The selection of consistency factor in semi-solid formulation was found to have a significant effect on investigated elements of the topical properties. Of significance, is the profound effect of varying the fatty alcohol chain length from n=16 (Kolliwax® CA) to n=18 (Kolliwax® SA) and a 50:50 mixture thereof (Kolliwax® CSA 50). The viscosity of the final formulation, when all other variables were kept constant, was decreased by a factor of 10 when the stearyl alcohol in equal mass quantities was used in a cream formulation. Additionally, quantifiable differences were observed at the microscopic level both in the oil phase (droplet size and distribution) and crystalline behavior of the API employed in the formulation. DSC scans of single wax components and wax-containing formulations provided critical data on the thermo-physical properties resulting from slight variations in fatty alcohol chemistry and composition. The polymorphic behavior observed with individual wax species is no longer evident when formulated in the emulsion (7 wt%); however, the recrystallization of the waxes when cooled from 90°C to room temperature provided evidence that stacking and crystalline arrangement is highly influenced by carbon chain length and more significantly fatty alcohol composition (i.e., when a mixture of fatty alcohols is employed). XRD analysis indicated increased crystallinity of the wax phase for systems containing stearyl alcohol; corroborating other deviations in measured product stability and viscosity. Despite differences in the API crystallinity, the fatty alcohol selection was not found to be a significant consideration in penetration modification of the active ingredient.