

WATER ABSORPTION

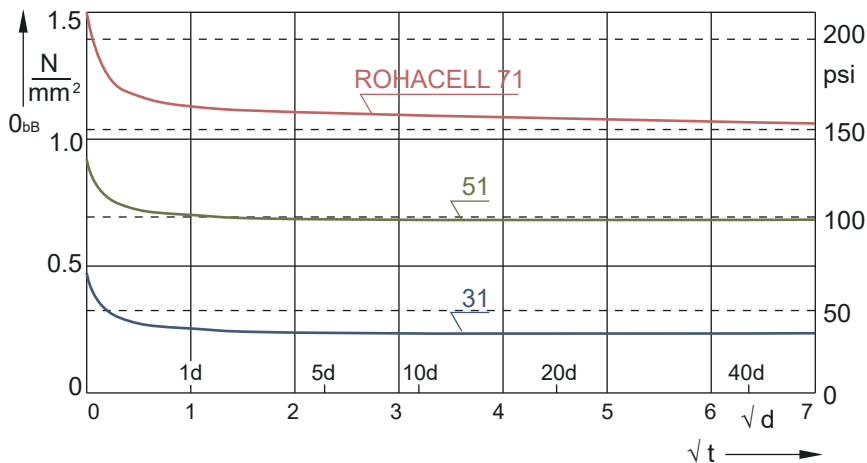
Polymethacrylimide (PMI) absorbs water in a manner similar to polyamide. The following table shows the absorption equilibria (equilibrium water content with respect to dried samples) of ROHACELL in damp air. Size of samples 2 x 2 x 0.08 inches (50 x 50 x 20 mm).

ATM HUMIDITY % R.H.	ROHACELL 31		ROHACELL 51		ROHACELL 71	
	VOL%	WEIGHT%	VOL%	WEIGHT%	VOL%	WEIGHT%
15	0.05	1.5	0.07	1.3	0.08	1.2
30	0.09	2.9	0.13	2.6	0.17	2.4
50	0.14	4.7	0.21	4.2	0.25	3.6
65	0.18	6.0	0.25	5.0	0.30	4.3
98	0.59	19.5	0.88	17.4	1.1	15.5

The following table illustrates the water absorption and change in volume of test specimens after 50 days of total immersion in water. These values show that despite the relatively high water absorption, the dimensional stability is satisfactory. Shrinkage of the samples is only observed after prolonged immersion at water temperatures above 122 °F (50 °C).

PROPERTY	TEMPERATURE	UNITS	ROHACELL		
			31	51	71
H2O Absorption	68°F (20°C)	vol %	13	15	16
	122°F (50°C)	vol %	18	23	26
Volume Increase on Water Immersion	68°F (20°C)	vol %	<1	<2	<3
	122°F (50°C)	vol %	<1	<2	<3

The diagram below shows that, irrespective of the period of water immersion, the compressive strength of ROHACELL settles at a constant level.



Compressive strength (ASTM D 1621-64) of ROHACELL immersed in water as a function of time.

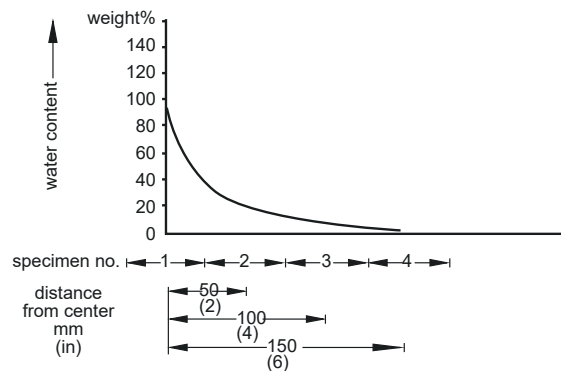
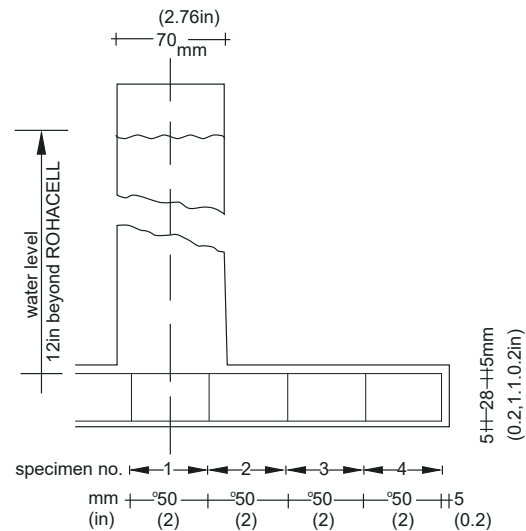
40-MONTH WATER PERMEATION TESTS WITH ROHACELL IN A SANDWICH STRUCTURE

For boat building and similar uses, the water penetration into FRP structural sandwich parts with damaged skins is of particular interest. Corresponding tests were conducted. ROHACELL with the dimensions 15.7 x 15.7 x 1.1 in. (400 x 400 x 28 mm) was laminated on all sides with glass reinforced polyester resin. The skins consisted of: mat (.09 lbs/ft²/450 g/m²), roving (.1lbs/ft²/500 g/m²), mat (.09 lbs/ft²/450 g/m²), roving (.1 lbs/ft²/500g/m²) and mat (.09 lbs/ft²/450 g/m²).

The laminating resin was a polyester (PALATAL P 51). The skins were applied manually and cold-cured with a thickness of about .2 in. (5 mm). In the middle of one of the surfaces a part of the skin with a diameter of 2.8 in. (70 mm) was removed. A tube was placed into this opening and sealed with silicone against the remaining skin. The tube was then filled with water to a height of 11.8 in. (300 mm).

Since ROHACELL is a foam with closed cells, the penetration of water is purely due to diffusion, a fact which was confirmed by preliminary tests. After 40 months, the skins were removed and the ROHACELL core examined for water absorption.

The places from which the samples were taken are shown in the illustration. The specimens were dried in a vacuum cabinet at 158 °F (70 °C) and the water content thus determined in per cent by weight. The size of each sample was 2 x 2 x 1.1 in. (50 x 50 x 28 mm). The water content reduces very quickly from the centre outwards, i.e. even after being in water for 40 months the specimen was not soaked. At a distance of about 5.9 in. (150 mm) from the water tube the material was practically dry.



MATERIAL BEHAVIOUR UPON EXPOSURE TO MOISTURE & HEAT

Even when ROHACELL is kept for a prolonged period at 100% rel. humidity and 158 °F (70 °C) the compressive strength, for example, is only slightly affected. When the specimen is subsequently kept under normal conditions (73.4 °F, 23 °C, 50% r.h.), the original values are recovered. The table also gives the changes in weight and volume under these conditions with respect to the original weight and volume.

ROHACELL	TEST CONDITIONS	CHANGES IN WEIGHT* (WEIGHT %)	VOLUME %	VOLUME CHANGES (VOL%)	PSI	N/mm ²
31	A	-	-	-	56.9	0.40
	B	4.4	0.13	-4.1	55.9	0.39
	C	1.8	0.06	-5.2	55.5	0.39
	D	0.7	0.03	-5.5	55.5	0.39
51	A	-	-	-	127	0.89
	B	4.1	0.20	-2.8	112	0.79
	C	1.9	0.09	-3.7	121	0.85
	D	1.0	0.05	-4.3	127	0.89
71	A	-	-	-	213	1.5
	B	3.8	0.27	-2.3	185	1.3
	C	1.7	0.13	-2.9	199	1.4
	D	1.2	0.10	-3.0	213	1.5

*) Versus initial values.

TEST CONDITIONS

A - Material as supplied

B - After 500h at 159°F (70°C) and a 100% r.h.

C - As B and another 500h in a standard climate of 73.4°F (23°C) and 50% r.h.

D - As B and exposure to standard climate of 73.4°F (23°C) and 50% r.h. until approx. constant weight.