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CONSTRUCŢII. ARHITECTURĂ

A DIFFERENT APPROACH OF THE ADHESIVENESS OF BITUMENS TO AGGREGATES

BY
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The estimation of the capacity of coverage in the laboratory may be made visually as well. The operator's subjective perspective, the angle of view, the luminosity, the nature and colour of aggregates are many factors that may influence the result. The computer-assisted image analysis qualifies and quantifies objectively enough the capacity of coverage of bitumen on aggregates, removing any exterior influences. It is a simple, repeatable and reproducible used method.

1. Introduction

The methods usually used in determining the adhesiveness of bitumen to aggregates were classic, standardized, but, besides these methods, many researchers tried to use the new, non-destructive but unpopular method, which is the computer-assisted image analysis.

This method was proposed by two French engineers, E. C o r n e t – ESSO researcher engineer and C. D e n e u v i l l e r s – chief of the SCREG Department [1].

Analysing and assessing wetted materials in the laboratory is not an easy mission. They are based especially on the expert opinion (assessment) of the technician that performs the assays, even if some of the mechanical characteristics are quantified or standardized. Very often, before being submitted to mechanical tests, the wetted materials are selected in the laboratory, especially depending on their aspect, and the manufacturing conditions are not always perfectly defined. In addition, the illumination conditions, the intrinsic tint of the aggregate, its granulometry (which draws colour heterogeneity), the operator's subjective evaluation, the angle from which the sample is observed, are factors that influence the result of the evaluation regarding the quality of the wetted materials.

In order to suppress the effect of these parameters, the computer-assisted image analysis proves to be a fully adapted assessment means. Truly, these technique allows fixing the light and view angle, and the effects of the operator's subjectivism and the nature of the aggregate (the latter is first analysed alone) are eliminated.

The manufacturing conditions need to be simulated (allegation energy and duration, temperature of the components and of the environmental air, humidity, type of blender, order and speed of introducing components, sizes and types of container in which the sample is placed after wetting, quantity, temperature, relative humidity,

The cold (hot) application of the computer-assisted image analysis to wetted materials allows to quantify the coverage capacity of an emulsion (or a bitumen) to an aggregate, the proportion of wetted surface regarding the intensity of the obtained tint, parameter related to the thickness of the bitumen film.

2. Equipment and Sample Processing (in the Laboratory)

The image analysis device is made of a digital camera with a 7,954,400-pixel resolution, a white light system and an image interpretation soft (a programme). The angle and the camera-sample distance are constant.

Were used the samples processed to determine the quantitative adhesiveness, as well as to take digital photographs (which was interpreted then by means of the computer).

The used laboratory method was that of the adhesiveness of bitumens for roads to natural aggregates – quantitative determination method [2].

The samples have processed effectively according to STAS 10969/3-83. Were weighed 250 g of 5/8 sort natural aggregate in a porcelain capsule and 12.5 g bitumen in another capsule. The capsules were introduced in the stove and heated at 140°C, thus used D70/100 bitumen for all samples.

After heating were introduced 250 g natural aggregate in the bitumen capsule and energetically mixed with a spittle until it became homogeneous. The capsule has took off the balneum and the mixing continued until the bitumen film stopped dribbling from the natural aggregate surface. Then the mixture was put in a Berzelius glass, covered it with a watch glass and let it chill to the room temperature, for one hour. After chilling, was poured 25°C distilled water onto the composition. The water level should exceed the composition level with 7/8 cm. The glass was covered again and left to rest at the room temperature for 24 h.

In the glass container of the re-circulating device was put the sifter 1/3 away from the container bottom. 250 g of 5/8 sort natural aggregate sample have layed on the sifter. Also, were added 1,300 cm^3 Brilliant Red colourant solution of the set concentration (C) and started the recirculation (the recirculation lasts for 90 min for one sample). The operation repeated as well for the aggregate samples covered with bitumen.

Then, was sampled 20 cm^2 recirculated colourant solution that had the C_1 concentration for the non-wetted aggregate and the C_2 concentration for the bitumen filmed aggregate.

The sampled colourant solutions are separately analysed spectral-photometrically. The extinctions and the value of the C_1 and C_2 concentrations of the solutions are determined from the calibration plot. The adhesiveness (S_n) is calculated according to the relation

$$S_n = 100 - \frac{C - C_2}{C - C_1} 100, \quad [\%],$$

where: C is the initial solution concentration, [%]; C_1 – the solution concentration

after recirculation on the natural aggregate, [%] and C_2 – the solution concentration after recirculation on the bitumen-filmed natural aggregate, [%].

In the event no other technical conditions are specified, the adhesiveness of the bitumen/emulsion to natural aggregates is deemed correspondingly if its value, determined by means of the most unfavourable method, is of 80% at least. If it does not reach this value, additives must be introduced in order to improve the adhesiveness value.

After recirculation it has been took out the bitumen-filmed aggregate samples, let them dry, then photographed them with a digital camera with 7,954,400-pixels resolution. It has kept an equal distance between the object glass and each analysed sample, and in order to remove the shades were used two small projectors (150 W each) placed correspondingly. The angle and camera-sample distance are constant.

3. Interpretation Programme

The image interpretation programme is called PHP (hereinafter referred to as the PHP *programme*) includes, among other things, the "image function library". The programme reads the input image pixel by pixel, taking the RGB values and comparing them with the reference ones. If all values are lower (we are interested in dark colours), then the respective pixel is counted and marked with a special colour, in order to visualize the result.

In each rolling, the script checks which the parameters are and if they do not fit, the image folders are displayed on the screen (it reads all the folders from the file and/or filters them, leaving only the jpg.s) and the three values for the RGB (red, green, blue) superior limit that may be set. If the "saving parameter" are RGB values saves the new values, and the "image parameter" starts the processing, that is read the image length (x-, y-sizes) on rows or columns (regardless of the order). The image is practically a matrix, a two-dimensional (vector) panel. The RGB is extracted from each pixel and is transformed in integer values (values in integral numbers) separately for R, G, B (the function of the "library" reveals it in hexadecimal form) and compared each of them with the reference ones.

If all the three values are lower, then the pixel corresponds to the requirements (dark colours have values close to 0 and the light ones have values close to 255, which is the maximum value and corresponds to white). If the pixel corresponds to the requirements, it is counted (the counter is "increased" with 1) and saved to the memory with a new special colour.

After it has checked the entire photograph (that is all the pixels), the image in the memory (with the pixels found and marked with a new colour) is saved on the disk. It can be noticed that for each image there is a number of pixels found for a certain RGB (that corresponds to a very dark hue) and the total number of pixels (7,954,400) corresponding to each image. The registered percentage is found by reporting the number of pixels counted by the programme as corresponding to the total number of pixels and represents actually the adhesiveness found through this procedure.

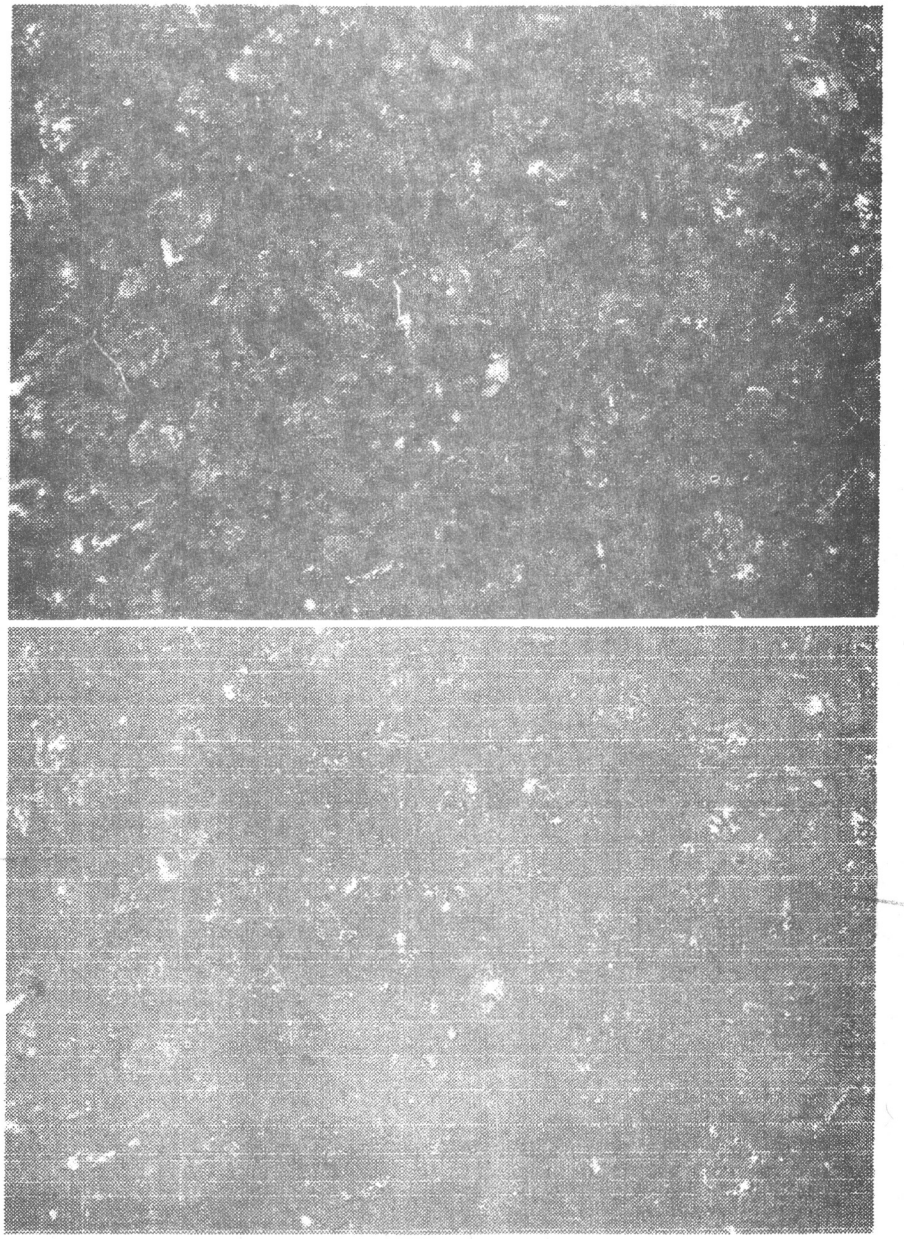

Fig. 1.– Found 6,334,558 pixels for R:130, G:130, B:130;
79.635899% by 7,954,400 pixels.

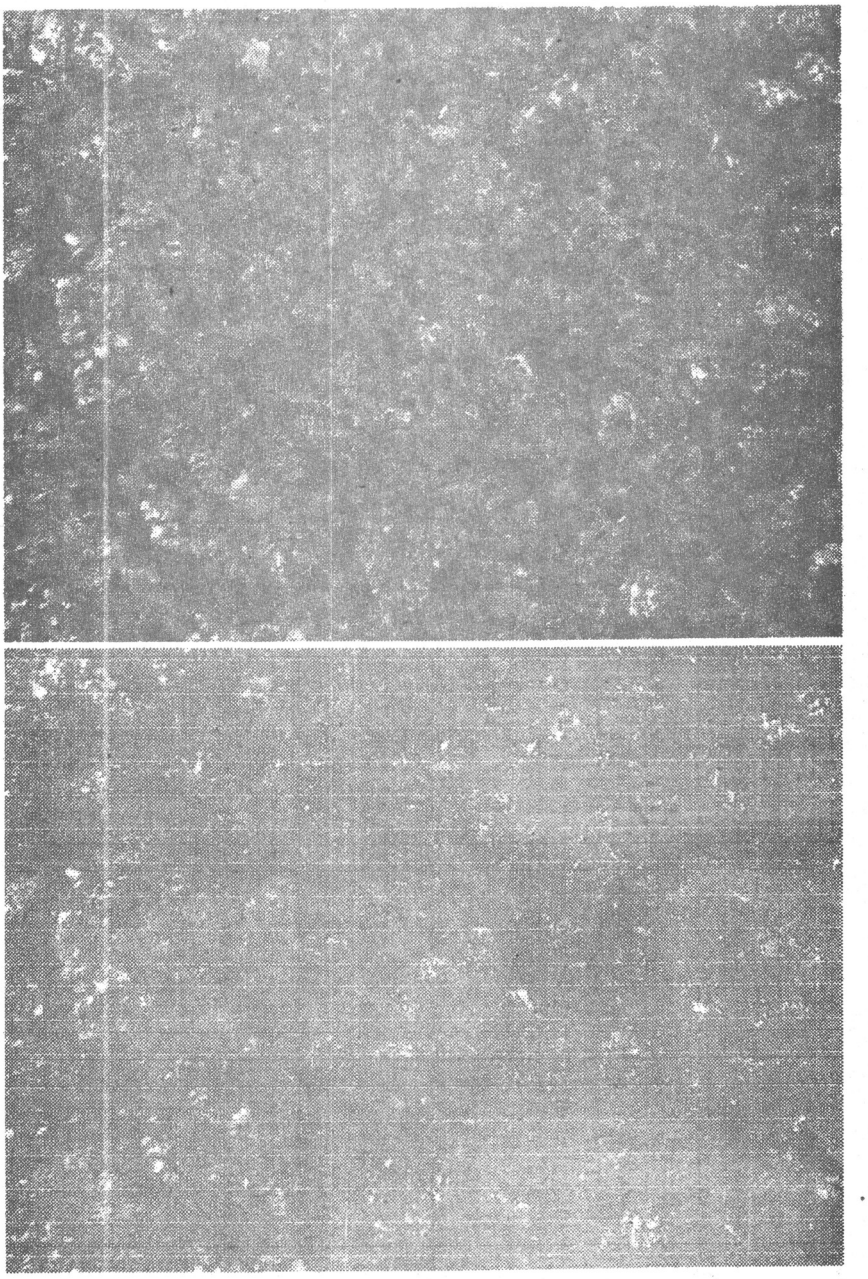

Fig. 2.– Found 6,300,876 pixels for R:130, G:130, B:130;
79.212461% by 7,954,400 pixels.

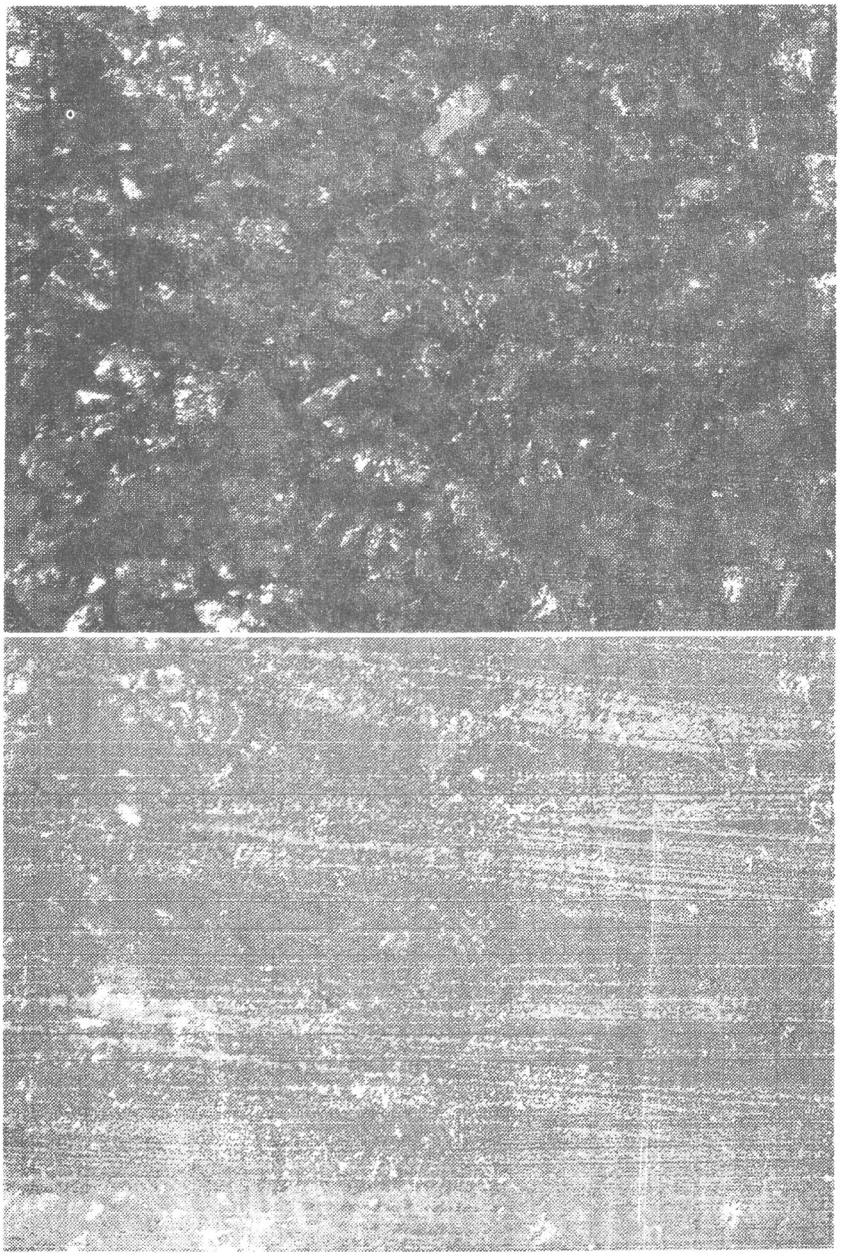

Fig. 3.– Found 6.292,459 pixels for R:130, G:130, B:130;
79.106645% by 7,954,400 pixels.

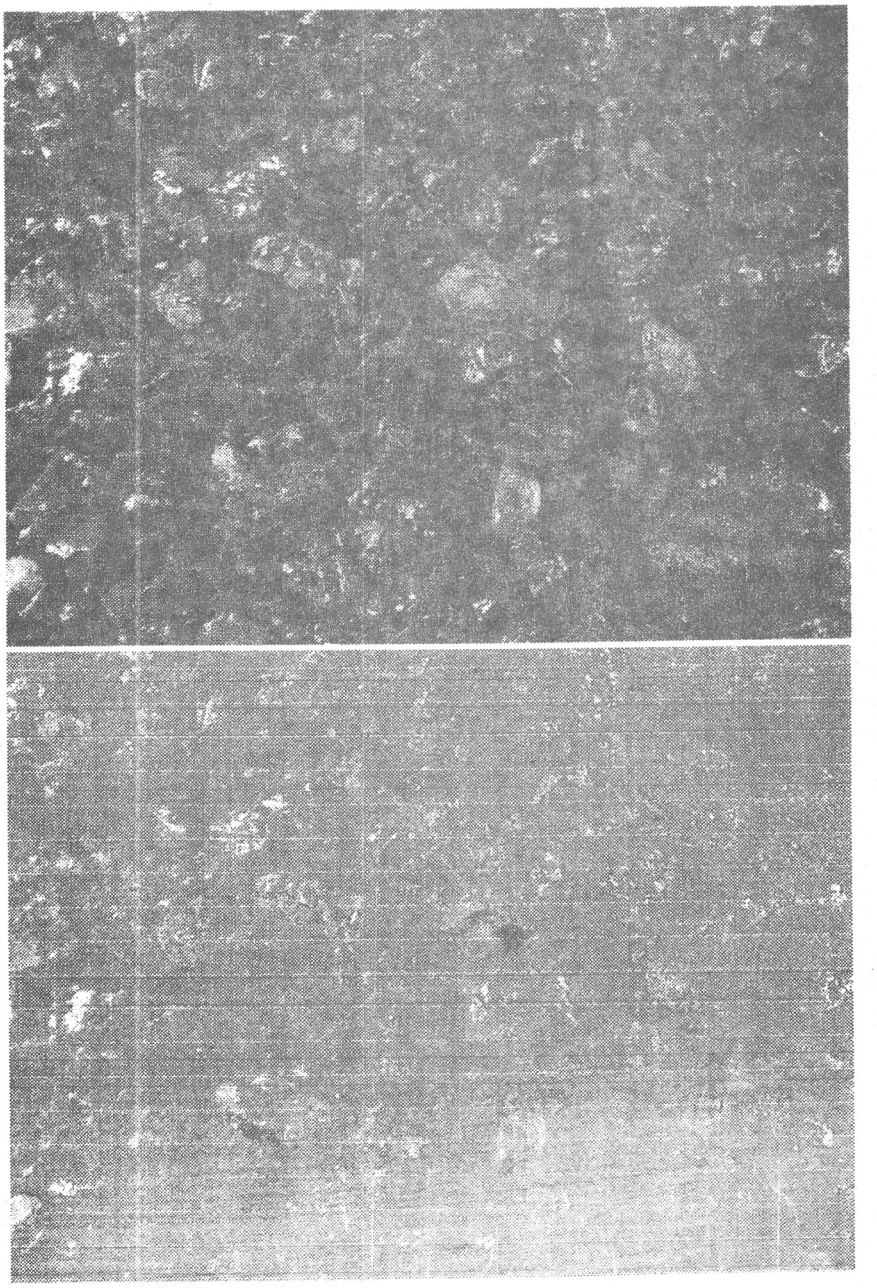

Fig. 4.– Found 6,164,505 pixels for R:130, G:130, B:130;
77.498051% by 7,954,400 pixels.

Table 1

Image	Quqntitative adhesiveness	PHP method adhesiveness	Bitumen	Aggregate 5-8
Fig. 1	74.03	77.63	B + 0.3% adhezive	Dornişoara
Fig. 2	67.33	79.21	EKO	Dornişoara
Fig. 3	74.60	79.10	Piteşti	Iglicioara
Fig. 4	52.40	77.49	ESSO	Dornişoara

4. Conclusions

The computer-assisted image analysis is a simple use means that allows qualifying and quantifying objectively the wetting capacity of a mineral skeleton by a bitumen or an emulsion.

As indicated in the Table 1, the obtained results – except for a few – fit the $\pm 5\%$ deviation foreseen by STAS.

There are differences between the samples that contain pure bitumen and those for which additived bitumen was used (adhesiveness improvement is visible, regardless of the used method).

The results obtained using this method are repeatable and reproducible and allow the elimination of a certain number of parameters that usually distort the reasoning regarding the capacity of coverage of bitumens (hot coverage in what concerns wet materials). These parameters, as it has been mentioned, are the luminosity, the operator's perspective, the nature and colour of the basic aggregate, etc.

Using the computer-assisted image analysis is for the time being at the level of research, but other current studies in the field of construction materials and other fields, may be taken into account in the research development.

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O ABORDARE DIFERITĂ A ADEZIVITĂŢII BITUMURILOR LA AGREGATE

(Rezumat)

Metodele folosite mereu pentru determinarea adezivităţii bitumului la agregate au fost cele clasice, standardizate, dar pe lângă acestea se poate folosi una nouă, nedistructivă, dar neagrementată şi anume analiza de imagine asistată de calculator.

Aprecierea puterii de acoperire în laborator se poate face şi vizual. Ochiul subiectiv al operatorului, unghiul de privire, luminozitatea, natura şi culoarea agregatelor sunt tot atâţia factori care pot influenţa rezultatul. Analiza de imagine asistată de calculator califică şi cuantifică în mod destul de obiectiv puterea de acoperire a unui bitum pe agregate, îndepărtând orice influenţe exterioare. Este o metodă simplă de utilizare, repetabilă şi reproductibilă.