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**PLASTIC AND RUBBER  
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**MATIERES PLASTIQUES  
ET CAOUTCHOUCS  
DANS L'ETANCHEITE  
DES CONSTRUCTIONS  
DU GENIE CIVIL**

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# A METHOD OF PROTECTION OF DRINKING WATER CONCRETE RESERVOIRS

Richard A. BARES                      Jan NAVRÁTIL  
Czechoslovak Academy of Sciences  
Prague, Czechoslovakia

## SUMMARY

Although the reinforced concrete used for the construction of potable water storage reservoirs is of high density and impermeability, it is necessary to protect their inner surface to prevent water seepage and provide smooth and easy-to-clean face.

The paper describes one type of protection paint coat on the epoxy-methylmetacrylate copolymer base which proved very well in practical applications.

## INTRODUCTION

In the construction of several big potable water reservoirs of reinforced concrete the owner required that the inner face of the reservoirs be provided with a protective coat to prevent the seepage of potable water into ambient ground in the places of possible local imperfections of concrete and/or shrinkage cracks and to provide a smooth, easy-to-clean surface.

The protective coat was to meet the following requirements:

- perfect bond with the concrete surface,
- perfect impermeability,
- smooth and easy-to-clean surface,
- sufficient impact strength and surface hardness,
- light colour,
- easy workability by means of brushes and spraying without any exacting additional treatment /e.g. heat treatment/,
- acceptable price /up to 140 Kčs/m<sup>2</sup>, i.e. 10 US \$ per sq.m/,
- hygienic safety after hardening,
- production of available home materials,
- durability and easy repair in case of damage,
- sufficient thixotropy.

For obvious reasons /particularly excellent bond with the concrete base and hygienic safety/ a material on the basis of epoxy resins was selected. The problem lay only in finding and applying their suitable modification which would maximally comply with the above requirements.

The application of epoxy resins to the painted or sprayed coats of masonry, particularly concrete, is connected with certain

difficulties. In dry environment perfect hardening of epoxy resin at a normal temperature /without the supply of additional heat/ is ensured by lower aliphatic polyamines /diethylenetriamine or triethylenetetramine/ in the capacity of setting agents. The course of the hardening reaction, which is accompanied by the generation of considerable heat /exothermic effect/, however, is very quick so that it not only shortens the period of the workability of the paint, but also influences unfavourably the properties of the resulting film and its cooperation with the base. Because of the speedy setting and hardening the resulting painted or sprayed coat retains residual stresses /due to the reaction shrinkage increased by the shrinkage due to the radiation of reaction heat/ which manifests itself as the brittleness of the film and represents the cause of the failure of the film/base system, when it is stressed mechanically or thermally.

The suppression of this behaviour of epoxy resin coats /films/ can be attained a/ by mild batching of the afore mentioned setting agents, b/ by the addition of plasticizers, or c/ by the use of other, special setting agents. A slower course of the setting and hardening of the resin and the facilitation of the self-deformation of the film reduce its residual stresses. However, without the subsequent subjection of the film to higher temperature these methods do not guarantee full hardening of the resin. Entirely unsuitable are these methods in the cases when periodic rinsing or permanent submersion of the film with a liquid are envisaged.

Water and aqueous solutions may extract from the film a/ non-reacted molecules of the resin /or penetrate into the film and make it swell/, b/ plasticizers, or c/ excessive quantities of special setting agents /batched in an overdose in the endeavour to achieve perfect hardening of the resin at a normal temperature/, to say nothing about the possible chemical /hydrolytical/ effect. The extraction of the film by organic solvents is even more intensive than the effect of water, as a rule, and the mechanical properties are impaired and the film fails within a shorter interval. With regard to the purity of the liquid the substances extracted from the painted or sprayed coat represent a contamination, this aspect coming to the fore

particularly in the case of potable water.

It has been proved that the afore mentioned difficulties are eliminated, if the epoxy resin is modified by the monomer of metacrylate. Such monomer, activated by 1-2% of dimethylaniline, decelerates the hardening of epoxy resin produced by lower aliphatic polyamines without preventing its complete hardening. This effect of the above mentioned monomer manifests itself even when the latter is added at the rate of 10% by weight of epoxy resin. In the film the metacrylate remains bound even if its quantity amounts to 25% of the resin/provided the contents of the diethylenetriamine or triethylenetetramine in the paint has been increased accordingly/. The addition of the metacrylate improves the application properties of the epoxy resin paint, particularly the mechanical properties /incl. the impact strength/ of the resulting film.

An example of the composition of the paint /in % by weight/ in accordance with the above conclusions is given below.

ChS Epoxy 15 /pure conventional resin on basis of bisphenol A-diglycidylether/	60
Monomer of methylmetacrylate /with 1% of dimethylaniline/	12
Thixotropic filler /Degusa 380 aerosil/	3
Pigments /microground/	12
Diethylenetriamine	7,5
Diluter /methylisobutylketone : xylene in the ratio of 1 : 2 by weight/	5,5

This paint was applied by spraying on a well sand-blasted and blown surface of concrete penetrated with an epoxy penetration spray 8 - 24 hours previously of the following composition / % by weight/:

ChS Epoxy 1200 /bisphenol A - diglycidylether resin plastified by 5% of dibutylphthalate/	28
Diluter /toluene: butyalcohol in the ratio of 1 : 1 by weight/	70
Diethylenetriamine /or a suitable amide-amine hardener/	2

The protective coat of the above composition was applied in 1974 - 1975 to approximately 20 000 m<sup>2</sup> of concrete surface and proved very well in performance. All requirements given at the beginning were fully complied with.