Cosmetic Rheology & Non-Newtonian Fluid Dynamics — Shear-Thinning & Yield Stress — Engineering Review 2026

Por Cristiano Ricardo · Publicado em 10/11/2026

Technical dermocosmetic engineering lecture by Prof. Cristiano Ricardo on cosmetic rheology & non-newtonian fluid dynamics: shear-thinning & yield stress (Formulation Engineering & Interfacial Rheology), featuring colorful schematic diagrams and clinical data.

Versão online e eventuais atualizações:
https://professor.cristianoricardo.com/post/cosmetic-rheology-non-newtonian-fluid-dynamics-shear-thinning-yield-stress-2026-11-10

Formulation Engineering & Interfacial Rheology · Cosmetic Engineering & Science

The flow behavior of a cosmetic product dictates shelf-life stability, pigment suspension, and sensory payoff upon skin application.

Engineering Mechanism & Kinetic Flowchart

Pseudoplastic (Shear-Thinning: Creams/Gels)
Newtonian (Water/Oils)
Dilatant (Shear-Thickening)
Shear Rate (?)
Viscosity (?)

Yield Stress (?0) and Gravitational Stability

Yield stress is the minimum finite force required to initiate flow. In mineral sunscreens, foundation creams, and clay emulsions, an engineered yield stress prevents dispersed pigments and oil droplets from sedimenting under gravity (Stokes' Law), ensuring physical integrity across a 3-year shelf life without phase separation.

Thixotropy and Hysteresis Loop Analysis

Thixotropic fluids undergo time-dependent, reversible breakdown under constant shear, followed by progressive structural recovery once agitation ceases. In rotational rheometry, the area between ascending and descending shear curves (the hysteresis loop) quantifies the breakdown kinetics, preventing post-application dripping while guaranteeing a velvety after-feel.

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Process Engineering & Scale-Up Implications

Measuring elastic (G') and loss (G'') moduli using cone-and-plate oscillatory rheometers allows formulation chemists to predict viscoelastic gel transitions, optimizing rotor-stator homogenizer speeds during pilot plant scale-up.

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