TYRIN™ 200
Chlorinated Polyethylene Resin

Tyrin™ Chlorinated Polyethylene thermoplastic resins (CPE) are widely used as impact modifiers in PVC extrusion and injection moulding applications. Tyrin™ CPE is especially effective in such applications as window, siding and pipe extrusion. Tyrin™ CPE impact modifiers provide excellent welded corner strength, gloss and low temperature impact performance. The chemical nature of CPE resins means that they retain their physical properties when exposed UV light this make Tyrin™ CPE especially effective in applications where resistance to natural weathering is important. In certain circumstances Tyrin™ CPE can be blended with core shell acrylic impact modifiers to optimize the cost performance balance.

PRODUCT PROPERTIES

Tyrin™ 200 is a medium viscosity chlorinated polyethylene with low crystallinity. It is used for the impact modification of rigid PVC profiles, pipes and sheets. It is available in powder form. When compared to other Tyrin™ grades such as Tyrin™ 6000 and Tyrin 7100 exhibits similar properties although in some very stringent impact tests is shown to have a slight inferior performance.

Physical	Nominal Value	Unit	Test Method
Chlorine	35.0	% by wt	Vendor
Ash Content	3.0	% by wt	Vendor
Volatiles	0.4	% by wt	Vendor
Bulk Density	0.43	g/cc	Vendor
Hardness	65	Shore A	Vendor
Particle Size	2.0	% by wt	0.9mm sieve

PROCESSING PROPERIES

As a result of its particular morphology PVC resin is relatively difficult to process. To reach its optimum physical properties the particular nature of the resin must be broken down and the additives in the formulations must be evenly distributed. The physical properties of a finished PVC article are therefore strongly influenced by the processing conditions. The processing conditions are themselves influenced by the components of the PVC formulation. Internal and external lubricants play their part but as a result of their relatively high addition level impact modifiers can also have a significant effect.

TEST FORMULATION

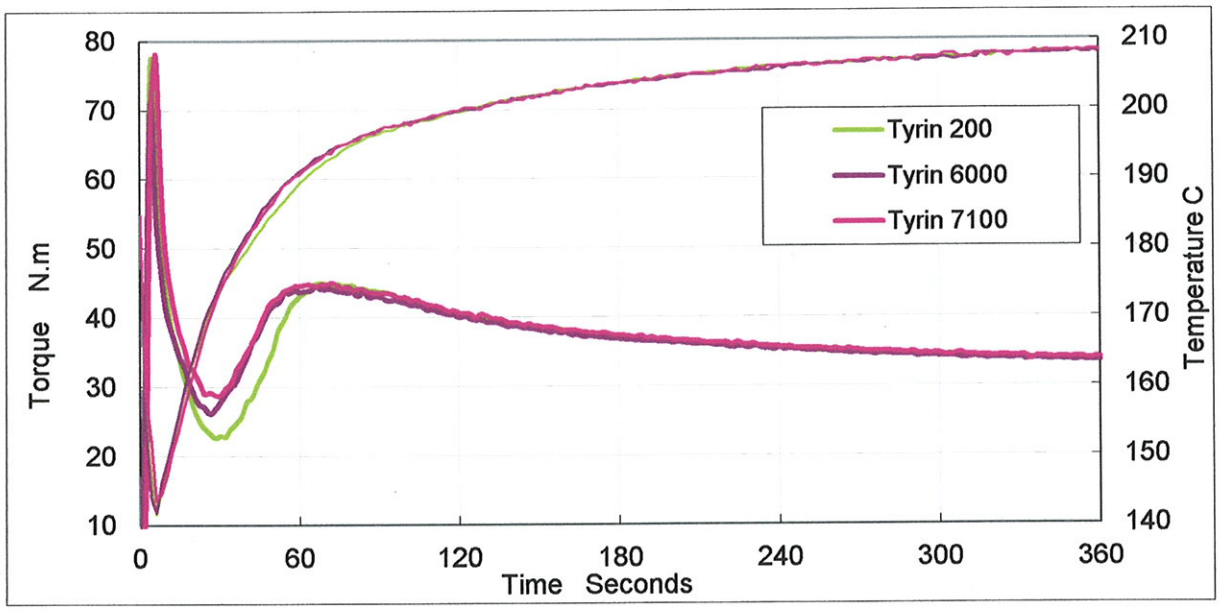
Compontent	A	B	C
SPVC K67	100	100	100
Ca/Zn Onepack	3.5	3.5	3.5
Competitor CPE	8		
Tyrin 200		8	
Tyrin 6000			8
CaCO3	8	8	8
TiO2	4	4	4

BRABENDER FUSION CHARACTERISTICS

A Brabender rheometer is sometimes used to evaluate the melting or fusion characteristics of a PVC formulation. A measured quantity of the PVC dryblend is introduced into the heated chamber of the Brabender. Mixing rotors blend and mix the powder together as it melts. The amount of torque or turning force on the rotors is measured as a function of time. The Brabender Fusion time is the time taken to reach the second peak on the torque curve as illustrated below.

A long fusion time could indicate that in an extruder the PVC would be difficult to fuse and poor physical properties would result. Too short a fusion time could mean that moisture and volatiles are trapped in the extruder barrel leading to bubbles and other defects in the finished article.

The Brabender Fusion curves below show that Tyrin™ 200 exhibits a fusion time very similar to that produced by Tyrin™ 6000 and Tyrin 7100



TWIN SCREW EXTRUSION CHARTERISTICS

TWIN SCREW EXTRUSION CONDITIONS

While the Brabender Rheometer gives a good indication of fusion characteristics the performance of the PVC formulation in a extruder is a more practical demonstration.

In preparation for the test the formulations were blended in a high speed mixer with a separate cooling chamber. The resulting dryblends were conditioned to allow a stable bulk density to be established before extrusion.

These extrusion conditions were recorded on a Laboratory Kraus Maffei KMDL-25.

The Laboratory KMDL-25 is a fully instrumented conical, counter rotating, twin screw extruder fitted with a profile die. Pressure transducers measure the melt pressure at two position in the barrel (before and after the vent) and in the adaptor between the barrel and die. Two temperature sensors record the melt temperature in the barrel and in the adaptor.

TWIN SCREW EXTRUSION CHARTERISTICS

Screw		Set Temperatures				
Speed	Temp	Barrel 1	Barrel 2	Die 1	Die 2	Die 3
rpm	° C	° C	° C	° C	° C	° C
36	**170**	**175**	**175**	**190**	**190**	**190**

		Torque	Feeding	Output	Pressure Readings			Temp	Adaptor
					1	2	Adaptor	Melt	Melt
CPE	**phr**	Amps	rpm	kg/hr	MPa	MPa	MPa	° C	° C
Tyrin 200	**8**	**3.36**	**46.0**	**13.04**	**1.2**	**7.0**	**19.5**	**162**	**178**
Tyrin 6000	**8**	**3.13**	**46.0**	**12.65**	**0.7**	**3.2**	**18.0**	**162**	**176**
Tyrin 7100	**8**	**3.19**	**46.0**	**12.86**	**0.8**	**4.3**	**18.8**	**162**	**176**

EXTRUDED CONDITIONS

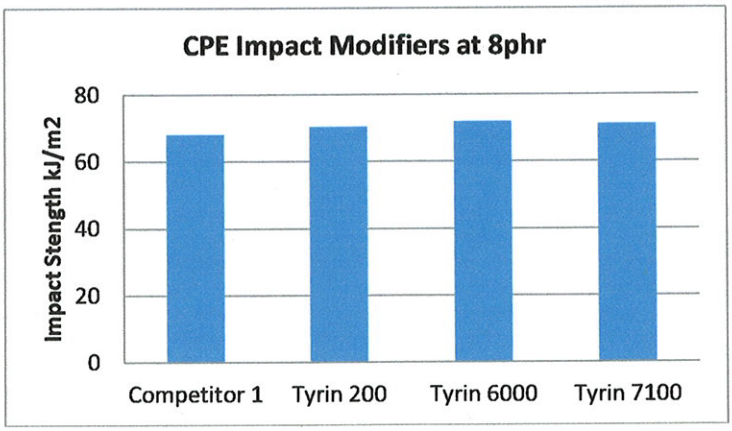
At the set temperatures and screw speed mentioned above Tyrin™ 200 demonstrates a slightly higher pressure buildup in the barrel and adaptor and a slightly higher melt temperature. This would indicate that the formulation containing Tyrin™ 200 is fusing slight faster in the extruder than the formulations modified with the other CPE samples.

IMPACT TEST RESULTS

Impact tests were carried on profiles extruded on the KMDL-25. Two different types of test specimen were prepared:-

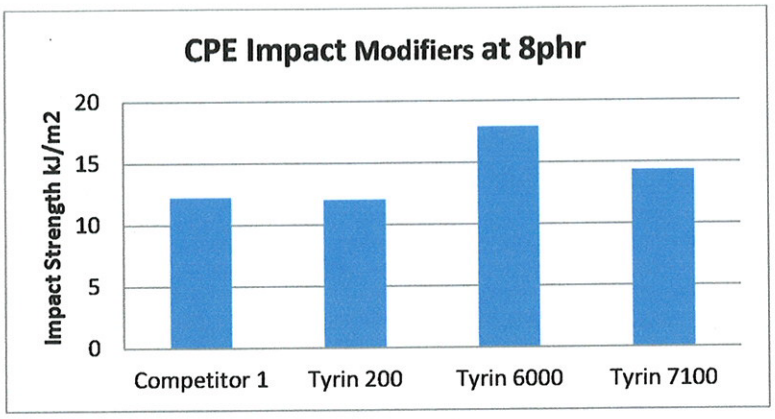
1. Double V Notch Charpy. With a 0.25mm radius V Notch
2. Single V Notch Charpy. With a 0.1mm radius V Notch

DOUBLE V NOTCH CHARPY IMPACT STRENGTH at 23°C
Ca/Zn Window Profile Formulation K67 SPVC



The double V notch impact test tends to promote a ductile mode of failure. In the test, when used at 8phr, Tyrin™ 200 has equivalent performance compared to other general purpose Tyrin™ grades and a slightly better performance when compared to a competitive CPE modifier. The usual pass level for this test is 60kJ/m2 and you can see that all of the modifiers easily pass this level.

SINGLE V NOTCH CHARPY IMPACT STRENGTH at 23°C
Ca/Zn Window Profile Formulation K67 SPVC

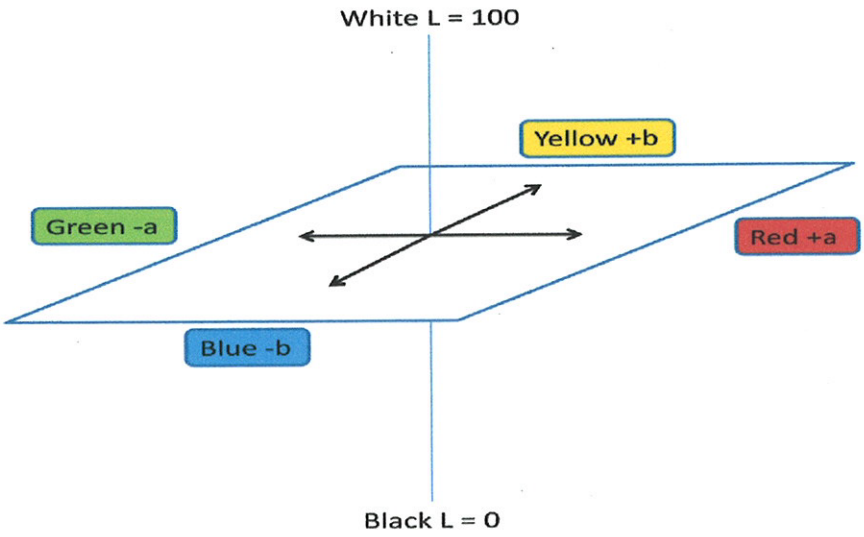


The single V notch Charpy test was developed in the UK and adopted as BS 7413. Because of the very tight radius (0.1mm) of the notch this test is very stringent and the usual mode of failure is a brittle break. In this test Tyrin™200 shows good performance when compared to a competitive CPE and slightly inferior performance when compared to the standard Tyrin™ grades. The pass level for this test is 12kJ/m2.

GLOSS AND COLOUR

In Window Profile applications the aesthetic properties of the finished profile are as important as the physical properties. The aesthetic properties are of course the properties that profile customers can see and quality and consistency in this respect is very important.

Colour is expressed using Lab colour coordinates as described below.



These measurements were carried out on profiles extruded on a KMDL-25 laboratory twin screw extruder. In these measurements show that Tyrin 200 performs very well displaying the highest level of gloss

Modifier	Gloss 60%	L Value	a Value	b Value
Competitor	31.0	93.49	-0.99	2.74
Tyrin™ 200	32.7	94.02	-0.92	2.39
Tyrin™ 6000	24.9	94.11	-0.83	2.30
Tyrin™ 7100	30.3	94.16	-0.86	2.54

OTHER PRODUCT PROPERTIES

Tyrin™200 has similar powder properties compared to other Tyrin™ products. Ash content is a measure of the inorganic material included in the CPE. In this test the Tyrin™ products have a lower inorganic content that a competitive product.

		Competitor	Tyrin™200	Tyrin™ 6000	Tyrin™7100
Flow Time	Seconds	8.57	9.71	8.48	8.49
Powder Density	g/cc	0.612	0.527	0.511	0.405
Compaction	%	0	0	0	0
Ash Content	%	2.86	0.21	0.81	0.74

Tyrin™ 200 is slightly higher melt viscosity and Mooney viscosity compared to Tyrin™ 6000

TYPICAL PROPERTIES

		Tyrin™ 200	Tyrin™6000
PSD D10		148	200
PSD D50		240	280
PSD D90		338	380
Heat of fusion	J/g	1.8	1.5
Melt viscosity	Poise	42380	27000
Mooney	MU	106	90
Thermal Stability	Minutes	229	70

Notes
These are typical properties only are not to be constructed as specifications. Users should confirm the result by their own tests.

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