Viser Technology Pte. Ltd.
Research and Application of Materials Science
https://doi.org/10.33142/msra.v1i1.669

Research Article Open Access

Influence of Processing Technology on Mooney Viscosity and Burning Time of Mixed Rubber

Qi Liu[1], **Hui Li**[1,2]

[1] Shenzhou Tires in Ningxia,PingLuo,753400,China;
[2] China University of Mining and Technology, Beijing 100039,China

Abstract:
The influence of mixed rubber processing technology on Mooney viscosity and burning time was studied. The results showed that the Mooney viscosity of mixed rubber increased with the extension of the parking time, and the burning time did not change significantly. With the increase of the number of thin pass, the Mooney viscosity of mixed rubber decreases continuously, and the burning time varies with different thin pass temperature..

Keywords: *mixed rubber; Processing technology; Mooney viscosity; Burning time; BoTong*

Citation: Q. Liu, H. Li, Influence of Processing Technology on Mooney Viscosity and Burning Time of Mixed Rubber. *Res Appl Mat Sci*, 2019,1(1): 24-27. https://doi.org/10.33142/msra.v1i1.669

Mooney viscosity, also known as rotational viscosity, is the value measured by Mooney viscometer. Mooney viscosity reflects the quality of rubber processing and molecular weight level and wide distribution range. Low Mooney viscosity rubber easy to adhere to the roll, its molecular weight is low and narrow distribution range. Scorch time is a physical quantity to measure the rate of early vulcanization of rubber. Burning time is too short, in the process of operation will cause the early vulcanization of rubber, affecting rubber mixing, rolling, pressing and other processes; Burning time too long, will lead to rubber vulcanization cycle too long and reduce the production efficiency.

After determining the rubber formula, the main factors affecting the rubber Mooney viscosity and burning time are the rubber processing process. Extending the parking time and increasing The Times of thin pass will affect the Mooney viscosity and burning time of mixed rubber [1]-[3].

1 Experiment

1.1 Main raw materials

Natural rubber: brand SMR20, Malaysia; Brominated butyl rubber: brand BIIR, waf international trade (Shanghai) co., Ltd. Carbon Black: brand Numbers (N234, N326, N375, N660), c Black Cat Carbon Black Co., Ltd. Butadiene rubber: brand BR9000, China petroleum northwest chemical sales branch; White carbon black: brand 175GR, palm Chemical Co.,Ltd; Silane coupling agent: brand tyc-si69, jingdezhen hongbai chemical technology co., Ltd. Zinc oxide: brand name: 99.7%, yangzhou zhenzhong zinc industry co., Ltd. Promoter: brand (NS, DZ, DM), shandong shangshun chemical co., Ltd.

1.2 Basic formula

In this experiment, four basic formulas of tires were selected for research (as shown in table 1).

Table 1 Basic formula of tires/phr

The raw materials	1#	2#	3#	4#
SMR20	100.00	45.00	100.00	20.00
BR9000	/	55.00	/	/
BIIR	/	/	/	80.00
N234	45.00	/	/	/
N326	/	/	56.00	/
N375	/	31.00	/	/
N660	/	22.00	/	69.00
oil	/	5.00	/	8.00
Silica White	15.00	/	/	/
TYC-Si69	3.00	/	/	/
ZnO	3.50	4.00	8.00	/
SA	2.50	2.00	/	2.00
4020	2.00	/	2.00	/
wax	1.00	2.00	/	/
S	1.30	1.40	/	0.80

The raw materials	1#	2#	3#	4#
HD-OT20	/	/	4.50	/
RA-65	/	/	5.00	/
NS	1.50	0.80	/	/
DZ	/	/	1.20	/
DM	/	/	/	1.30
Other	2.50	5.50	2.50	8.80

Note: the basic formula is 100 copies of raw rubber as the benchmark, other raw materials according to the corresponding number of copies.

1.3 Main equipment and instruments

Kobe steel: BB430 mixer; Yiyang rubber & plastic machinery co., Ltd. : GN255 mixer, xk-660 mixer; Qingdao xianrui electromechanical co., Ltd. : xk-160 type smelting machine; Alpha corporation: Mooney viscometer MV2000.

1.4 Sample preparation

The mixing rubber was prepared by conventional mixing process. After 4 hours of parking, 1.5 kg of tread rubber, tire side rubber, tire rubber and dense layer rubber were respectively cut, and roller was used on the XK-160 type furnace.(Roller temperature: 60 ± 5 °C, Roller distance: 2.0 mm) 5 times out of the piece, parked 4 hours after the test.

Through the design of three schemes for mixing rubber Menny viscosity, burning time test study.

Option one: Sampling tests after the specified time for laboratory parking(as shown in Figure 1).

Option 2: After the roller temperature is 45 ± 5 °C and the roller distance is 0.5 mm, the machine is parked for 8 hours(as shown in Figure 2).

Option 3: After the roller temperature is 90 ± 5 °C and the roller distance is 0.5 mm, the machine is parked for 8 hours(as shown in Figure 2).

Laboratory temperature 23±3℃, humidity 40 ~ 60%.

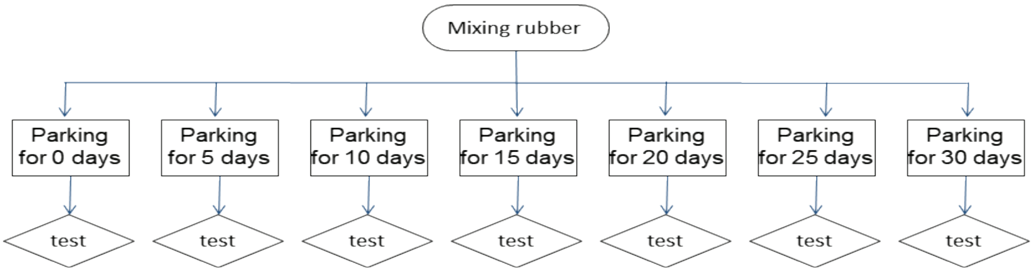

Figure 1 Effect of parking time on mixing rubber test

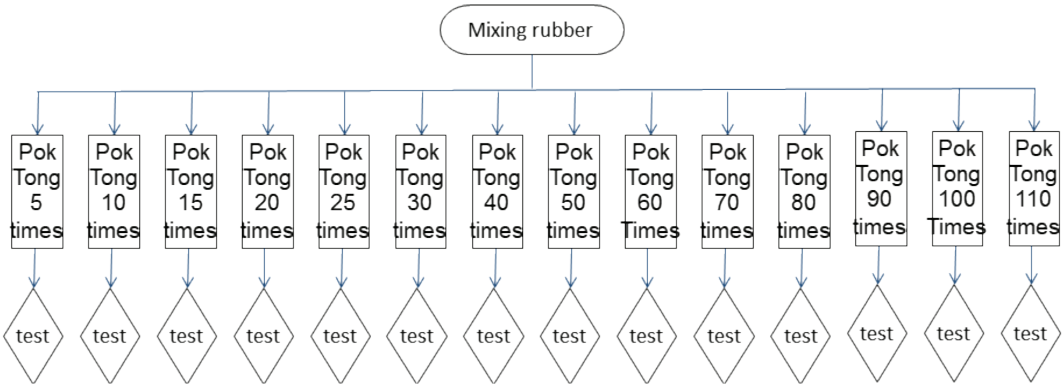

Figure 2 Effect of thin-pass times on mixing rubber

1.5 The performance test

All properties of rubber are tested in accordance with the corresponding national or enterprise standards.

1.5.1 The effect of parking time on rubber properties

Menny viscosity(shown in Table 2) and scorch time(shown in Table 3) of mixed rubber were sampled at intervals of 5 days.

Table 2 Rubber Mooney viscosity test at different parking times

Project	Parking time /d							
	0	5	10	15	20	25	30	R
1#	75	77	77	78	79	79	83	8
2#	62	62	62	62	63	63	64	2
3#	80	82	82	82	83	83	84	4
4#	69	69	70	70	71	71	71	1

Note: the test equipment is American alfarmeni viscometer, ML100℃ (1+4) min (Use a large rotor at 100 °C to Preheat the Menny viscometer cavity for 1 minute and rotate the corresponding Menini viscosity for 4 minutes.); R is for range (the same below).

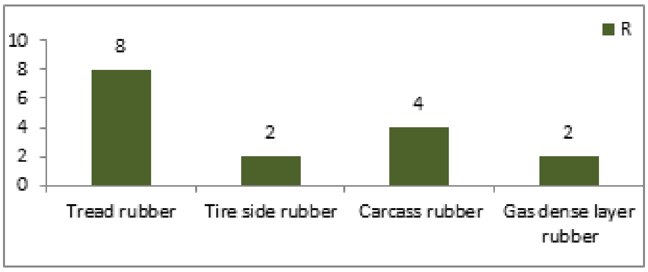

Figure 3 Menny viscosity is range after mixed rubber is parked(R)

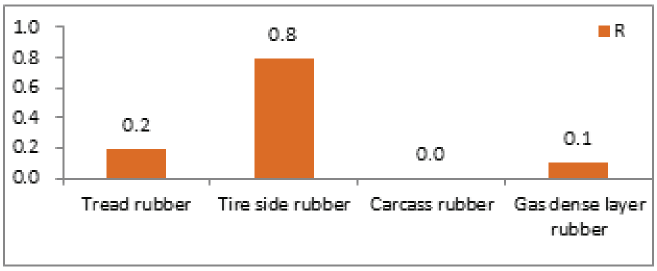

Figure 4 Scorch time is range after mixed rubber is parked(R)

Table 3 Rubber burning time test with different parking time/min

Project	Parking time /d							
	0	5	10	15	20	25	30	R
1#	14	14.1	14	14.1	14.2	14.3	14.2	0.2
2#	19.7	20.1	19.1	18.8	18.5	18.3	18.9	0.8
3#	12.4	12.8	12.2	12.4	12.6	12.7	12.4	0
4#	5.9	5.8	5.7	5.8	5.8	5.9	6	0.1

Note: test equipment, same as above, T5 (Using a large rotor at 130 °C to Preheat the Menni viscometer cavity for 1 minute after the rotor rotates the Menni viscosity value to increase by 5 values.).

Table 4 Rubber Mooney viscosity test at 45±5℃

Project	BoTong number/Number													
	5	10	15	20	25	30	40	50	60	70	80	90	100	110	R
1#	60	59	58	57	57	56	52	56	55	53	52	51	50	49	11
2#	56	56	55	54	54	53	52	54	53	52	51	51	50	49	7
3#	69	66	65	63	62	60	58	53	51	50	48	47	45	43	26
4#	63	62	62	61	61	60	59	62	60	59	59	57	57	55	8

Note: test equipment and test conditions are the same as above.

Table 5 Rubber charring time of 45±5℃ thin pass test/ min

Project	BoTong number/Number													
	5	10	15	20	25	30	40	50	60	70	80	90	100	110
1#	13.7	13.8	13.8	14	14	14	14.1	13.7	13.5	13.6	13.9	13.9	13.8	14
2#	19.9	19.6	19.7	20	20.1	19.9	20.1	21	21	21.4	21	21.1	21.1	21.1
3#	13.4	13.5	13.5	14	13.9	14.2	14.5	16.4	16.4	16.8	16.8	17.1	17.3	17.4
4#	7	7	7.1	7.3	7.6	7.7	8	8.4	8.7	9.1	9.1	9.2	9.5	9.6

Note: test equipment and test conditions are the same as above.

Table 6 Rubber Mooney viscosity of 90±5℃ thin pass test

Project	BoTong number/Number										
	10	20	30	40	50	60	70	80	90	100	110	R
1#	61	58	57	56	55	54	53	52	51	51	51	10
2#	56	55	54	54	52	50	50	49	49	49	48	8
3#	74	73	72	71	71	70	70	69	69	68	68	6
4#	65	65	65	64	64	64	63	63	63	63	63	2

Note: test equipment and test conditions are the same as above.

1.5.2 Effect of thin pass times on rubber properties

(1) the rubber Mooney viscosity (as shown in table 4) and burning time (as shown in table 5) were sampled and tested under thin pass condition with roll temperature of 45±5℃ and roll spacing of 0.5mm.

(2) the rubber Mooney viscosity (shown in table 6) and

Table 7 Rubber charring time of 90±5℃ thin pass test min

Project	BoTong number/Number										
	10	20	30	40	50	60	70	80	90	100	110
1#	14.7	14.8	14.8	14.8	14.9	14.9	15	14.5	14.8	14.5	14.4
2#	24.2	24.2	24.3	24.4	24.5	24.7	25.3	25.1	25.3	25	25.2
3#	15.1	15.1	15.3	15.5	15.5	15.8	15.9	15.8	16	16	16.1
4#	8.4	8.4	9	9.2	9.4	9.5	9.7	9.8	10	10.2	10.1

Note: test equipment and test conditions are the same as above.

burning time (shown in table 7) were sampled and tested under the thin pass condition of roll temperature 90±5℃ and roll spacing 0.5mm.

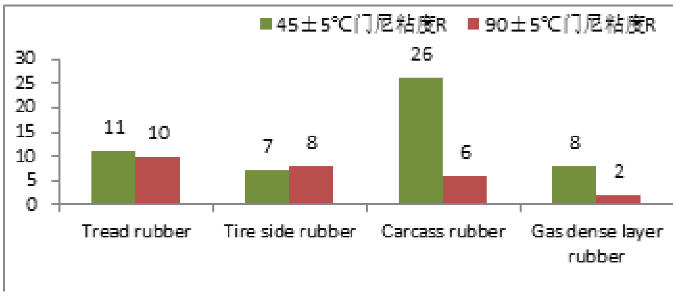

Figure 5 Menny viscosity is range after mixing rubber thinning(R)

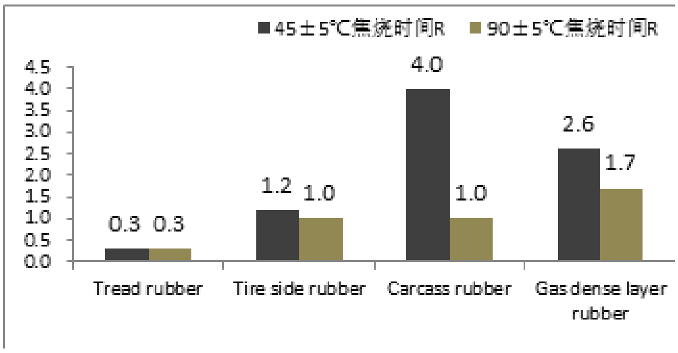

Figure 6 Scorch time is range after mixing rubber thinning(R)

2 Results and discussion

2.1 Effect of parking time on rubber properties

As shown in Table 2 and Figure 3, as the parking time extends, the Meni viscosity of mixed rubber continues to increase, and the Meni viscosity of tread rubber increases significantly.

As shown in Table 2 and Figure 3, as the parking time extends, the burning time of the rubber on the side of the tire is shorter than that of other rubber, and the burning time of other mixed rubber is not obvious.

2.2 Effect of thin pass times on rubber properties

As shown in Tables 4, 6, and 5, with the increase in the number of thin-pass, the Meni viscosity of mixed rubber has decreased, and the low temperature(45 ± 5 °C, the same below) thin-pass has the most effect on the Meni viscosity of fetal rubber. The most obvious.

As shown in Tables 5, 7, and 6, the burning time of mixed rubber has been extended with the increase of the number of thin-pass, and the low temperature thin-pass has the most obvious effect on the burning time of fetal rubber and gas-dense rubber.

The influence of mixed rubber and low-temperature thin-pass on the Moni viscosity and coking time of rubber is more obvious than that of high-temperature(90 ± 5 °C) thin-pass.

3 Conclusion

(1) The parking time(one month) is extended, the Meni viscosity of the mixed rubber is increased, and the burning time of the rubber on the side of the tire is shortened relatively significantly.

(2) Increase the number of thin-pass times(110 times), decrease the Meni viscosity of the mixed rubber, extend the scorch time at low temperature thin-pass(in which the scorch time of the fetal rubber is the most obvious) and extend at high temperature thin-pass. Not obvious.

(3) In the process of actual rubber processing, the effect of extended parking time or extended mixing time on the processing performance of rubber in different parts of the tire is different.

Reference

[1] zhang anqiang, wang lianshi, zhou yiyu, research on coke burning performance in CR mixing process [J], rubber industry, 2003.50 (5) : 261-265.

[2] Jiang zhijie, miao guishao, study on coking time of mixed rubber [J]. Special rubber products, 1999.20 (2) : 12-15.

[3] Lin yaling et al. Scorch characteristics of rubber under mixing conditions [J]. Rubber industry, 2003.50 (11) : 645-650.