

# 101. ビニロン繊維による石綿含有率低減化製品の 温水浸漬試験

STUDY ON HOT WATER IMMERSION TEST OF ASBESTOS REDUCING PRODUCTS  
BY PVA FIBER

千葉大学工学部	前田 孝一
日本大学工学部	岸谷 孝一
大分大学工学部	平居 孝之

Koichi MAEDA※1 Koichi KISITANI※2  
and Takayuki HIRAI※3

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## [ABSTRACT]

この論文は、アスベスト低減化製品、ノンアスベスト製品、及び、従来のアスベスト製品の耐久性の評価として、温水浸漬試験を行なった結果を報告している。すべての試験体はハチェックマシンで製造された小波板である。温水の温度は60℃で、浸漬期間は、64日である。結果として次のことが明らかになった。1) ほとんどの試験体で浸漬により吸水率が10～20%増大したが、これはマトリックスの空隙が増大したためと考えられる。2) アスベスト低減化製品の場合、温水浸漬による曲げ強度の低下は見られなかったが、ノンアスベスト製品の場合、5～15%の強度低下がみられた。

※1 Department of Architecture Engineering, Faculty of Technology, Chiba University

※2 Department of Architecture Engineering, Faculty of Technology, Nihon University

※3 Department of Architecture Engineering, Faculty of Technology, Oita University

## 1. PREFACE

Steps have been taken to apply safety measures for asbestos which is considered to be hazardous when it is inhaled in large volume into human body. As a way to solve this problem, effort has been made to reduce asbestos by replacing it with other fibres such as organic fibres, glass fibres, carbon fibres.

Properties of the finished products that should be specially taken into consideration when other fibres are used are fire preventing capability and fire resistance as well as durability. Durability is usually measured by "Hot Water Immersion Test". According to the research made in the past, bending strength, dimensional stability and impact strength of fibre reinforced cement sheets are measured after the sheet was immersed in hot water of 60-80°C, for 1-2 months. By this test, deterioration that could be caused by high alkali environment caused by hydration of cement is checked for fibres and the degree of adhesion of fibres to matrices.

Under this study, the comparative hot water immersion test was made by using slates of small corrugation of the types of (1) asbestos reducing products (asbestos content below 5%), (2) asbestos substitution products (non-asbestos), (3) ordinary asbestos products (standard products).

This study has been made a part of "Study of Fibre Reinforced Cement Products with Reduced Amount of Asbestos" which has been conducted by Kenzai Shiken Centre since 1991 under assignment of MITI.

## 2. EXPERIMENT

### 2.1 TEST PIECES

The types and symbols of the pieces are shown in Table 1. All the test pieces are slates with small corrugation. The products containing PVA fibres as asbestos replacement are the products that already been in the market. For reference, according to the analysis by inner standardization method by using X-ray diffraction equipment, the content of asbestos contained in the test pieces of A,B,C has been proven to be 2.9%, 3.6% and 3.2% respectively. The asbestos reducing products and asbestos substitution products containing acrylic fibres, alkali-resistant glass are shown in Table 2. Number of the test pieces is 6. 3 pieces are applied for immersion in hot water and 3 pieces are left in a test room for air cure. Dimension of the test pieces is a 150 mm wide x 360 mm long x 6 mm thick.

### 2.2 METHOD OF EXPERIMENT

Specific gravity, water absorption ratio, bending strength were measured for the 3 test pieces immersed in hot water as well as for the 3 test pieces left in the room. Taking into consideration the research work of

non-asbestos slates for exterior use conducted in E.C., the temperature of hot water was set to be 60°C.

The items of the test are (1)weight of each test pieces at the time when the test piece is delivered, (2)weight of the test piece right after completion of the hot water immersion(weight with after absorbed), (3)water submerged weight measured right after hot water immersion test, (4)oven dry weight dried right after completion of the hot water immersion test, (5)maximum bending load.

The period of immersion of test pieces in hot water is 64 days.Drying was done at 105°C for 24 hours. Water absorption was measured after test pieces were completely immersed in water for 24 hours.Specific gravity and water absorption ratio were obtained in accordance with the following formula. Volume = weight with water absorbed -water submerged weight (converted into cm<sup>3</sup>)

Specific Gravity = oven dry weight/Volume

Water absorption ratio = (weight with water absorbed - oven dry weight ) / oven dry weight x100%

After hot water immersion, the test piece is left in a test room for 2 days and dried at 105°C for 24 hours and then bending test was conducted.Another group of 3 test pieces for air cure is kept until one day prior to the bending test and dried at 105°C for 24 hours and then bending test was conducted. The test pieces of both groups were tested on the same days. The bending test was conducted by center loading with 30 cm span. The test equipment is displacement control machine with maximum load of 5000 kgf. Figure 1 shows its external appearance.

### 3. RESULT OF HOT WATER IMMERSION TEST AND ITS STUDY

Table 3 shows the results of specific gravity, water absorption ratio and bending strength measured on the air cured test pieces as well as the water immersed test pieces. Each figure is an average figure obtained from 3 pieces. Figure 2 shows the change of water absorption ratio of the test pieces before hot water immersion and after it. The result is shown by comparison of water absorption ratio of water immersed test pieces against water absorption ratio of the cured test pieces.

With regard to the change of specific and water absorption ratio of the test pieces before water immersion and after it, specific gravity of the most of the test pieces after immersion show decrease of about 3%. While water absorption ratio increased by 10-20%. It can be considered from this fact that volume of void inside the test pieces increased after water immersion test. Figure 3 shows the change of bending strength of the test

Table 1 Variation of specimens and their symbols

Type	Type of reinforcement	Manufacturer	Symbol
Asbestos Reducing Products(asbestos content< 5%)	PVA Fiber	A Company	A
		B Company	B
		C Company	C
	acrylic Fiber	Test product	D
	alkali resistant Fiber		E
Asbestos Substitute Products (non asbestos)	PVA Fiber	A Company	F
	acrylic Fiber	Test product	G
	alkali resistant Fiber		H
Ordinary asbestos Products		A Company	I
		B Company	J

Table 2 Mixture of substitutes by acrylic fiber and alkali resistant glass fiber (weight%)

Symbol	reinforcement		cement	pulp	mineral additives		
	acrylic fiber	asbestos			wollastonite	calcium carbonate	sepiolite
D	1.5	5	69.5	4	16	3	1
G	1.5	0	69.5	4	16	8	1

(weight%)

Symbol	reinforcement			cement and admixture	pulp	mica
	GRC fiber	asbestos	PVA fiber			
E	1.5	4	0.25	85.25	4	5
H	1.5	0	0.25	89.25	4	5

Table 3 Results of hot water immersion test

Type	Symbol	Air cured specimen			Water impregnated specimen		
		Specific gravity	Adsorption (%)	Max load (kgf)	Specific gravity	Adsorption (%)	Max load (kgf)
Asbestos Reducing Products(asbestos content< 5%)	A	1.60	20.9	133	1.55	24.7	156
	B	1.54	22.5	168	1.55	23.2	175
	C	1.59	21.3	112	1.55	23.7	116
	D	1.46	25.9	99	1.42	30.2	110
	E	1.54	23.4	116	1.49	27.1	103
Asbestos Substitution Products (non asbestos)	F	1.45	26.1	88	1.41	30.1	76
	G	1.50	24.1	126	1.48	27.6	118
	H	1.42	27.2	108	1.36	32.6	104
Ordinary asbestos Products	I	1.63	20.0	138	1.58	23.0	149
	J	1.69	17.6	130	1.64	21.7	144

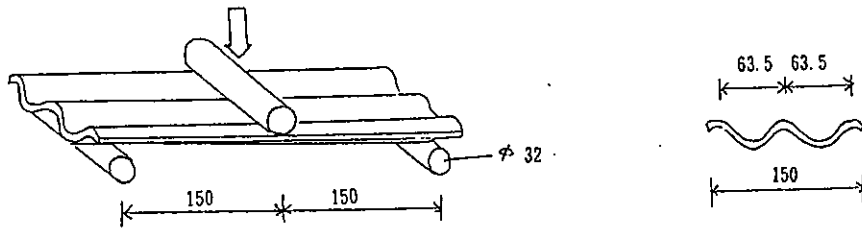


Fig.1 Benbing test

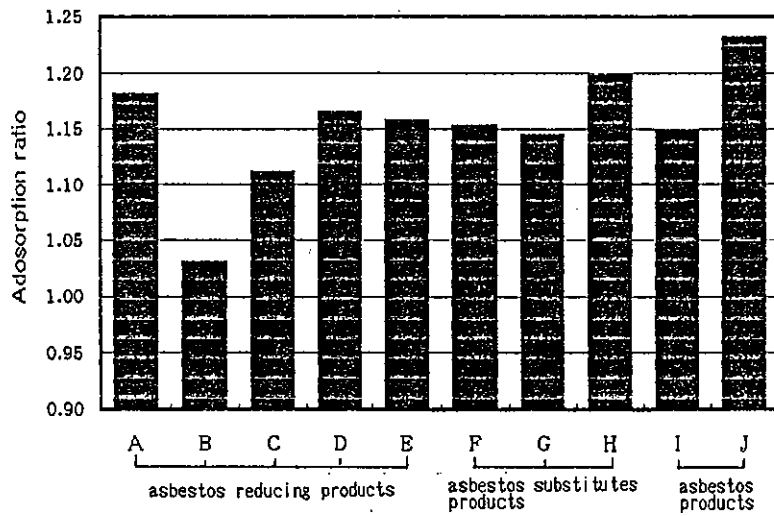


Fig.2 Adosrption ratio of hot water immersed specimens to air cured specimens

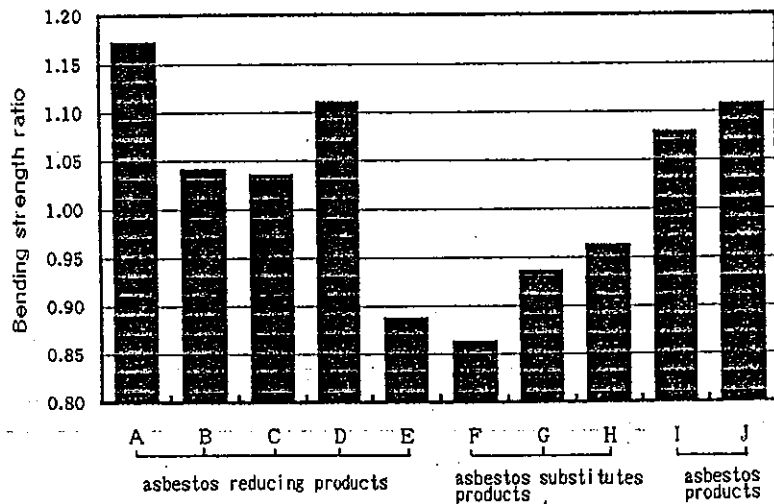


Fig.3 Bening strength ratio of hot water immersed specimens to air cured specimens

pieces before water immersion and after it. The result is shown by comparison of maximum load of the water immersed test pieces against maximum load of the air cured test pieces. No decrease of bending strength after water immersion was observed for ordinary asbestos products like in the case of the weatherability test result. Regarding asbestos reducing products, no decrease of bending strength after water immersion was observed except the test piece E which showed about 90% decrease. All the asbestos substitution products showed 85-90% decrease. Like in the case of weatherability test result, decrease of bending strength of asbestos substitution products after water immersion is a little greater than that of other test pieces.

#### 4. CONCLUSION

- (1) Ordinary asbestos products and asbestos reducing products showed almost no decrease of bending strength after the 60°C hot water immersion test for 64 days whereas all the asbestos substitution products showed about 90% decrease of bending strength.
- (2) With regard to change of specific gravity and water absorption ratio before water immersion and after it, there was as a whole about 3% decrease of specific gravity and about 10-20% increase of water absorption ratio and it is considered that there can be an increase in volume of void inside the test pieces after water immersion.

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