Polymeric nanoparticle dispersions based on sustainable alternatives cosolvents to NMP

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Aqueous polymeric nanodispersions are real alternatives to reduce volatile organic compounds emissions in coatings and adhesive products. Aqueous polyurethane dispersions (PUD) have particular importance due to their similar performance to conventional solvent borne products[1].
This kind of dispersions are based on linear polyurethane dispersed in water due to an ionic internal emulsifier introduced in their molecular structure. The industrial fabrication process requires an organic solvent to reduce the viscosity during prepolymer synthesis. This organic solvent remains in the dispersion in order to allow coalescence of nanoparticles and film formation[2]. In industrial scale the solvent with better balance between performance and cost is N-methylpyrrolidone (NMP). However, the use of this chemical has been restricted by European Union [3].
In this study alternative green solvents have been selected and studied in order to get aqueous polyurethane nanodispersion with low toxicity and low carbon footprint [4].
NMP and three green alternatives have been used to synthesize PUDs following the same procedure in four cases. The dispersions obtained have been studied and compared, analysing: nanoparticles size distribution, Z- potential (electrostatic stabilization), stability time, figure e2 and polymer molecular weight.
According with all results obtained, the three sustainable alternatives to NMP studied are very promising for obtaining less toxic and more sustainable aqueous polyurethane dispersions. However, further studies and researches are needed in order to validate these new sustainable solvents as substitutes of NMP in polyurethane nanodispersion systems.

References

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[2] J. K. Oh, J. Anderson, B. Erdem, R. Drumright, and G. Meyers, *Prog. Org. Coatings*, vol. 72, no. 3, pp. 253–259, Nov. 2011.
[3] The European Commission, "Commission Regulation (Eu) 2018/588," Off. Journal Eur. Union, vol. 1, no. 1272, pp. 16–19, 2018.
[4] C. M. Alder et al., Green Chem., vol. 18, no. 13, pp. 3879–3890, 2016.

Figures

Solvent	Boiling point(ºC)	Incineration	Recycling	Biotreatment	Aquatic impact	Air impact	Health Hazard	Exposure potential	Reactivity &Stability
NMP	202	3	4	3	10	6	1	9	9
1	203	4	4	5	9	6	4	8	10
2	207	8	7	10	10	6	4	8	10
3	242	4	5	6	10	10	10	10	10

Figure 1: Table. Scoring outcomes for solvents studied, GKS´s sustainability guide: 1the lest green and 10 the most green [4].

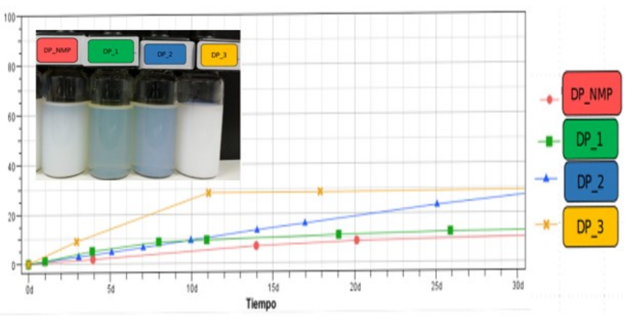

Figure 2: Nanodispersions photograph and graphic of destabilization kinetics