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, guanidines, potassium hydroxides

All induce lanthionization: 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 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 hydro tropes 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.

Amphoteric 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.