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Evaluation of Flow Ability Response in EVA Emulsion Preparation with Different Vinyl Acetate Percentage by Intrinsic Viscosity Measurement

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Abstract

Ethylene–vinyl acetate (EVA) copolymers were chosen for this work because they show different characteristics depending on their vinyl acetate (VA) percentage. EVA has a wide range of applications, including coating of photovoltaic cells and covering of tires and cables, as a consequence of the different varieties of the material depending on the VA percentage. To date, no study has been conducted yet to determine the relationship between VA percentage and the flow ability response of an emulsion. Previous studies commonly highlighted the effect of particle size and emulsifier concentration on the emulsion process, but none of these studies directly discussed the effect of VA percentage of an EVA copolymer on the flow ability response of an emulsion. In this study, correlation between polymer-interaction was studied through measurement of intrinsic viscosity

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Nomenclature	
EVA	Ethylene vinyl acetate
VA	Vinyl acetate
°C	Celsius
%	Percentage
2EH	2-Ethyl hexanol
PPD	Pour point depressant
cP	Centipoise
dL/g	densi-liter per gram
η	Viscosity

1. Introduction

EVA is produced by copolymerization of ethylene and vinyl acetate (VA). It is one of the most useful polymers because of its wide range of applications, including pour point depressant (PPD), coating of photovoltaic cells and covering of tires and cables, as a consequence of the different varieties of the material depending on the VA percentage [1]. With increasing proportion of the polar co-monomer VA, the products change from modified PE to rubber-like products. EVA is mainly recognized for its flexibility and toughness (even at low temperatures), adhesion characteristics and stress-cracking resistance. The effects of VA percentage depend on the polar nature of the acetoxy side chain. When the VA percentage is increased, the polarity of the copolymer also increases. Because of its polar nature, EVA copolymers are more compatible with or soluble in a polar solvent [2].

Several researches have studied the performance of EVA copolymer as PPD which mainly in solution form. [3-5]. Conventional EVA PPD solution have active percentage in range of 5 – 10 wt.% which quite low to achieve good performance. It is a common feature of high polymers that at concentrations of 0.5 to 5.0 % their solutions may appear viscous to very viscous and may even form thick non– flowable gels. Unfortunately, the PPD solution has disadvantage which often become solids at low temperature. As a solution for this problem, emulsion technique has been implemented.

Emulsion systems have been widely used in several applications such as food, cosmetic and pharmaceutical industries. Yet, in PPD chemical production, emulsion technology being less explored or exposed which quite beneficial to study further in this area since there are only a few studies regarding PPD emulsion product. Regardless of recent challenge in producing pour point, most patent just focusing on their process [6-10]. No additional study on the effect of certain emulsification parameter has been highlighted.

Ethylene–vinyl acetate (EVA) copolymers were chosen for this work because they show different characteristics depending on their vinyl acetate (VA) percentage. To date, no study has been conducted yet to determine the relationship between VA percentage and the flow ability response of an emulsion. Previous studies commonly highlighted the effect of particle size and emulsifier concentration on the emulsion process, but none of these studies directly discussed the effect of VA percentage of an EVA copolymer on the flow ability response of an emulsion. Understanding this correlation between VA percentage and emulsion formation is quite valuable information for the manufacturer to know the response of the polymer particularly EVA copolymer which comes which different grade of VA in the emulsification in which to optimize the emulsion formulation. The aim of this study is to evaluate relationship between the VA percentage of EVA copolymers in the flow-ability response of the prepared PPD emulsion.

2. Materials and methods

The copolymer EVA (with 12%, 18%, 25%, and 40% VA), 2-ethyl-hexanol, paraffin wax, and sorbitane monooleate (Span 80) as nonionic emulsifier were purchased from Sigma-Aldrich. Glycol solution and hexane were purchased from Merck. Distilled water as aqueous phase was used in this study.

EVA emulsification process starts with polymers were blended vigorously with some amount of solvent with heat applied for 2 hours. Surfactant was added into the molten polymer blend while homogenously stirred for 30 minutes.