



GLYPLEX[®]
ACTIVE MATRIX

The Science of Beautiful Hair and Scalp

A Quantitative Assessment of
Keratin Recovery and Scalp
Surface Equilibrium



CROSSCHEM
PURE CHEMISTRY



Table 1 Technology Highlights

PARAMETER	OBSERVED RESPONSE
Young's Modulus	Reduced vs. bleached hair
Break Extension	Restored to near-virgin levels
Premature Breakage	Reduced by 77.8%
KRI™	98.8
Surface Particle Reduction	~29–31%
Hydration Response	Progressive directional increase

Testing Baseline: 20% GLYPLEX® Active Matrix

Restoring Keratin. Rebalancing Scalp.

GLYPLEX® is a next-generation dual-domain recovery technology developed to support both keratin fiber mechanics and scalp surface equilibrium through measurable scientific performance.^{4,11}

Independent testing using a 20% **GLYPLEX®** solution demonstrated significant improvements across multiple hair fiber performance parameters, including reduced stiffness, restored extensibility, improved tensile behavior, and reduced premature breakage (**TABLE 1**).⁴ Exploratory scalp evaluations

further suggested directional improvements in desquamation behavior, hydration response, and lipid equilibrium.¹¹

GLYPLEX® was engineered not as a traditional cosmetic coating system, but as a functional active matrix technology designed to support multidimensional interactions throughout damaged keratin structures while simultaneously supporting scalp surface balance.^{2,3,10}

Technology Overview

Dual-Domain Hair and Scalp Recovery

Hair and scalp are interconnected biological systems. Hair fibers originate within the scalp environment and remain influenced by scalp conditions throughout their lifecycle. Damage to either domain affects appearance, manageability, resilience, and long-term hair quality.^{5,6,7}

GLYPLEX® was developed to support both structural hair recovery and scalp surface equilibrium through a unified, system-level approach. The technology incorporates a proprietary active matrix architecture designed to interact with damaged keratin structures through hydrogen bonding and ionic interactions, while supporting hydration behavior and surface turnover dynamics.^{2,3,9,10}

Figure 1 Comparative Stress-Strain Analysis

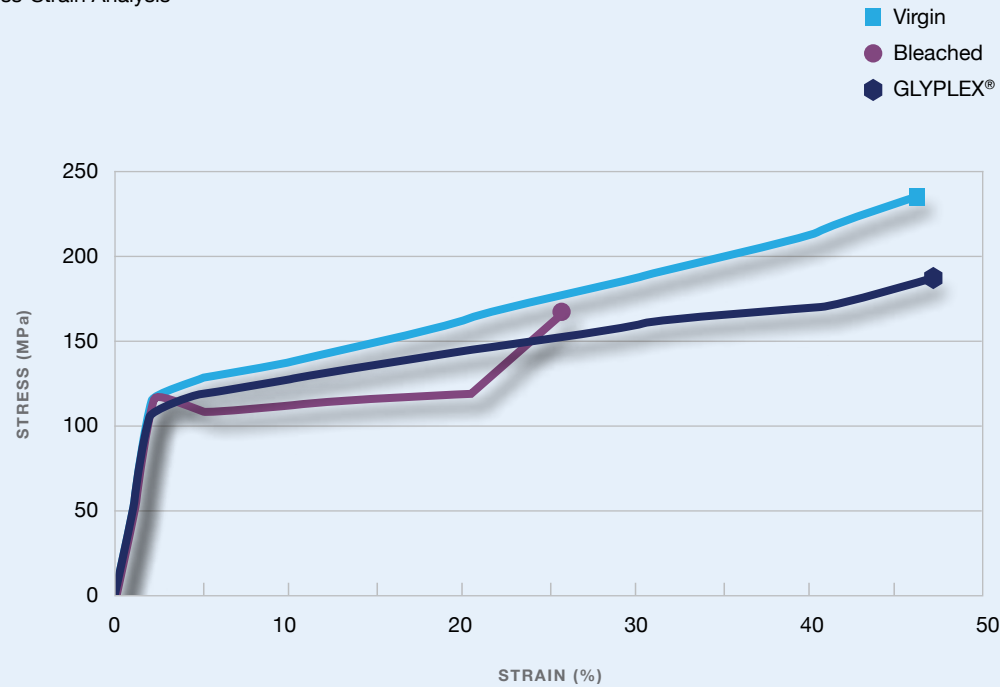


Table 2 Mechanical Parameters Evaluated

PARAMETER	FUNCTIONAL MEANING	VIRGIN	BLEACHED	GLYPLEX®
Young's Modulus (MPa)	Fiber flexibility and stiffness	5515	5992	5200
Break Stress (MPa)	Tensile strength	229.4	163.7	181.1
Break Extension (%)	Elastic deformation before failure	45.2	25.3	46.0
Premature Breakage	Weak-fiber fracture behavior			



Keratin Recovery Science

Understanding Hair Fiber Damage

Human hair derives its strength, flexibility, and resilience from a highly organized keratin structure composed of α -helical proteins, intermediate filaments, and associated matrix proteins.^{1,2,3} Mechanical performance depends on the integrity of this network and the interactions that stabilize it, including hydrogen bonding, ionic interactions, hydration-dependent plasticization, and structural protein organization.^{2,3}

Chemical processing, heat styling, UV exposure, and mechanical wear disrupt these interactions,

producing fibers that become stiffer, weaker, less extensible, and increasingly prone to brittle fracture.^{2,4}

GLYPLEX® was developed as a functional active matrix technology designed to support recovery of damaged keratin behavior through multidimensional interactions within compromised fiber structures. The technology was engineered to support balanced flexibility, stress distribution, and mechanical resilience within chemically damaged hair (**FIGURE 1**).^{2,3,4}

Damage Mechanics and Stress–Strain Analysis

Mechanical Recovery of Damaged Hair Fibers

Independent tensile testing was conducted on virgin hair fibers, bleached hair fibers, and bleached hair treated with **GLYPLEX®** using standardized, constant-rate extension methods under controlled environmental conditions (**TABLE 2**).⁴

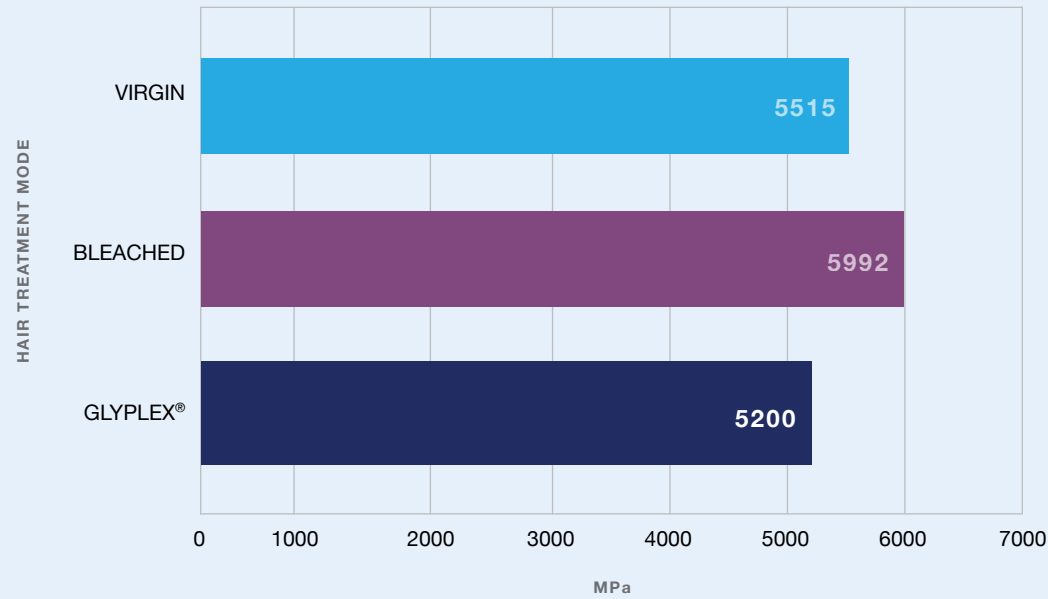
Representative tensile behavior curves derived from measured mechanical parameters are shown on page 4 (**FIGURE 1**).

Comparative Stress–Strain Analysis

Bleaching shifted the fiber profile toward brittle mechanical behavior characterized by increased stiffness, lower extensibility, reduced tensile performance, and early fracture behavior.^{2,3,4}

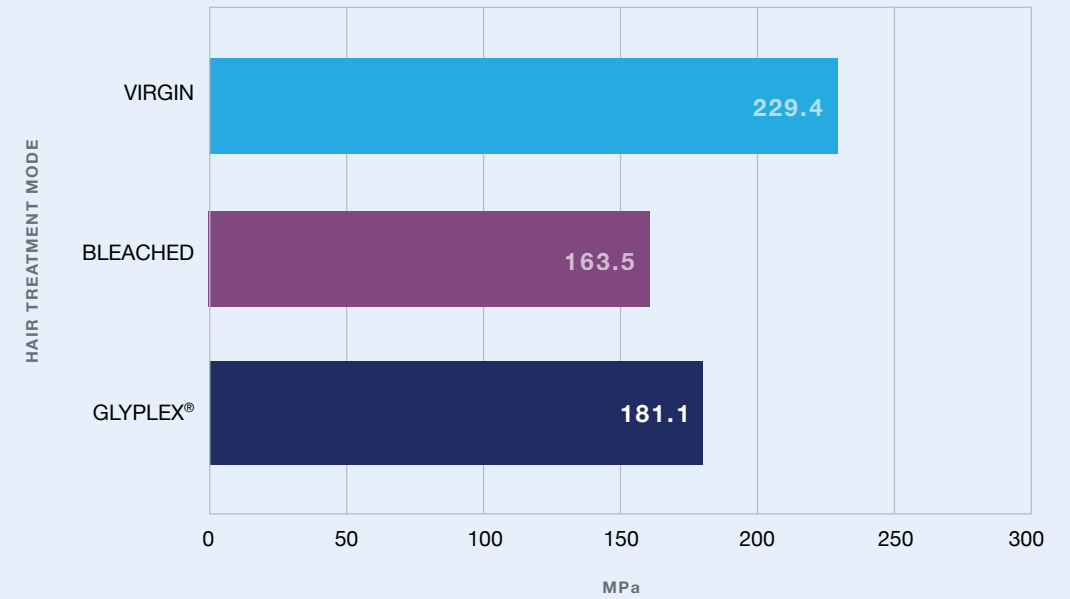
GLYPLEX® treatment shifted the fiber response back toward a more virgin-like mechanical profile through improved flexibility, elastic deformation, and stress distribution.⁴

Figure 2 Young's Modulus of Hair Fibers by Treatment



KEY FINDING: **GLYPLEX®** reduced stiffness by 13.2% relative to bleached hair.⁴

Figure 3 Break Stress



KEY FINDING: **GLYPLEX®** improved break stress by 10.6% relative to bleached hair.⁴

Young's Modulus: Flexibility Recovery

Restoring Fiber Flexibility

Young's modulus measures resistance to elastic deformation and reflects the balance between flexibility and rigidity within the keratin matrix.^{2,4}

Bleached hair demonstrated increased stiffness consistent with brittle, damaged fiber behavior.^{2,3}

GLYPLEX® reduced the modulus relative to bleached hair and restored flexibility toward a near-virgin mechanical state (**FIGURE 2**).⁴

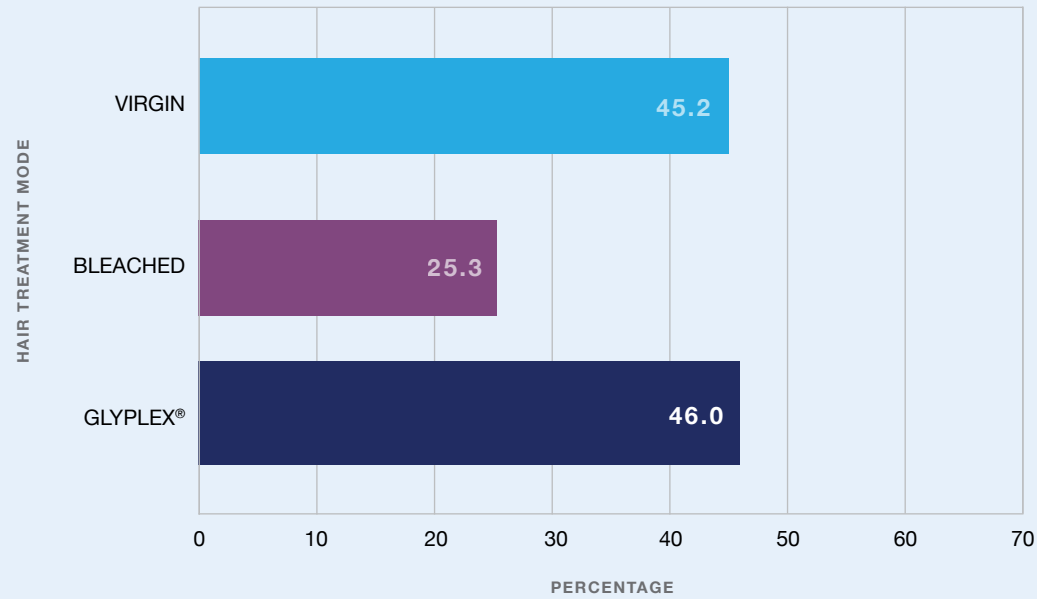
Break Stress: Tensile Strength Recovery

Restoring Tensile Performance

Break stress reflects the load-bearing capacity of the keratin matrix and the fiber's ability to resist fracture under mechanical force.^{2,4}

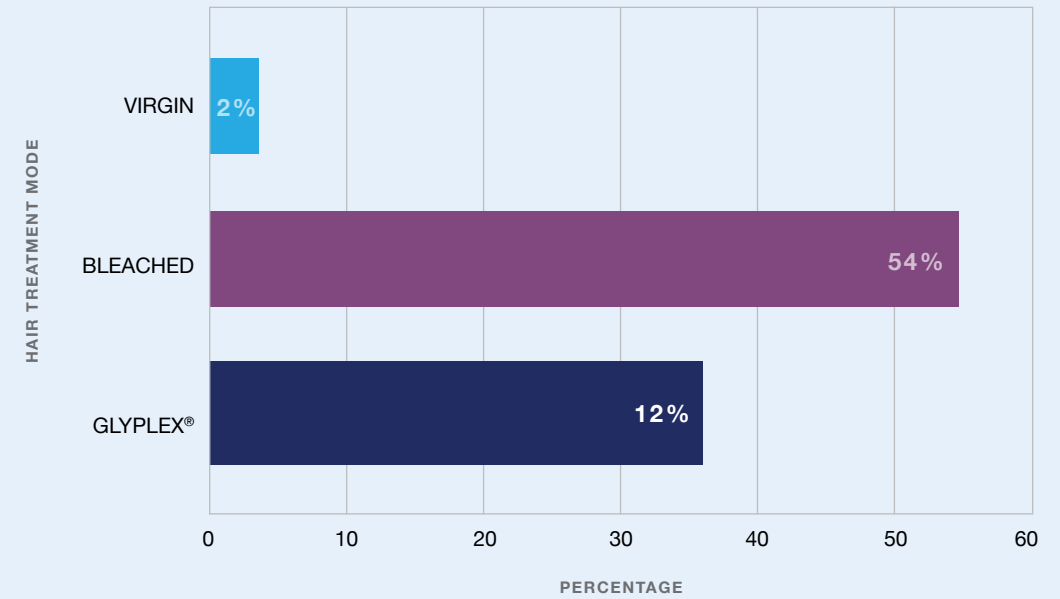
Bleaching substantially weakened the hair fiber structure. **GLYPLEX®** improved break stress relative to the damaged control, demonstrating meaningful recovery of tensile performance (**FIGURE 3**).⁴

Figure 4 Break Extensions %



KEY FINDING: GLYPLEX® restored extensibility to 46.0%, effectively matching virgin hair performance.⁴

Figure 5 Premature Breakage of Hair Fibers by Treatment



KEY FINDING: GLYPLEX® reduced premature breakage by 77.8%.⁴

Break Extension: Elastic Recovery

Restoring Elastic Deformation

Break extension measures how far a fiber can elongate before failure. Healthy hair can stretch and recover, while damaged hair loses this capability and becomes increasingly brittle.^{2,3}

Bleaching reduced extensibility by approximately 44%.⁴ GLYPLEX® restored break extension to near-virgin levels, indicating recovery of controlled elastic deformation behavior (FIGURE 4).⁴

Premature Breakage Reduction

Reducing Weak-Fiber Failure

Premature breakage measures the percentage of fibers that fail below 20% strain and reflects the weakest portion of the fiber population.⁴

Bleached fibers demonstrated severe early failure behavior, while GLYPLEX® dramatically reduced weak-fiber breakage and restored more resilient deformation behavior (FIGURE 5).⁴

Figure 6 GLYPLEX® KRI™
Integrated Keratin
Recovery Profile

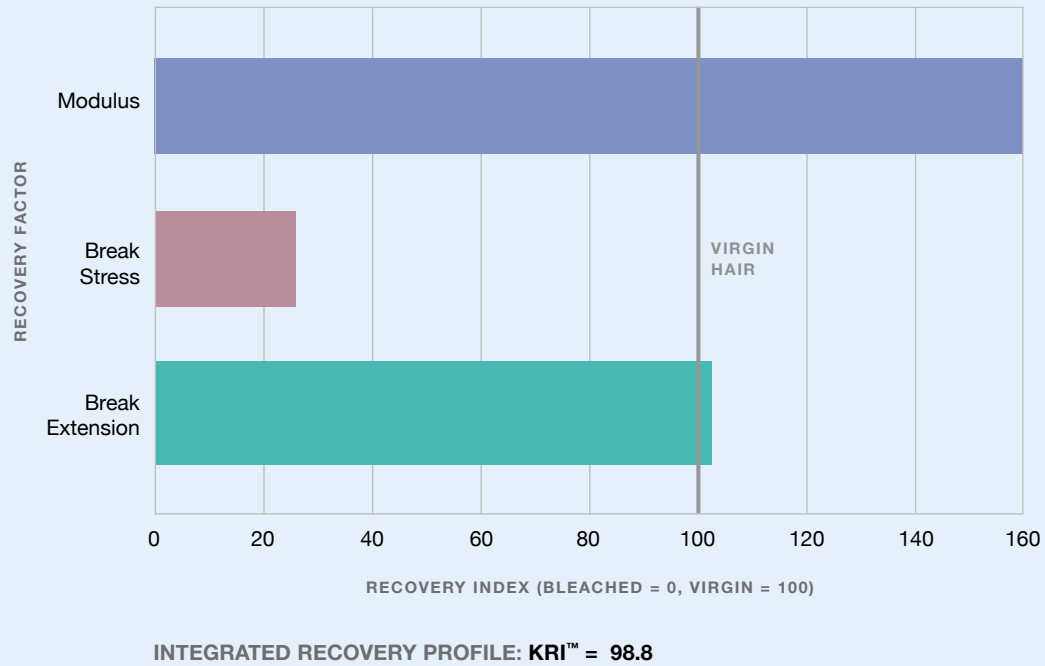


Table 3 Key Qualified Outcomes

MEASUREMENT	RESULT
Young's Modulus	Reduced vs. bleached control
Break Extension Recovery	Near-virgin performance
Premature Breakage Reduction	77.8%

KRI™ = 98.8



KRI™ Platform

Quantifying Keratin Recovery

CrossChem developed the **Keratin Recovery Index (KRI™)** to provide a multidimensional framework for quantifying functional keratin recovery.^{2,4}

KRI™ integrates flexibility, strength, extensibility, and functional resilience into a unified mechanical recovery framework.⁴ **KRI™** is intended to represent integrated functional mechanical recovery across the evaluated tensile parameters and does not imply complete molecular restoration of damaged hair fibers.

Bleached hair serves as the damaged baseline while virgin hair represents intact functional performance.⁴

A **KRI™** of 98.8 indicates that **GLYPLEX®** treated fibers approach the functional performance profile of virgin hair across multiple mechanical dimensions (**FIGURE 6**).

Technology Significance

Beyond Cosmetic Conditioning

Traditional systems often focus primarily on temporary surface conditioning or silicone deposition.

GLYPLEX® was designed as a functional recovery platform intended to support keratin mechanics, structural flexibility, and long-term fiber resilience.^{2,3}

The **KRI™** framework allows multidimensional hair recovery to be communicated through a normalized performance model rather than isolated tensile claims (**TABLE 3**).⁴

Table 4 Surface Turnover and Hydration Response

SCALP CONDITION APPLICATION	PARTICLE REDUCTION (%)	INTERPRETATION
Normal scalp (rinse-off)	29.4	Rapid reduction in surface particles
Dry scalp (extended contact)	31.0	Increased benefit with prolonged contact time
Overall performance	~29-31	Consistent improvement in desquamation efficiency



Scalp Surface Equilibrium

Hydration. Desquamation. Lipid Balance.

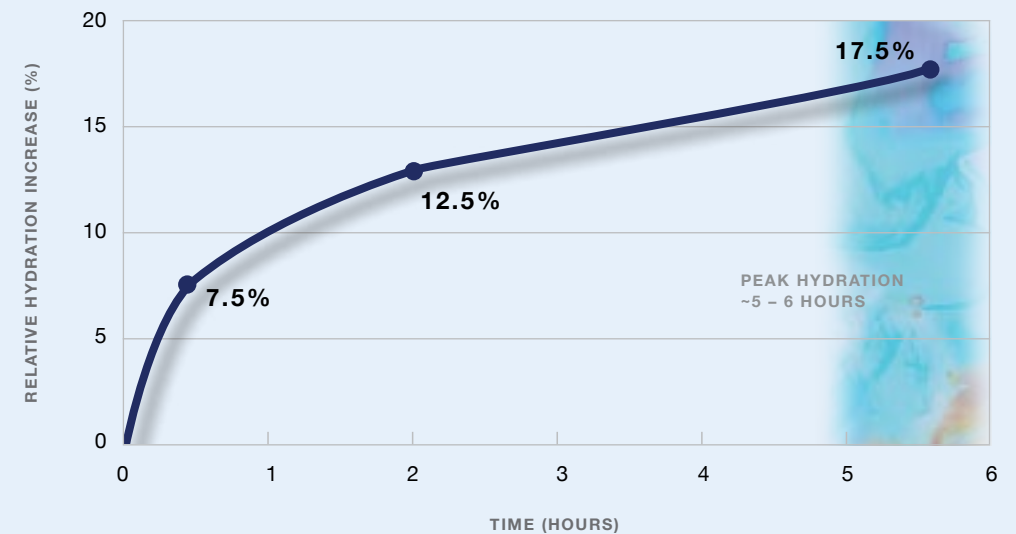
Scalp surface dynamics were independently evaluated using D-Squame adhesive sampling, digital microscopy, and ATR-FTIR spectroscopy.¹¹

Exploratory testing conducted on a limited five-subject pilot population suggested directional improvement in desquamation behavior, hydration-associated response, and lipid equilibrium following **GLYPLEX**[®] application.¹¹ Due to the small

sample size and inherent biological variability associated with scalp measurements, these observations should be interpreted as exploratory and mechanistic rather than statistically conclusive clinical outcomes.

Healthy scalp function depends on balanced desquamation, hydration, and sebum distribution.^{5,6,9,10} **GLYPLEX**[®] was evaluated for its ability to support these interconnected surface dynamics (**TABLE 4**).¹¹

Figure 7 GLYPLEX[®] Promotion of Time-Dependent Hydration



ATR-FTIR analysis further suggested a progressive increase in hydration-associated signal over time following **GLYPLEX**[®] application.¹¹

Desquamation and Hydration Dynamics

Surface Turnover and Hydration Response

Desquamation is governed by orderly corneocyte turnover within the stratum corneum.^{8,9,10} Retained corneocyte accumulation contributes to visible flaking, uneven texture, and scalp surface buildup.^{9,10}

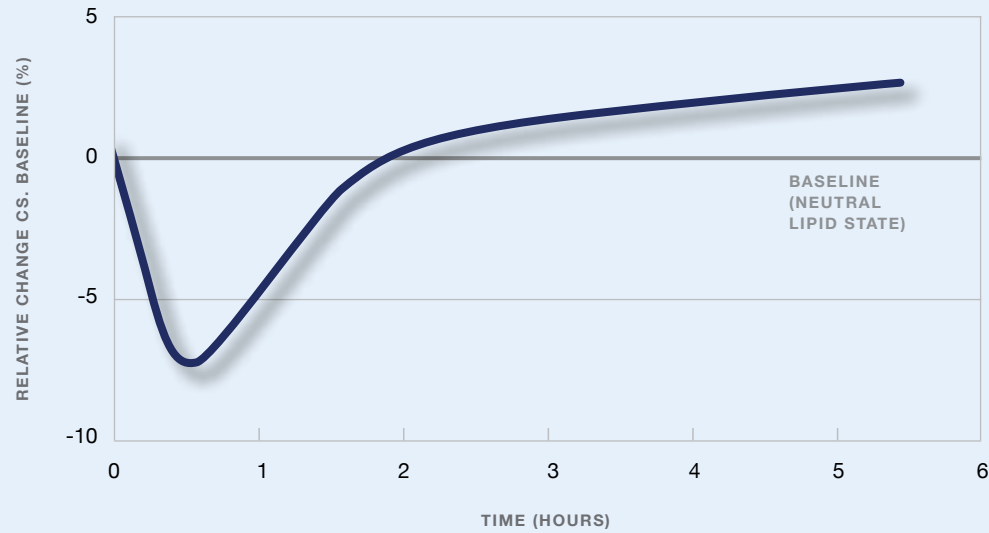
GLYPLEX[®] demonstrated directional reduction in retained surface particle burden across both normal and dry scalp conditions.¹¹

Key Observation

Hydration increased progressively from 30 minutes through approximately five to six hours, suggesting sustained hydration support rather than transient surface wetting.¹¹

ATR-FTIR analysis further suggested a progressive increase in hydration-associated signal over time following **GLYPLEX**[®] application (**FIGURE 7**).¹¹

Figure 8 Promotion of Time-Dependent Sebum Re-equilibration



Sebum Equilibrium and Surface Balance

Sebum Modulation Without Stripping

Sebum is essential for scalp barrier function, lubrication and surface flexibility.^{9,10} **GLYPLEX®** demonstrated transient lipid modulation followed by return toward baseline equilibrium (**FIGURE 8**).

The observed response suggests redistribution rather than aggressive stripping, supporting preservation of natural scalp lipid behavior while reducing excess surface accumulation.^{9,10,11}

Suggested Surface Benefits

- Improved desquamation behavior
- Hydration support
- Balanced surface lipids
- Reduced particle retention

References

- 1 Robert J. Lancashire. "Chemistry of Garments: Animal Fibres." University of the West Indies. August 2011.
- 2 J. McKittrick et al. "The Structure, Functions, and Mechanical Properties of Keratin." JOM, Vol. 64, No. 4, 2012.
- 3 Franz J. Wortmann et al. "Thermal denaturation and structural changes of α -helical proteins in keratins." University of Manchester.
- 4 Independently conducted tensile testing performed on behalf of CrossChem Limited, November 5, 2025.
- 5 Jahan Tajran, Amanda A. Gosman. "Anatomy, Head and Neck, Scalp." StatPearls.
- 6 F. John G. Ebling. "Human skin." Encyclopedia Britannica.
- 7 Harold Ellis, Vishy Mahadevan. "The Surgical Anatomy of the Scalp." Surgery, Vol. 32.
- 8 Adrian Rad. "Stratified epithelium." Ken Hub.
- 9 Luis J. Borda, Tongyu C. Wikramanayake. "Seborrheic Dermatitis and Dandruff." J Clin Invest Dermatol.
- 10 G. A. Turner et al. "Stratum corneum dysfunction in dandruff." International Journal of Cosmetic Science.
- 11 Independently conducted in vivo scalp evaluation performed on behalf of CrossChem Limited, April 6, 2026.
- 12 Source material derived from the GLYPLEX® technical white paper developed by CrossChem Limited Research & Development
- 13 GLYPLEX® is a cosmetic ingredient technology intended for professional formulation applications. This document is not intended to diagnose, treat, cure, or prevent disease



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