

# E-COMMERCE WITH SERVING MANUFACTURING KNOW-HOW FOR GLASS FIBERS

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## ABSTRACT

In conventional E-commerce system, only plain product information is supplied via Internet. However, if we can supply also technical support, it will become the next generation E-commerce. Glass fiber industry is limited society with less open material data. To promote the sales of secondary raw material for glass fiber industry, we are developing an E-commerce system which can supply technical information and support design of glass fiber products. The system supports physical/chemical information, material design technique, and quality evaluation of manufacturing technique and products. These are going be connected to the CHN International Electronic Accounting and Distribution System.

**KEYWORDS:** E-commerce, Glass fiber, Secondary raw material, Manufacturing know-how, Design support

## 1. INTROUCTION – FIBER INDUSTRY

Fiber glass is an special limited industry having not so much of market and few opened precise information materials inspite of having high level of technology. Fig.1 shows the world market size of glass fibers originally investigated by NBL Co., Ltd. Though about ten years ago, US, Japan, and Europe occupied almost market, presently are caught up with developing countries, and center of production has been moving to Southeast Asia as shown in Fig.2.

Between these ten years the most grown up country is China, and they are producing glass fiber goods all-roundly as shown in Fig.3, whose amount of product is growing 40-50%/year as shown in Fig.4. They became top of the world in

**World production of  
glass fibers in 2007 (by NBL)**

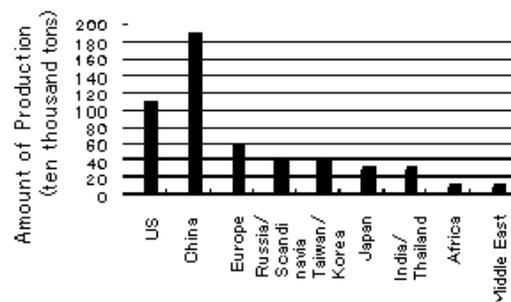


Fig.1: World market size of glass fibers.

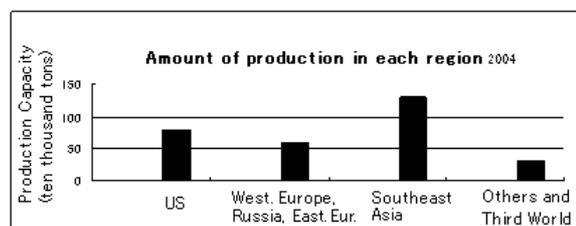


Fig.2 Regional amount of production  
(research by NBL Co., Ltd).

2006, and we feel their energy possibly occupying 75% of world share in 2009. As shown in Fig.5, the main raw materials of glass fiber is non-organic materials easy to supply locally and chemical materials (secondary materials) necessary for the manufacturing are exported from advanced countries as well as the facilities. Capacity of the Chinese market of the secondary materials is several ten thousand tons as shown in Fig.6, or 100 million US\$ as shown in Fig.7, and its world market is three times.

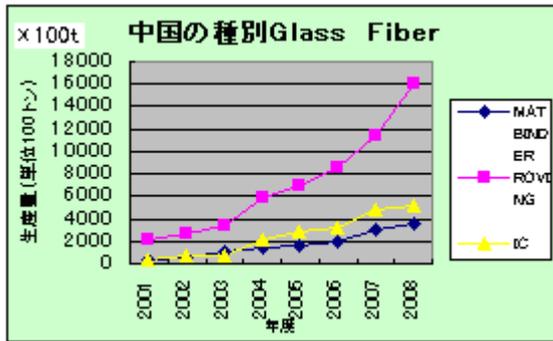


Fig.3: Amount of each kind of product (by NBL).

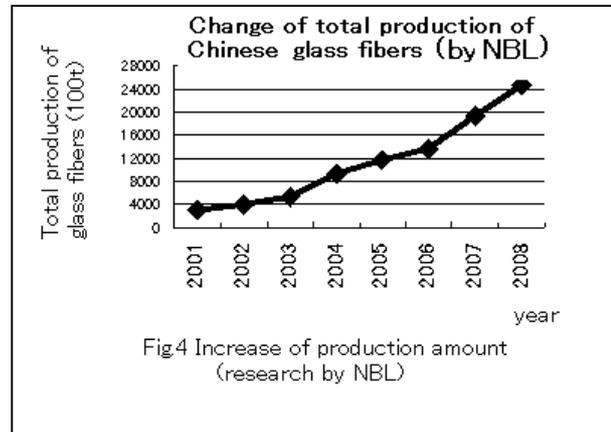


Fig4 Increase of production amount (research by NBL)

### 3.1 Raw Material

生産素材の組成基準を表示する。基準はロット毎に検査する。

Table 04 E-Glass素材構成の基準例

SiO <sub>2</sub>	54.0±1 (%)	CaO	22.5±1 (%)
B <sub>2</sub> O <sub>3</sub>	7.5±1 (%)	K <sub>2</sub> O+Na <sub>2</sub> O	0.8 (%)以下
Al <sub>2</sub> O <sub>3</sub>	14.0±1 (%)	FeO	0.15 (%)以下
Fe <sub>2</sub> O <sub>3</sub>	0.5 (%)以下	( E-Glass Standard )	
TiO <sub>2</sub>	0.5 (%)以下		
MnO	3.0 (%)以下		

Fig5 Main raw materials of glass fibers (research by NBL)

We, NBL Co., Ltd, succeeded the engineering service business including providing technical know-how for the manufacturing aiming selling the secondary materials to these market by utilizing IT [1], made sure of 10 % world share (about 50% Chinese share) in the glass fiber market, and made firm inroads into the foreign market.

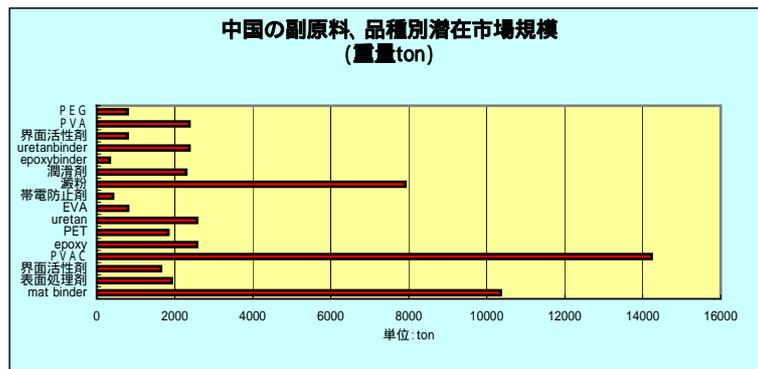


Fig.6: Chinese market capacity of secondary raw materials of glass fibers (research by NBL; 2007).

These research results are presented in this conference.

## 2. COMMON BASIC KNOWLEDGE

Since fiber glass industry is small and the number of committing engineers is not so many, there exist few technological information materials and even more its technological contents are not opened so much. In such situations, if we can sell necessary secondary materials and products via internet under the conditions of providing techniques including patents, we can obtain profit in the technical service business, and we can construct a new business model with high competitive power. The first step is providing users the above world market information. The 2nd step for such technical information is the basic technological knowledge of such as chemical and physical basic experiments shown in Fig.8 and 9.

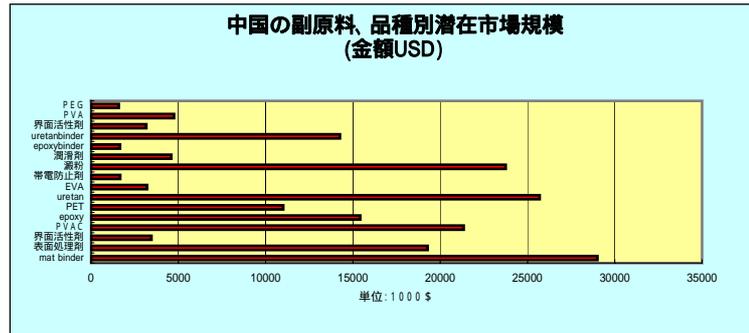


Fig.7: Market capacity of secondary raw materials (by NBL).

**1 FIBER GLASS 生産のための副原料の選定方法**  
 Selection method of secondary materials for fiber glass production

[Q1: 選択された副原料が混合調査できるか?]  
 Can the selected material combined?

1. 1 集束剤の混合実験  
 (1) 配合手順の試験方法 mixing experiment

ガラス板 (300mm角) + ガラス棒 (6~10mmφ)

ガラス板上でうすくひきのばす。何回か順番に添加して混合していく。この時温度に注意する事 (実際の温度に近い条件でテスト)

(2) 判定  
 般に手順は1水、2表面処理助剤、3表面処理剤、4乳化剤、5柔軟剤、6油剤帯電防止剤、7接着剤の方法と、1の次に7を用いる方法などがある。手順を仮定して、順に摺り混ぜると、完全に混合できない時はコロイド状(ゼリー状)やつぶ状の不完全混合が発生する。この時は混合は不完全であり、対策を必要とする。

(3) 合格状態  
 「A1: ガラス面をとおして、接着剤がふんわり均一になっっている事。」

(参考: ファイバー生産設備)  
 一般にメルト方式で経済速度1500mから2000m/分の条件下で1000kgのファイバーを生産するには、約330kgの乾燥性集束剤(サイジング材とも呼ぶ)を使用。サイジング材中の潤滑剤成分(集束剤成分とも呼ぶ)は3.5%から7%、ファイバーに付着させる乾燥集束材(付着剤とも呼ぶ)は0.4%から1.2%である。使用サイジング材の潤滑剤と付着剤の割合(歩留まり)は、約30%から70%である。なお、使用サイジング材(集束剤)の割合は、必ず潤滑剤が10%の高湿エマルジョン(厚塗り)であり、生産時に混合する。

Fig.8 Basic technique of chemistry (from NBL Net Service).

## 3. BASIC KNOWLEDGE OF FIBER MANUFACTURING

Explaining detail of basic theory of manufacturing and designing glass fiber, and providing for each product whole technical contents necessary for designing each product are provided as the 3rd step. The basic structure of glass fiber for electronics board is shown in Fig.10, and its enlarged fiber structure is shown in Fig.11. By providing unopened technical contents via Internet, we can serve specific users. Concerning design of the secondary raw material, research results of NBL are also explained from total view point as shown in Fig.12.

**7 接着状態の強度理論近似計算**

[Q12: 集束材の強度はどのように計算されるか?]  
 集束剤の接着は接着剤の粒子(0.03D)が0.4~2wt%一般に使用されていると考える。その粒子はランダムにファイバー間にある。(接触部)この粒子の乾燥によりガラスフィラメントが接着する。この考え方をモデルにすれば左記となろう。

必要接着力は  
 ① はり応力(剪断力)  
 ② 曲げ剛性

であり、絶対値は解析が複雑であるので相似則を用いて必要接着力の設計方法を導く。  
 ①②モデル図から接着点の平均長さが相似則の最大の要因と理解されよう。Lは必要接着剤の量と径により近似できる。

(剪断力)  
 $T = n\sigma$  ..... (1) ここでσ: 一点当りの接着力  
 n: 点数(単位長さ当り)

接触は断面モデルから6接触とするとnは接着剤の必要wt%を $W_1$ とすると、接着剤の量Wはガラス密度 $\rho_g$ 、接着剤密度 $\rho_B$

$W = W_1 \times (\pi/4)(D^2) \times L \times \rho_B$  ..... (2)  
 $n = W / ((3/4)(d^2)(\rho_B))$  ..... (3)

(1)(2)式よりLを導く(n=6の時)  
 $W_1 \times (\pi/4)(D^2) \times L \times \rho_B = n \times (3/4)(d^2)(\rho_B)$   
 $L = 3nd^2 \rho_B / (\pi W_1 D^2 \rho_B) = 18d^2 \rho_B / (\pi W_1 D^2 \rho_B)$  ..... (4)

Fig.9: Basic technique of physics (from NBL Net Service).



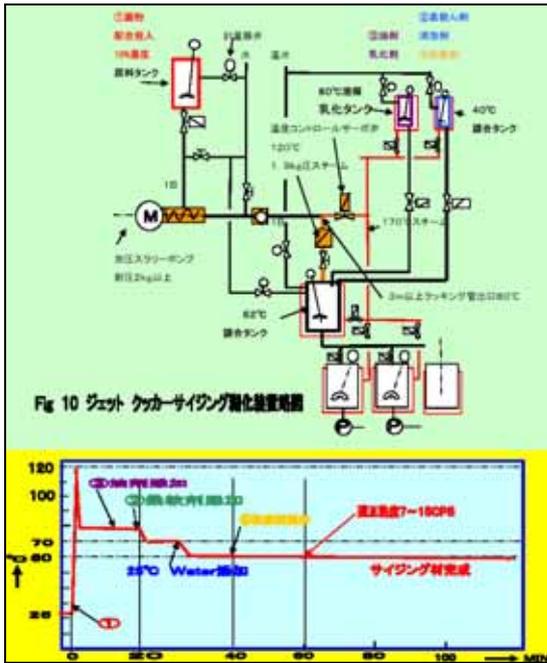


Fig.15 Jet cooker (from NBL Net Service).

### 5. QUANTITY CONTROL OF PRODUCT

In manufacturing glass fibers, we need a lot of know-how. As an example, we provide via Internet. Fig.18 shows major points related to the quality of product. Fig.19 shows explanation of cause of occurring fluff. Fig.20 shows explanation of where and why occurring fluff in the process. Also the causes and points of occurring fluff of yarn are explained as shown in Fig.21.

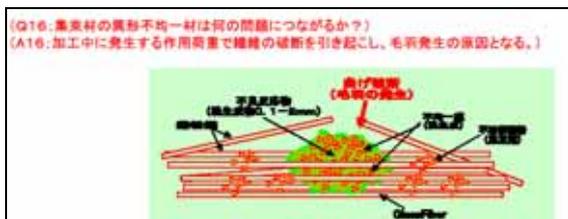


Fig.18: Points related to product quality (from NBL Net Service).

操作手順	薬名	重量 (kg)	添加 (%)	組成 (%)	
高圧機温度 103℃	HAS-Body PD-2050B	23.0	1.91	21.1	43.3
	HAS-Body S-210D	23.0	1.90	21.0	
	PVA	0.0	0	0.0	
	計量	200.0			
重量 450kg (70→75℃へ移行)	Total (10%濃度)	480.0			55.7
冷水添加 80℃へ冷却	Solignum GP-1	18.0	1.90	20.7	34.7
	Solignum GP-1	2.4	0.24	2.1	
	計量 (80℃)	90.0			
	計量	80.0			
	10%濃度	280.0			
② 14G OKG 40~50℃	PEG-800	1.2	0.12	1.1	3.8
	Solignum GW-1B (30%)	8.0	0.24	2.8	
③ 70 OKG	計量 (1%濃度)	60.0			9.4
	計量	50.0			
④ 4 OKG	計量	4.00			6.16
	計量	4.00			
⑤	減粘剤 TSA-727	0.004	0.08	0.004	6.16
⑥ ①+②+③+④+⑤	計量	17.000	0.12	10.0	

Fig.16 Combining condition of jet cooker (from NBL Net Service).



Fig.17 Quality of pasted starch. (from NBL Net Service).

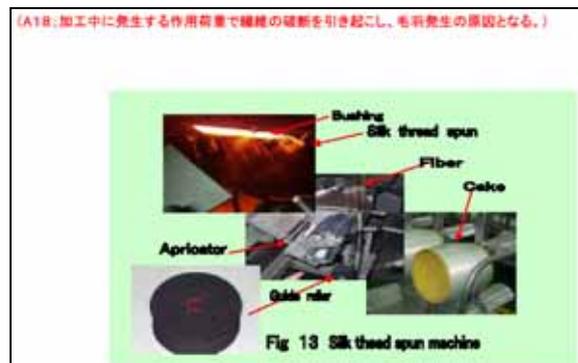


Fig.19: Cause of fluff (from NBL Net Service).



Coupling	一般FRP	KRMA003	103	約12-20	一般FRP用リエスナール
	耐熱FRP	KRMA755	104		耐熱塩水、高温用塗料
	耐食FRP	KRMA403	102		エポキシ、ビニルエステル用
	FRTP	KRMA903	101		熱可塑性樹脂用
Resin	PET	NBL-42	314	約60-80	一般FW用PET、高耐熱型
		NextLeo300	328		一般FW用PET、高耐熱型
		Superflex300	301		一般FW用PET、EM
		Superflex381	381		一般FW用PET、耐熱、EM
		Superflex381	381		一般FW用PET、耐熱、EM
	PET/EPO	A-09	318		EPOXY/PET混合樹脂
		NBL-70	319		828型EM
	EPO	KE-002	345		828型EM
		KE-116	345		836型EM
		KE-301C	348		耐熱型、1002型EM
		KE-1022	350		耐熱型、1001型EM
	E-102	304	透明型、1001型EM		
303		耐熱型、1001型EM			
URETHAN	NBL-50	318	RP用ウレタンSOPANE、SM20%系		
	NBL-07	306	耐熱型、1001型EM		
EVA	NBL-05843	232	耐熱型、1001型EM		
	GM-0000	230	SM100%系樹脂、一般用		
EVA	NBL-43	205	SM100%系樹脂、高弾性高力		
	NBL-00862	710	一般「Mat」も使用可能		
EVA	GH-20	812	IC クロス剤		
	GA-10	813	IC クロス剤		
Lubricant	Paraffin Oil	K-4300	807	約10-30	パラフィンオイル、乳化剤混入
	Paraffin Oil	809	809		パラフィンオイル
Sulfonate	Amide	GW-18	803	約10-20	EPOXY 硬付剤兼剤
	Cation	KP-10	822		EPOXY 硬付剤兼剤
Surfactant	Surfactant	SPF-30	814	約0-5	EPOXY 硬付剤兼剤
	Silicon Oil	NBL-371	825		塗料系、高弾性 KE-543用済
DOP	410	818	818	約0-5	一般「Mat」も使用可能
	410	818	818		一般「Mat」も使用可能
Hardener	Hardener	HAC	→82	約0-10	IC クロス剤
	Hardener	HAC	→82		IC クロス剤

Fig.24: Quality standard of secondary raw materials for FW (from NBL Net Service).

3.2 Standard of GD and NBL Specification(A-AAA)  
Table 05 FW Roving 規格と品質等級の対応例

規格No.	2400TEX規格(大径糸圧縮仕様)				1200TEX規格(内圧縮仕様)			
	規格値	△級	△△級	△△△級	規格値	△級	△△級	△△△級
捻率 (%)	0.25±	0.08	0.05	0.03	0.25±	0.08	0.05	0.03
捻率 (1/200)	0.55±	0.85	0.5	0.4	0.55±	0.85	0.5	0.4
捻率 (1/200)	0.2	0.3	0.3	0.4	0.2	0.3	0.3	0.4
捻率 (1/200)	0.25±	0.3	0.35	0.4	0.25±	0.35	0.4	0.45
捻率 (1/200)	0.2	0.3	0.3	0.4	0.2	0.3	0.3	0.4
捻率 (1/200)	14.0±	16	16	16	14.0±	16	16	16
捻率 (1/200)	2400±	2400±	2400±	2400±	1200±	1200	1200	1200
捻率 (1/200)	80	80	80	80	30	30	30	30
捻率 (1/200)	34	34	34	34	17	17	17	17
捻率 (1/200)		750	910	1040		910	1040	1170

Fig.25: Quality standard of glass fiber products.

## 8. BASIS OF MANUFACTURING MAT

The system supports also manufacturing process of fiber mat. They also include documents of production technique, optimum production condition, production method in laboratory, and Technical materials provided by the net service are web pages, able to print to the regular document size of A4. Fig.26 shows a format of each technical material, and Fig.27 shows a sample of explaining method in the materials. Also necessary information is provided as in Fig.28. How to determine the optimum manufacturing condition and model of the manufacturing condition are explained as shown in Fig.29. Confirming method in laboratory before manufacturing in the line is explained as shown in Fig.30. Basis of quality of products (Fig.31) and QA of technical explanation (Fig.32) are also provided.



Fig.26: Format of each technical material (from NBL Net Service).

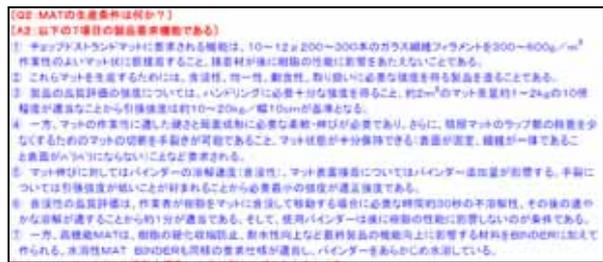


Fig.27 Explaining style in materials

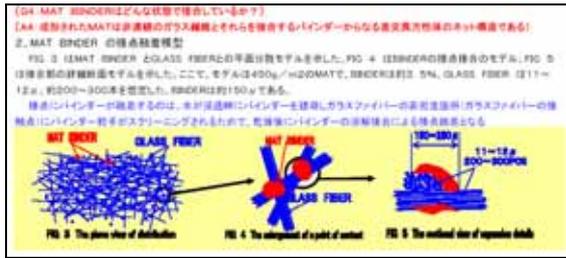
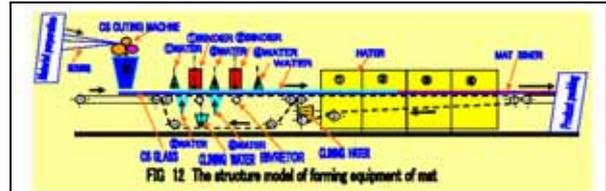


Fig.28: Necessary detailed information (from NBL Net Service).



標準的製造条件・品質管理・品質の関係

項目	ガラス繊維仕様		樹脂仕様		成形条件		品質管理		
	種類	規格	種類	規格	温度	速度	含水率	強度	延伸率
標準	11μ	200	FR-900	FR-900	170	1.2	15	1800	1800
11μ	200	FR-900	FR-900	FR-900	170	1.2	15	1800	1800
11μ	200	FR-900	FR-900	FR-900	170	1.2	15	1800	1800
11μ	200	FR-900	FR-900	FR-900	170	1.2	15	1800	1800

Fig.29: Optimum manufacturing condition of mat (from NBL Net Service).



Fig.30: Laboratory manufacturing (from NBL Net Service).

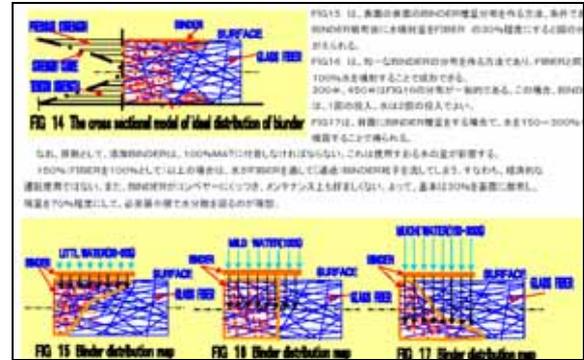


Fig.31: Basis of quality of products.

① 正しい繊維分散・樹脂浸透が品質の保証は何を確保すればよいか?

② 製品の品質管理と生産・材料不良との関係で発生する不良原因

不良原因	原因	対策
繊維分散不良	原因: 繊維分散不良	1, 2, 3, 4, 5, 6
樹脂浸透不良	原因: 樹脂浸透不良	7, 8, 9, 10
繊維分散不良	原因: 繊維分散不良	1, 2, 3, 4, 5, 6
樹脂浸透不良	原因: 樹脂浸透不良	7, 8, 9, 10
繊維分散不良	原因: 繊維分散不良	1, 2, 3, 4, 5, 6
樹脂浸透不良	原因: 樹脂浸透不良	7, 8, 9, 10
繊維分散不良	原因: 繊維分散不良	1, 2, 3, 4, 5, 6
樹脂浸透不良	原因: 樹脂浸透不良	7, 8, 9, 10
繊維分散不良	原因: 繊維分散不良	1, 2, 3, 4, 5, 6
樹脂浸透不良	原因: 樹脂浸透不良	7, 8, 9, 10

Fig.32: QA, technical explanation (from NBL Net Service).

### 9. OTHER FUNCTIONS

The system also provides commercial information of products including basic quality data of product (Fig.33), compatibility of products (Fig.34), MSDS (Material Safety Data Sheet) for exports (Fig.35), specification of product (Fig.36) which may be used for dealing maker guarantee document, certificate of approval of ISO (Fig.37), product information (Fig.38), information of packing shape, and information of material makers (Fig.39).

Public presentation: (https://nblao) Business: (https://chn.co.jp)

Submaterials table (NBL collecting)

No.	Code	Prod. name	Product name	Unit	Price	Material	Resin system	Others / feature	Static factory
180	Coating	epoxyresin	SRM123	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, PE, ACRYL, PO, ABS, PVC, NYLON, MELAMIN, PHENOL, FURAN, EPOXY	Chiba Zhaihi factory
181	Coating	epoxyresin	SRM200	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, FRTP = A-110 (PS, PE, ACRYL, PO, ABS, PVC, NYLON, MELAMIN, PHENOL, FURAN, EPOXY)	Chiba Zhaihi factory
182	Coating	epoxyresin	SRM400	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, FRTP = A-107 (ACRYL, URETHANE, PET, ABS, MELAMIN, PHENOL, FURAN)	Chiba Zhaihi factory
183	Coating	epoxyresin	SRM500	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, FRTP = A-114 (PS, PE, PO, ABS, PET, EPDM)	Chiba Zhaihi factory
184	Coating	epoxyresin	SRM375	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, FRTP (heat resistance) (EPOXY, PET, URETHANE, PO, MELAMIN)	Chiba Zhaihi factory
185	Coating	epoxyresin	SRM1000	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, FRTP (PD, PE)	Chiba Zhaihi factory
186	Coating	epoxyresin	SRM200	kg	930	Shikoku Chemical Co., Ltd.	epoxy/epoxy/epoxy/epoxy	FR, FRTP (heat resistance) (EPOXY, PET, URETHANE, PO, MELAMIN)	Chiba Zhaihi factory
187	Coating	FRTP (A-110)	A-110	kg	930	Shikoku Chemical Co., Ltd.	FRTP	FRTP	Chiba Zhaihi factory
188	Coating	FRTP (A-107)	A-107	kg	930	Shikoku Chemical Co., Ltd.	FRTP	FRTP	Chiba Zhaihi factory
189	Coating	FRTP (A-114)	A-114	kg	930	Shikoku Chemical Co., Ltd.	FRTP	FRTP	Chiba Zhaihi factory
190	Coating	FRTP (A-110)	A-110	kg	930	Shikoku Chemical Co., Ltd.	FRTP	FRTP	Chiba Zhaihi factory
191	Coating	FRTP (A-107)	A-107	kg	930	Shikoku Chemical Co., Ltd.	FRTP	FRTP	Chiba Zhaihi factory
192	Coating	FRTP (A-114)	A-114	kg	930	Shikoku Chemical Co., Ltd.	FRTP	FRTP	Chiba Zhaihi factory

Fig.33 Basic quality data of product (from NBL Net Service).



PRODUCT INFORMATION				
2003.4.20 by NBL				
product name		Starch NBL-130		
product maker		Shikibo Ltd		
product use, capacity		sizing material, main material		
chemical component (structure)		corn starch hydroxypropyl ether (starch)		
physical property	item	unit	standard value / test method	
	moisture rate		11.0~13.5 / Infrared moisture meter	
	ash		0.05~0.15 / 600°C, electric furnace	
	P11		6.65~6.94 / 5% suspension, P11 meter	
	viscosity	50°C 10.0~24.0mpas		185%, 50°C, viscometer
		60°C 13.0~30.0mpas		
		50°C 15.0~40.0mpas		
	status	Light yellow & white powder		
usage	lot determination	one batch/1000~1500kg/one lot		
	meaning of lot number	Ex. A.B123 produced year (A)/month (B)/product number (D)		
	sampling method	take out about 500kg product bag as sample		
	reserved sample	500g		
	test score list	3 sets		
shipping	packing material	with 3 layers of craft paper		
	package indication	product name, container quantity, company name		
	package size	1100 x 1100 x 1900(mm)		
	weight per package	25kg x 4 bags/pallet x 20 pallets/container 2000kg/40 container		
	storage condition	normal temperature, indoors		
	storage period limit (product guaranteed period)	6 months after supplied		
company	manufacturing company	Shikibo LTD.		
	supplier	NBL		
	physical distribution company	NBL		

Fig.38: Product information  
(from NBL Net Service)



Fig.39: Introduction of material makers  
(from NBL Net Service).