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Research Article

Influence Mechanical Properties BR Compound for Manufacture diaphragm of Safety Relief Valve (SRV)

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Abstract

The aim of this work was to manufacture the diaphragm for Safety relief Value using Poly Butadiene Rubber(BR) high Cis grade (97%), this diaphragm use in Propane gas storage tank under conditions of 1.351 Psi pressure and -40 Co propane gas Temperature, the compositions were prepared in Laboratories Inc. Tires Babylon*. The tests included the tensile, hardness, and Rheometric properties of BR compound using a vulcanization system [ASTM D3182]. Carbon black (N326) was used as a filler (40 pphr). To determine the tensile strength, M300 (tensile stress at 300% elongation) and elongation at break a tensile test device called (Tensilmete) was used According to ASTM D412, operating at strain rates of 500 mm/min. Finally, by using a device (Hardness), to determine the Hardness IRHD of BR compound. We design such compound by using diaphragm rubber suitable for low Temperature properties, and design a mould for curing the diaphragm physical and curing properties, we have made for a design compound and performance test also we have done by fitting the producing diaphragm in the work and showing a good result.*

Keywords: *diaphragm, Poly Butadiene Rubber(BR), M300 (tensile stress at 300% elongation).*

1. Introduction

The rubber (BR-cis) of the best of these species and discovered this type of rubber for the first time in Europe in 1930, And was not in when known in the industry And was first used in the tire in 1943 and the industry, but production advanced and talk to him was in 1965, just so it is considered one of the modern types that developed the rubber industry through high properties added by the industry in improving the rebound property and corrosion resistance properties and crack resistance and low temperature resistance and is what it takes diaphragm rubber.

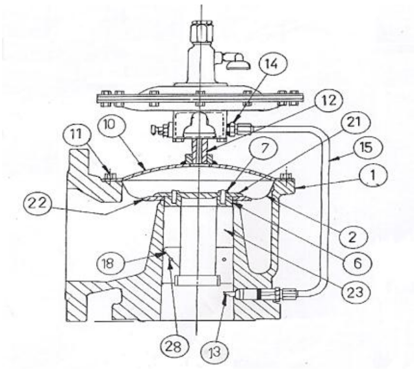

Fig.1 Details and the location of the diaphragm rubber in Safety Relief Valve (SRV).

Figure (1) shows the details and the location of the diaphragm rubber in Safety Relief Valve (SRV).

No.	Desoription	No.	Desoription
1	Body	14	Connector
2	**Diaphragm**	15	Supply tube
6	O-ring , seat	18	Gulde spring
7	Seat bolt	21	Top olate
10	Cap	22	Retainer plate
11	Bolt cap	23	Guide
12	Nipple	28	Spring pin
13	Dipper tube		

Therefore, the final requirements that had to be performed by this product are:

Resistance to low temperature of propane gas (-40 C^o).
Sensitivity to pressure 1.351 psi
These conditions are the real problem that must be accessed through the preparation of technological lane that follows the final requirements that include experimentation to design specification rubber compound resist conditions and low temperatures with investigation dimensions required for the importance of that to achieve light weight, enabling it to work for Sense the low pressure (1.351 psi).

Tire production consumes approximately 60% of the global synthetic rubber production. Of this, SBR is the largest-volume polymer, representing over 65% of

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the synthetic rubber used in tires. Polybutadiene (BR) ranks second in production output.

However, in the case of butadiene, the maximum cis-1,4 content attainable is much less than for isoprene; typical commercial polybutadienes prepared in hydrocarbon solution with butyllithium initiators have microstructures in the range of 36–44% cis-1,4, 48–50% trans-1,4, and 8–10% 1,2 microstructure.

Nordsiek documented a series of empirical guidelines which might be used in designing a polymer for a set of tire performance targets. By preparing various blends of BR and SBR, Nordsiek produced a series of compounds in which the Tg increased from -100 to -30°C.

Day and Futamura evaluated the impact of variation in l,2-butadiene and styrene content in SBR on the properties of a compounded formulation. Briefly, (1) an increase in styrene produced an increase in tensile strength, (2) an increase in vinyl-1,2-butadiene resulted in a drop in both tear strength and ultimate elongation, and (3) at equal Tg, neither vinyl 1,2-butadiene nor styrene level affected the formulation's hysteretic properties.

2. Experimental work

2.1 Materials

The Elastomers used in this study, i.e. BR (Poly Butadiene Rubber high Cis grade (97%) was supplied by the laboratories of the public company of tires Babylon. Carbon black (N330) and other fillers Materials was obtained from same company too.

2.2 Preparation Specimens

Rubber specimens for various mechanical testings, including the tensile test, hardness test and Rheometric test were prepared by mixing the rubber compounds. The formulation of rubber compounds was shown in Table 1.

Table 1 Compound Recipes

Ingredient	BR blend (pphr)
Poly Butadiene (BR)	100
Zinc oxide	3.0
Streaic Aid	2.0
Carbon black (N-326)	40
Calcium Carbonate	10
P-oil	10
Sulphur	2.0
MBS1	1.0

[1] 2-(4-morpholinothio) benzothiazole

2.3 Determination of Mechanical Properties

1. Tensile properties were measured based on the ASTM D412 procedure by a tensile tester (Tensilmete) using a dumbbell specimen at room temperature and at a crosshead speed of 500 mm/min. All the test specimens of the tensile test were compression molded (35 MPa) 350 bars at 150°C [ASTM D3182] and cure time 45 min. For the tensile experiment, dumbbell samples were cut from a 2 mm thick molded rubber sheet. The gauge length and width of the dumbbell was 33±2 and 6.3±0.1mm respectively. [ASTM D 412 (Test Method A)] was adopted for the tensile testing procedure of the rubber samples.

2. The test specimens (hardness test) were compression molded 350 bars at 150 C°, and cure time 15 min, [ASTM D 3182].

3. The cure time for all the tests specimens above, According to specification for Dunlop British Company.

4. The mold for molding rubber manufacturing diaphragm having developed designs required for implementation. Process was conducted to model the rubber compound for the following conditions (Curing time of 30 minutes at 160 C^o) The Final Product Dimensions of the diaphragm as in Figure (2).

Fig. 2 The diaphragm for Safety Relief Valve (SRV)

3. Results and discussion

3.1 Tensile Test

From Table 3 we can observe a great properties particularly, that break stress reach to 8.5 MPa and break strain 290% and Stress of 150% elongation (M150) 3.694 MPa.

Table 3 Results of Tensile and Hardness test for BR Compound

Properties	BR Compound
Break Strain %	290
Break Stress [MPa]	8.5
Stress of 150% elongation [MPa]	3.694
IRHD	56

M150 is affected by several factors such as surface reactivity which determines the polymer–filler interaction, aggregates, size and shape of particles, structure and filler particle dispersion in rubber (p. 342).

3.2 Hardness Test

Table (3) shows the values of the hardness test to the BR Compound and the maximum value of Hardness reach to 56 [IRHD].

3.3 Curing Properties

Tests were conducted vulcanization and curing properties for BR compound using the Rheometric device was in below:

Vulcanization Time (T90) 3.72 minutes.
Curing Time (Ts2) 1.66 minutes.
And as shown in fig. (3)

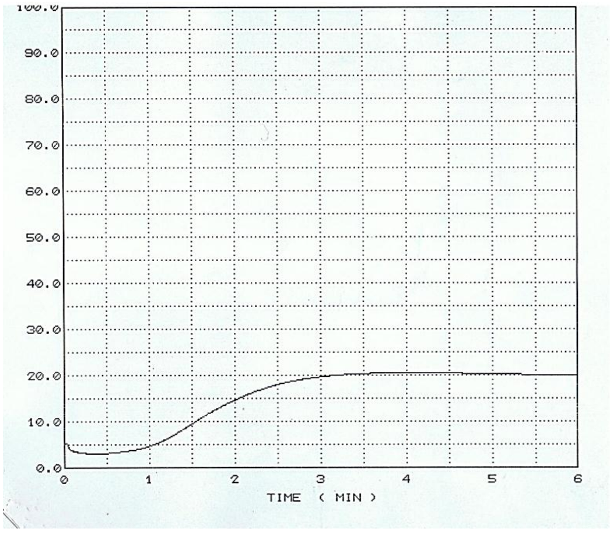

Fig. 3 Torque-Time curve for BR compound.

3.4 Checking performance

In order to measure the efficiency of the performance of the model Manufacturer of rubber veil was placed to work in accordance with the circumstances listed above to work diaphragm (pressure psi 1.351 and ambient temperature for propane and butane - 40 C°).

Where the diaphragm proved successful in terms of responding to the work specified in the above pressure and resistance to low temperature (- 40 C°).

Conclusions

1) The tests in which the spacing (diverge) of the particles such as tensile test, there is a significant impact and improved properties.
2) Tensile strength, M150 of BR Compound. The maximum value of tensile stress at BR.
3) The hardness of the BR Compound or generally of elastomers, increases with the filler ratio increases. The maximum value of hardness at BR compound reach to 55 [IRHD].
4) Reduce cost manufacturing diaphragm for the safety valve, because it usually manufacture of natural rubber, and there is a big difference at the cost between Nature Rubber NR and Polybutadiene BR.
5) The diaphragm proved successful in terms of responding to the work specified in the above pressure and resistance to low temperature (- 40 C°).

References

S. Datta, (2004) Rubber Compounding, Chemistry and Applications, B. Rodgers (Ed.), Marcel Dekker Inc., New York.

E. W. Duck and J. M. Locke, (1977) The Stereo Rubbers, W. M. Saltman (Ed.), Wiley- Interscience, New York, p. 139.

K. H. Nordsiek, (1985) The 'Integral Rubber' Concept—An Approach To An Ideal Tire Tread Rubber, Kautschuk Gummi Kunstsoffe, Frankfurt,Vol. 38, pp. 178–185.

G. L. Day and S. Futamura, (1986) Paper 22 presented at a meeting of the Rubber Division, American Chemical Society, New York.

Kraus G. (1965) Reinforcement of Elastomers, Interscience, New York.

S. Woff, M.J. Wang, (1992) Rubber Chem. Technol. 65, 329.