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RESEARCH REGARDING THE USE IN ROAD TECHNIQUE OF BITUMINOUS SCHIST FROM ROMANIA

[*]Eng. Dumitru-Dragos Hanganu
[**]Prof. Dr. Ing. Gheorghe Gugiuman

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Corresponding Author: Eng. Dumitru-Dragos Hanganu; Email: hanganu.dragos@gmail.com; doi:10.46360/cosmos.et.620211002

Abstract

The use of bituminous schist is imposed by a significant increase in the price of bituminous binders, simultaneously with the gradual degradation of the road network in Romania, as well as with the increase of motorization and, therefore, the limitation of rehabilitation possibilities due to high costs. By incorporating bituminous schist into the asphalt mixture, a significant reduction in the amount of bitumen conventionally used is achieved, a binder that is currently only imported.

Also, given the progressive increase in demand for asphalt mixtures, and consequently for road bitumen, correlated with the quantitative and qualitative deficit of this essential material in road works, highlighted the importance of use in the preparation of bituminous mixtures of unconventional components, such as bituminous schist.

Considering that the only norm based on which the technological recipes for asphalt mixtures with bituminous sand are made underwent the last modifications in 1985, one of the specific objectives of the doctoral thesis was to update the technical specifications contained in the norm in order to streamline the process. associated with these mixtures and for a better national implementation of these practices. Without this long-awaited review, the use of this unconventional material would become more difficult, although it has both technical, economic and environmental benefits.

This report presents studies performed on experimental and theoretical activities, undertaken in order to acquire new knowledge on the specified materials, respectively the crushing sand used in the preparation of asphalt mixtures, based on observations, tests and interpretation of laboratory results, which, based on some already existing knowledge will lead to a significant improvement of the knowledge of applicability of these materials in a specific field, respectively that of construction materials.

Regarding the studies on bituminous schist, it is proposed to continue the research by preparing different types of technological recipes for asphalt mixtures where the classic sand is replaced with bituminous shale crushing sand and determining the physical-mechanical characteristics by laboratory tests.

Keywords: Bituminous Schist, Asphalt Mixtures, Bitumen.

Introduction

Description of the current state of knowledge in the related area of the topic

In Romania, studies were carried out on bituminous schist by almost all Romanian geologists, starting with Cobâlcescu in 1877, continuing with Mrazec in 1907, Athanasiu in 1926, Popescu - Voiteşti in 1943, etc. In 1956, Nicolae Grigoraş is the one who makes the first studies in more detail on bituminous schist. Of all the formations in Romania, the bituminous rocks studied in more detail are: the liasic bitumolites from Anina, the bituminous rocks from the Audia Formation and the oligo-Miocene disodiles from the Carpathian flysch. [2]; [3]

At the Cretaceous level, the Audia Formation are mentioned the so-called "black schist", representing the oldest deposits in the external flysch. The black color of this formation is given either by the presence of manganese compounds from the decomposition of volcanic ash, or by the presence of compounds of Fe (hydrotroilite) and organic matter (Bancila, 1958; Filipescu et al., 1966, 1968; Savul and colab., 1965). The Oligocene bituminous rocks in the Carpathian flysch are made up of three petrographic categories: menilite, brown marl and disodile. For each of them, the mineral substrate is different: for menilites it is made of silicolitic material, for brown marls of clay - carbonate material and for disodiles of silto - clay material.[1] The lias deposits from Banat, more precisely from Anina, were the only bituminous rocks studied more closely, being exploited for a short period of time in the 19th century. The bituminous lias deposits from Anina are analyzed, their thickness being approximately 74 m, and the content in “shale” oil being between 4.9% and 6.6%

*Ph.D. Student, ”Gheorghe Asachi” Technical University of Iasi-Romania, Faculty of Civil Engineering and Building Services, Iasi, Romania.
** Ph.D. Supervisor, Faculty of Civil Engineering and Building Services, Iasi, Romania.

(Grigoraș, 1956; Grasu et al., 2007). These bituminous rocks from Anina develop on the flanks of a north-south oriented anticline and a slight eastern vergent (Pauliuc, 1975). [3]

Having a small percentage of organic matter, bituminous schist in Romania were not exploited industrially, except for those in the Anina area, which were used at a local thermal power plant for a short period of time (Trasca - Chirița, 2016).

1.2 Revealing, through the critical analysis of the current stage, the fact that the proposed topic can have a significant contribution to the development of knowledge in the field;

Bituminous schist are a future energy source if we take into account the fact that the world resources of bituminous schist are 4-5 times higher than the world resources of crude oil (Trașca - Chirița and Baciu, 2012).

1.3 Specification of the proposed contributions, related to the previous critical analysis.

Regarding the studies on bituminous schist, it is proposed to continue the research by:
-preparation of different types of technological recipes of asphalt mixtures where the classic filler to be replaced with shale filler and determination of physical-mechanical characteristics by static and dynamic tests.
-preparation of technological recipes for asphalt mixtures where bituminous schist are incorporated in their natural state, without being subjected to grinding and determination physical-mechanical characteristics through static and dynamic tests. [4]

In the present study, mineral aggregates from the Suseni quarry - Harghita county and natural sand from the Tupilați gravel pit - Neamț county will be used.

Nr. crt.	**Caracteristica**	**Sort 0/4 mm**	**Sort 4/8 mm**	**Sort 8/16 mm**	**Sort 16/22,4 mm**
1	Rock of origin Magmatic rock, of andesite type	Rock of origin Magmatic rock, of andesite type			
2	Granularity declared by the manufacturer (passes% through sieve of ... mm)				
	22,4				
	16	-	-	100	92,7
	8	-	100	93,9	5,5
	4	-	98,5	3,0	0,1
	2	98,1	5,9	-	-
	0,125	65,8	0,2	-	-
	0,063	11,3	-	-	-
3	Sand equivalent, SE 70.2% - - -	70,2 %	-	-	-
4	Evaluation of fine parts, MB 2.5 g / kg - - -	2,5 g/kg	-	-	-
5	Particle shape (flattening coefficient) - 17.4% 13% 7.3%	-	17,4 %	13%	7,3%
6	Particle shape (shape coefficient) - 15.1% 10.2% 6.3%	-	15,1%	10,2%	6,3%
	Granule density and water absorption				
	Density of dry granules in the oven				
	Density of saturated and dry surface granules	2,676 Mg/m^3	2,663 Mg/m^3	2,657 Mg/m^3	2,674 Mg/m^3
	Apparent density of granules				
	Water absorption of the granules. 2.715 Mg / m3 2.708 Mg / m3	2,715 Mg/m^3	2,708 Mg/m^3	2,707 Mg/m^3	2,713 Mg/m^3
	- -	2,783 Mg/m^3	2,788 Mg/m^3	2,796 Mg/m^3	2,785 Mg/m^3
		1434%	1676%	1860%	1485%
8	Resistance to crushing Los Angeles (on the fraction 10/14 mm)	-	-	16,3 %	-
9	Micro-Deval wear resistance (on the 10/14 mm fraction)		-	14,2 %	-

10	Crushing strength - impact method (fraction 10/14 mm)	-	-	8,67%	-
11	Freeze-thaw resistance	-	0,6%	0,3%	0,2%
12	Test with magnesium sulphate (fraction 10/14 mm)	-	-	5,4%	

Table 1: Properties of Mineral Aggregates - Suseni Quarry

The Share of Mineral Aggregates in Asphalt Mixtures

The aim is to obtain high-performance asphalt mixtures, in which the mineral skeleton consists of sorts of natural quarry mineral aggregate (Suseni quarry) and crushing sand from bituminous shale, useful for making asphalt wear and bonding layers:

BA 16 and BAD 22.4, asphalt concrete with chipping - hereinafter referred to as standard asphalt mixtures for wear and connection layers of road systems.

BA 16 and BAD 22.4, of asphalt concrete type with chipping - hereinafter referred to as asphalt mixtures with bituminous crush sand for wear and connection layers of road systems.

The percentage distribution of the sorts according to the granularity of each of them, for the four types of asphalt mixtures, is shown in tables 9; 10; 11; 12.

The granulometric curves obtained for the four types of asphalt mixtures are shown in figures 1; 2; 3; 4.

Type/ sort aggregate	**%**	**22,4mm**	**16mm**	**8mm**	**4mm**	**2mm**	**0,125mm**	**0,063mm**
C 8/16	28	28	27,87	1,68	0,10	-	-	-
C 4/8	22	22	22	20,08	1,47	0,09	-	-
NC 0/4	32	32	32	32,00	31,79	22,91	4,05	2,21
NN 0/4	9	9	9	9	8,95	7,17	1,02	0,19
Filer	9	9	9	9	9	9	7,84	6,79
Total	**100**	**99,87**	**71,76**	**71,76**	**51,31**	**39,17**	**12,91**	**9,18**
Lmin		100	90	61	39	27	8	7
Lmax		100	100	82	64	48	15	11

Table 2: Percentage Distribution of Sorts for Standard Asphalt Mixture BA 16

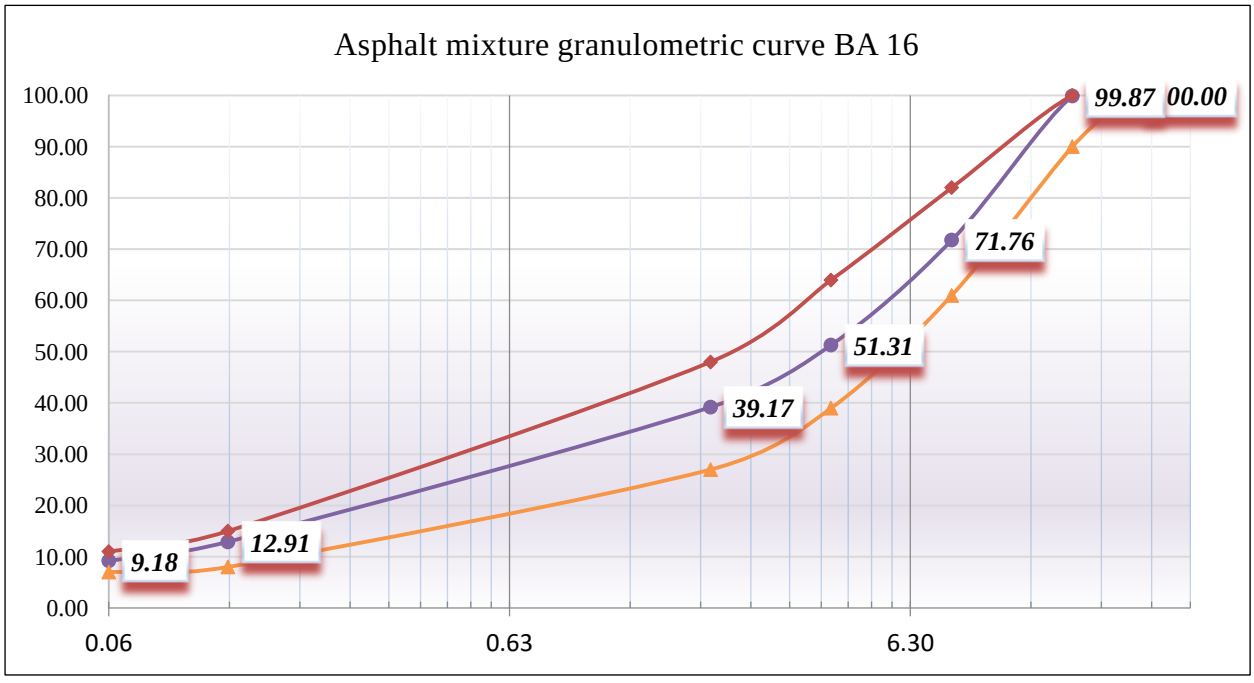

Figure 1: Particle Size Curve BA Standard Asphalt Mixture 16

Type/sort aggregate	%	22,4mm	16mm	8mm	4mm	2mm	0,125mm	0,063mm
C 8/16	40	40	39.82	2.4	0.15	-	-	-
C 4/8	21	21	21	19.16	1.4	0.08	-	-
NCN 0/4	24	24	24	24	23.84	23.46	12.95	5.83
NN 0/4	10	10	10	10	9.55	7.97	1.13	0.21
Filer	5	5	5	5	5	5	4.38	3.77
Total	**100**	**100**	**99.82**	**60.56**	**39.94**	**36.51**	**18.46**	**9.81**
Lmin		100	90	61	39	27	8	7
Lmax		100	100	82	64	48	15	11

Table 3: Percentage Distribution of Sorts for Asphalt Mixture with Crushing Sand BA 16

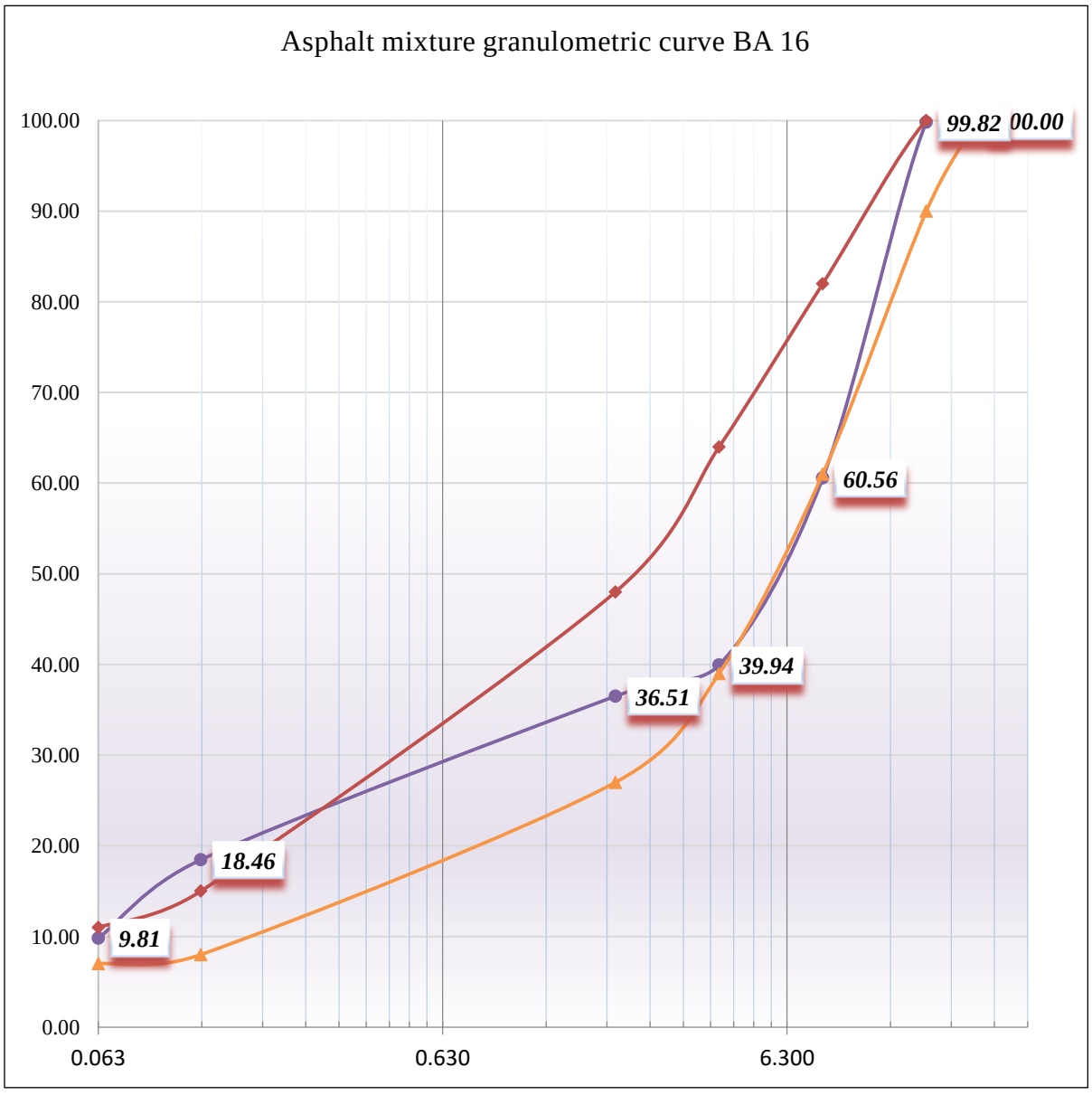

Figure 2: Granulometric Curve Asphalt Mixture Type BA 16 with Bituminous Shale Crushing Sand

Type/sort aggregate	%	31,5mm	22,4mm	16mm	8mm	4mm	2mm	0,125mm	0,063mm
C 16/22,4	20	20	13,08	0,64	-	-	-	-	-
C 8/16	28	28	28	27,87	1,68	0,11	-	-	-
C 4/8	17	17	17	17	15,51	1,14	0,07	-	-
NC 0/4	15	15	15	15	15	14,90	10,74	1,90	1,04
NN 0/4	15	15	15	15	15	14,32	11,95	1,70	0,31
Filer	5	5	5	5	5	5	5	4,38	3,77
Total	**100**	**100**	**93,08**	**80,51**	**52,19**	**35,47**	**27,76**	**7,98**	**5,12**
Lmin		100	90	73	42	28	20	5	3
Lmax		100	100	90	61	45	35	10	7

Table 4: Percentage Distribution of Sorts for BAD Standard Asphalt Mixture 22.4

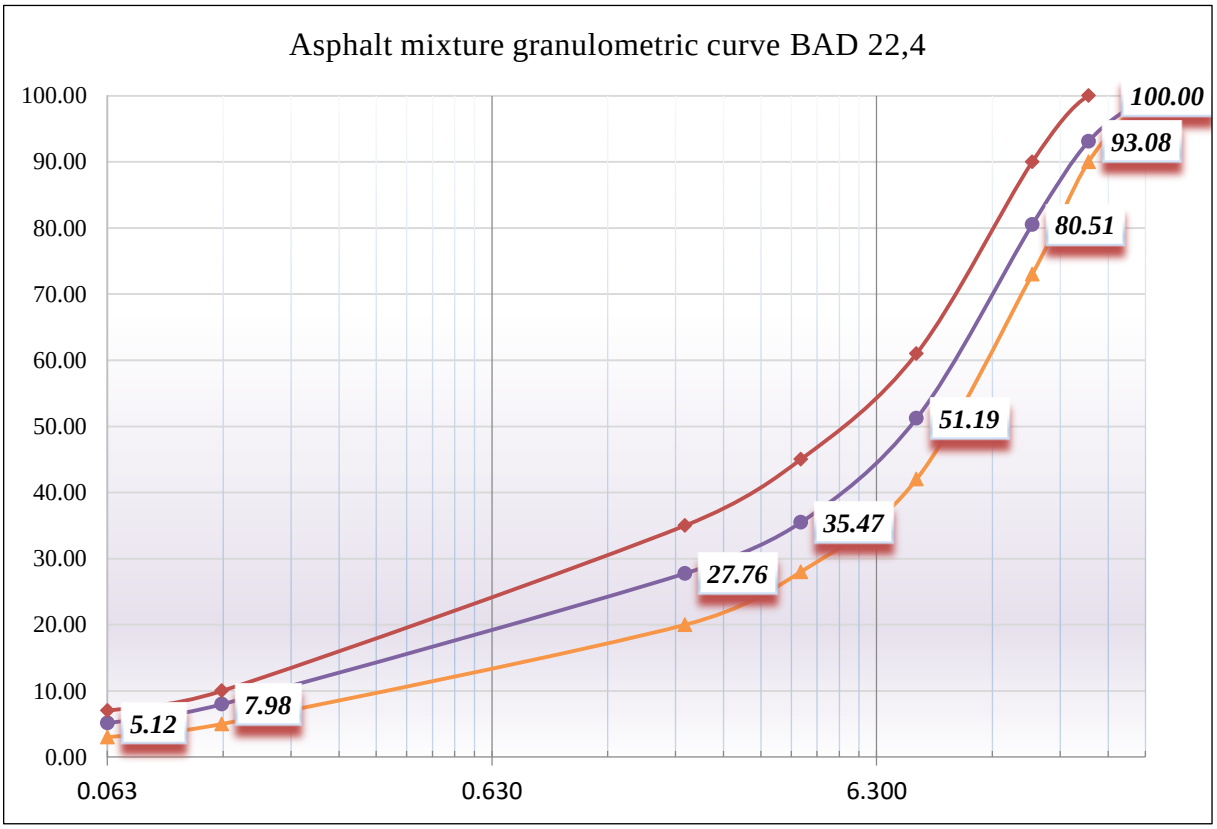

Figure 3: Granulometric Curve BAD Standard Asphalt Mixture 22.4

Type/ sort aggregate	%	31,5mm	22,4mm	16mm	8mm	4mm	2mm	0,125mm	0,063mm
C 16/22,4		22	14.38	0.71	-	-	-	-	-
C 8/16		30	30	29.86	1.8	0.11	-	-	-
C 4/8		18	18	18	16.43	1.20	0.07	-	-
NCN 0/4		13	13	13	13	12.92	12.7	7.02	3.26
NN 0/4		13	13	13	13	12.41	10.36	1.47	0.27
Filer		4	4	4	4	4	4	3.5	3.02
Total		**100**	**92.38**	**78.57**	**48.23**	**30.64**	**27.13**	**11.99**	**6.45**
Lmin		100	90	73	42	28	20	5	3
Lmax		100	100	90	61	45	35	10	7

Table 5: Percentage Distribution of Sorts for Asphalt Mixture Type BAD 22.4 with Bituminous

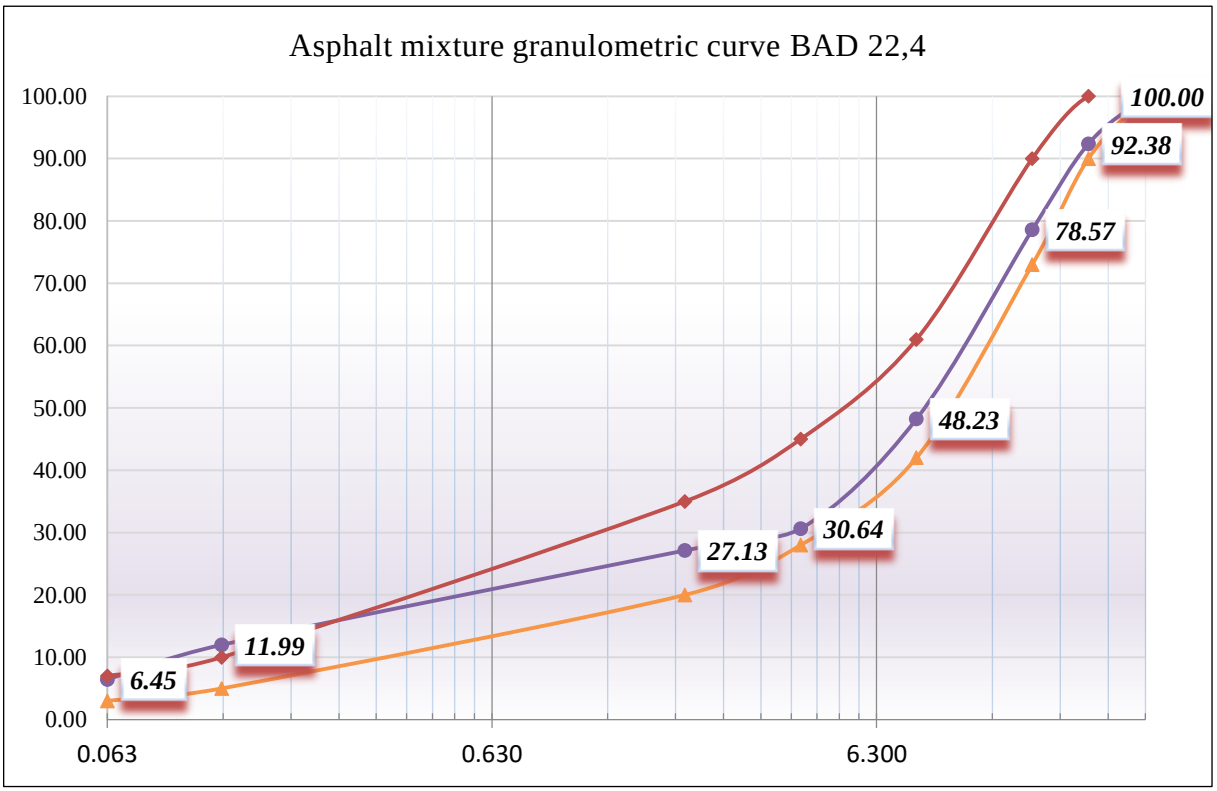

Figure 4: Granulometric Curve Asphalt Mixture Type BAD 22.4 with Bituminous Crush Sand

Conclusion

Analysing in parallel the standard asphalt mixtures and those prepared with bituminous crush sand, the same tendency of increasing / decreasing the characteristic values can be observed, along with the variation of the binder dosage.

For all technological recipes of asphalt mixtures prepared in the laboratory of roads with crushing sand from bituminous shales, the values of physical - mechanical characteristics were determined by static tests: bulk density, water absorption, stability at 60 °C, flow index, swelling at 28 days.

The results obtained from the studies performed in the road laboratory are favourable for asphalt mixtures prepared with bituminous shale crushing sand.

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