New Poly(vinyl chloride) - Based Blends: Aspects of Processability (Part I)

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ABSTRACT

The concurrent influence of the nature and ratio of some impact modifiers, of the ratio of processing aid and of the carbon black on the main parameters characterizing the Brabender plastogram of some new rigid poly (vinyl chloride) - based compounds is studied.

Key Words

poly (vinyl chloride) compounds, impact modifier, processing aid, carbon black, processability

INTRODUCTION

The special properties of plastics have permitted their application in building industries, as substituents for traditional materials like wood, glass, concrete and metals. In this respect, special importance is paid to the utilization of plastics as profiles, various woodworks (doors, windows, window blinds, roller blinds, panelling, handrails, etc.) and drain pipes, many of them with outward application [1-3].

The main advantages brought about by the utilization of plastics for such ends are: lower cost, simpler maintenance, elimination of additional dyeing operations, noise attenuation and resistance to UV radiations [3].

Out of the numerous plastics employed as profiles in building industries, special mention is to be made of poly (vinylchloride) - PVC, which confers particular mechanical characteristics (such as high tensile strength, impact resistance, high modulus of elasticity), as well as high Vicat melting point and suitable behaviour to the action of atmospheric agents [4], for profiles with external utilization made of this polymer.

Starting from such considerations, the present paper discusses some new blend receipts for the obtainement of PVC profiles for outward utilization, on stressing the influence exercized by the nature and ratio of some PVC impact modifiers (such as chlorinated polyethylene-CPE 3615 and Kane Ace B 56 A as an acrylic impact modifier), of the processing aid (Paraloid K 120 N) and of the carbon black upon the processability aspects of the blends thus obtained.

Determination of the processing characteristics of the PVC-based blends may be made on various types of equipment, including the Brabender plastographs [5-9] and extrusiometers [9-15].

The former ones plot curvilinear diagrams (i.e., plastograms) indicate the evolution, in time, of the rotation moment.

Interpretation of the results given by such diagrams involves calculation of the average torque recorded, that may be transposed in rectangular coordinates, inducing possible modification of the scales'moduli.

EXPERIMENTAL

The influence of the nature and ratio of some additives on the processability of unplasticized PVC-based blends has been determined by means of the following materials: PVC S67 D (STAS 6641-79), tribasic lead sulphate (STAS 7494-80), dibasic lead stearate (STAS 7644-80), lead sulphate (STAS 7768-78), dibasic lead phosphite, calcium stearate, stearine (STAS 2618-70), epoxidized soyabean oil (STAS 12335-85), low molecular weight polyethylene, carbon black (STAS 101-51), CPE 3615 (Dow Chemical, USA - Table 1), Kane Ace B 56 A (Mitsui Kaneka, Japan - Table 2) and Paraloid K 102 N (Rohm and Hass, Holland - Table 3).

The composition of the mixtures under study were based on an improved formula utilized in the fabrication of PVC rigid profiles (in gravimetric parts - p), namely: PVC + x_1 (impact modifier) - 100; carbon black - x_2; Paraloid K 120 N - x_3; tribasic lead sulphate - 3.0; dibasic lead stearate - 1.0; lead soap - 1.0; dibasic lead phosphite - 1.0; calcium stearate - 4.0; stearine - 3.0; epoxidized soya bean oil - 1.5; low molecular weight polyethylene - 0.4; in which the impact modifiers' ratio varied between 6 - 11 p, the carbon black ratio between 1-5 p, while that of the processing aid was between 0.3 - 1.2p. Programming of the experiments was made with rotatable, centered, second order program.

Charges of 12 kg have been employed, dosing of compounds being made manually. The mixing of components was performed in a rapid mixer (Hanschel, Germany, volume of the hot vat = 100L), on taking the parameters and technologies specific to blends containing impact modifiers and/or processing aids [17,18].

For the estimation of the blends processability, plastograms were employed taken on a PIS-type Brabender plastograph with a W 30 H vat, recorded under the following conditions: volume of the mixing vat, 30 cm^3; amount of blend introduced into the vat, 34 g; temperature of the vat, 160 ± 1 °C; rotor rate, 60 rot/min; recording domain, 0-100 N.m.

The plastograms thus obtained (**Figure 1**) permitted the determination of: the torque from start of fusion (A), M_A; minimum torque (B), M_1; maximum torque (C), M_2; regime torque, M_3 and time to attain maximum torque (fusion time), t_1.

RESULTS AND DISCUSSION

Results of the analysis of the recorded Brabender

Table 1. Chlorinated polyethylene characteristics

Characteristic	Test Method	Unit	CPE 3615*
Chlorine content	CPE D-6a[1]	%	36
Melt viscosity	CPE D-3a	Poise/1000	26.5
Heat of fusion	CPE D-14a	cal/g	0.2
Residual crystallinity	CPE D-14a	%	2
100% Modulus	CPE D-1/ASTM D-412	MN/m^2	1.1
Tensile strength	CPE D-1/ASTM D-412	MN/m^2	10.5
Elongation at break	ASTM D-412	%	800
Bulk density	CPE B-2	g/cm^3	0.43
Specific gravity	CPE D-7/ASTM D-792	g/cm^3	1.16
Low temperature brittleness	ASTM D-746	°C	-68
Volatiles	CPE 13-4	%	0.2
Typical screen analysis retained on 20 Mesh	CPE B-la/ASTM D-1921	%	0
Hardness-Shore A (10B)	CPE D-2a/ASTM D-1706	-	55
Izod impact, notched	ASTM D-256	J/m	1035

* CPE 3615-obtained by chlorination of low pressure polyethylene 1-Dow test method

Table 2. Acrylic impact modifier characteristics

Characteristic	Test Method	Unit	Kane Ace B 56 A*
Aspct	-	-	White powder
Bulk density	*	g/cm^3	0.30±0.05
Specific gravity	ASTM D-792	g/cm^3	1±0.03
Typical screen analysis retained on 16 mesh	ASTM D-1921	%	0
Volatiles (105 °C, lh)	*	%	1.5
Izod impact.notched	ASTM D-256	kg.cm/cm	
-20 °C			14.1
-0 °C			21.7
-23 °C			30.4
Tensile strength	ASTM D-638	daN/cm^2	53.8
Charpy impact, notched	ASTM D-256	$kg.cm/cm^2$	15.4

* Mitsui Kareka test methods

Table 3. Processing aid characteristics

Characteristic	Test Method	Unit	Paraloid K 120 N
Aspect	-		White powder
Bulk density	*		0.30
Viscosity (solution 10% in toluene)	*	Poise/1000	600
Temperature brittleness	ASTM D-746	°C	91
Specific gravity (25 °C)	ASTM D-792	g/cm³	1.18
Refraction index (25 °C)	*	-	1.49
Molecular weight	-	-	10^6
Volatiles	-	%	0.5
Solubility	*	-	In: methyl ethyl ketone, cyclo - hexanone, toluene, dichloroethane

* Rohm and Hass test methods

plastograms are listed in Table 4.

They have been processed by the regression method, by means of suitable programs, on an IBM compatible PC computer with regression equations of the form:

$$y = a_o + \sum a_i x_i + \sum a_{ij} x_i x_j + \sum a_{ii} x_i^2 \text{ , } i < j$$

where: y = the studied characteristics;
a_i, a_j = regression coefficients;
x_i, x_j = independent variables,
being thus obtained.

The values of regression coefficients, as well as the other characteristics involved in their calculation are given in Tables 5 and 6.

The computer has been programmed, too, for plotting the resoponse surfaces in x_1 - x_3 coordinates, for three levels of x_2 (surface 1, x = 0.0 p; surface 2, x = 2.5 p and surface 3, x = 5.0 p) which were kept constant.

This method of processing results was preferred as the influence of the carbon black additions (photostabilizer, filler and/or reinforcing material) on the processing of PVC compounds is less known; also, this component is less subjected to significant physical transformations during processing [18].

In spite of its significance in feeding the forming machines such as extruders or injection machines that assure processing of PVC compound as dry blend, the torque form start of fusion (M_A) is less important for the phenomena occurring subsequently in these equipment.

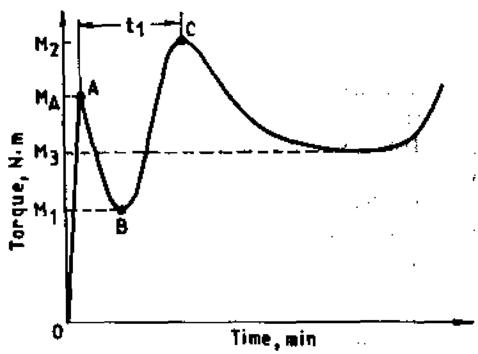

Fig.1. Shape of the Brabender plastogram and their characteristic parameters

Table 4. Experimental results

Sample number	PVC	x_1 CPE 3615	x_1 Kane Ace B 56 A	x_2	x_3	M_A, N.m	M_1, N.m	M_2, N.m	M_3, N.m	t_1, min.
0	1	2	3	4	5	6	7	8	9	10
1	92.38	7.62	-	1.01	0.48	37.40	16.75	27.25	26.50	6.20
2	87.62	12.38	-	1.01	0.48	38.10	17.75	26.00	25.50	7.60
3	92.38	7.62	-	3.99	0.48	36.45	17.40	27.45	26.65	5.55
4	87.62	12.38	-	3.99	0.42	40.15	24.00	28.25	26.60	1.25
5	92.38	7.62	-	1.01	1.02	30.45	18.00	28.95	27.75	7.00
6	87.62	12.38	-	1.01	1.02	35.90	21.60	27.75	26.10	3.90
7	92.38	7.62	-	3.99	1.02	38.00	18.60	28.45	27.60	4.50
8	87.62	12.38	-	3.99	1.02	36.40	20.35	27.75	26.25	3.95
9	94.00	6.00	-	2.50	0.75	32.60	14.60	28.80	28.10	14.45
10	86.00	14.00	-	2.50	0.75	34.25	17.50	25.60	24.60	5.65
11	90.00	10.00	-	-	0.75	29.25	18.80	28.25	27.34	8.35
12	90.00	10.00	-	5.00	0.75	40.60	21.75	27.10	26.90	4.70
13	90.00	10.00	-	2.50	0.30	43.65	19.25	29.80	26.40	7.55
14	90.00	10.00	-	2.50	1.20	45.45	20.45	25.80	28.20	6.45
15	90.00	10.00	-	2.50	0.75	32.00	15.00	25.25	24.90	6.05
16	90.00	10.00	-	2.50	0.75	32.00	15.00	27.40	24.60	6.08
17	90.00	10.00	-	2.50	0.75	39.20	18.70	28.25	26.60	5.65
18	90.00	10.00	-	2.50	0.75	40.45	19.20	29.20	26.55	4.40
19	90.00	10.00	-	2.50	0.75	37.15	20.10	27.45	26.25	4.65
20	90.00	10.00	-	2.50	0.75	33.70	23.40	26.40	25.30	6.00
21	92.38	-	7.62	1.01	0.48	25.70	15.00	30.40	28.05	4.45
22	87.62	-	12.38	1.01	0.48	40.25	25.70	32.70	28.40	1.35
23	92.38	-	7.62	3.99	0.48	25.60	14.40	31.20	28.10	6.50
24	87.62	-	12.38	3.99	0.48	26.20	16.65	32.45	28.40	3.75
25	92.38	-	7.62	1.01	1.02	28.40	16.60	34.60	28.75	2.90
26	87.62	-	12.38	1.01	1.02	27.45	17.45	32.55	28.00	2.75
27	92.38	-	7.62	3.99	1.02	32.70	21.30	36.70	28.30	2.00
28	87.62	-	12.38	3.99	1.02	28.20	21.00	36.70	29.65	1.70
29	94.00	-	6.00	2.50	0.75	25.80	15.40	32.85	27.90	3.30
30	86.00	-	14.00	2.50	0.75	28.50	22.55	35.80	28.50	1.40
31	90.00	-	10.00	0.00	0.75	33.70	15.40	30.40	27.35	4.10
32	90.00	-	10.00	5.00	0.75	29.50	18.55	36.00	29.10	2.10
33	90.00	-	10.00	2.50	0.30	24.30	14.45	29.90	26.40	4.85
34	90.00	-	10.00	2.50	1.20	29.60	17.00	34.00	28.45	2.70
35	90.00	-	10.00	2.50	0.75	39.50	19.60	35.40	28.40	2.85
36	90.00	-	10.00	2.50	0.75	34.70	17.20	33.60	28.60	2.80
37	90.00	-	10.00	2.50	0.75	27.55	17.00	32.80	27.75	2.55
38	90.00	-	10.00	2.50	0.75	32.20	18.45	32.80	28.40	2.05
39	90.00	-	10.00	2.50	0.75	34.00	17.80	34.20	28.40	2.25
40		-	10.00	2.50	0.75	33.20	17.90	33.40	28.40	2.65

If an attemp is made, to determine the variation of this characteristic as a function of the independent variables considered in the study, the response surfaces - plotted graphically in Figure 2 - have to be analyzed.

The observation to be made is that, for compounds containing chlorinated polyethylene (CPE), without carbon black as an impact modifier (Figure 2a), M_A first decreases with increasing the content of the processing aid in the system, followed by a slight increase. The position of the observed minimum corresponds to a content of about 1.0p processing aid for blends containing higher ratios of impact modifier from compounds. From such blends, M_A passes through a large maximum, concurrently increasing within the studied limits of the ratio of impact modifier in the system. The position of this maximum corresponds to a content of about 7.5p, remaining unchanged from all Paraloid ratios from the compounds.

Introduction, followed by an increase of the carbon black ratio in the compounds, does not modify significantly the aspect of the response surfaces. Nevertheless, increasing the carbon black ratio in the blends increases M_A, which is more pronounced for smaller contents of impact modifier. Increasing of the processing aid ratio also causes an increase of M_A, in parallel with increasing the carbon black ratio in the blends.

In the case of compounds containing acrylic impact modifier (AIM) without carbon black (Figure 2b), the response surface shows a considerable decrease of M_A with an increase of the processing aid ratio in the system. Within the studied limits of this impact modifier content, the characteristic considered passes through a maximum, whose position corresponds to a ratio of about 7.5p, in the case of higher contents of processing aid, being subsequently shifted towards 9.5p for blends containing lower Paraloid ratios.

Introduction of 2.5p and 5.0p, respectively, of carbon black in these compounds modifies considerably the M_A mode of variation. The first observation to be made is that, at higher ratios of

Table 5. Regression coefficients and regression analysis for CPE - containing blends

Coefficient number	Coefficient expression	Properties				
		M_A, N.m	M_1, N.m	M_2, N.m	M_3, N.m	t_1, min
1	free term	35.788	19.046	27.319	25.712	5.6921
2	x_1	0.8077	1.306	-0.5662	-0.7277	-1.5635
3	x_2	2.068	0.8212	0.001319	0.3374	-1.1419
4	x_3	-0.6101	0.3419	-0.203	0.4011	-0.227
5	x_1^2	-1.066	-0.9411	-0.01078	0.1483	0.9428
6	x_1x_2	-0.5062	0.4687	0.3187	0.1562	-0.3937
7	x_1x_3	-0.06875	-0.2812	-0.1812	-0.2437	-0.09375
8	x_2^2	-0.5348	0.5557	0.1575	0.4265	-0.3061
9	x_2x_3	0.8687	-0.9437	-0.3687	-0.1562	0.5687
10	x_3^2	2.875	0.4051	0.2018	0.4849	-0.1378
Minimum error, %		0.04	0.41	0.06	0.02	0.14
Maximum error, %		11.83	27.86	8.19	4.52	127.5
Correlation coefficients		0.817	0.632	0.517	0.855	0.759
F regression		2.244	0.739	0.405	3.038	1.516
Standard deviation of estimation		3.39	3.13	1.47	0.76	2.287

Table 6. Regression coefficients and regression analysis for A M - containing blends

Coefficient number	Coefficient expression	Properties				
		M_A, N.m	M_1, N.m	M_2, N.m	M_3, N.m	t_1, min
1	free term	35.152	18.296	33.025	28.373	2.5228
2	x_1	1.043	1.869	0.4731	0.1654	-0.6956
3	x_2	-1.184	0.2852	1.187	0.307	-0.06302
4	x_3	0.5792	0.651	1.516	0.3806	-0.7557
5	x_1^2	-2.603	0.5119	0.5098	0.04517	-0.04815
6	x_1x_2	-2.187	-1.200	0.125	0.2562	0.025
7	x_1x_3	-2.575	-1.55	-0.700	-0.00625	0.675
8	x_2^2	-1.026	-0.1967	0.1112	0.05403	0.2175
9	x_2x_3	2.400	2.237	0.7125	0.1437	-0.800
10	x_3^2	-2.673	-0.6395	-0.3316	-0.2294	0.4567
Minimum error, %		0.320	0.840	0.080	0.100	1.070
Maximum error, %		29.00	12.09	16.28	2.77	44.33
Correlation coefficients		0.736	0.919	0.81	0.794	0.939
F regression		1.317	6.038	2.125	1.898	8.364
Standard deviation for estimation		5.52	1.58	1.88	0.552	0.596

processing aid and low contents of impact modifier, introduction of carbon black in compounds induces a considerable increase of the M_A values. For blends containing high ratios of AIM and low ratios of Paraloid, the value of this characteristic decreases with the introduction and then increase

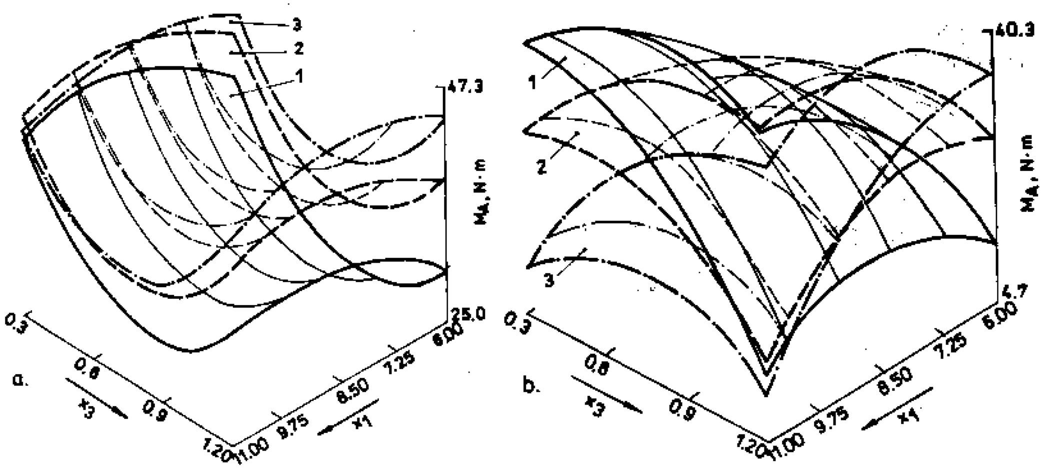

Fig.2. Aspect of the response surfaces within the experimental domain x_1-x_3, for the torque from start of fusion (M_A)

of the content carbon black in the compounds.

In the case of compounds containing carbon black, mention has to be made of the fact that, at higher ratios of processing aid, M_A decreases continuously with the increasing ratio of impact modifier in the system. For the same compounds, yet with lower ratios of Paraloid, this characteristic passes through a maximum whose position corresponds to approximately 9.0p.

Within the domain of the processing aid content under study, M_A decreases continuously with increasing the ratio of processing aid, in the case of blends having high ratio of Kane Ace, passing through a maximum whose position corresponds to about 0.7p Paraloid in compounds with low content of AIM.

Point B on the plastograms (Figure 1) denotes the maximum torque (M_1) recorded during plasticization of compounds, while Figure 3 shows the influence of the nature and ratio of various additives from the blends compositions on the value of M_1.

Analysis of the response surfaces presented in the figure indicates that for blends containing CPE (Figure 3a) but no carbon black, increase of the processing aid ratio induces a slight increase of M_1. At low ratios of Paraloid, this increase is negligible, nevertheless, it becomes more pronounced with the increase of the processing aid content in the compounds. For the same blends, variation of the minimum torque, as depending on the impact modifier ratio, evidences a maximum whose position corresponds to a content of about 8.0p, remaining unchanged for all Paraloid contents in compounds.

Introduction and subsequent increase of the carbon black ratios in such compounds modify the aspect of the response surfaces analyzed. The first observation to be made is that, in the case of compounds with low ratios of processing aid, the value of M_1 increases significantly at the introduction and then increase of the carbon black ratio, for high contents of Paraloid, the introduction of carbon black inducing decreases of this characteristic.

Variation of the minimum torque value, depending on the CPE content, for carbon black-containing blends, is the same as that for compounds which do not contain it in their composition; nevertheless, the position and value of the maximum depend on the ratio of the other additions in the blends.

The response surfaces obtained for the AIM-containing blends differ from those recorded with CPE-containing ones (Figure 3b). For such compounds, in the case of blends without carbon black, M_1 is observed as decreasing with increase of the processing aid content in the system. The

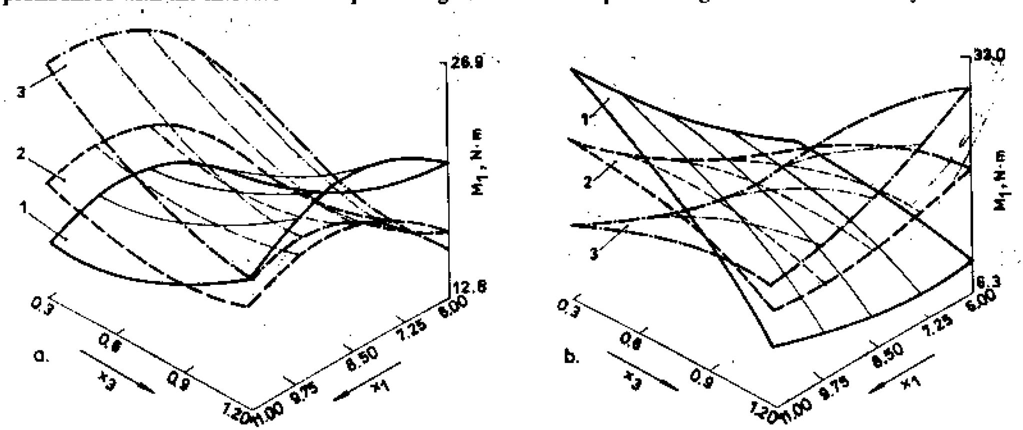

Fig.3. Aspect of the response surfaces within the experimental domain x_1-x_3, for the minimum torque (M_1)

decrease is considerable for compounds with high Kane Ace ratios, and less important for those with lower AIM contents. In this situation, too, variation of M_1 is modified when introducing carbon black into the blends. At lower contents of impact modifier and high Paraloid ratios, the introduction and subsequent increase of the carbon black ratio induces an increase of the minimum torque value, while, in the case of mixtures with low contents of processing aid but high Kane Ace ratios, the presence of carbon black causes a decrease of M_1. Another observation is that, at a content of 5.0 p carbon black and high ratios of Kane Ace, M_1 varies slightly with the content of Paraloid in the blends. For such compounds, yet at lower ratios of impact modifier, increase of the Paraloid ratio in compounds assures a more pronounced increase of M_1.

The peak indicating the maximum torque (M_2) corresponds to the ending of the blends plasticization. The way in which this characteristic is influenced by the nature and ratio of the compounds components may be established on following the response surfaces plotted in Figure 4.

The aspect of these surface shows that, for blends containing CPE but no carbon black, M_2 varies slightly with the processing aid ratio, decreasing considerably with increase of the impact modifier content in compounds (Figure 4a).

Introduction of carbon black in blends does not modify the variation of M_2 with the content of CPE in compounds, but induces a considerable decrease of the maximum torque with increasing the Paraloid ratio in blends. Thus, the situation is reached when, for blends with low contents of processing aid, the introduction and then increase of the carbon black content induces an increase of M_2 while for compounds with high contents of Paraloid, the opposite situation is observed, i.e. the blends containing carbon black are characterized by M_2 values lower than those corresponding to compounds that do not contain it.

For Kane Ace - containing blends (Figure 4b), regardless of the ratio of the other additions from the system, increase of the impact modifier ratio in compounds has no influence on the maximum torque. For such blends, in the absence of carbon black, M_2 increases with increasing the Paraloid ratio in compounds.

In the case of mixtures containing 2.5 p carbon black, M_2 passes through a minimum value (corresponding to a about 0.6 p Paraloid), in parallel with increasing the content of processing aid in compounds, while, for compounds with 5.0 p carbon black, this characteristic decreases continuously with increasing the content of Paraloid.

The regime torque (M_3) offers information on the processing behaviour of wholly plasticized compounds. The influence of the nature and ratio of components from the blends upon the variation of this characteristic may be deduced on following the aspects of the response surfaces plotted in Figure 5.

For blends containing CPE but not carbon black (Figure 5a) M_3 decreases with increasing the impact modifier ratio. This behaviour is not influenced by the nature and ratio of the other components from the blends. For the same blends, variation of M_3 with the content of Paraloid indicates the presence of minimum, whose position corresponds to a ratio of about 0.75 p processing aid.

The presence of carbon black in these blends does not modify the shape of the response surfaces, yet, introduction and subsequent increase of its ratio induces an increase of the regime torque, indicative of an increase in the viscosity of the melt in the device's vat.

For blends having utilized Kane Ace as impact modifier (Figure 5b) in the absence of carbon black, M_3 decreases slightly with increasing the AIM ratio, passing through a slight maximum, depending on the content of Paraloid.

Introduction of 2.5 p carbon black in these compounds cancels the influence of the impact modifier ratio while the dependence of M_3 on the content of Paraloid remains unchanged.

At a content of 5.0 p carbon black in compounds, the regime torque increases with increasing the Kane Ace ratio and its variation as a function of the Paraloid content becomes negligible.

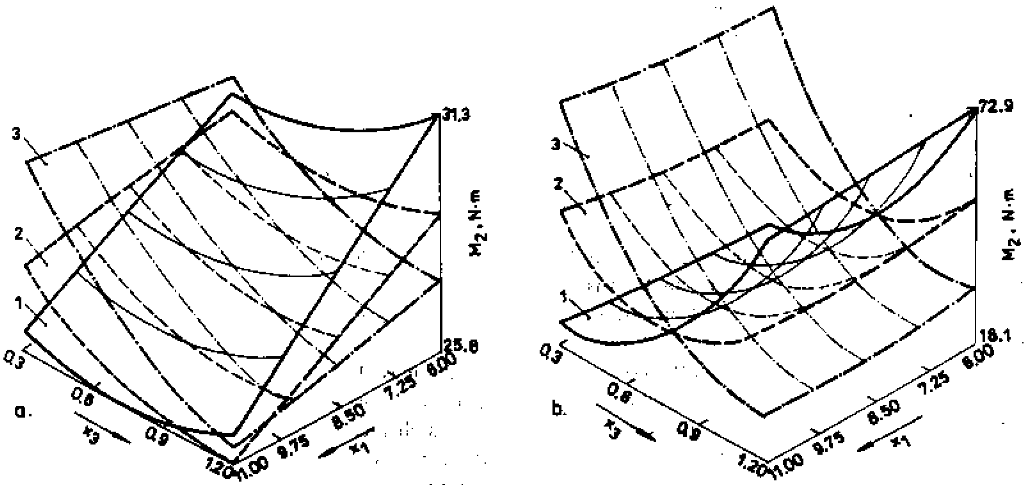

Fig.4. Aspect of the response surfaces within the experimental domain x_1-x_3, for the maximum torque (M_2)

Fusion time (t_1) is closly correlated with the composition of the blend subjected to testing, which is evidenced by the response surfaces presented in Figure 6.

Their analysis indicates that, for blends with CPE but without carbon black, the fusion time increases insignificantly with an increase of the processing aid ratio, and decreases considerably on increasing the content of impact modifier in these compounds (Figure 6a).

Introduction of carbon black in these compounds does not affect the variation of t_1 with the content of impact modifier, instead, addition of carbon black induces a decrease of the

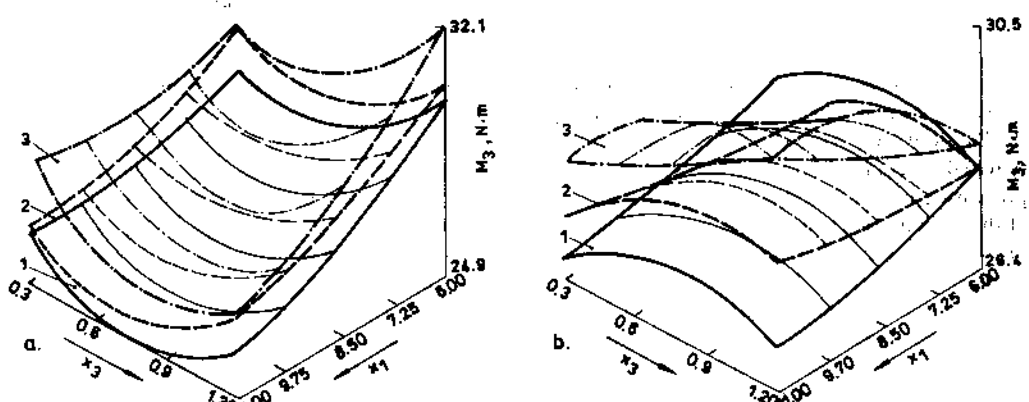

Fig.5. Aspect of the response surfaces within the experimental domain x_1-x_3, for the regime torque (M_3)

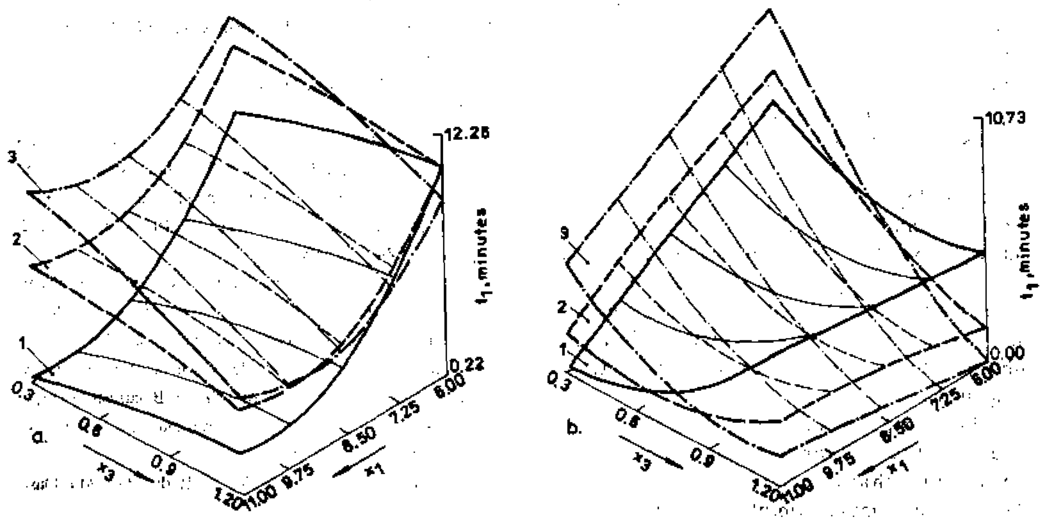

Fig.6. Aspect of the response surfaces within the experimental domain x_1-x_3; for the fusion time (t_1)

characteristic considered with increasing the Paraloid ratio in the blends. For such blends, at higher CPE contents and low ratios of processing aid, the fusion time of compounds containing carbon black is much higher than that corresponding to blends not having such addition in their composition. The influence of carbon black addition is much lower for compounds with higher ratios of Paraloid.

In the case of blends containing AIM but no carbon black, fusion time depends, only to a slight extent, on the Kane Ace ratio, yet it increases with increasing the content of processing aid in compounds. The introduction of 2.5 p carbon black in these blends causes a slight increase of the fusion time depending on the content of the impact modifier, the dependence of this characteristic on the Paraloid ratio remaining, nevertheless, unchanged. Increasing to 5.0 p the carbon black ratio decreases considerably the fusion time, concurrently with increasing the content of impact modifier in the system. Such influences create the situation in which the intrduction and subsequent increase of carbon black in compounds induces increases of the fusion time with blends containing low ratio of processing aid, as well as decreases in compounds with high content of Paraloid. The higher the carbon black ratio in compounds, the more important both the increase and the decrease of the fusion time become.

CONCLUSIONS

Determination of the concurrent influence of the nature and ratio of the impact modifier, of the processing aid ratio and of the carbon black on the main parameters characterizing Brabender plastograms has proved to be quite a difficult task. Nevertheless, some conclusive aspects have to be mentioned.

Although playing an almost equal influence on the physicomechanical characteristics of blends, the nature of the impact modifiers influences, in a different way, the processability of the compounds in which they are introduced.

In the case of blends containing chlorinated polyethylenes, M_A and M_1 excepted, passing through a maximum corresponding to about 7.5 - 8.0 p, the value of the other characteristics under study (M_2, M_3, t_1) decreases continuously with increasing the impact modifier content in compounds. For blends containing this impact modifier, the influence of the processing aid introduced in the rigid PVC compounds, for increasing their adhesion to the surface of the active organs of the processing devices [9], is different, depending on both the characteristic considered and on the carbon black ratio in the system. With only a few exceptions (M_1 and M_2 at higher processing aid ratios), in the case of CPE - containing blends, the values of the characteristics analysis increase with the introduction and subsequent increase of the carbon black ratio in compounds.

For compounds containing acrylic impact modifier, the influence it exercises on the parameters characterizing the Brabender plastograms is much complex, depending to a greater extent on the ratio of the other additions for the system (such as processing aid and carbon black).

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