PREPARATION AND DEVELOPMENT OF AN ETHYLENE VINYL ACETATE (EVA) COPOLYMER EMULSIFICATION SYSTEM FOR POUR POINT DEPRESSANT (PPD) APPLICATION

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UNIVERSITI SAINS MALAYSIA

2016

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by

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Thesis submitted in fulfillment of the requirements

for the degree of

Master of Science

March 2016

ACKNOWLEDGEMENTS

I would like to express my appreciation to my project supervisor, Professor Azlan Ariffin for taking me as his student, and giving me advices and patient guidance throughout my Master project. His willingness to give his time so generously has been very much appreciated.

My grateful thanks are also extended to PhD students, Mr. Mohd Amin Mohd Razali and Mr. Afrizal Admiral for their commitments as my mentors in giving me a lot of support, guidance and advice.

Next, I would like to convey my special thanks to Dean, Professor Dr. Zuhailawati binti Hussain, Deputy Deans, lecturers and all staffs of School Materials and Mineral Resources Engineering, Universiti Sains Malaysia (USM), for their kind assistant and supports. Without their kind cooperation, this study would not be completed on time.

Finally, I wish to thank my parents for their support and encouragement throughout my study.

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LIST OF ABBREVIATIONS

EVA	Ethylene Vinyl Acetate
PPD	Pour Point Depressant
rpm	Rotation per minute
FTIR	Fourier Transfer Infra Red
DSC	Differential Scanning Calorimetry
ppm	Part per million
F/T	Freeze-thaw
Mw	Molecular Weight

LIST OF SYMBOLS

dL/g	Deci litre/gram
g	gram
µm	Micrometer
^{o}C	degree celcius
mN/m	Milinewton/meter
g/mol	Gram per mol
%	Percentage
Δ	Delta
mPa.s	Millipascal-second
^{o}C	Degree celcius

PENYEDIAAN DAN PEMBANGUNAN SISTEM PENGEMULSIAN ETILENEA VINIL ASETAT (EVA) KOPOLIMER DALAM APLIKASI AGEN PENEKAN TITIK TUANG

ABSTRAK

Produk emulsi agen penekan titik tuang berkelebihan untuk digunakan dalam suhu yang rendah kerana ia meningkatkan ciri-ciri pengendalian fizikal berbanding produk tradisional. Penyediaan emulsi EVA kopolimer yang stabil adalah kritikal bagi kejayaan penghasilan emulsi EVA kopolimer. Kajian ini mempertimbangkan kesan VA (vinil asetat) yang berbeza untuk EVA kopolimer dalam menghasilkan emulsi untuk mengekalkan kestabilan emulsi. Melalui analisa kelikatan intrinsik dan kromatografi penyerapan gel, hubungan antara kandungan VA daripada EVA kopolimer dan tindak balas keupayaan mengalir emulsi semasa pengemulsian telah diterokai. Keputusan menunjukkan bahawa kandungan VA yang tinggi menyumbang kepada ketidakstabilan emulsi. Kesan kandungan VA dikaji secara lanjut dengan mengubah nisbah pelarut / polimer untuk memerhati tindak balas keupayaan mengalir emulsi. Hasil kajian menunjukkan bahawa dalam setiap siri, nisbah pelarut / polimer yang tinggi menghasilkan keupayaan aliran emulsi yang baik pada kandungan VA, 12% dan 18 %. Tambahan pula, keputusan menunjukkan bahawa parameter keterlarutan dan kandungan VA menunjukkan korelasi yang baik dan berat molekul mempunyai pengaruh penting ke atas tindak balas keupayaan mengalir emulsi dan pengurangan titik tuang. Emulsi EVA12S8 menunjukkan prestasi pengurangan titik tuang yang terbaik, 12^{o}C pada 300 ppm. Selepas itu, kesan agen emulsi tidak berion terhadap kestabilan emulsi dikaji untuk memperolehi muatan yang optimum. Alat interfacial tensionmeter, alat ZetaSizer Malvern, ujian kestabilan emulsi, kaedah kitaran beku-cair, dan Brookfield meter telah digunakan

untuk menyiasat kestabilan emulsi. Peningkatan kepekatan agen emulsi sehingga 3 % mengurangkan ketegangan antara muka dalam sistem cekap, dengan itu membolehkan pemecahan titisan yang lebih efisien semasa pengemulsian. Ini mengurangkan saiz titisan dimana akan meningkatkan kestabilan dan kelikatan system. Melebihi kandungan ini, kestabilan emulsi mula merosot. Selepas itu, kesan pemboleh ubah proses penyeragaman yang berbeza terhadap kestabilan emulsi telah dikaji berdasarkan uji kaji eksperimen. Emulsi ini telah disediakan menggunakan pengacau mekanikal dan pengadun ricih tinggi. Sorbitan monooleate (Span 80) ditetapkan pada kandungan 3% sebagai ejen emulsi. Pembolehubah yang dikaji adalah kekuatan pengacau, suhu process penyeragaman dan masa. Hasil kajian menunjukan bahawa kondisi optimum bagi process penyeragaman adalah 5000 rpm bagi kekuatan pengacau, 80^{o}C untuk suhu process penyeragaman dan 30 minit untuk masa. Melampaui kondisi tersebut yang biasanya dirujuk pemprosesan yang terlebih batas, ia akan menjejaskan saiz zarah emulsi dan kestabilan emulsi.

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ABSTRACT

PPD emulsion product is advantageous for use in sub-ambient temperature as it improve the physical handling characteristic compared to traditional product. The preparation of stable EVA copolymer emulsion is critical for the success of production of EVA copolymer emulsion. This study considers the effect of different VA (vinyl acetate) of EVA copolymer in producing the emulsion form as to maintain the emulsion stability. Through the intrinsic viscosity and gel permeation chromatography analysis, the relationship between VA content of EVA copolymer and the flow ability response of an emulsion during emulsification is explored. The result is shown that higher VA content contributes to the instability of the emulsion. Effects VA content were further study by varying the solvent/polymer ratio to observe the flow-response of the emulsion. The results showed that in each series, a higher solvent/polymer ratio produces good flow ability emulsion at 12% and 18% of VA content. Furthermore, these results also revealed that the solubility parameter and VA content show good correlation and that molecular weight has an important influence on the flow ability response of emulsion and pour point reduction. EVA12S8 emulsion exhibited the highest pour point reduction, 12^{o}C at 300 ppm. Subsequently, impact of nonionic emulsifier on emulsion stability was studied as to obtain the optimal loading. Interfacial tensiometer, ZetaSizer Malvern instrument, emulsion stability test, freeze–thaw cycle method, and Brookfield viscometer were employed to investigate emulsion stability. Increasing the emulsifier concentration

up to 3% will decrease the interfacial tension in the system efficiently, thus allowing for more efficient droplet break-up during emulsification. This will reduce the particle size, which in turn increased the stability and viscosity of the system. Beyond this loading, the emulsion stability began to decline. Afterward, the effects of different homogenization parameters on emulsion stability were investigated. The emulsion was prepared using paddle agitator and high-shear mixer. Sorbitan monooleate(Span 80) at constant 3% loading as emulsifier. Three parameters were monitored in this section, namely stirring intensity, homogenization temperature and time. The results showed that the optimum homogenization conditions are: stirring intensity, 5000 rpm; homogenization temperature, 80^{o}C and homogenization time, 30 minutes. Exceed these conditions as commonly referred as over-processing; it will impair the emulsion particle size and the emulsion stability.