102. ビニロン繊維による抄造スレートの開発

STUDY ON VINYLON FIBER REINFORCED CEMENT SHEET PRODUCTS

大分大学工学部 平居 孝之
ユニチカ（株）化成事業本部 溝口 和雄
熊本大学工学部 村上 聖

Takayuki HIRAI *1 Kazuo MIZOGUCHI *2
and Kiyoshi MURAKAMI *3

[KEY WORDS] Vinylon, PVA Fibre, Cement Sheet, Hatschek-type, Non-asbestos, Flexural Strength, Noncombustibility

[ABSTRACT] ハチェック式抄造機でアスベストセメントシートを製造する技術は完成され使用実績も多い。ところが人体への有害性のあるアスベストに替えて、人体に安全な種類の繊維を用いてハチェック式抄造機でセメントシートを製造する技術の開発が望まれている。アスベストに替わるものとして、セメント補強という観点から強度などの性能の改善に効果の著しいビニロン繊維が有望視されている。ビニロン繊維だけを用いてハチェック式抄造機でセメントシートを製造しようとすると、シリンダーでの濾水性が早くなり、バット水位の調節が困難となり、更にセメント粒子が流出する。アスベストを用いた場合は、他の材料を入れなくてもセメント粒子の捕捉性、保水性、保形性、不燃性などすぐれた抄造性能、製品性能を発揮するが、ビニロン繊維を用いる場合は、これらの性能を満足させるための方法が必要になる。本研究では、パルプ、セピオライト、マイカ、ワラストナイト、シリカヒュームなどの抄造助剤を入れる方法で、アスベストを全く使わずにビニロン繊維を使って従来の製品に近い性能を有するセメントシートを、ハチェック抄造機で製造できることを明らかにした。

*1 Prof. Oita Univ., Dr. Eng.
*2 Unitika Ltd. Poval and PVA Fiber Div.
*3 Assoc. Prof. Kumamoto Univ., Dr. Eng.

1. INTRODUCTION

If asbestos fibres used in the Hatschek type machine is substituted by vinylon fibres without any modification in formulation, it will cause an increase in filterability of water of the cylinders and will make it difficult to control water level in the vats. Besides, cement particles also flow out making it difficult to produce slates with required quality. Asbestos fibres possess remarkable features in quality such as filterability of water, retaining of cement particles, retention of water, shape forming, reinforcement, incombustibility, etc. Vinylon fibres have excellent reinforcing property but are inferior to asbestos fibres in other properties and in order to cover such defects, vinylon fibres need to be used with other special agents. Each agent has its characteristic and should be selected depending on what properties are required for finished products.

2. SPECIAL AGENTS USED WITH VFRC PRODUCTS

2.1 Pulp

Use of highly refind pulp(over 50' SR)can decrease filterability of water and can increase effect of retaining cement. This can also function to assist good dispersion of vinylon fibres and other special agents. This is indespensable agent in formulation but if it is used in excessive volume, there could be problem in dimensional stability and incombustibility. Therefore, volume of pulp needs to be minimized.

2.2 Water swelling type inorganic fine powders

Bentonite, Ballclay and Sepiolite are in this category. Especially, They are effective to decrease filterability of water. At the higher side of alkalinity(pH12), better effect of water swelling property is obtained. Effect of tackiness is also obtained and various characteristics are improved such as dispersion of fibres, retention of water, smoothness and plasticity of slates, prevention of delamination. Sepiolite at the same time has an effect as an adsorbent and is very effective for clearing-up of running water which makes long term continuous operation possible. Effective particle size of these agents is below 10 micron in diameter.

2.3 Inorganic fine powders

Silica-fume, fly-ash, wollastonite, silicon dioxide containing substance, carbonate, etc. can be used. Particle size below 10 micron(250- 300 mesh pass)is preferable, as it is effective to decrease filterability of water.

2.4 Mica

This is effective to increase dimensional stability. It is especially required for non-sabestos slates, as non-asbestos sloates contain organic fibres such as pulp, vinylon, etc. Phlogopite of fine particles(gold mica)particularly is effective to improve dimensional stability, efficiency of sheet making, incombustibility(surface test). Use of mica is rether easy, as it is available in various grades.

2.5 Cohesive agent

High polymer cohesive agents(polyacrylamide type)are used to increase retaining of cement

particlas and inorganic fine powders. However, use of excessive volume of cohesive agent will enlarge flocks and cause an adverse effect on filterability of water. Careful attention is required in this respect.

3. MAKING, VFRC PRODUCTS

The sample of VFRC sheet(v-1, v-2, -v-9)has been manufactured by the sheet making machine of experimental scale described in the Fig, 1. The rew materials were fed in accordence with the following orders. One batch volume in the pulper is 120 kgs.

Water-Pulp-Asbestos(non beaten)-Sepiolite-Wollastonite-Silica Fume-Vinylon-Mica-Cement.

Sheet making started in 15 minutes after the base slurry was fed into the chest and the volume of additional water and that of cylinder showering water were quantitated.

KURI-FLOCK PA331(made by Kurita Kogyo Co., Ltd.)was used as flocculant.

Green sheets were wrapped with vinyl sheets after pressing and cured under the room temperature for a certain fixed time.

The testing method of evaluation is based JIS.

4. RESULIS AND DISCUSSION

The properties of the samples were shown in the Table 1. As shown in the result of the operation, 80% of vat efficiency was maintained in any of the experiments of v-1, v-2, v-3 and it can be considered that this formulation can be applicable to the operation by an industrial scale machine. The level of Japanese spec, of incombustibility is very severe than overseas one, but the result of v-1 was passed. V-4, v-5, v-6 were shown the difference of the toughness in some reinforced fibres. Fig, 2 were shown that the toughness of VFRC product was better than others. V-7, v-8, v-9 were shownthe difference of the vat efficiency and the incombustibility causing the difference of the pulp contents. Much volume content of the refined pulp were shown the result of the better vat efficiency but inferior one of the dimensional stability and the incombustibility. In case the performance or physical properties are desired to be improved, for example, to improve bending strength, that can be achieved by changing the ratio of each component like increasing volume of vinylon. In this case, care should be taken to keep balance of the formulation by making use of characteristics of each component.

5. CONCLUSION

As a result of the work, vinylon fibre reinforced cement products by using some special agents that can be commercially used has been successfally developed, and this is anew cement sheet having better toughness than the convensional asbestos cement sheet.

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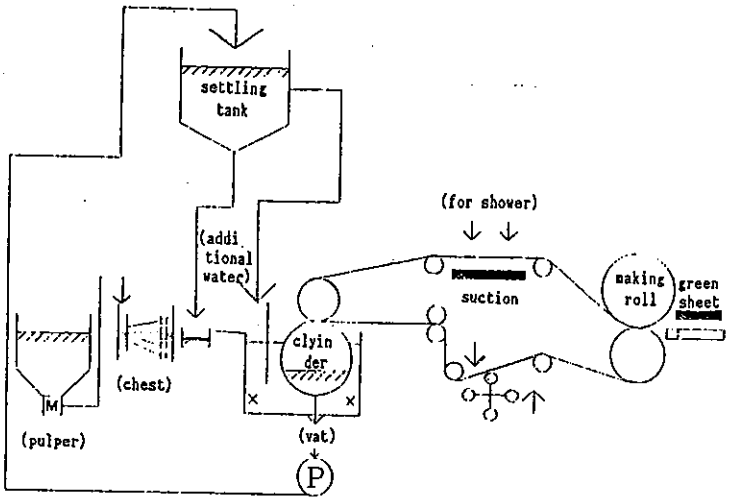

Cylinder: 65mesh, 340mm wide, 500mmφ
Making roll: pressure 40kg/cm, 600mmφ
Sheet making speed: 15m/min.

Fig. 1 Sheet making machines of experimental scale

注)

CSF:
Canadian Standard Freeness

Toughness:
Available to count [J/㎡]

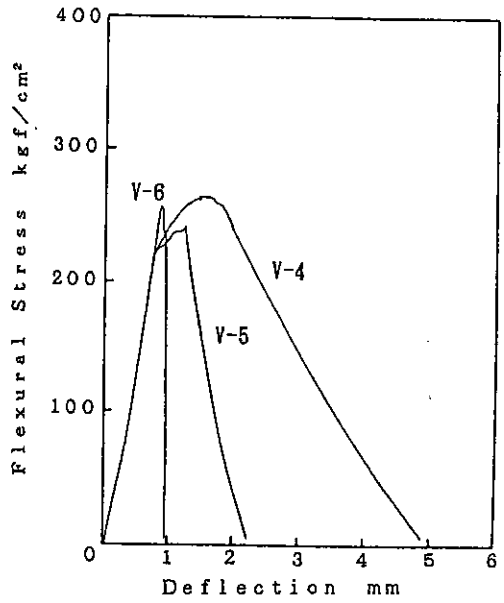

Fig. 2 Toughness

Table;1 Formulation of VFRC, the result of the operation and VFRC product

Formulation (wt%) \ Test No.		V-1	V-2	V-3
Vinylon	(AA-1.6^{D}/6mm)	1.5	1.2	1.0
PAN	(Dolanit 1.5dtex/6mm)			
Asbestos	(5R-3)		2.0	4.0
Pulp	(CSF 60mℓ)	3.0	2.0	1.5
Sepiolite	(P)	0.5		
	(ML)	1.0	1.0	
Mica	(M-60)	10.0	2.0	
Wollastnite	(A-60)		6.0	8.0
Silicafume	(SF)		3.0	4.0
Cement	(OPC)	84.0	82.8	81.5
Operation Result				
Concentration				
Vat	(%)	7.50	6.21	5.82
Drainage	(%)	1.30	1.23	1.14
Efficiency	(%)	82.7	80.2	80.4
Process				
Water Level	(cm)	14	14	14
Dispersion		Good	Good	Good
Number of Ply		25	25	29
Properties				
Specific Gravity	(g/cc)	1.51	1.52	1.59
Thickness	(mm)	6.18	6.65	6.97
Moisture Regain	(%)	3.32	3.78	4.29
Water Absorption	(%)	24.4	24.2	21.2
Flexural Strength	:MD	252.1	242.5	276.9
	(kgf/cm²) :ACR	196.3	212.1	239.0
Flexural Strength	:MD	110.6	104.9	109.5
at/d²	(kgf/cm²) :ACR	90.8	93.0	93.4
Impact Strength	:MD	3.50	3.38	3.22
	(kgf·cm/cm²) :ACR	3.35	2.45	2.29
Demensional Stability	:MD	0.170	0.182	0.145
at 60℃	(%) :ACR	0.161	0.199	0.169
Non-Combustibility				
Material Test		Passed	Passed	Passed
Surface Test		Passed	not passed	not Passed

V－4	V－5	V－6	V－7	V－8	V－9
1.5	1.5	15.0	1.5	1.5	1.5
3.0	3.0	1.2*	3.0	5.0	8.0
1.0	1.0		1.5	1.5	1.5
10.0	10.0		7.0	7.0	7.0
84.5	84.5	83.8	87.0	85.0	82.0
8.03	6.56	7.95	7.96	8.61	7.63
1.28	1.17	0.49	1.46	0.93	0.36
84.0	82.2	93.6	81.7	89.2	95.3
11	11	13	13	14	15
Good	Good	Good	Very Good	Very Good	Very Good
16	17	20	25	26	27
1.68	1.69	1.50	1.67	1.61	1.60
5.00	5.10	5.40	5.57	5.76	5.63
2.20	2.10	6.70	2.30	4.30	4.70
19.3	19.0	26.7	18.7	21.3	19.6
262.7	241.7	255.2	289.8	253.6	248.2
242.6	207.0	225.7	254.6	232.5	226.7
93.1	84.6	113.4	103.9	97.8	96.9
86.0	72.5	100.3	91.3	86.8	88.5
3.40	2.75	2.68	3.36	3.57	3.68
3.30	2.70	2.39	3.20	3.13	3.22
0.185	0.193	0.179	0.178	0.215	0.258
0.180	0.185	0.174	0.169	0.220	0.270
Passed	Passed	Passed	Passed	not Passed	not Passed
Passed	Passed	Passed	Passed	Passed	not Paseed

*: not refined