

Effects of Chain Transfer Agent and Reactive Diluent on the Viscosity and Physical Properties of UV-cured Coatings

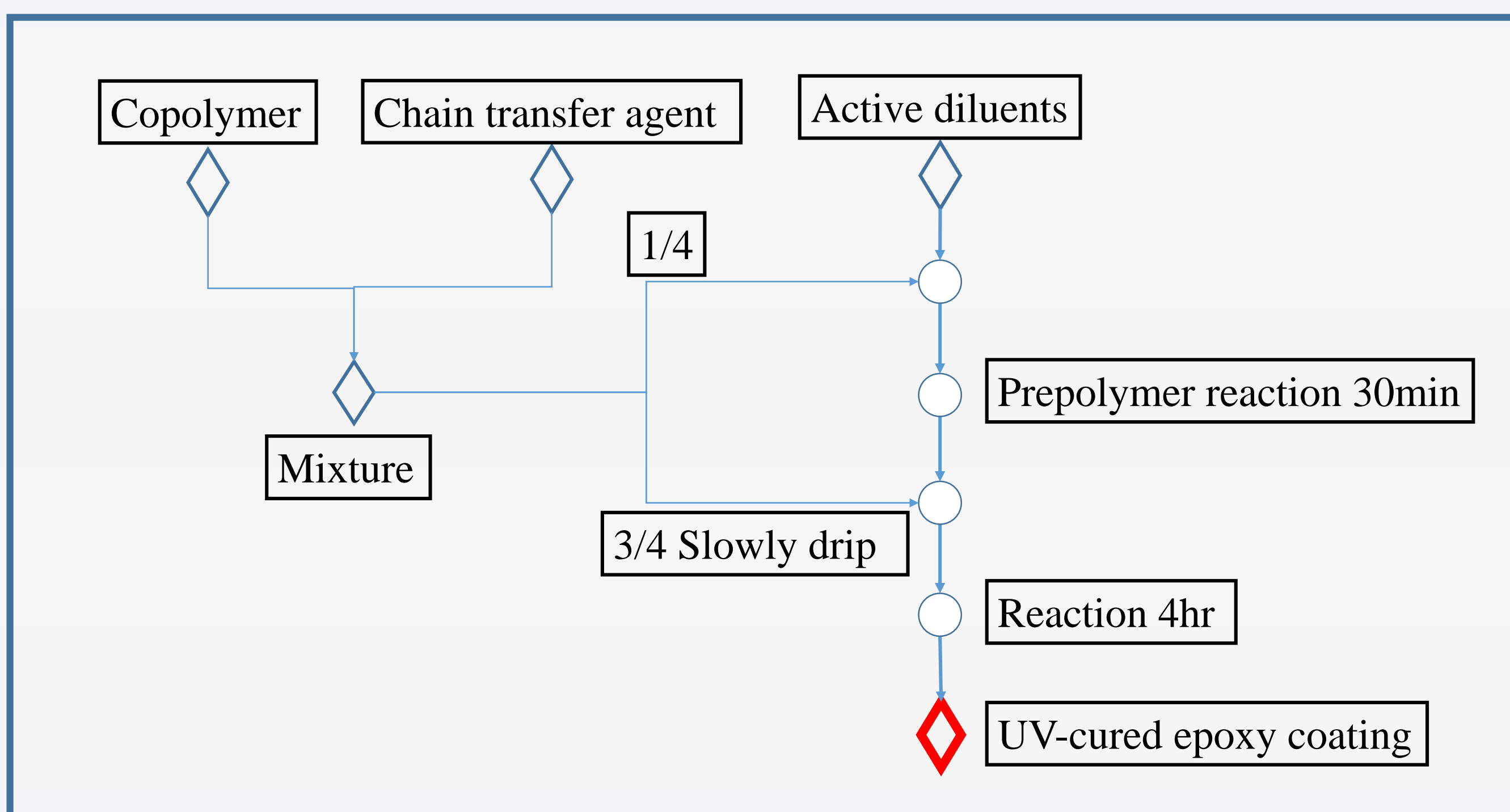
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Abstract

The recent studies showed the degree of polymerization and viscosity of the coating could be reduced by the chain transfer agents; the epoxy reactive diluents could directly react with the polymer and instead of using the traditional volatile solvents. In this study, the effect of chain transfer agents and reactive diluents on the viscosity, adhesion and hardness of the coating film were studied by using acrylates with epoxy functional groups and two kinds of soft and hard acrylates.

The results of the cross hatch adhesion test showed the adhesion property of film increased as the adding amount of the chain transfer agent increased by using linear α -methylstyrene dimer (DMP) as a chain transfer agent; however, the viscosity of coating and the hardness of the film decreased. As the adding amount of the chain transfer agent is 6%, the viscosity of the coating, the film hardness and the adhesion test were 1123cp, HB, and level 0 respectively. As replacing traditional solvents with reactive diluents, the results showed that increasing epoxy functional group of reactive diluents followed by the viscosity of coating and hardness of the film increased, but the adhesion test decreased.

Experimental



Results And Discussion

一. Effects of different chain transfer agent on physical properties

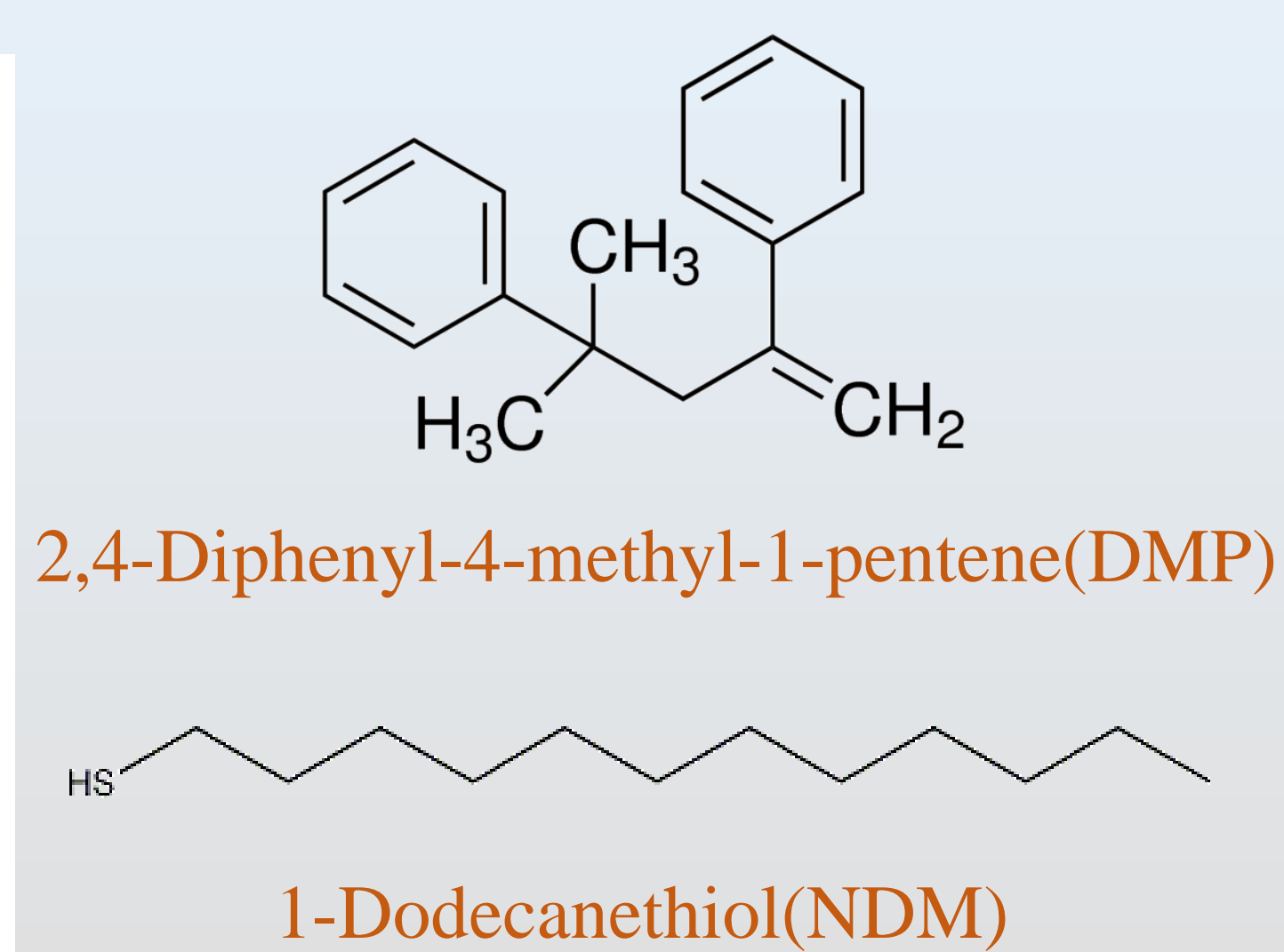
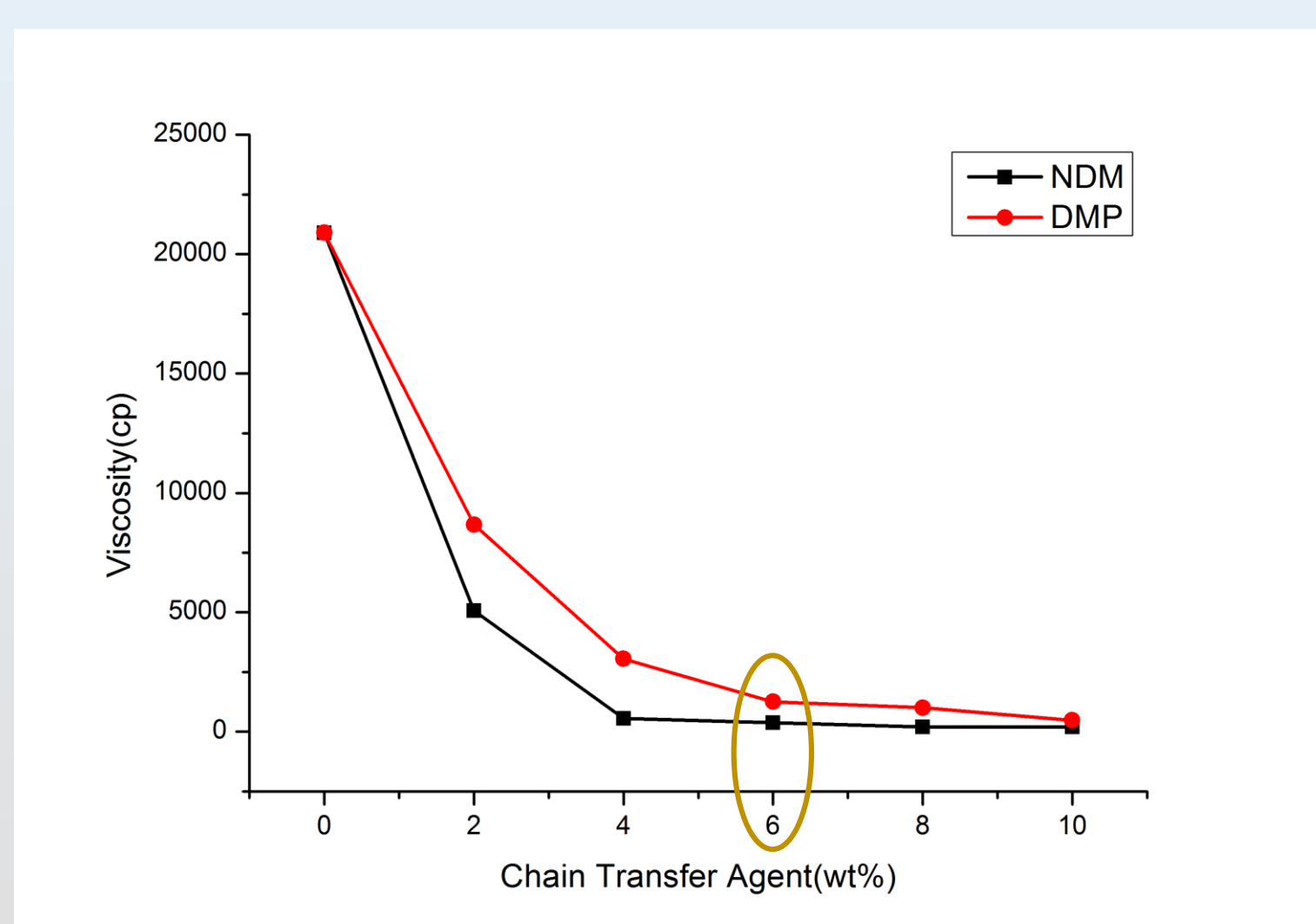
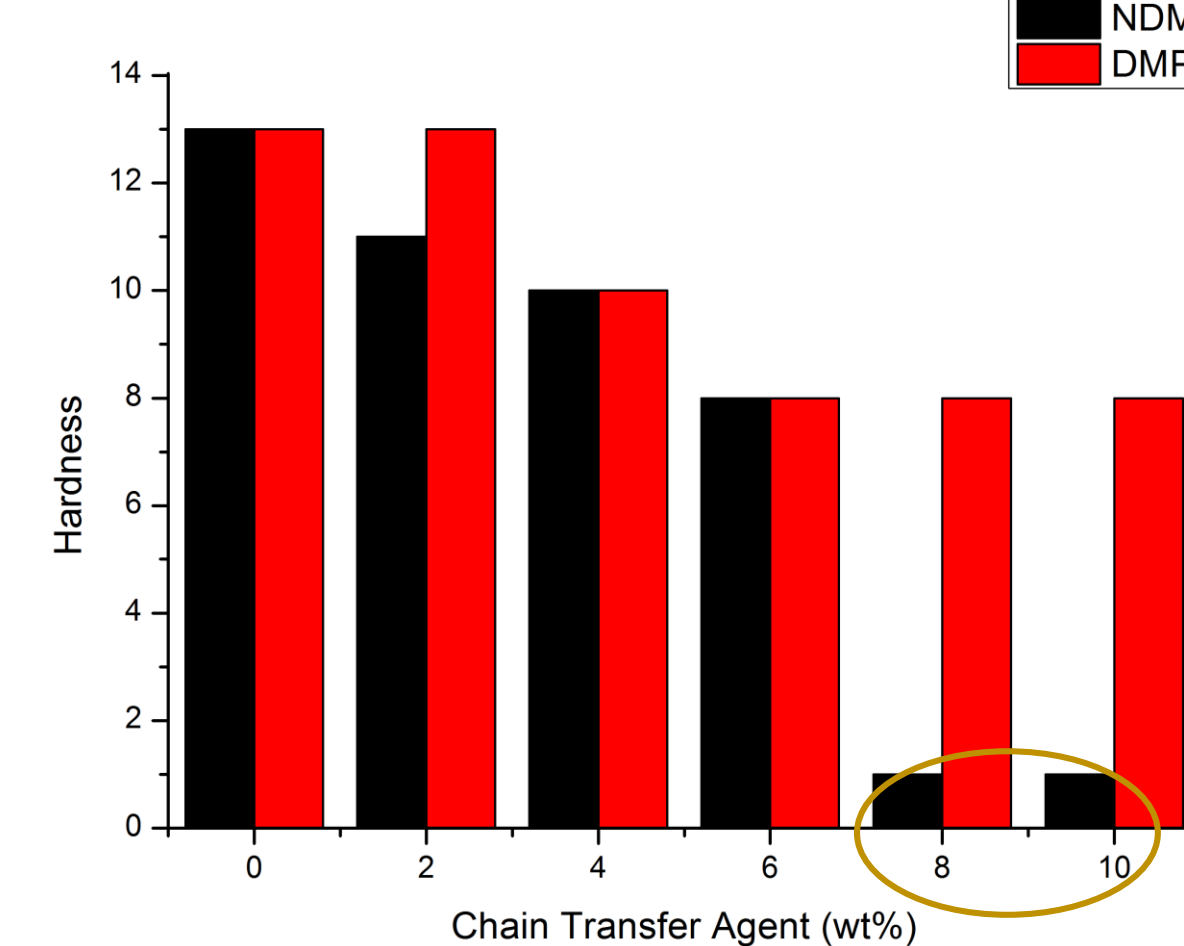


Fig. 1 Effects of different chain transfer agent on viscosity.

- The viscosity of solution decreased with increasing chain transfer agent.
- The viscosity of solutions were 380cp and 1250cp, on adding both NDM and DMP of 6%.
- The lowest viscosity of solution was 200cp on adding NDM of 10%.

Conclusion

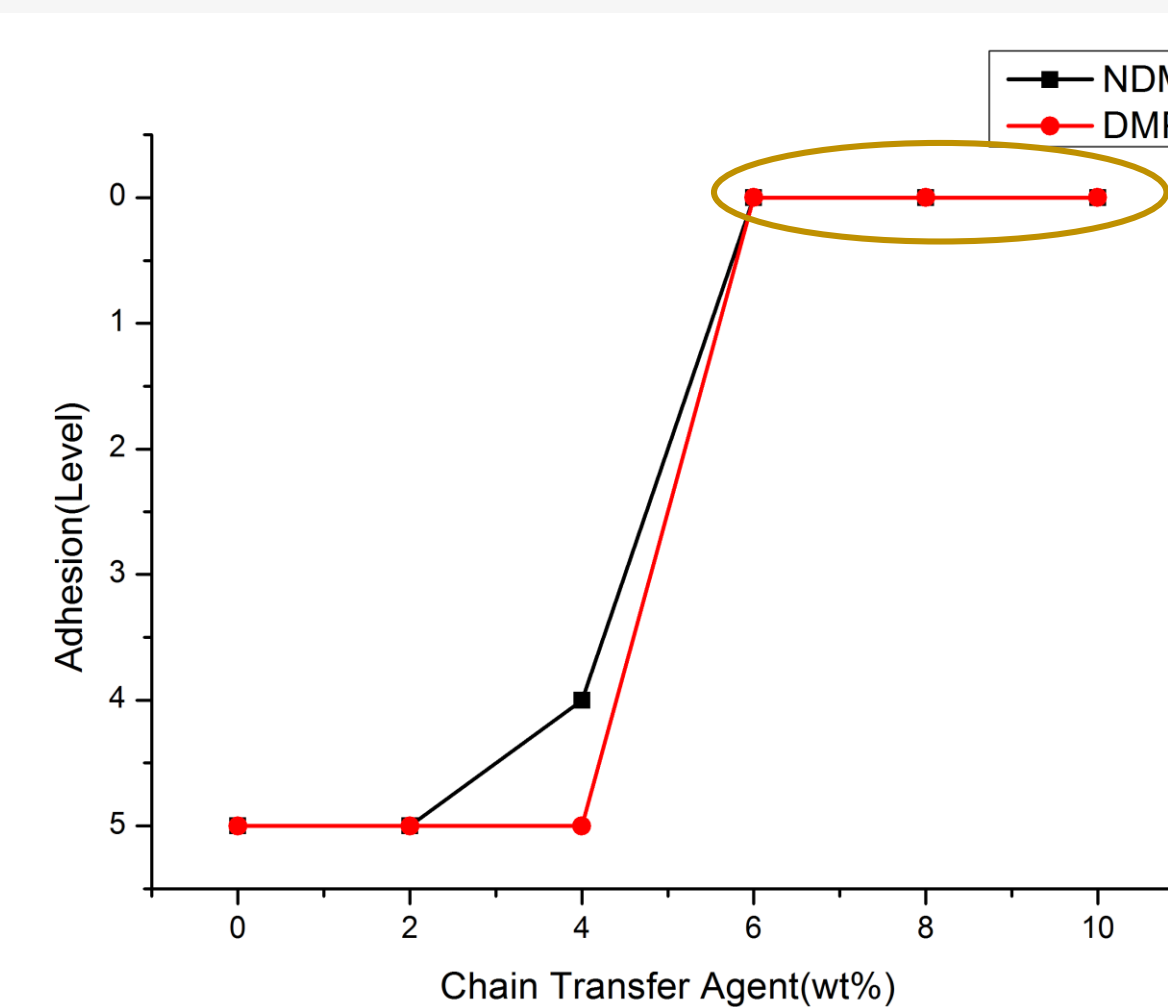
- The UV-curable coatings with low viscosity and excellent physical properties were fabricated by using cationic photopolymerization on adding chain transfer agent and reactive diluents.
- The lowest viscosity of solution was 200cp on adding chain transfer agent NDM of 10%.
- The optimal hardness and the adhesion property of the film was 4H, 4H and 5H on adding bifunctional reactive diluent and 6% DMP.



Pencil hardness	<6B	6B	5B	4B	3B	2B
Hardness level	1	2	3	4	5	6
Pencil hardness	B	HB	F	H	2H	3H
Hardness level	7	8	9	10	11	12
Pencil hardness	4H	5H	6H	7H	8H	>9H
Hardness level	13	14	15	16	17	18

Fig. 2 Effects of different chain transfer agent on hardness.

- The hardness of both coating decreased with increasing chain transfer agent.
- The hardness decreased to level 6B on adding NDM of 8wt%.

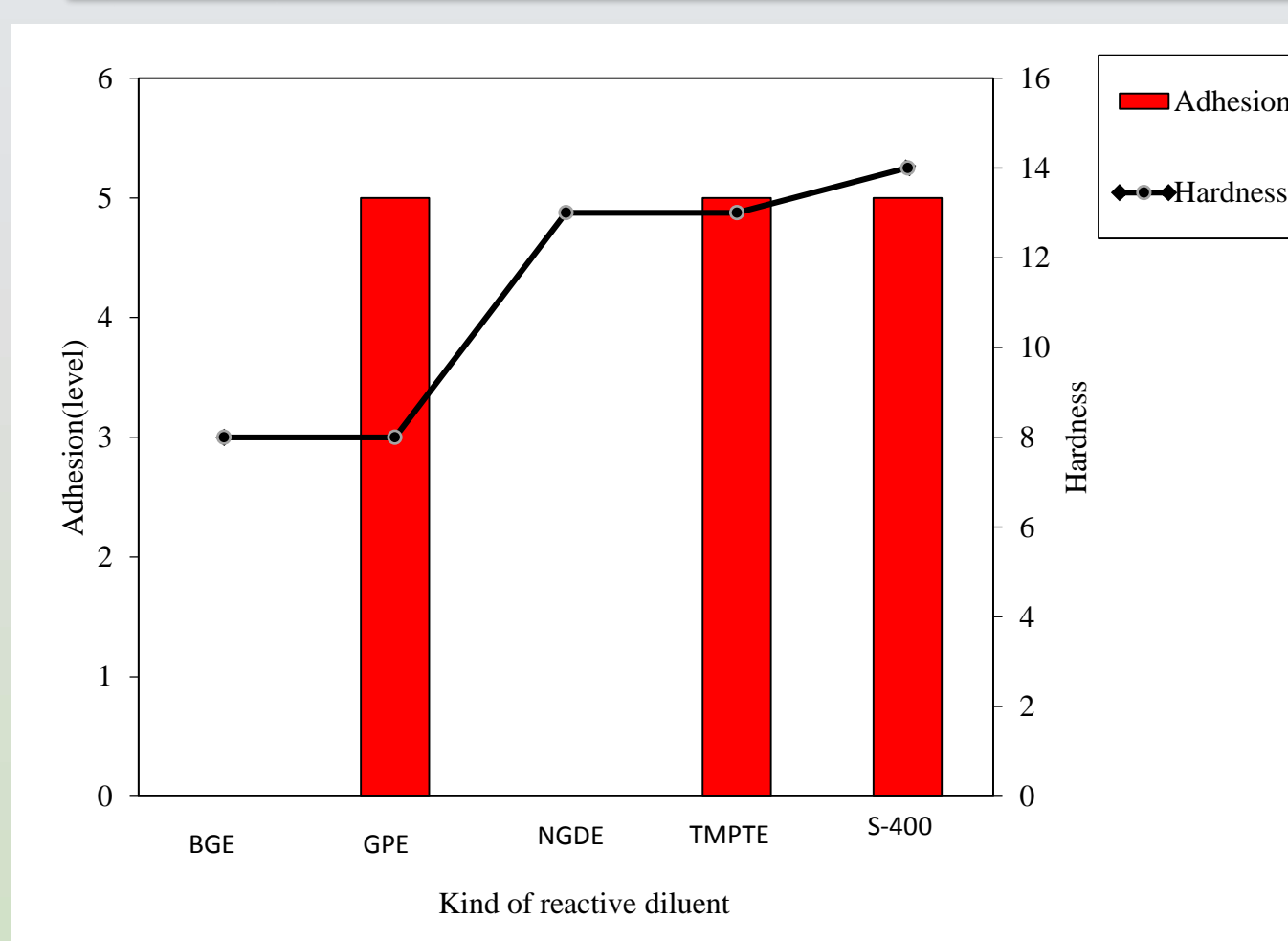


Level	Exterior
0	No stripped
1	
2	
3	
4	
5	

Fig. 3 Effects of different chain transfer agent on adhesion property.

- The adhesion property was improved when the amount of the chain transfer agent increased.
- The adhesion property can achieve to level 0, on adding amount of NDM and DMP of 6%.

二. Effect of different diluents on physical properties



Reactive diluent	Structure	Kind
Butyl glycidyl ether(BGE)		Monofunctional
Glycidyl phenyl ether(GPE)		Monofunctional
Neopentyl glycol diglycidyl ether(NGDE)		Bifunctional
Trimethylolpropane triglycidyl ether(TMPTE)		Trifunctional
Pentaerythritol glycidyl ether(S-400)		Tetrafunctional

Fig. 4 Effects of different active diluents on hardness and adhesion of coatings.

- The best adhesion property can achieve to level 0, on adding active diluents of BGE and NGDE.
- The hardness can achieve to 4H, 4H and 5H on adding NGDE, TMPTE and S-400, respectively.