“Old school” formulas use refatting agents.  
E.g. PEG-75 lanolin, glyceryl esters, lanolin.

*Most* use cationic polymers:  
form coacervates then deposit upon dilution.  
(see D. Goddard, R. Lochhead, et.al.)

Commonly used: polyquaternium-10, cationic guar,  
acrylamide copolymers, e.g. polyquaternium-7, PMAPTCl.

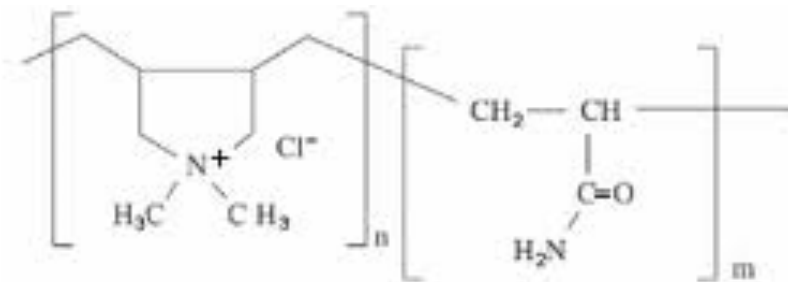


Figure 1. Polyquaternium 7® structure.

# Worthy elements to consider

Use lower viscosity: 2000 – 4000 cps.

Must work QUICKLY, easily into hair & dissociate fast.

Relaxed hair is vulnerable to breakage when scrubbed too vigorously!

Good hydrotropes to displace residual cream base.

Capacity to neutralize average head of hair with 60 ml product.

# Minimize the formula –maximize the efficacy.

Do not impede cuticle penetration to cortex.

Do not reduce surfactancy, cleansing.

Do not reduce acid dissociation.

Do not use excessive film-formers.

Do not overload shampoo formula with too many resins, oils, conditioning agents.

Every minute counts...just like this speed presentation!

# Order of addition

Disperse cationic resins & quats first.

Amphoterics added next .

Best hydrotrope: Disodium Cocoamphodipropionate

Very mild, excellent cationic coupler.

Some folks use good 'ol CAPB, cocoamphoacetate.

D.I.Y.'ers would often use amphoteric-heavy baby shampoos for mildness.

# Order of addition

Nonionics next, *then* Anionics.

When coacervation is employed, use anionics with lower charge/mass , e.g. SLES-2, SLES-3, sulfosuccinates.

(see D. Goddard, et.al.)

Avoid SLS, ALS, AOS, TEALS...

... unless coacervation not an issue, 'cuz these are cheap, good surfactants... though irritating.

# Order of addition

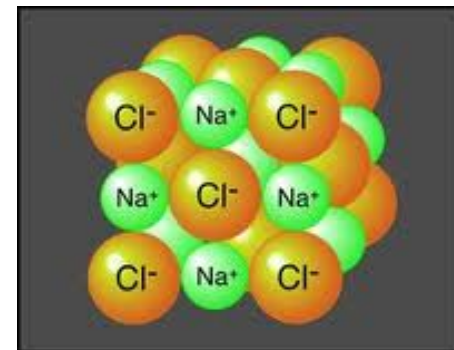
- Builders (amides)
- Acidulants : citric > lactic > malic > phosphoric
- EDTA for calcium removal , preservative aid
- Preservatives
- Fragrance, color

# Extras

- Colorimetric pH indicators (e.g. phenolphthalein, phenol red) to alert when neutralization achieved
- Menthol to soothe burning sensation of scalp
- Hair dyes (non-oxidative!) since uptake conditions are ideal: open cuticle, high pH, efficient absorption
- Small molecule conditioning agents.... again, uptake conditions ideal.

# To salt or not to salt

- School of thought instructs fluxing hair with electrolytes Mg, Na, Cl, S
- Theory not coherent but charged species could aid realignment of keratin salt bridges, lessen cysteine “partner switching”.
- Amino acids, smaller protein chunks may be advised as alternative.
- Needs further study



# Resist over-formulating

- 98% of clients follow up with conditioning step
- Save the exotic oils & botanicals for that step or your next skin-care project
- Scalp irritation is present most of the time.  
Don't make matters worse with other irritants.  
(E.g. salicylic acid)
- Too many charged species may reduce acid dissociation, neutralizing power

# Less is more sometimes

- IF pH too low and cationic polymer too much, instability may occur
- Overbuilt systems too high in viscosity may even damage hair by excessive work on head
- Consider refatting agents instead of cationic polymers

(less expensive and work well)

- Omit oils, silicones, free amines, complex molecules.

# Think outside the box

- Classic silicone conditioning systems not advised; can hinder penetration of water and acids
- Sulfate-free can be useful and marketable since less irritating than SLS, ALS, AOS
- Dispense with pearls, color, fragrance, anything unnecessary. Sell it as 'natural' neutralizing.
- This product is to be considered a chemical tool.

# Product research activity

- Get thee to the OTC Beauty Supply store
- Found in and near the African-American community. See lots of brands!
- Watch pro stylists in action at the salon or at trade shows like Bronner Brothers'
- Retail products nearly all guanidine hydroxide systems for reduced potential to cause burning, shedding and lawsuits

# Conclusion

- Speed presentation makes the MWSCC November dinner meeting less tedious than usual.
- Speed presentation effectively eliminates inarticulate “ahhhs”, “uhhhs”, and “ya’ knows”
- Speed presentation can be fun if not used for evil.
- I furnish a speed presentation so that YOU don’t have to.