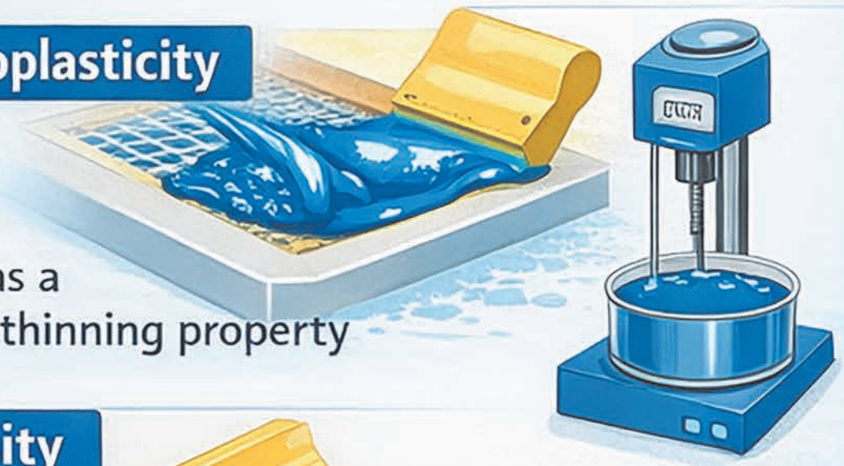
RHEOLOGICAL BEHAVIOUR DURING SCREEN PRINTING

Flow properties of screen printing ink

Thixotropy

Ink thins and flows under shear
and thickens when at rest

Pseudoplasticity



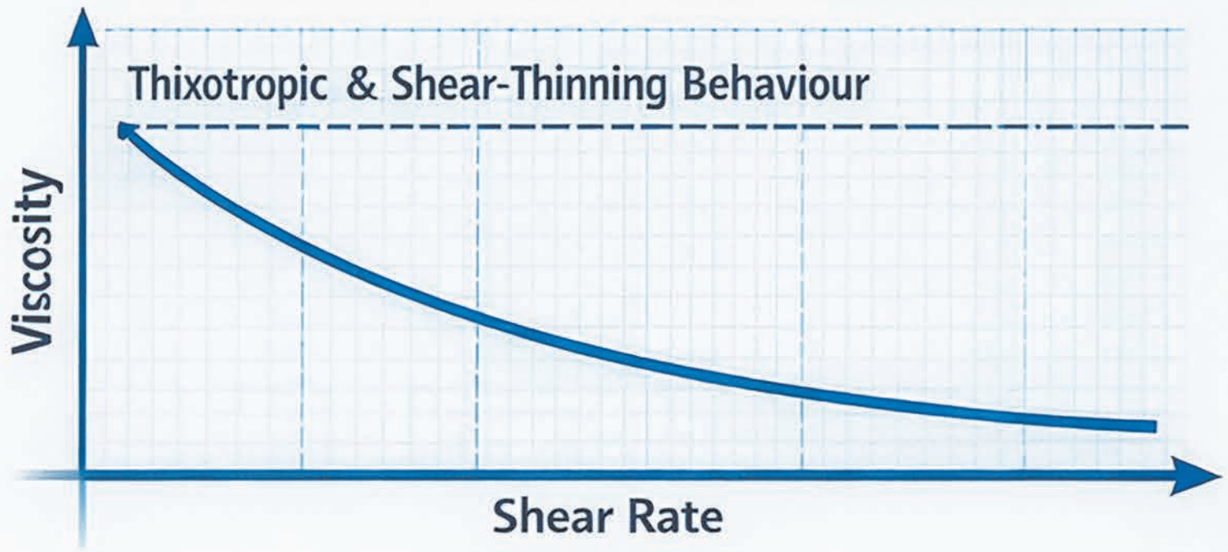
Ink has a
shear-thinning property

Viscosity

Balanced consistency
for screen printing

Allows good adhesion to substrate

FLOW CURVE OF SCREEN PRINTING INK



Before Printing | During Shear | After Printing

Before Printing → During Shear → After Printing

INK FLOWS → During Shear → **INK FLOWS** After Printing → **INK REMAINS THICK**

Rheological Behaviour During Screen Printing

Rheology — the science of flow and deformation of matter — is the discipline that governs the behaviour of screen printing inks. An ink is not simply a coloured liquid: it is a complex rheological system whose behaviour changes dynamically as a function of the mechanical forces applied. Understanding this complexity is the prerequisite for controlling ink transfer, dot gain, and dot edge quality.

The Three Fundamental Rheological Parameters

Thixotropy — The Memory of Rest

Thixotropy is the property that makes screen printing inks functionally unique. A thixotropic ink behaves radically differently under two conditions: at rest and under mechanical stress.

At rest — before printing and after the squeegee has passed — the ink maintains **high viscosity**: it is dense, stable, resistant to spontaneous flow. This high resting viscosity is the condition that prevents ink from draining through mesh openings by gravity, that maintains the deposited dot in the shape and size achieved at the moment of mesh snap-off, and that prevents lateral post-deposit expansion.

Under **shear stress** — during the squeegee stroke — the ink's internal structure temporarily breaks down: viscosity drops and the ink flows fluidly through the mesh openings. When the stress ceases, the structure rebuilds and viscosity recovers — the **recovery** phenomenon — "freezing" the dot in the shape achieved at the moment of snap-off.

Thixotropy is therefore not a passive behaviour: it is the active mechanism that allows ink to be simultaneously fluid enough to pass through the mesh during printing and viscous enough to maintain dot shape after deposit.

Pseudoplasticity — Shear-Thinning

Pseudoplasticity — also called **shear-thinning** — describes the relationship between shear stress and viscosity: as shear rate increases, viscosity decreases in a non-linear manner. This property is clearly visible in the **flow curve** of screen printing ink: the descending curve shows how viscosity progressively decreases as shear rate increases.

In practice, this means that the same squeegee applying the same pressure to an ink produces different results at different print speeds: at higher speed, shear rate is greater, viscosity is lower, and ink flows more easily. Controlling print speed means indirectly controlling the operational viscosity of the ink — and therefore its transfer behaviour.

Viscosity — The Balance of Consistency

The absolute viscosity of the ink — its resistance to flow under standard conditions — must be calibrated to find a balance between opposing requirements. Viscosity that is too high produces insufficient transfer, irregular solid coverage, and risk of mesh clogging. Viscosity that is too low produces excessive spreading, undefined dot edges, and risk of ink draining through the mesh by gravity between strokes.

Optimal viscosity is that which guarantees **good substrate adhesion** — the ink must correctly wet the substrate surface to ensure adhesion — while maintaining the **balanced consistency** necessary for correct dot definition.

The Complete Rheological Cycle

The temporal sequence of rheological behaviour during printing is a precise and repeatable cycle:

Before printing → Ink is at rest on the mesh: high viscosity, intact structure, no spontaneous flow.

During shear stress → The squeegee applies shear: viscosity drops, ink flows through the openings, the dot forms on the substrate.

After printing → Stress ceases, recovery rebuilds viscosity: the ink "solidifies" in the dot shape, resisting lateral expansion.

This cycle — flow during shear, solidify at rest — is the physics that makes quality screen printing possible. Every deviation from this optimal cycle translates directly into a degradation of printed dot quality.