Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(3):1299-1301

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

A pilot study on characteristic of table tennis bat rubber

[1]Zhang Wei-bing, [1]Luo Yin and [2]Michael Graham

[1]Faculty of Sports Science, Ningbo University, Ningbo, China
[2]Sport and Exercise Science, Glyndwr University, Wrexham, LL11 2AW, UK

ABSTRACT

The blending ratio of styrene butadiene rubber and natural rubber was very important to table tennis bat's rubber. The purpose of this study also investigated the performance of rubber racket due to the material changing. The results reflected that natural rubber and styrene butadiene rubber blends had best compatibility at ratio of 82/18. Considering the performance and cost synthetically, the amount of calcium carbonate should be moderate.

Key words: blending ratio; accelerator; table tennis

INTRODUCTION

With the popularity of table tennis all around the world, the consumption of table tennis racket increased gradually. Table tennis fans with different performances demand different table tennis racket [1]. It is necessary to produce the table tennis racket with different quality in order to meet the consumer demand of different levels of table tennis fans .performance of the table tennis racket mainly depends on the quality of the rubber of table tennis racket [2]. Depending on the racket rubber performance could be classified as High-grade racket and Low-grade racket. High-grade rubber contains more raw rubber without fillers, There are so many advantages like luster bright, high elasticity, viscosity, is good for controlling and spinning the ball, but the cost is higher, So it is more suitable for professional athletes [3]. While some filler is added in to the cheap rubber , the content of the raw rubber is low, the performance of rubber is poor, low cost, suitable for mass sports fan , it is also accepted by the general merchants. This paper manufacturing rubber with the natural rubber and styrene butadiene rubber as the main raw material, The aim of this research is to explore the influence of the proportion of adhesive, accelerant and gross, dosage of filler calcium carbonate on performance of NRSBR blend rubber.

EXPERIMENTAL SECTION

Natural rubber (NR);styrene butadiene rubber (SBR); dibenzothiazyl disulfide (DM); diphenylguanidine(D); zinc oxide; sulphur; octadecanoic acid; calcium carbonate; industrial products.80 NR, 20SBR,1.5 sulphur,1.5 zinc oxide, 1.5 octadecanoic acid, 260 calcium carbonate, accelerator l.25 DM, l.25 M,2.5 D. Compound rubber was produced in SU-70 small-mixer, adding rubber, accelerator, zinc oxide, stearic acid, calcium and sulfur in order according to the formula and the mixing rate was 20 r / min. After uniform mixing, sampling and then prepared the compound rubber. The sample was sit for 8h for the measurement of vulcanization curve using the MDR-2000 intelligent computer vulkameter. Curing was on the plate vulcanizing in the condition of 155 ^{0}C, 10 min and 15 Mpa. After refrigeration, the sample was set for 24h at room temperature and then use XFX dumbbell prototype sample machine for preparation.

Tensile properties were measured with WDW electronic tensile testing machine. Tensile strength, elongation at break and 300% elongation of vulcanized rubber were measured according to the national standard of rubber tensile test (GBT/528 1998), and hardness measurements completed with LX-A Shore durometer.

RESULTS AND DISCUSSION

Table 1 showed that tensile strength, elongation at break and 300% modulus tended to be increasing first and then decreasing as the content of SBR in compound rubber increased. The tensile strength and elongation at break reached to a maximum as the ratio of NR/SBR was 82/18;with increasing content of SBR, the rubber hardness showed an increasing trend. Due to the crystal formed during the transformation of natural rubber under the stress, which resulted in self-reinforcing effect. Therefore, the tensile strength and elongation at break decreased as the content of natural rubber was poorer. In this condition, the hardness increased but without significance.

If the main component was NR, the size of latent defect in rubber increased as the component of SBR increased, which leaded to cracks. It indicates SBR contributes to abrasion instead of tear strength which because of higher tear strength of NR and higher abrasion of SBR. In conclusion, the value of NR/SBR in raw rubber was 82/18 which can achieve the best combination property.

Table 1.Material property of NR/SBR proportion

	100/0	82/18	62/38
Tension (MPa)	23.4	25.7	19.3
Hardness	62	65	68

It is common that accelerators of the thiazole(e.g. accelerator M and DM) and the guanidine(e.g. accelerator D)are mixed to compose the mixed, which results in fast curing, high production efficiency, excellent strength and elongation. T tensile strength and elongation at break increased first and then decreased with the increasing of accelerator D and decrease of accelerators DM and M. The tensile strength and elongation at break reached to a maximum as the ratio of DM/M/D was 1.25/1.25/2.5. 300% modulus tended to be decreasing following with increasing and reached to the minimum as the ratio of DM/M/D was 1/1/2.5.While the hardness of the rubber displayed decease following increase with no significance, and reached to the minimum as the ratio of DM/M/D was 1.25/1.25/2.5.In general, tensile strength and elongation at break reached to a maximum as the ratio of DM/M/D was 1.25/1.25/2.5,which exerts the best comprehensive mechanical property. Consequently, we adopted the ratio of DM/M/D as 1.25/1.25/2.5 in the raw rubber. Tensile strength peaked and elongation at break decreased with the increasing of mixing ratio, which resulted from enlargement of crosslinking density. However, overstocked cross bond prevented the directional alignment of molecular chain when the crosslinking density increases continuously and the formation of crystal. As well, because of uneven distribution of cross bond, excessive crosslinking density leads to the local concentration of stress and reduce the effective segments in the net, which resulted in the decrease of tensile strength of vulcanized rubber[4].

Table 2.Multiple of using total augmentor

	2	4	6
Tension (MPa)	22.5	26.1	26.3
Hardness	73	69	61

On the basis of the best ratio of DM/M/D as 1.25/1.25/2.5, other criteria remains unchanged to obtain the effect of the total amount of accelerator on the mechanical property of vulcanized rubber. Table 2 showed that tensile strength and elongation at break tended to be increasing following decreasing with the enlarging amount of accelerator [5]. The tensile strength and elongation at break reached to a maximum while the hardness displayed a decreasing trend and the 300% modulus showed decrease following with increasing as the total amount of accelerator was 5.In conclusion, the amount of 5 was most appropriate for the mechanical property of vulcanized with tensile strength and elongation at break reaching to the maximum. Therefore, this study adopted 5 as the total amount of accelerator. Also, the effect of total amount of accelerator on tensile strength and elongation at break is associated with crosslinking density. After the peak of tensile strength and elongation at break, with persistently increasing of accelerator amount, crosslinking density increased sequentially, and the result was tensile strength and elongation at break decreased. Considering the comprehensive effect of mixing ratio and total amount, this study employed the DM/M/D ratio of 1.25/1.25/2.5 with the total amount of 5 to obtain the optimum combination property

of the rubber.

A large number of calcium carbonate was filled in rubber to enlarge the volume of the sample as well as saving the expensive natural rubber to lower the cost [6, 7]. Despite of the amount is large, the effect on the rubber property cannot be neglected. In this study, the amount of calcium carbonate is much larger than the usual does, which mainly aimed at increasing the amount of filler as much as possible without affecting the appearance of the vulcanized rubber (no blooming).Table 3 showed the effect of calcium carbonate amount on the mechanical property of the vulcanized rubber.

Table 3. Calcium carbonate using to the bat's material

	75	150	300
Tension (MPa)	12.3	16.8	22.6
Hardness	66	72	76

Table 3 displayed that the tensile strength and elongation at break tended to be decreasing while the hardness tended to be increasing with the increasing amount of calcium carbonate in the mixing rubber. When the increasing amount of calcium carbonate reached to the extent of declining the rubber content, the tensile strength and elongation at break decreased and influenced the toughness of the rubber. In addition, excess amount of calcium carbonate may lead to blooming on the rubber surface and affect its appearance, so that the performance of the rubber is reduced. With comprehensive consideration on economical efficiency and function, this study selected 260 as the amount of calcium carbonate [8].

CONCLUSION

Natural rubber and styrene butadiene rubber for the rubber properties of table tennis bats are complementary. The mixing use of accelerator DM/M/D contributes to the property of vulcanized rubber. Considering the performance and cost synthetically, the amount of calcium carbonate should be moderate.

REFERENCES

[1] H Yang, *Journal of Chemical and Pharmaceutical Research*, **2013,** 5(12), 296-301.
[2] Y Kimura; M Okamura; T Harioka; T Hara, *Masui*.**2013**, 62(12), 1469-1471.
[3] S Guo; T Shiraoka; S Inada; T Mukai, *Sensors*, **2014**, 14(2), 2225-2238.
[4] A Destrebecqz; A Cleeremans, *Psychonomic Bulletin& Review*, **2001**, 8, 343–350.
[5] M Dole, *J. Chem. Ed.* **1997**, 54(12), 754.
[6] MI Liff, *Phys. Teach.***2004**, 42, 536–540.
[7] G Savarino; MR Fisch, *Am. J. Phys.* **1991**, 59, 141–145.
[8] J Dowling; GH Mullen, *Phys. Teach.***1974**, 12(4), 231–233.