WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 12, Dec., 2022

EFFECT OF SECONDARY WASTE PRODUCTS ADDED TO THE COMPOSITION OF THE ORGANIC BINDER ON THE PROPERTIES OF BITUMEN

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Abstract
This study aims to improve the physico-mechanical properties of highway bitumen by adding recycled waste to it, as well as to improve asphalt concrete that meets the sustainability criteria. The results obtained in the laboratory tests when different percentages of crumb rubber were added to the 60/90 lead petroleum bitumen are presented.

Keywords: Bitumen, waste, rubber, secondary product, rheological properties, penetration.

Asphalt concrete is a material used all over the world. Bitumen is known to play the most important role in such materials as it binds a high fraction of inorganic macrometer-sized particles and provides a suitable material for pavement use.
Additives can be used to increase the overall rheological properties, which provide high benefits in terms of resistance to mechanical pressures and wear. Among these, waste products are used as very effective additives in increasing overall performance, viscosity, cracking parameter and recovery from deformation. In this context, we provide a critical analysis of advanced technologies used to improve bitumen productivity using waste products. We critically review the costs associated with their use and provide our opinion as to which may be appropriate for the analysis of bitumen and asphalt containing waste products [1].
Laboratory tests are divided into several stages, which begin with the evaluation of bitumen and rubber materials. After that, rubber mixtures with different bitumen content are prepared and tested to obtain the optimal amount of secondary waste. The optimal value of bitumen is used to prepare asphalt mixtures modified with different percentages (1,3,5,7,10,15) of waste. Finally, the results of laboratory tests are obtained and analyzed [2].
Properties of bitumen

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BND 60/90 asphalt binder was used in this study. A number of laboratory tests were conducted to evaluate the properties of bitumen, for example: softening temperature, conditional viscosity, elongation.

Data GOST 22245-90 " Bitumens and Specifications" and they are listed in Table 1 [3].

Table 1

Brand	Softening temperature should not be low.	viscosity of the bitumen at 25 °C, 10 $^{-1}$ mm	Elongation at 25 °C , sm, should not be low
	bitumens		
BND 200/300	35	201-300	-
BND 130/200	40	131-200	70
BND 90/130	43	91-130	65
BND 60/90	47	61-90	55
BND 40/60	51	40-60	45

According to the laboratory test, the results given in the table below were obtained. The results show that the conditional viscosity of the bitumen increased as the amount of secondary product increased, and the penetration value for BND60/ 90 decreased from the gost requirement when the amount of rubber reached 7%.

Figure 1 Determination of conditional viscosity of bitumen

Viscosity Of The Bitumen

Table 2

Secondary product added to BND 60/90, %	N1 (mm)	N2 (mm)	N3 (mm)	Average value, mm
Without addition	65	67	67	66.3
1% i/m	64	62	6 3	63
3% i/m	47	5 0	5 0	49
5% i/m	47	47	44	46
7% i/m	40	41	37	39
10% i/m	37	36	38	37
15% i/m	28	27	29	28

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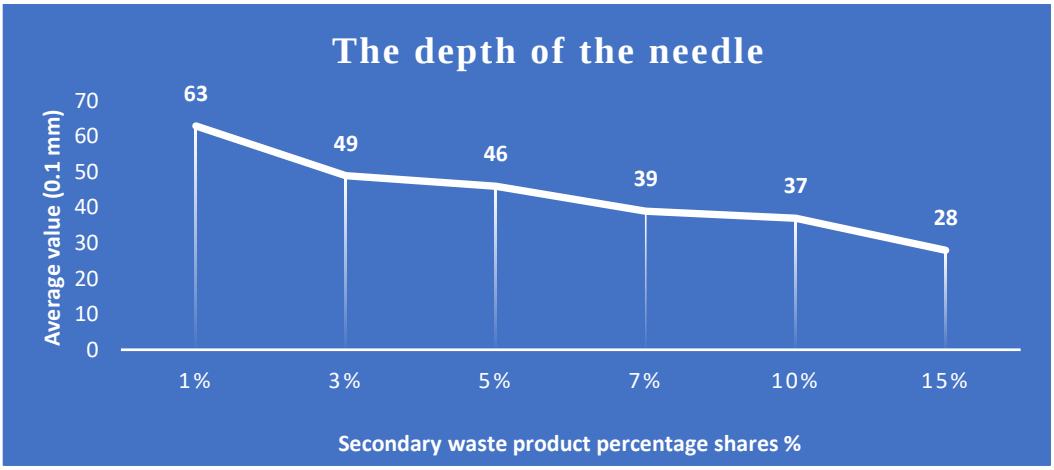

Figure 1. The depth of the needle

Figure 2. Bitumen flexibility determination

Long - term flexibility determination laboratory test to the results according to BND 60/90 way oil of bitumen elasticity decreased observed . Secondary product percentage share by 7 % when delivered BND 60/ 90 bitumen flexibility guest from demand decreased observed BND 40/60 bitumen to the indicator suitable came

Elongation length, (mm)

Secondary product added to BND 60/90, %	N1	N2	N3	Average value(mm)
Without addition	720	720	720	720
1% i/m	715	717	716	716
3% i/m	700	709	705	704.6
5% i/m	651	644	643	646
7% i/m	515	527	557	533
10% i/m	440	460	420	440
15% i/m	400	430	421	417

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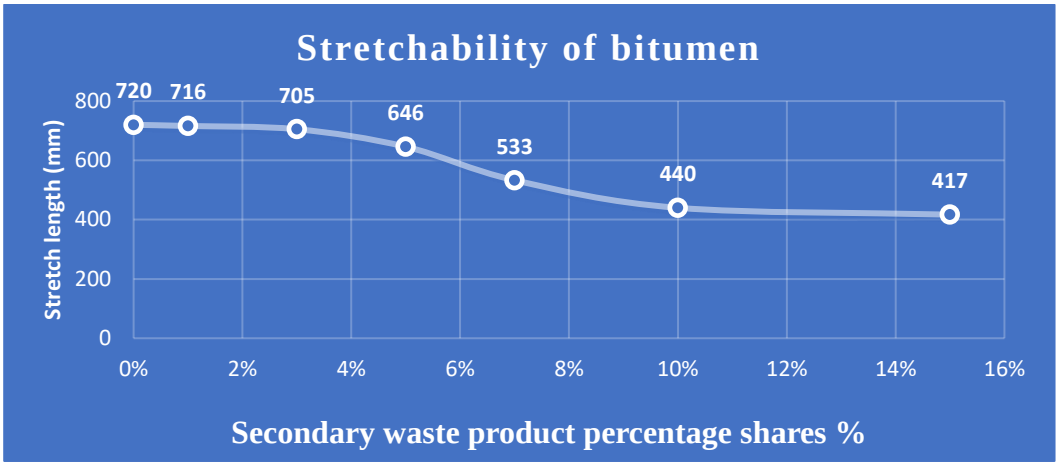

Chart 2 Determination of stretchability of bitumen

Fig. 3 Determination of softening temperature of bitumen

Softening temperature of bitumen **It** is an important property and is the upper limit of its use. The following results were obtained.

Softening temperature of bitumen

Secondary product added to BND 60/90, %	N1	N2	Average value
Without addition	48.3	48.4	48.4
1% i/m	48.6	48.7	48.6
3% i/m	51	50.9	50.9
5% i/m	51.4	51.8	51.6
7% i/m	52.7	53.1	52.9
10% i/m	55.9	55.4	55.7
15% i/m	59.4	61	60.2

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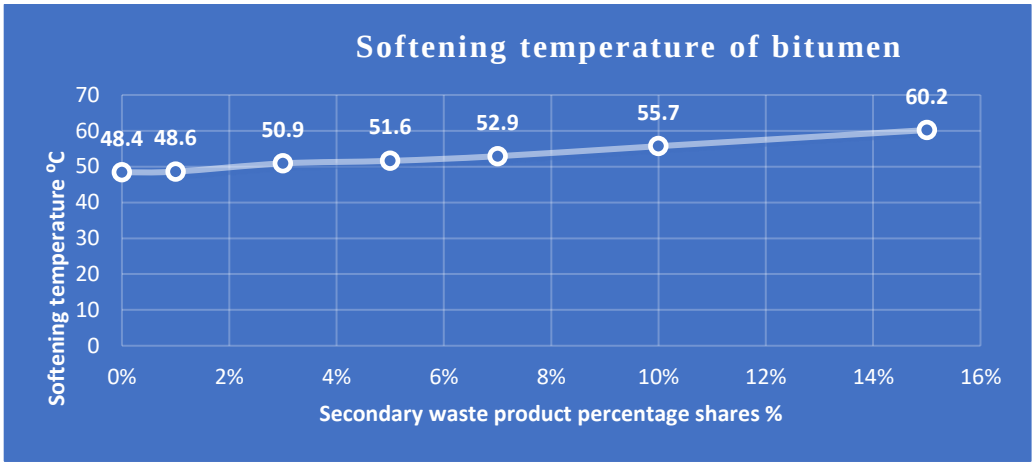

Graph 2 Determination of softening temperature of bitumen

Secondary product effect on bitumen properties, viscosity value is reduced, softening temperature is improved, elongation value is reduced.

The results obtained from the tests show that the optimum proportion of bitumen by weight (IM) is 5%. The use of rubber materials used as a bitumen modifier has great benefits, firstly, it reduces emissions and protects the environment from pollution, and secondly, it improves the properties of bitumen and, as a result, increases the durability of the road. According to other studies, experimental results show that modified bitumens with their low thermal sensitivity perform better than conventional bitumens, with better resistance to cracking.

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