상전이 물질을 함유하는 수분산 PU에서 계면활성제의 효과

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Effects of Several Surfactants in the WBPU/Octadecane as a Phase Change Material

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1. Introduction

Polyurethane(PU) materials have been generally used in the automobile, paint, furniture, adhesive, and textile industries. The use of Waterborne PU was motivated form the environmental point of view, i.e. reduction of solvent emissions into the atmosphere(volatile organic compounds, VOC)[1]. Generally speaking, phase change materials (PCM) have the capability of absorbing or releasing thermal energy to reduce or eliminate heat transfer at the temperature range of the particular temperature stabilizing material[2]. PCM has been applied to architecture and aerospace as temperature regulation system or heat transfer media. PCM applied to clothes relies on the change of outside temperature or body[3].

In this study, Effects of several surfactants in WBPU/octadecane were studied on the particle size distribution, mechanical and thermal properties of these polymers.

2. Experimental

2.1. Materials

Poly(tetramethylene adipate glycol)(PTAd, Mw=2000, Hosung petrochemical Co., LTD.) as softsegments was distilled at 85℃ under vacuum before using. Dimethylol propionic acid(DMPA, Aldrich) as ionic moiety, N-methyl-2pyrrolidone(NMP, Aldrich) as a DMPA solvent, triethyleneamine(TEA) as a neutralization agent, ethylene diamine(EDA) as a chain extender, isophorone diisocyanate (IPDI, Fluka) as a hard segment, octadecane(Aldrich) as a phase change material, dibutyl tin dilaurate(DBTDL, Aldrich), MEK, anionic surfactants(dodecyl benzene sulfonic acid sodium salt 50%(DBSASS) or C_{12}~C_{16} sulfonate 40%) and nonionic surfactants (NP(poly(ethylene glycol) nonyl phenyl ether-4)*, NP-10) were used without further purification.

*the number : the number of ethylene oxide.

2.2. Synthesis

The synthesis of WBPU was carried out under nitrogen atmosphere in a four neck round -bottom flask equipped with a thermometer, stirrer, inlet of dry nitrogen, condenser and a heat jacket. PTAd was placed in the flask and degassed under vacuum at 85℃ for 1hour. Then, DMPA/NMP and DBTDL were added to them for 30 minutes under gentle stirring(about 100rpm). IPDI was added and then reacted at 80℃ for 3hours. MEK(10wt% of solid) at 60℃ for 30 minutes. The neutralization was carried out by adding TEA for 30 minutes under 400rpm. Then, dispersion was performed by adding H_2O(65wt% of solid) for 30 minutes with vigorous stirring

The segmented prepolymer was extended by dropping with EDA as a chain extender at 40℃. All the aqueous dispersions of 35wt% solid were obtained after evaporating of MEK. Surfactants and octadecane with a various ratio were added in the prepared WBPU. Blend films were prepared by casting these dispersions on Teflon plates at 40℃ for 72 hours.

2.3. Characterization

Particle size analysis was done by using lazer-scattering equipment(Autosizer, Melvern II C). To identify the synthesis of WBPU, FTIR(Nicolet Impact 400D sample, 32 scans at 4cm^{-1} resolution) were collected in the transmittance mode. The thermal behavior(ΔH of endothermic and exothermic peak) was examined by using a DSC 220C(SEIKO) at a heating rate of 10℃/min(in heating) and 5℃/min(in cooling) under a nitrogen atmosphere. The mechanical properties were measured at room temperature by using Tinius Olsen 1000.

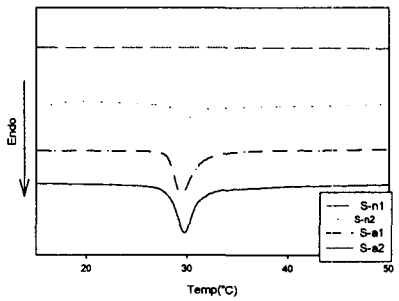
3. Results and Discussion

The amount of surfactant was in the range of 1~10wt% of octadecane and two surfactants (TDE-3 and TDE-9) with a various ratio were mixed and used in the WBPU/octadecane. The stable emulsion state and ΔH depended on the amount and composition of surfactants. Nonionic surfactants(NP-4, NP-10) were used to improve the stability and the content of octadecane in WBPU/ octadecane system in this study.

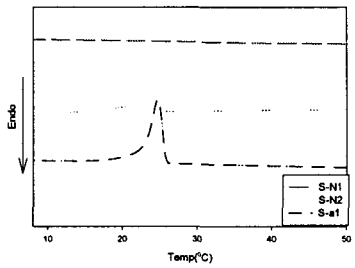
Table 1. The sample designation and the composition of surfactant/WBPU/octadecane

sample designation	surfactant	octadecane (g)	WBPU (g)
S-a1	DBSASS	1	20
S-a2	C_{12}~C_{16} sulfonate 40%	1	20
S-n1	NP-4	1	20
S-n2	NP-10	1	20

* : Surfactants were fixed at 2.5wt% of octadecane in the Table 1.



Δ H of otadecane with different emulsifiers in WBPU of DMPA0.5



Δ H of octadecane with different emulsifiers in WBPU of DMPA0.5

4. References

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