Synthesis and Characterization of Comb Polycarboxylic Acid Dispersants for Coatings

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ABSTRACT: Comb polycarboxylic acid dispersants (CPCADs) graft acrylic copolymers which consist of hanging methoxy polyethylene glycol chains and carboxylic acid groups on main acrylic chain. The CPCADs have been synthesized by radical polymerization of methacrylic acid and methoxy polyethylene glycol methacrylate as a nonionic unsaturated hydrophilic macromonomer. The CPCADs are polymeric surfactants that can be used as anionic dispersant. Methoxy polyethylene glycol methacrylate has been synthesized by esterification of methacrylic acid and methoxy polyethylene glycol in the presence of methanesulfonic acid as catalyst. These have been characterized with ¹H-NMR and GPC. Acid values of CPCAD dispersants have been determined. The dispersion of CPCAD dispersants depends on their molecular weights, length mPEG, and acid values. Dispersion of titanium dioxide in typical solvent-based paint formulation has been investigated. The physicochemical and mechanical properties of surface coatings having CPCADs such as gloss, hardness, and contrast ratio have been investigated. © 2012 Wiley Periodicals, Inc. J Appl Polym Sci 126: 877–881, 2012

Key words: synthesis; graft copolymer; polymeric dispersant; polycarboxylic acid; comb surfactant

INTRODUCTION

Polymeric dispersants have been available for recent years with improved performance over traditional surfactants.¹⁻³ Surfactants typically have a two-part structure: a hydrophilic chain for steric stability and a hydrophobic group for pigment wetting or anchoring. Steric stability is achieved by providing a polymeric layer around the pigment particles which overcomes the normal tendency of the particles to associate with each other. The surface activity of these surfactant groups leads to a range of prosperities (foaming/defoaming, wetting/dispersing, emulsification, and solubilization) of which some are desirable and some detrimental to coating performance. The continuing developments in high molecular weight polymeric dispersants are aimed at improving and maintaining the desirable characteristics while minimizing or eliminating the negative aspects, particularly with regard to water sensitivity. In water-based systems, electrostatic stabilization is also often used since a charged double layer will provide interparticle stability, particularly in the wet paint. A dispersant is a term referring to specific additives that improve the dispersion of solid particles in a liquid medium.

Traditional surfactants encompass this behavior and a very broad class of materials falls within this general group.⁴⁻⁵

Polymeric dispersants stabilize colloidal systems via a mechanism commonly known as steric stabilization. In physicochemical terms, polymeric dispersants can reduce interactions between pigment particles much more effectively than conventional dispersants can. The most obvious consequence of this is an ability to reduce viscosity in a pigment-containing formulation. Polymeric dispersants are therefore excellent for reducing the viscosity of millbases, but their influence on the rheology of the final paint or ink depends very much on the type of coating system.⁶⁻⁸

The ability to reduce pigment particle–pigment particle interactions also confers a series of benefits of polymeric dispersants into productivity advantages (higher pigment concentrations), color strength advantages (more efficient use of color), and paint quality advantages.⁹⁻¹⁰ Flooding and floating effects are dependent on the degree of pigment flocculation and the relative densities and sizes of the different pigment particles in the system. A paint system is optimized by balancing these variables, and polymeric dispersants offer a way to modify the flocculation/deflocculation balance. The gloss of a surface coating system is clearly sensitive to the presence of any large particles. By increasing the efficiency of the grinding process, polymeric dispersants can ensure the absence of large pigment particles. The