Pengaruh formulasi filler CaCO3 dan Co-heat stabilizer epoxidized soya bean oil serta parameter proses pencampuran hot melt mixing terhadap sifat mekanik plasticized-poli vinil klorida = The Influence of filler CaCO3 and Co-heat stabilizer epoxidized soya bean oil formulation with hot melt mixing process parameters to mechanical properties of plasticized-poly (vinyl chloride)

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Abstrak

Poli Vinil Klorida (PVC) memiliki nilai kegunaan yang luas dan beragam dikarenakan sifat mekaniknya yang dapat disesuaikan dengan kebutuhan (contoh : Unplasticized PVC dan Plasticized PVC dimana penggunaan plasticized PVC mencapai 60% dari konsumsi PVC diseluruh dunia), namun memiliki keterbatasan dalam sifat kestabilan termal selama proses pencampuran hot melt mixing P-PVC. Kebutuhan akan plasticized-poly (vinyl chloride) (P-PVC) dengan nilai modulus kekakuan (modulus young) yang optimum dan nilai kekuatan tarik (tensile strength) yang tinggi dapat dicapai dengan menerapkan formulasi aditif plasticizer dan filler CaCO3 serta pengaturan nilai parameter proses hot melt mixing seperti suhu, waktu dan kecepatan pencampuran dalam ranah nilai yang optimal, dan penggunaan heat stabilizer beserta co-heat stabilizer epoxidized soya bean oil (ESBO) ditujukan untuk mengatasi keterbatasan termal P-PVC selama proses pencampuran P-PVC dalam alat rheomix (twin screw extruder).
Studi ini berusaha untuk memformulasikan filler CaCO3, plasticizer di-octyl Phatalate (DOP) dan ESBO serta parameter proses pencampuran dalam proses pencampuran PVC-P, dengan memvariasikan kadar filler CaCO3 dari 0 hingga 90 PHR (part per hundred PVC resin) dan ESBO di nilai 0 hingga 6 PHR dengan menjaga kadar DOP tetap di nilai 28 PHR dalam resin PVC-XXX selama proses pencampuran lelehan, serta memvariasikan suhu pencampuran di suhu 170C hingga 200C, variasi waktu mixing dari 60 hingga 420 sekon dan memvariasikan kecepatan mixing di angka 90 hingga 120 rpm untuk mencapai nilai modulus kekakuan dan nilai kekuatan tarik yang optimal.
Hasil menunjukan bahwa penambahan filler CaCO3 dari 0 hingga 90 PHR dalam proses pencampuran lelehan mampu meningkatkan nilai kekakuan PVC-P. Nilai kekuatan tarik dan modulus kekakuan mencapai nilai optimum di suhu, waktu dan kecepatan pencampuran di nilai 180C, 300s dan 100 rpm. Hal yang menarik adalah bahwa ESBO tidak hanya bertindak sebagai co-heat stabilizer, disaat bersamaan penambahan ESBO dari 0 hingga 4 PHR mampu menurunkan nilai modulus kekakuan (bertindak seperti plasticizer) PVC-P, dan ini menunjukkan bahwa ESBO berpotensi untuk digunakan sebagai primary plasticizer yang berarti mengurangi penggunaan DOP.
.....Poly (vinyl chloride) has versatile and varies application due to its mechanical properties that can be adjusted correspond to consumer needs (ex. Unplasticized PVC and Plasticized PVC where the usage of plasticized PVC reach 60% from all PVC consumption around the world), but still have many limitations which is PVC is unstable during processing (hot melt mixing). Demand of plasticized PVC with high tensile strength and modulus young can be achieved by optimizing the formulation of plasticizer, filler CaCO3 with other additive and apply the optimum adjustment of mixing parameter process (temperature, time, and speed of mixing), and the usage of heat stabilizer and co-heat stabilizer epoxidized soya bean oil (ESBO) where

synergize to stabilizing the molecules of plasticized PVC during processing.

The aim of this research is to formulate the additive (filler, DOP, ESBO) and mixing parameter process which is can produce plasticized PVC with high mechanical properties by varying the concentration of filler $CaCO_3$ from 0 up to 90 PHR (parts per hundred PVC resin) and the concentration of ESBO from 0 up to 6 PHR while at the same time keeping the concentration of DOP still on 28 PHR in matrix of PVC-P during hot melt mixing, and varying the mixing temperature from 170C going to 200, varying the duration of mixing from 60 going to 420 seconds and varying the speed of mixing from 90 going to 120 rpm to obtain the optimum of modulus young and tensile strength properties.

The result shown that the optimum modulus young and tensile strength of plasticized PVC was achieved by setting temperature, time, and rpm of hot melt mixing in certain value respectively 180C, 300 seconds and 100 rpm. The remarks is that ESBO is not only acted as co-heat stabilizer, at the same time the addition of ESBO from 0 up to 4 PHR can reduce the modulus young properties of plasticized PVC (ESBO acted as secondary plasticizer), and this lead to conclusion that ESBO has a great potential to become primary plasticizer to reduce the usage of DOP that can be reduce the risk in health issue during processing of plasticized PVC.