

Czech University of Technology in Prague

KLOKNER INSTITUTE

Metals - Concrete - Composite materials - Structural materials -
Loading - Mechanics - Reliability - Testing -
Diagnostics and reconstruction -
Measuring instruments manufacturing - Test labs and shops

N E K A P spol. s r.o. (Ltd.)

Vlaská 15

Praha 1

110 00

Your letter No./dated: Our No.: Administered by: Date:

Re: Tests of impermeability and resistance to exposure to diesel oil of the Xypex coating composition

The laboratory of the Klokner Institute of Czech University of Technology performed observations of the effects of Xypex waterproof treatment of concrete exposed to diesel oil and transformer oil. The basis of the test was to observe penetration of diesel oil through test samples under pressure of 14 kPa (the pressure of 1.4 m of water column). Used as test samples were concrete objects of cylindrical shape, 100 mm in diameter and 50 mm long, of Class B 20 (according to CSN standard No. 73 2400). Xypex Concentrate and Xypex Modified were applied to parts of these objects; for comparison, a number of samples were left untreated. A funnel was then attached to each sample by means of epoxy resin ChS 1200. In the course of the test itself, 50 ml of diesel oil was poured onto the test sample. Under pneumatic pressure of 14 kPa the diesel oil penetrated into the sample. The evaluated parameter of the test was the time needed for the liquid medium to penetrate across the tested sample, or the average maximum depth of penetration of the liquid medium through the sample after 28 days of exposure, as the case may have been. These evaluations were performed visually on the fracture surface following the transverse tensile strength test.

It may be stated that under the circumstances of the test (test protocol No. 02/93/K1) the examined surface treatment stopped the penetration of diesel oil and/or transformer oil through concrete.

signature

Prof. Ing. Pavel Novak, DrSc.
director
Klokner Institute
Czech University of Technology

Stamp: Czech University of Technology
Klokner Institute

Administered by: Ing. Tomas Klecka, CSc.

Tel.: 332 3857

[Footnoted particulars of the institute's official letter]

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Telephone:	Particulars of bank account:	Reg. ID No. of
02-332...	Komerčni banka Praha 6	organization:
	# 3428-061	022721
	numeric bank code: 0100	

Answering machine:	Telex:	Fax No.:
02-3119989	123048 meru	02-3117027

TEST PROTOCOL No. 02/93/K1

Commissioning of test

Ordered by (Client): NEKAP spol s r.o., Kosorska 5, 152 00
Praha 5, represented by Ing. Jan Mandelik

Supplied by: Czech University of Technology, Klokner
Institute, Solinova 7, 166 08 Praha 6,
represented by Ing. Tomas Klecka, CSc.

Manufacturer of supplied samples¹: CAIDAN HOUSE, CANAL ROAD,
TIMPERLEY, CHESHIRE WA 1 TE,
UNITED KINGDOM

Commissioned as: Contract No. 7 337 93, dated 02/15/93

Subject of test: Tests of impermeability and resistance of
Xypex coating to:
1. ensilage juices
2. diesel oil
3. gasoline
4. transformer oil

Supply (taking) of samples:

The samples of Xypex coating materials were supplied to
Klokner Institute of Czech University of Technology by
the client's representative, Mr. Jiri Prihoda, on June
17, 1993, in "mikroten" (soft plastic) bags, as follows:

- 1) Xypex Concentrate - 2120 g
- 2) Xypex Modified - 1410 g

Beside the samples of tested coating materials respective
liquid media were supplied by the client as well:

1. ensilage juices (pH 6.9)
2. unleaded gasoline "Natural"
3. diesel oil
4. transformer oil

All these liquids were supplied in polyethylene bottles
in the quantities of 1.5 litres each.

The tested coating materials and liquid media are kept on
record by the client.

¹Fill in providing the supplier is not identical with the
manufacturer of samples.

Identification of testing regulations, applied methods and procedures

No technical standard valid in Czech Republic (Czech and Slovak Federal Republic) contains provisions stipulating tests of impermeability and resistance of coating materials to exposure to a variety of liquid media. The testing procedure applied, as described below, is based upon experimental activities of many years standing in the field of study of transport phenomena occurring in surface treatment of concrete. Testing procedure No. 28 was elaborated in the Klokner Institute of Czech University of Technology for the purposes of observation of impermeability and resistance of surface treatments of concretes; with regard to the special application of the coating, it was used in a modified version.

The principle of the test

The basis of the test is to observe penetration of liquid media through the test samples under the pressure of 14 kPa.

Test procedure

Prepared for the test are concrete samples of cylindrical shape, 100 mm in diameter and 50 mm long. For every liquid medium, measurements are performed on three samples treated by the coating and three samples without the coating. A funnel - equipped by a piece of hose c/w a hose connector - is affixed to each sample on the outside of the cylinder by means of epoxy resin ChS 1200; at the same time epoxy resin is applied to the wall of the cylinder. In the course of the test itself, 50 ml of liquid are poured onto the tested surface of the sample, while by means of a hose connector the sample is connected to a distribution equipment in which pneumatic pressure is set by means of the pressure gauge to 14 kPa. The liquid is regularly checked and exchanged.

Test evaluation

The result of the test is comparison of time needed for the penetration of the liquid medium across the samples with and without the coating, or comparison of the depth of penetration of the liquid medium after 28 days, as the case may be.

Results obtained in test

Performance of the test

24 samples of concrete of cylindrical shape, 100 mm in diameter and 50 mm long, were prepared for testing of Xypex coating composition. The concrete mixture was designed for Class B 20 concrete according to CSN standard No. 732400 of the year 1986. The quantities of individual components and some complementing data are shown in Table 1.

Table 1. Composition of concrete mixture for preparation of foundation concrete samples.

Composition	Units	Quantity
Cement "SPC 325 Lochkov"	kg.m ⁻³	435
Gravel, fraction 0-8 "Chrzin"	kg.m ⁻³	1618
Water	kg.m ⁻³	227
Weight per volume of the fresh mix	kg.m ⁻³	2280
Abrams cone test	mm	95

Apart from samples designed for Xypex tests, 6 check samples with dimensions of 100x100x100 mm were produced for the purpose of determining the class of concrete. The compression strength results for the said samples after 28 days of storage in compliance with the standard (95% relative humidity) are given in Table 2.

Table 2. Compression strength of concrete after 28 days.

Sample No.	Compression strength $R_{CK}^{a=100}$ (MPa)
1	28.8
2	30.3
3	30.7
4	29.5
5	30.5
6	29.5
Mean value	29.9

The stated cube strength value of 29.9 MPa as determined on cubes of dimension $a=100$ mm, equals the value of $R_{CK}^{a=150} = 28.7$ calculated for the cube strength of a sample with edge length $a=150$ mm. According to CSN standard 73 2400, such concrete may be classed as B 20.

Immediately after being produced, the samples for impermeability and resistance tests were placed into an air-conditioned storage at 20°C and 95% relative humidity for a period of 24 hours. The samples were then removed from the moulds and placed onto tap water. After 24 hours, the surfaces of 12 samples were coarsened by steel brush and a coat of Xypex Concentrate was applied to the cylinders (3 parts of Xypex Concentrate mixed with 1 part of water - in case of 3 samples only this single coat was applied; the samples are designated as "C"). Three hours later a

second coat of Xypex Modified was applied to 9 of these samples (5 parts of Xypex Modified mixed with 2 parts of water; these samples are designated as "M"). The samples thus set up were kept for the period of three weeks in basins, placed on gratings so as to be submerged in water up to the line of 10 mm with the surface opposite to the one treated by application of the coat. 12 pcs check samples were stored in the same way (designated as "K"). Following this storage, the samples were left to dry on air for 2 days at the temperature of 20⁰C and 65% relative humidity. Prior to having funnels attached, which was done by means of Epoxy 1200 glue, the samples had been degreased by pure acetone and dried over their surfaces by a hair dryer. After the glue had solidified, water was poured into the funnels and left to work for 3 days under the pressure of 14 kPa. After water had been discharged, the funnels were filled with testing liquid media. The test further proceeded according to the above-mentioned test procedure.

Results obtained in test

The evaluated test parameter was the time needed for the liquid media to penetrate across the test samples, or the average and maximum depth of penetration of the liquid media after 28 days of exposure. These evaluations were performed visually on the fracture surface following the transverse tensile strength test. The obtained values are represented in Table 3.

Table 3. Measured values of penetration of liquid media through test samples.

Design. of samples	Liquid medium	Aver. value of penetration of liquid medium (mm)	Max. value of penetration of liquid medium (mm)	Time of penetration (days)
BK1	unleaded gasoline "Natural"	50	50	28
BK2		50	50	28
BK3		40	45	--
BM1	unleaded gasoline "Natural"	32	40	--
BM2		28	36	--
BC1		35	42	--
NK1	diesel oil	50	50	6
NK2		35	45	--
NK3		50	50	8
NM1	diesel oil	1	1	--
NM2		2	3	--
NC1		2	3	--
OK1	transformer oil	10	18	--
OK2		9	17	--
OK3		8	21	--
OM1	transformer oil	2	4	--
OM2		1	3	--
OC1		1	1	--
SK1	ensilage juices	12	16	--
SK2		15	20	--
SK3		18	24	--
SM1	ensilage juices	4	5	--
SM2		5	6	--
SM3		6	8	--

