INFLUENCE OF CONCRETE SKIN ON DE-ICING SALTS RESISTANCE

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Introduction

Many leading experts agree on the importance of monitoring the "concrete skin" as the most loaded area affected by the external environment. Surfacing, concrete mixture composition and curing are of great importance for the concrete surface resistance. The paper introduces an experimental program focused on the monitoring of de-icing salts resistance, depending on surface roughness [1]. Quantitative evaluation of the concrete surface was performed by using confocal laser scanning microscopy, which is the new generation of optical systems that are able to make all measurements in 3D resolution. These measurements are supplemented by results of mechanical tests and measurements of surface absorption.

Measuring methodology

Some opportunity of objective and quantifiable evaluation of concrete surface is offered by a confocal laser scanning microscope LEXT OLM 3000, which we use for different types of observations and measurements. Confocal laser scanning microscopy represents a new generation of optical systems with the high accuracy, 3D projection and measuring. It offers new possibilities for development and control of various materials and components.

It allows also 3D observation and highly accurate 3D measurement in a real time. Owing to an excellent resolution 0,12 □m and an range of magnification 120x - 14 400x the LEXT is assigned directly to research workers that work between limits of common optical microscopes and scanning electron microscopes (SEM). Apart of a situation in SEM any sample can be put directly on the microscope table without pre-preparation. Confocal microscope is suitable ideally for ultra-detailed observation of surfaces and measurements that are necessary during production of micro-devices, such as MEMS (Micro Electro Mechanical System), during development of new materials and also at contemporary compact devices during a spatially more compacted surface installation. Install software of microscope makes it possible computation of overall 15 parameters. With regard to correlation under each quantity, we can afford a simplification, which consists in selecting of generated quantities. In this case were chosen after previous experiences for evaluation only one parameter - arithmetical middle height (a).

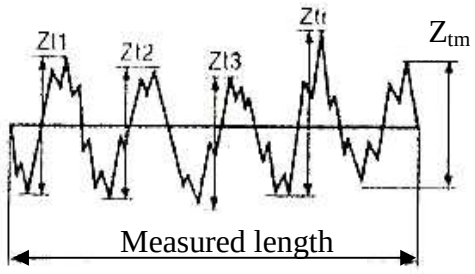

Fig. 1 Used surface measuring parameter - arithmetical middle height [2]

In experimental program we focused on observation of influence on de-icing salts resistance in relation with surface morphology measured by laser confocal scanning microscopy. De-icing salts resistance was measured by ČSN 73 13 26 – C method on block specimen with edge 200mm and high 75mm, which were cut from the panels with base 150/400mm and height 700mm. Load cycle rests on embedding of measured surface by 3% NaCl by temperature – 18°C of circulating air during 3 hours and then refrosting period with +5°C during other 3 hours. The surface waste is caught and salt solution is changed. When surface waste of the specimen is dried-up, general waste is determined in g/m^2.

Table 1 Concrete mixture composition

Mixture		M30	M40
Concrete component		Weight [kg/m^3]	Weight [kg/m^3]
Cement CEM I 42,5 R		400	400
	0-4mm	930	930
aggegate:	4-8mm	315	315
	8-16mm	600	600
Plasticizer		3	2
Water		180	180

Table 2 Surface properties of mixture M30

Separation agent application	Thin film	Spray	Without s.agent
Arithmetical middle height [ηm]	3,9756	4,5345	5,6886
General surface waste after 25 cycles [g/m^2]	407,8	377,6	241,8
Surface absorbability after 5 minutes [g/m^2]	175	237,5	112,5

Table 3 Surface properties of mixture M40

Separation agent application	Thin film	Spray	Without s.agent
Arithmetical middle height [ηm]	6,1288	5,1367	3,6911
General surface waste after 25 cycles [g/m^2]	319,4	317,2	223,5
Surface absorbability after 5 minutes [g/m^2]	325	337	312,5

From microscopy results is evident different surface properties on samples. Small differences are just in the way application of separation agent, according to earlier attempts have been confirmed, that an ideal way of applying is a very thin film. When using the spray to the formwork is applied surplus of separation agent and the surface layer is so unduly diluted. Test of de-icing salts resistance is very popular for durability comparison. The measured data from experiments confirmed the influence of surface structure to durability of concrete. Quite interesting results were achieved at the surface with no application of separation agent [3]. These surfaces showed the best resistance to action of de-icing salts. Used separation agent is on base of degradable oil. Impaired surface resistance is caused by the resultant evaporation of the part of oil and creation of subsequently capillary system, which means additional access roads for aggressive medium. For the evaluation of surface structure influence on de-icing salts resistance were used measured values only after 25 freeze-thaw cycles, because the greatest impact is on the beginning of measuring. Other waste evolution has usually linear character, that's why final values were not included.

Conclusion

The experiment demonstrated marked deterioration of surface layer properties due to the use of separating agent. The obtained data implies the recognition that for the higher resistance of the concrete surface is much better application to minimize the amount of resources, otherwise, there are undesirable deterioration of durability. This assumption was confirmed by measurements of surface absorption after 5 minutes. Similar experiments were provided with other fluids, like oil or ethanol. Results corresponded very well with the visual observation, so with using immersion vibrators is final surface smoother and in this case closed to penetrating of various aggressive medium.

References

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