KVALITETA PRIRODNIH AGREGATA I NJIHOV UTICAJ NA IZRADU I ODRŽAVANJE ZAVRŠNOG SLOJA KOLOVOZNIH KONSTRUKCIJA

QUALITY OF NATURAL AGGREGATE ROCKS AND THEIR INFLUENCE ON PRODUCING AND MAINTAINING FINAL LAYER OF ROAD CONSTRUCTION

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REZIME

Istraživanje ležišta prirodnih agregata i njihovo dobivanje izuzetno je važno za kvalitetu i cijenu asfalta za završni sloj kolovozne konstrukcije.

Postojeće deformacije kolovoznih konstrukcija koje su posebno izražene u poslijeratnom periodu mogu se primijetiti na svim važnijim putnim pravcima u BiH. Praktična i teoretska saznanja iz oblasti proizvodnje i upotrebe kamenih agregata znatno su pridonijela poboljšanju kvalitete u proizvodnji asfalta za završni sloj kolovozne konstrukcije kao i za održavanje postojećih saobračajnica. Tako se znalo dešavati da fizičko-mehaničko-tehnološka svojstva kamena budu dobra, a da ne daju dovoljno kvalitetan materijal za proizvodnju bito-nosivih i habajućih slojeva.

Geneza stijene odnosno tip stijene koji je upotrijebljen za spravljanje asfaltne mase ima presudan značaj koji direktno utiče na trajnost kolovozne konstrukcije kada su u pitanju asfaltne mješavine iste vrste. Kod proizvodnje asfalta u asfaltnim bazama postoji tehnologija doziranja sa tačnom recepturom određenih potrebnih masenih procenata pojedinih frakcija agregata i sita koja vrše sijanje sušenih agregata u skoro idealnim uslovima. U konkretnom slučaju sijanje i doziranje može imati za posljedicu na kvalitet a samim time i na trajnost ugrađenog asfalta.

U radu se daje prikaz istraživanja ležišta i eksploatacije i prerade sa aspekta utjecaja na cijenu asfalta i trajnosti završnog sloja kolovozne konstrukcije.

Ključne riječi: kolovozna konstrukcija, habajući slojevi, trajnost i održavanje

1.INTRODUCTION

For each of country and its prosperity and economic development is one of basic conditions of development is good structure network of road. This fact was confirmed many times as a rule especially when we analyzed the Western European countries. Happen to know that physical mechanical and technological properties are good but not enough to provide quality materials for production bateaux and wear layers. Primary research goal is to determine the qualities of stone aggregates from deposits in B&H with the aspect of cost and durability of the final asphalt layer of road construction. Asphalt is composed of three major components aggregates, bitumen and filler. In this study, aggregate was taken as one of functional changes

often as is connects the mass of asphalt and is mostly responsible for the durability of the final layer of road construction.

2. ASPHALT CONCRETE

2.1. Origin and historic development of asphalt

Wearing off asphalt mix appeared in France before the First World War, 1914-1918, (Avenue Lon Champ in Bologna Forest). In 1923, according to information during International Road Congress in Seville, there were 168 km of asphalt wearing off layer. Those roads were concentrated around Paris. However this type of wearing off asphalt layer was used earlier in the USA.

First wearing off layer of mixed bitumen from natural asphalt from Ron Walleye was made by Belgian Desmert in New York in 1870. Asphalt from Trinidad became very important and in 1930 there were approximately 35 mil m^2 of asphalt layer in the USA. In Europe it had been used tar layers before asphalt one, but that type of layer had a bad quality. In those times procedure of producing tar was quick and connection material was too soft to make a stabile mixture. [10]

2.2. The basic types of asphalt concrete mix asphalt

It means a series of asphalt mix, very different characteristics, whose classification is not always easy. Distinguish hot and cold asphalt mixes, and on the basis of whether the asphalt is or not passes through the drum dryer which is removed moisture. This difference does not prejudice heating binders.[10]

Table 1. The basic types of asphalt concrete mix asphalt

Class of traffic load	*Name of type of asphalt concrete*								
	For wearing off layer(AB)								*For connexion layer (VAB)*
	AB2	*AB 4*	*AB 8*	*AB11*	*AB11s*	*AB16*	*AB16s*	*AB22s*	*VAB 22, VAB 22s*
Highway Class 1	-	-	-	-	-	-	+	+	+
Class 2	-	-	-	-	+	-	+	+	-
Class 3	-	-	+	+	-	+	-	-	-
Class 4	-	+	+	-	-	-	-	-	-
Class 5	+	+	-	-	-	-	-	-	-
Walking paths. bike paths and car parks	+	+	+	-	-	-	-	-	-
Dimension of granular aggregate	*0-2*	*0-4*	*0-8*	*0-11*	*0-11*	*0-16*	*0-16*	*0-22*	*0-22*

3. MATERIALS FOR PRODUCING ASPHALT CONCRETE ANT THEIR PROPERTIES

3.1. **Exploring quality rocks for prodaction aggregates**

The overall development of any country depends on a good and wellconnected road network. All other infrastructure developments, in turn, get benefited by such wide spread road network. For highway construction and maintenance world over including Bosna end Hercegovina, millions of tons of mineral aggregates are used.

Most of the regionally and locally occurring good quality rocks, gravels and sands are the sources of road construction materials. However, depending on the locale, aggregates of minor quality may also have to be used for highway construction and maintenance some times for economic reasons, preservation of the environment and also in order to avoid large hauling distances.In open pits and quarries modern mining is based on excavating large masses of rock using heavy machines of great capacities.

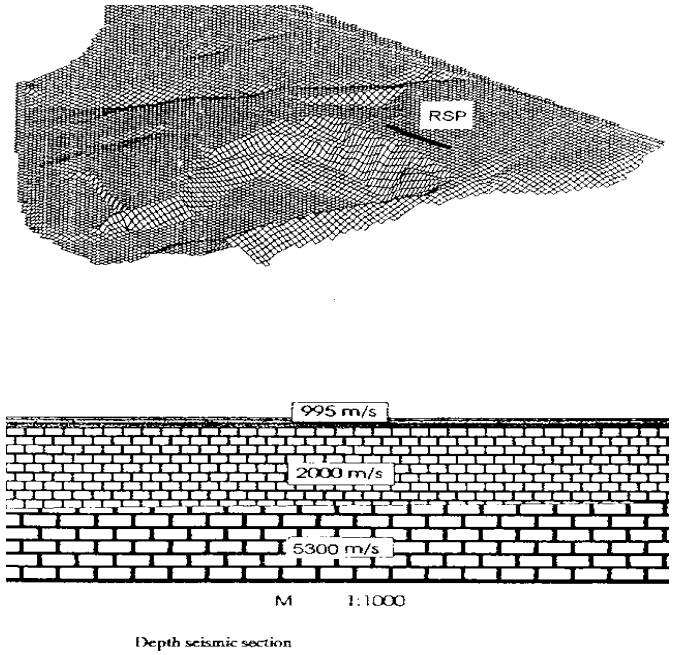
Blasting in open pits and quarries depends on physical and chemical properties of rocks and blasting method relating to them. Three factors control the fragment size distribution: the rock structure, the quantity of explosive and its distribution within the rock mass. The degree of fragmentation influences the economy of excavation operations.

Results of engineering-geological research are significant for the optimization of blasting parameters. These data are showing a real picture of rock mass, and they are as follows: statistics of density of discontinuities, determination of “GSI”, Hoek-Brown criteria for strength of rock mass and “in situ” determination of mechanical parameters, including geophysical survey data.

Rock formations as they occur are not homogenous and isotropic and even on small scale the homogeneity varies. The strength of rock mass decreases with the increase in frequency of joints and the deformability of rocks depend on their orientation. It is the interaction between the rock mass and stresses generated due to explosive detonation, which may produce favorable or harmful blasting results.

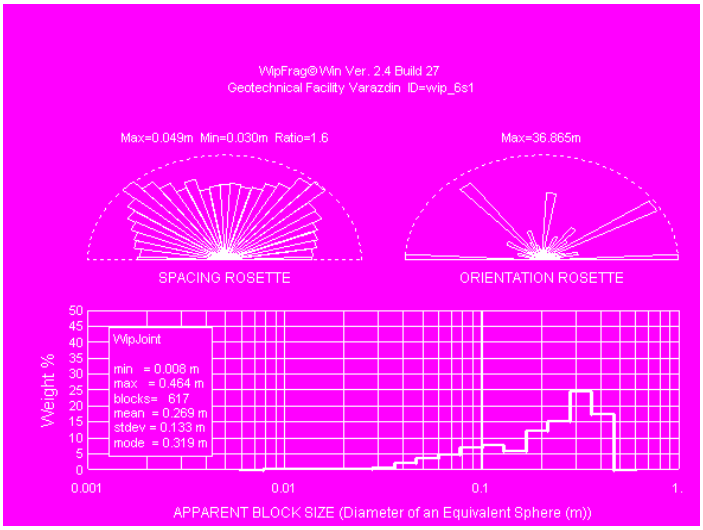
Refractory seismic defining the velocity of longitudinal seismic waves, for a long time was a background for determining of break line and blasting effects.

In certain rock mass types, velocity of longitudinal seismic waves indicate a very good correlation with average rock blocks separated by natural discontinuities.



Slika 1. Depeth sizmic section

Slika 2.Rockmass ckaracterisicts including structural feature recognition, and fragmentation size distribution with the use of WipFrag software



Slika 3.Apperent block size

3.2. Bitumen

Bitumen is grimly dark, at normal temperature in the solid, completely soluble in carbon sulphide (CS2). It can be found in the nature or received by the processing of oil and its derivatives. On the basis of penetration (penetration depth) is divided into seven types:
BIT 200, BIT 90,BIT 60,BIT 45,BIT 25 i BIT 15.[10]
In consideration of small dispersion of natural bitumen, the needs of the travel industry for bitumen are satisfied by fractional oil distillation or natural oil.
Depending on the permit, bitumen can be divided in:

- distillate bitumen, which is obtained by distillation of oil
- a highly vacuumed bitumen
- bitumen for industrial purposes

3.3. Fillers

Chargers are stone flour square that pass trough sieve of 0.09 mm in the minimum percentage of the amount of 80%. Granule metric composition bellows this value is available only by rinsing or blowing the microscope. Cubic metre of filler has a weight of at the least 1250 kg/ m_3. Filler applied in the production of asphalt should not contain any in gradients soluble in water, not to react with water.

4. ANALYSIS OF ASPHALT COST

For the analysis of prices of asphalt were taken primarily material costs: fractions, fillers, bitumen and fuel. Price list of material were taken from December, 2009, from quarries limestone: Gramat Gracanica, Terakop Zivinice, Ingram Srebrenik, Stupari and etc. and eruptive origin spiliti from Vares.
Price filler taken from coke chemical factory Lukavac while the price of bitumen were taken as the average values of Pancevo, Sisak and Mol Refinery in Hungary and Austria. Basic production costs were taken as transmission and fixed costs. The calculation started with the

assumption that the work on the new base asphalt capacity 100 t/h the planned annual production of 40,000 t. of all the quarries were taken certificates and recipes for the production of asphalt concrete 16 where the percentage contents some fractional parts taken from the certificates issued by Institute for transport and the Faculty of Civil Engineering University Sarajevo.

Table 2.Analysis of asphalt cost

Materials	*e:*		*Price :*	*Sum*
Fraction 0-4	*44*	*%*	*18.5*	*8.14*
Fraction 4-8	*21*	*%*	*18*	*3.78*
Fraction 8-16	*27*	*%*	*17*	*4.86*
Filler	*3*	*%*	*50*	*1.65*
Bitumen	*5*	*%*	*600*	*40.00*
Petrol	*7*	*lit.*	*1.87*	*12.60*
			TOTAL:	***71.30***

Producing costs

Table 3.Combine costs

Asphalt base and termosilos					
1.Consumption of electricity:	*400*	*500*	*Kw/h*	*0.2*	*40,000*
2.Lubricant:	*400*	*0.9*		*8*	*2,880*
3.Other 1% (1+2)					*428.8*
			TOTAL:		***43,308.8***
Loader					
1. Petrol:	*400*	*0.87*		*22.4*	*16,755.20*
2. Motor oil	*400*	*8*		*0.5*	*1600*
			SUM:		***18,355.20***

Total of combine costs: ***61.664***

Fixed costs:

Table 4.Asphalt plant and termosilos *Buying price* *2.000,000*

Amortizacija %	*10,00*				*200.000*
Investing maintance %	*2,00*				*40.000*
Current maintance %	*3,00*				*60.000*
Insurance %	*0,5*				*10.000*
			TOTAL:		***310.000***

Table 5.Loader *Bying price* *100.000,00*

Amortizacija %	*12.5*				*12,500*
Investing maintance %	*6.25*				*6,250*
Current maintance %	*6.25*				*6250*
Insurance %	*0.6*				*600*
			TOTAL:		***25,600***

Fixed cost in total: ***335,600***

PLANNED ANNUAL PRODUCING t:	***40,000 t***
Costs of testing material, certificates attests and salaries of employees	***1.50***
PRODUCTION PRICE OF ASPHALT KM:	***82.73 KM***

Analysis of stone aggregate costs from stone-pit Gramat Gracanica is shown in the table above and the other prices of asphalt from others stone-pits are calculated at the same way. In that way we got asphalt costs of limestone: Gramat Gracanica 82.73 KM, Terakop Zivinice 79.84 KM, Sevarlije Doboj 84.18 KM, Ingram Srebrenik 86.69 KM, Pritoka Bihac 79.19 KM, Hrnicici Velika Kladusa 83.13 KM, Dzehvarusa Cazin 87.15 KM, but asphalt costs if eruptive origin aggregate are higher. [5,6,7]

5. EXAMPLES OF EXAMINATION OF SLIPPERY AND WEARING OFF OF FINAL ROAD CONSTRUCTION MADE AND BUILT ON ROADS IN B&H BY A METHOD OF SANDNBLASTING

Table 6:The results of testing of asphalt made of spiliti from Bares and diabaz from Ribnica and Trnava .

Pattern	*Distance of the edge of line (m)*	*Pojedinična vrijednost ispitivanja metodom pjeskarenja*					*Approx. value (mm)*	*Air temperature °C*	*Asphalt temperature °C*
V-1	*1.00*	*1.15*	*1.09*	*1.17*	*1.06*	*1.10*	*1.11*	*30.00*	*32.80*
V-2	*1.00*	*1.40*	*1.46*	*1.43*	*1.49*	*1.37*	*1.43*	*29.20*	*33.90*
V-3	*1.00*	*1.35*	*1.20*	*1.30*	*1.15*	*1.25*	*1.25*	*32.30*	*42.50*
R-1	*1.00*	*1.28*	*1.22*	*1.29*	*1.71*	*1.22*	*1.23*	*33.70*	*43.50*
R-2	*1.00*	*1.88*	*1.75*	*1.69*	*1.87*	*1.88*	*1.80*	*29.70*	*31.20*
R-3	*1.00*	*1.48*	*1.84*	*1.44*	*1.22*	*1.14*	*1.43*	*37.00*	*45.80*
T-1	*1.00*	*1.33*	*1.22*	*1.36*	*1.16*	*1.36*	*1.29*	*28.80*	*31.20*
T-2	*1.00*	*1.19*	*1.17*	*1.08*	*1.12*	*1.14*	*1.14*	*29.40*	*31.80*
T-3	*1.00*	*1.96*	*1.90*	*1.84*	*1.86*	*1.92*	*1.90*	*29.40*	*31.80*

The tables show the results of testing of pavement roughness structure by blasting methods measuring the stock given the notice certain irregularities (various cracks, dust, irregularities, etc.). In order to obtain representative results measurement was done at five different points in the range of one meter. Testing of roughness of aggregate from Vares has been done on a main Road M 4 in Gracanica, Lukavac, Doboj Istok; the same examination about igneous aggregate from Banovici has been done on Main Road M 18 in Zivinice and Djurdevik and the same one about aggregate from stone-pit Trnava has been done in Gradiska. All asphalt roads has been done in a period 2001-2002 and each of them has an attest and regular documentation. [2,3,4]

6. CONCLUSION

Genesis of rocks or a rock type that is used for producing asphalt had a crucial importance which directly affects the durability of road construction when it comes to asphalt mixture of the same species. In the production of asphalt in the asphalt base there is a technologies dosage correct recipes certain percent of the required mass of individual fractions of aggregates in almost ideal conditions. In this case spreading and dosing may have

consequence son the quality and therefore the durability of asphalt built. The highest durability asphalt gets from small-grainned eruptive stone grains.The highest durability of road construction has been got from small eruptive stone granules. For example: the highest durability and roughness is on the asphalt road AB 16, which is made from eruptive origin aggregate spiliti from Vares. The less lasted road construction has been made from stone-pit Terakop Zivinice , on the part of the road Zivinice-Lukavac. Stone granulation for making asphalt concrete eruptive origin from quarries Vares.(spiliti), Ribnica (diabaz) and Trnava (diabaz) have a high reference for use in the final layer of road construction large peak loads in all categories of road.

7. LITERATURE

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