

MONOMER ADHESION TO PLASTICS

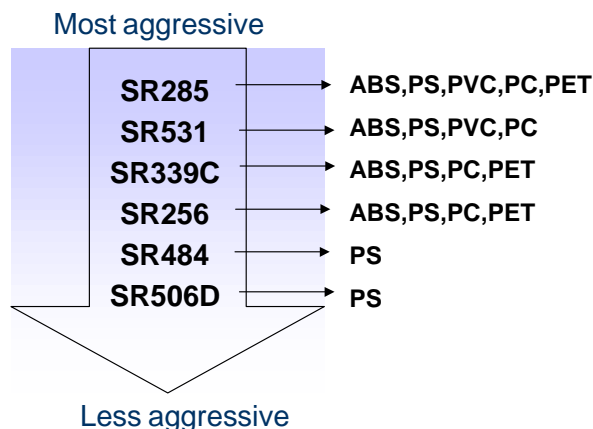
Adhesion to plastics of UV curable formulations may be quite difficult to achieve. Different factors are responsible for this poor adhesion. First, the instantaneous curing creates shrinkage which is very unfavourable. Secondly, some plastic substrates have a very low surface tension, which causes wetting issues, resulting, again, in poor adhesion. Today, however, the use of plastic substrates is still growing, because of their versatility of mechanical properties, of appearance and cost also.

This study has been performed on different types of substrates for which specific surface tensions are listed below.

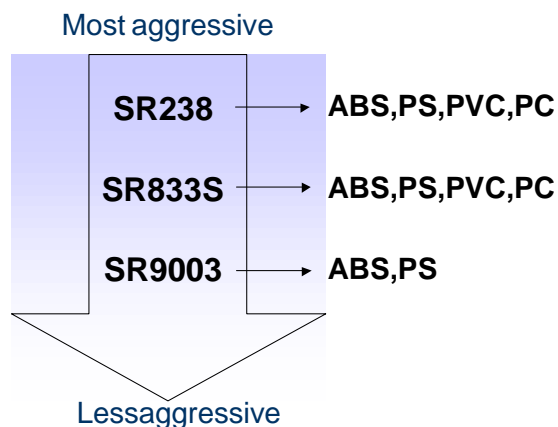
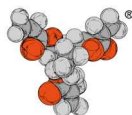
Substrate	Surface tension (Dynes/cm)
PP	$E < 36$
PE	$36 < E < 38$
PVC white	$36 < E < 38$
PVC transparent	$38 < E < 40$
PC	$38 < E < 40$
PET	$38 < E < 40$
PS	$38 < E < 40$
PMMA	$44 < E < 46$
ABS	$46 < E < 48$

To select the best monomers for each substrate, swelling tests were performed to highlight their aggressiveness against the surface. This very simple but very useful test gives an idea of the ability of each monomer to slightly solvate the plastics, hence creating very good adhesion.

The test was first performed on monofunctional monomers:



The same test was performed with difunctional monomers.



Finally, the swelling test gives a very good indication of which monomers should be used for adhesion to each specific plastic. The table below summarizes the results performed on the entire range of mono and difunctional monomers.

	PVC	ABS	PS	PC	PET	PMMA	PP	PE
monofunctionals								
SR506D	/	/	+	/	/	/	/	/
SR531	++	++	+	+	/	/	/	/
SR339C	/	++	++	++	++	/	/	/
SR395	/	/	++	/	/	/	/	/
SR285	++	++	++	++	++	+	/	/
SR256	/	++	++	+	++	/	/	/
SR335	/	/	++	/	/	/	/	/
SR484	+	/	++	/	/	/	/	/
SR489	/	/	++	/	/	/	/	/
difunctionals								
SR9003	/	+	+	/	/	/	/	/
SR833S	+	+	+	/	/	/	/	/
SR238	+	+	++	++	/	/	/	/
SR606A	/	/	/	/	/	/	/	/
SR230	/	+	/	++	/	/	/	/
SR259	/	+	/	+	/	/	/	/
SR268US	/	+	/	++	/	/	/	/
SR272	/	+	/	++	/	/	/	/
SR306	/	+	/	+	/	/	/	/
SR508	/	+	+	+	/	/	/	/

++:strongmark

+:slightmark



In most cases, it is possible to find at least one monomer likely to swell at type of substrate, but two problems remain: adhesion to PP and PE.

Polyolefines are completely inert against monomers, and they also have very low surface tension. To overcome these two issues, it could be useful to modify their surfaces by using special treatment (Corona or flame); but it is not always possible, and sometimes not efficient enough.

Sartomer has developed two specific products for direct adhesion to these substrates.

PRO2940	PRO3158
Nonchlorinated resin diluted in SR506D (IBOA)	Chlorinated resin diluted in SR506D (IBOA)
1500mPa.s	6000mPa.s

These two resins are able to provide perfect direct adhesion on mainly PP and PE substrates, but on many other substrates as well.

	PRO2940	PRO3158
PP	1	0
PE	1	2
PVC	0	0
PC	1	0
PMMA	1	0
ABS	1	0
glass	1	3

0: perfect adhesion with crosshatch test

5: worse adhesion with crosshatch test

Based on these two products, a full system (basecoat + topcoat) could be formulated with excellent adhesion and very good chemical and scratch resistance.

Example 1: Chlorinated Basecoat + Topcoat

Basecoat	PRO2940	88%
	SR256	8%
	Darocur1173	4%
Topcoat	CN104B80	77%
	SR506D	12%
	SR9051	5%
	Darocur1173	5%
	TegoRAD2200	1%
Adhesion (crosshatch)	Very Good	
Levelling	Very Good	
Nails scratch	Very Good	
Acetone swab	>300s	
Pencil hardness	H	

**Example2: Nonchlorinated Basecoat+Topcoat**

Basecoat	PRO3158	95%
	Darocur1173	4%
	Irgacure819	1%
Topcoat	CN922	41.1%
	SR238	15.4%
	SR454	20.5%
	SR506D	10.2%
	SR9003	7.7%
	CN385	2%
	D1173	3.1%
Perso hardness (100µon glass)	279	
Flexibility (100µon steel)	20mm	
Adhesion (crosshatch)	Very good	
Levelling	Very good	
Nail scratch	Good	
Acetone swab	>300s	
Pencil hardness	H	

Applications:

PP/PE flooring tiles
 PP/PE packaging
 PP/PE plastic pieces