Properties of selected polyurethane sealants in the sealing of cement-based materials

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INTRODUCTION

Our society has been cementing materials practically since the beginning of construction history. We still need to bond various materials together today, and we can see cemented joints virtually everywhere. Naturally, cemented joints have developed over time, but now we have shifted from the original natural materials to the area of the chemical industry. Due to the significant expansion of the chemical industry, great advances have been made in the development and application of sealants in the field of cemented joints over the last two decades. [1]

Cement joints are now a common part of the building industry, and we could not imagine modern construction without them. Their main aim is to prevent substance exchange between the construction materials and external environment. They also ensure thermal and sound insulation, and some even contribute to the construction's fire resilience. [2] We can find them virtually in all parts of building constructions, for example between prefabricated concrete elements in façades, around windows and doors, in the joints between floors and walls etc. Even though we can find cemented joints in various places, it is evident that different demands are imposed on different joints. So obviously there are significant differences between the individual cemented joints. [2,3]

And as a result of the different demands on cemented joints, when designing a cemented joint, we have to take into account all the variables which might negatively influence the cemented joint. To the greatest extent these variables include external climatic influences. [3] If we assume that a cemented joint will be exposed to external climatic influences, it is necessary to select a sealant where the manufacturer states that it is resilient to negative climatic phenomena. On the Czech market, there is really a huge number of different sealants from different manufacturers, which differ in terms of quality and price. This can make it difficult for the regular user to navigate such an extensive offer and choose the right sealant. And this situation is also complicated by the fact that the manufacturer's recommendations concerning resilience of the sealant do not always correspond with reality. This is another reason why the following research was undertaken, which is intended to compare the regular sealants available on the Czech market and their properties after exposure to negative climatic influences.

MATERIAL AND METHODS

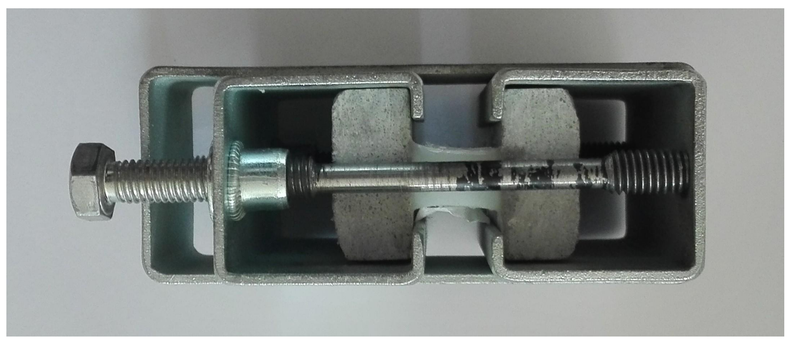
For the purposes of this research it is necessary to select the base material, sealant recommended by the manufacturer for the needs of cementing the selected base material, and a suitable primer.

The decisive factor for choice of the material used in this survey is how difficult the material is for the creation of cemented joints and its availability on the Czech market. Glass reinforced concrete was selected as the base material based on these criteria. This material has a large number of dust particles on its surface which greatly weaken the cohesion between the sealant and its surface layer. This property should be in part improved by the application of a primer before the actual sealant.

For this paper, three polyurethane sealants available on the Czech market and primers recommended by the manufacturer were selected.

The test methods described in this article are based on the valid Czech technical standard ČSN EN ISO 8340 Building construction - Sealants - Determination of tensile properties at maintained extension. This standard gives a precise definition of the test body and a precise tensile test procedure. But it does not precisely define the test rig.

Fig. 1 Stretching of the test specimen



RESULTS

Tests were performed on five test samples of each sealant. The evaluation of the test results was performed by a visual inspection of the test sample and then measuring using a calliper. For greater transparency of result evaluation, the testing is divided into two sections - testing at the temperature of (23 ± 2) °C and testing at the temperature of (-22 ± 2) °C, the test results of which are recorded in a clear tables. Tables contain an evaluation of the joint between the sealant and the base material, and any breakage is described.

Table 1. Test according to ČSN EN ISO 8340
at temperature of (23 ± 2) °C

Type of sealant	Polyurethane sealant					
	Sealant A			Sealant B		
Base material	No	Joint	Breakage	No	Joint	Breakage
Glass reinforced concrete	1	Failed	one-sided separation when stretched by 25 %	1	Failed	one-sided separation when stretched by 25 %
	2	Failed	one-sided separation when stretched by 25 %	2	Failed	one-sided separation when stretched by 25 %
	3	Failed	one-sided separation when stretched by 25 %	3	Did not fail	none
	4	Failed	one-sided separation when stretched by 25 %	4	Did not fail	none
	5	Failed	one-sided separation when stretched by 25 %	5	Did not fail	none

ANALYSIS OF RESULTS, DISCUSSIONS

When testing samples at both (23 ± 2) ° C and (-22 ± 2) ° C, there is only one defect in the tested samples, namely one-sided separation of the sealant from the base material. This failure occurred along the entire length of the sealed joint and therefore the sealant must be evaluated as unsatisfactory.

When tested at a temperature of (23 ± 2) ° C, we can observe in the test results that sealant A shows much worse cohesion of the sealant with the base material than sealant B. In the first of these sealants, all tested samples are broken.

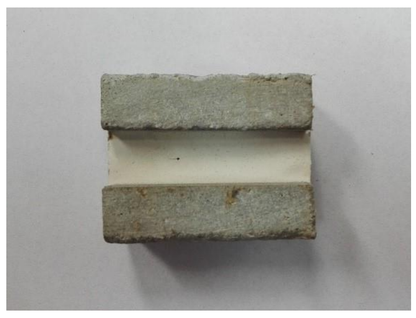
Also when tested at a temperature of (-22 ± 2) ° C, sealant A shows a clear failure of the sealed joint on all tested samples. Thus, sealant B generally shows better results in this particular test than sealant A, but none of them still passed rotation of the test specimen.

Table 2. Test according to ČSN EN ISO 8340
at temperature of (-22 ± 2) °C

Type of sealant	Polyurethane sealant					
	Sealant A			Sealant B		
Base material	No	Joint	Breakage	No	Joint	Breakage
Glass reinforced concrete	1	Failed	one-sided separation when stretched by 25 %	1	Failed	one-sided separation when stretched by 25 %
	2	Failed	one-sided separation when stretched by 25 %	2	Did not fail	none
	3	Failed	one-sided separation when stretched by 25 %	3	Did not fail	none
	4	Failed	one-sided separation when stretched by 25 %	4	Failed	one-sided separation when stretched by 25 %
	5	Failed	one-sided separation when stretched by 25 %	5	Did not fail	none

Fig. 2 Broken sample

Fig. 3 Intact sample



CONCLUSION

It is evident from the author's measurement that each of the tested sealants displays shortcomings when used for cementing the selected base material. As a result it must be stated that in spite of the recommendations given by the manufacturer and specified suitability of the sealant for cementing glass reinforced concrete base materials, none of the tested sealants can really be recommended as suitable for cementing.

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