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Innovative Use of Torcreting (Guniting) for Repairing Wearing Surface of Roads

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Abstract

The paper presents the research in laboratory conditions and the analysis of the benefits that could be brought by the transfer into the road repairs of the technological concept currently used in the field of civil and industrial constructions for buildings repairs and consolidations, namely the guniting procedure. We analyzed the influence of the deposition under pressure of the asphalt mixture layer, in order to highlight if further compaction, vibration and jointing operations are needed, which would increase the costs of the works. The results are gratifying and we bring this procedure to the attention of the road maintenance authorities, as it has similar results to the current procedures, but with low costs.

Keywords: Guniting procedure; IR technology; Nozzle; Mixture jet; Sandblasting

Introduction

The preventive maintenance works of the roads are carried out in a sequence of steps, focusing on accomplishment of quality works, observance of the technical standards in force, the timely performance of the works, their quality, low costs and environmentally friendly technologies. The material used to achieve the maintenance works for the reconditioning of some areas in road wearing surface is the asphalt mixture that must meet the quality conditions according to the technical standard AND 605/2016 in Romania [1].

The wearing surface, an important part of the road structure, is the upper part of this one, having the role of resistance to the tangential forces of the traffic (weight of motor vehicles), environment etc. At the same time, the wearing surface must have an efficient roughness to ensure safe traffic and good sealing against the ingress of the rainwater into the structure of the roadway. The research paper starts from the presentation of the current technologies for the repair of the wearing surface using the process of cold or hot coating with asphalt mixtures and compaction and reaches the presentation of a new technological process taken from the field of the civil and industrial constructions-pressure coating with asphalt mixtures of the damaged area, followed by a surface leveling operation by superficial sandblasting [2].

Operations currently performed on the wearing surface

Damage occurred in the wearing surface (Figure 1), especially in winter and spring, lead to a slowdown of the traffic, to the diminution of traffic safety measures and to the wear and tear of the motor vehicles.

Figure 1: Damages to the wearing surface.

The traditional technologies for laying the asphalt mixture in the affected areas are carried out as follows:

A. The affected area of the wearing surface in the roadway is determined and measured.

B. The affected area is cleaned, stripped and primed, as a zone and perimeter.

C. Application of asphalt mixtures by gravity flow and compaction of the affected area.

The material used to repair the potholes in the wearing surface is heated in special units consisting of devices for proportioning, sorting, mixing the aggregates with bituminous binder. The temperatures necessary for the preparation of the asphalt mixtures are specified in the standards or in accordance with the manufacturer's data sheet. For example: in the case of the 35/50 bitumen, the temperature is in the range of 150-170 ºC and the aggregates are in the range of 140-190 ºC; it results a material with a temperature ranging from 150 to 190 ºC when going out from the mixing machine. The temperatures of the asphalt mixture must have a small loss per unit time, in order to maintain the characteristics at application. One must take into account that the temperature of the applied material must be in the range of 145 ºC at the pouring and 110 ºC at the end of the pouring. In order to determine the characteristics of the cast material, samples must be taken for laboratory verification [3-6].

When verifying the samples, the composition of the applied material and its physical chemical characteristics must be taken into consideration. The current repairs are performed by classic or modern technology, using radiant panels with infrared rays-IR, Figure 2. Current repairs have a limited efficiency or they are costly, (Figure 2).

Figure 2: Wear layer repair operation (classic - a, with IR technology- b).

Implementing guniting technology to repair holes in the wearing surface

We analyzed and implemented at laboratory level the technology applied in the civil and industrial construction industry (consolidation repairs) for the repair of medium size holes in the wearing surface of the public roads. In the construction industry, this procedure is called guniting and is performed by means of a special equipment and dry/wet material, by applying it on the vertical surfaces to be repaired, Figure 3.

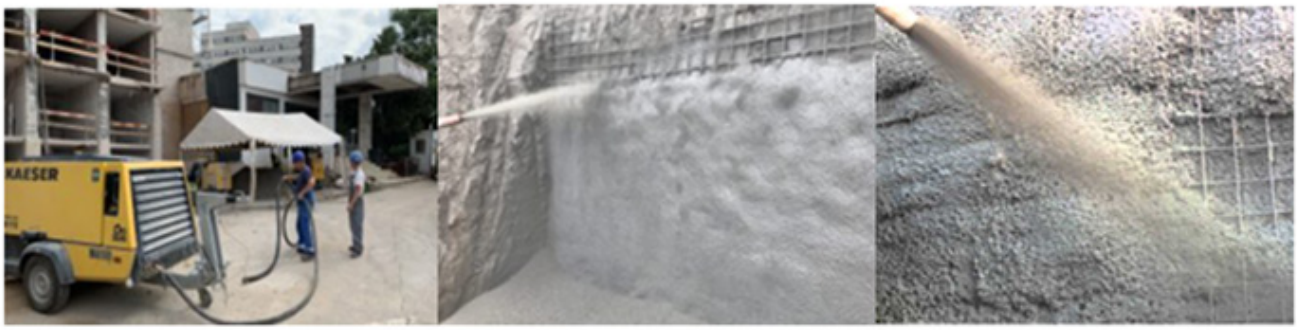

Figure 3: Guniting process and equipment for wall reinforcement.

We took over this technology and we started to study the possibility of applying it to the repair of the potholes in the roadway. The followed steps consisted of taking a piece of material with the composition of the wear layer (Figure 4); making several holes (a) to allow the introduction of the asphalt mixture under pressure (b); cutting (c) through the depositing area for study. After cutting the plate, we notice a compact and uniform structure of the deposited material, the lack of gaps and a good adhesion with the edges of the wear (Figure 5). After inserting the asphalt mixture under pressure, with a medium granulation after cooling, a fine sandblasting process is performed, in order to achieve an efficient roughness.

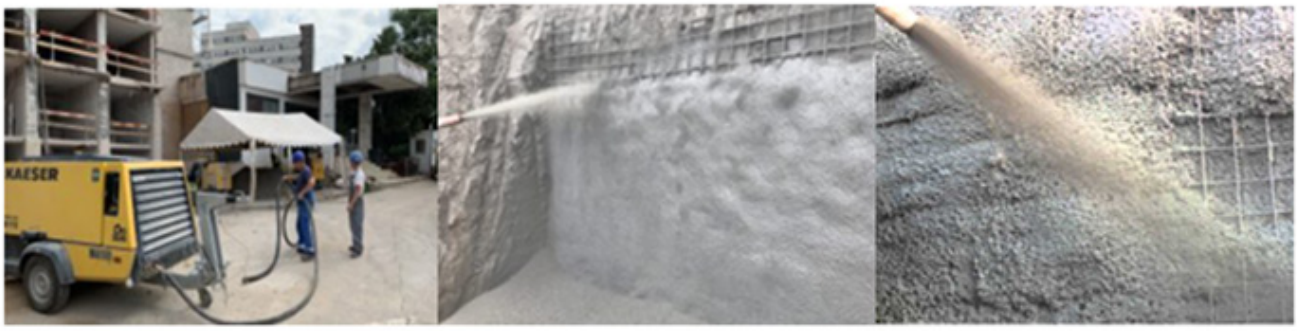

Figure 4: Wearing surface after applying the guniting operation (a-holes, b-mixture, c-cutting).

Figure 5: Section in the area of the deposited material.

The research carried out highlights a direct proportional dependence between the force of application of the asphalt mixture in the affected area and the granulation of the composition. The priming of the affected area remains efficient, but the mechanical tests show a direct connection between the force with which the asphalt mixture is deposited and the efficient embedding of the material, if it is placed in 2 layers at least, keeping a temperature of about 135-150 ºC. In this case, the material has a good compaction, with no need for other technological operation. The tests performed and listed in Table 1 prove that the deposited material does not lose its characteristics by the injection method.

Table 1: Characteristics of the Asphalt Mixture.

Test	Um	Initial Characteristics	Characteristics after Laying
Softening point	^{0}C	82	80
Penetration at 25 ^{0}C	l/10mm	43	40
Elastic recovery at 25 ^{0}C	%	91	87.5

The analysis from an economic point of view showed a decrease of the total expenses, by eliminating the compaction operation, by reducing the manpower and the execution time, keeping the parameters specified in the standards. This procedure will be

tested on a road that needs repairs, after multiple tests that will be performed in the laboratory of CESTRIN-Romania.

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