CWG Input Regarding Global Availability of Composite Materials and Technology

Global Availability of Key CCL-Listed Composites Items

Item	Availability By country	Companies by name and web site	Substantiation Notes:
High Performance organic fiber Above 1C010.a	US Netherlands??? Japan Iochu Macedonia?	DuPont Teinjin Aramid Iochu (Zylon PBO – organic)	Para-aramid products at both DuPont and Teijin Aramid
Aramid fiber over 1C010.e.1	US Netherlands	DuPont Teijin Aramid	
1C010.b	See Attached PAN and Carbon Availability Chart	See Attached PAN and Carbon Availability Chart	Market data from membership
Carbon Fiber over 1C010.e.1	See Attached PAN and Carbon Availability Chart	See Attached PAN and Carbon Availability Chart	Market data from membership
1C010.c	US France China?? Russia??	Saint-Gobain Saint- Gobain	Confirmed by Saint Gobain Confirmed by Saint Gobain Industry indication of materials being made in China Don't know if thresholds are met
1C210–High Strength glass	US Mexico Japan Taiwan?? China?? Russia	AGY Owens Corning Nittobo NSG (Nippon Sheet Glass) Formosa? AO-Steklonit (IVG Vertex)?	AGY Confirmed by AGY Confirmed by Toho Industry indications May be under different name now

Global Availability of Key CCL-Listed Composites Items

Item	Availability By country	Companies by name and web site	Substantiation Notes:
1C008.a.1 (BMI)	US EU China (R&D)	Cytec Cytec R&D Houses Jiao Zuo Tian Yi Technology Co. Ltd.	Input from Cytec Awareness of Chinese development by Cytec Data sheets in hand
1C008.a.2 (PAI)	US Japan	Solvay Auram Mitsui Chemicals	
1C008.a.3 (API)	US China?? Japan	Maverick P2SI Cytec Daychem Changzhou Plastics Company Ube	Member background info
1C008.a.4 (PEI)	US China??	SABIC R&D	Input from SABIC
1C009.b	Japan	Ube	

Global Availability of Key CCL-Listed Composites Items

Item	Availability By country	Companies by name	Substantiation Notes
1B001 / 1B101 Filament winding machines	Too many to list. Available from China, US, Europe, etc	Too many to list from many worldwide suppliers	Internet search reveals a multitude of winding machine suppliers
Tape laying Machines	US Spain France	MAG Cincinnati Ingersoll Milling Machine MTorres Forrest Line	These are just the recognized leaders. There are other smaller players.
Tow Placement Machines	Spain France US Macedonia? Germany??	MTorres Forest Line MAG Cincinnati Ingersoll Milling Machine Electroimpact Accudyne Mikrosam Brotje	These are just the recognized world leaders. http://www.electroimpact.com/ http://www.mikrosam.com/ Extensive web site – composites Expo in Moscow Marketing machines – no knowledge of sales yet

Global Availability of Key CCL-Listed Composites Items

Item	Availability By country	Companies by name	Substantiation Notes
1B001.F NDI Equipment	UK	-Ultrasonic Sciences Limited (UK) www.ultrasonic-sciences.co.uk	Member industry survey
	Canada	-Tecscan (Canada) www.tecscan.ca	
	Israel	-ScanMaster (Israel) www.evs-sm.com	
	Spain	-Tecnatom (Spain) http://www.tecnatom.es -MTorres (Spain) http://www.mtorres.es	
	Germany	-General Electric Inspection Technologies (Germany) http://www.ge-mcs.com/en/ultrasound/integrated-systems.html	
	Japan	-Toshiba (Japan) http://www.toshiba.co.jp/index.htm	
	Netherlands	-Midas NDT (UK) http://www.midas-ndt.co.uk/midas.html -PScan (Netherlands) http://www.p-scan.com -Olympus (Canada): -http://www.olympus-ims.com/en/?apd=1&adid=rdt&acid=engle&gclid=CIjagOeK1qYCFQTNKgod1G0AJA	

Carbon Fiber Manufacturers

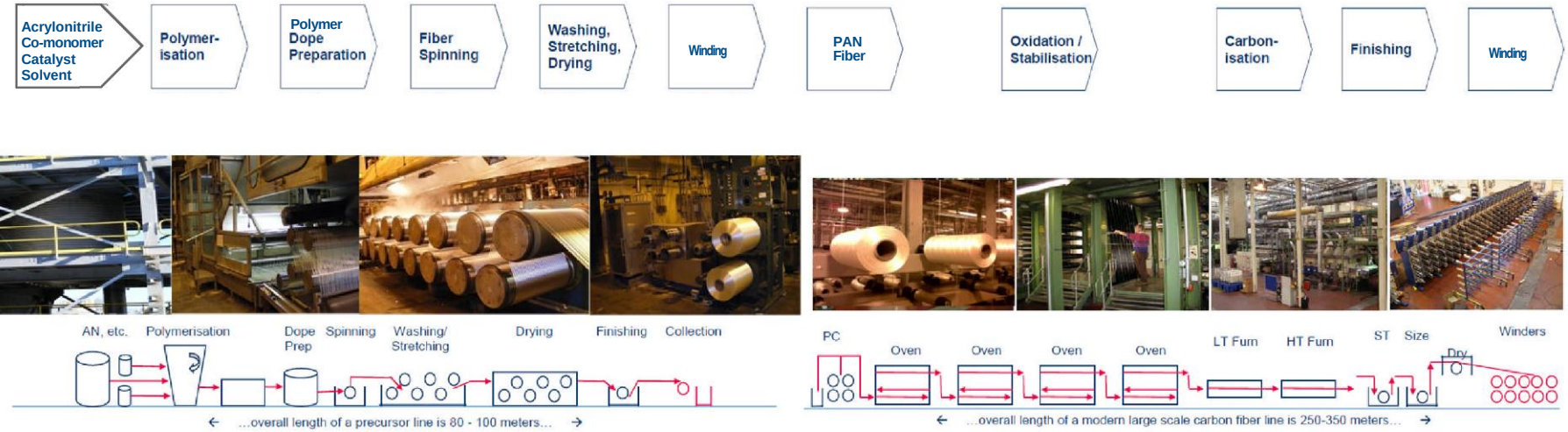
- Carbon Fiber production is already established in 13 countries:
  - U.S., E.U. (FR, GR, UK, SP, Hun), Japan, Taiwan, Mexico, Turkey, India, Saudi Arabia, China.
    - IM fiber is currently made in U.S., E.U. (FR, GR, SP) and Japan, with Turkey and China close behind.
  - IM fiber can be developed in the remaining countries.
- Carbon Fiber production can easily be established in 8 more countries which produce acrylic fiber:
  - Belarus, Brazil, Iran, Italy, Peru, Portugal, Thailand, Uzbekistan
    - Upgrades needed from acrylic fiber to polyacrylonitrile (PAN) precursor
      - Similar chemistry and processing: acrylic fiber is 85% AN, PAN is over 93% AN, i.e. higher purity.
    - Addition of oxidation and carbonization (Ox/Carb) furnaces (export restrictions?)
  - MRC, FPC, AKSA, Zoltek, EPG/Lenzing and Jilin Qi Feng have successfully migrated from acrylic fiber to PAN, then added Ox/Carb furnaces.
  - Eventually, these 8 countries could also develop IM fiber capability.

Carbon fibers are closely related to acrylic fibers, which are not export controlled.

Carbon Fiber Manufacturing Process

Step 1: Convert AN to PAN Fiber

Step 2: Convert PAN Fiber to Carbon Fiber



Chemical processing/polymerization:

- Essentially the same for acrylic fibers and PAN precursor:
  - Acrylic fibers are at east 85% AN
  - PAN precursor is at least 93% AN
- Most technology is in the chemical processing.

Thermal Processing

- The oxidation ovens and carbonization furnaces have export restriction
- Less technology in the thermal processing.

Known Carbon Fiber Producers

	Company	State	Country	AN	AF	PAN	SM-CF	IM-CF	Comments
1	Toray	Ehime	Japan	No	No	Yes	Yes	Yes	T800and above
2	Toray	Decatur, AL	US	No	No	Yes	Yes	Yes	T800and above
3	Toray	Abidos	France	No	No	No	Yes	Yes	T800 and above
4	Toray	Gumi	Korea	No	No	No	2013	No	Industrial fibers only
5	Toho	Mishima	Japan	No	No	Yes	Yes	Yes	IMS40, IMS60
6	Toho	Rockwood, TN	US	No	No	No	Yes	Yes	IMS40, IMS60
7	Toho	Oberuch	Germany	No	No	No	Yes	Yes	IMS40, IMS60
8	Mitsubishi Rayon Corp. (MRC)	Otake/Toyohashi	Japan	Yes	Yes	Yes	Yes	?	Industrial fibers only
9	Mitsubishi Rayon Corp. (MRC)	Sacramento	US	No	No	No	Yes	?	Industrial fibers only
10	Mitsubishi Rayon Corp. (MRC)	Inverness	UK	No	No	No	Yes	?	Industrial fibers only
11	SGL Carbon	Evanston, WY	US	No	No	No	Yes	No	Industrial fibers only, PAN from MRC
12	SGL Carbon	Moses Lake, WA	US	No	No	No	Yes	No	Industrial fibers only, PAN from MRC
13	SGL Carbon	Muir of Ord	Scotland	No	No	No	Yes	No	Industrial fibers only, PAN from MRC
14	SGL/EPGJV	Kelheim	Germany	No	Yes	Yes	No	No	With Lenzing/Dolan Acrylic
15	Formosa Plastics Corp (FPC)	Mailiao	Taiwan	Yes	Yes	Yes	Yes	?	Possible
16	Hexcel	Decatur, AL/SLC, UT	US	No	No	Yes	Yes	Yes	IM7, IM10+advanced fibers
17	Hexcel	Illescas	Spain	No	No	No	Yes	Yes	IM7, IM10+advanced fibers
18	Cytec Carbon Fibers	Greenville & RH, SC	US	Yes	No	Yes	Yes	Yes	T40-800 and MRC technology
19	Zoltek	Abilene, TX	US	No	No	No	Yes	n/a	Industrial fibers only
20	Zoltek	Nyergesujfalu	Hungary	No	No	Yes	Yes	n/a	Industrial fibers only
21	Zoltek (Cydsa AF plant)	Guadalajara	Mexico	No	No	Yes	Yes	n/a	Industrial fibers only
22	AKSA	Yalova	Turkey	No	Yes	Yes	Yes	Soon	Currently T300 equiv., Planning T800
23	SABIC (with MRC)	Riyadh	Saudi Arabia	2013	2013	2013	2013	?	MRC providing technology
24	Kemrock	Gujarat	India	No	No	Yes	Yes	?	Pilot plant using NAL technology (India)
25	Jiangsu Hengshan Fiber Mat'l	Jiangsu	China	No	No	Yes	Yes	Soon?	Currently T300 equiv., Possible T800
26	ZhongFu ShenYing Carbon Fiber	ZhongFu	China	No	No	Yes	Yes	?	?
27	Sinosteel Jilin Carbon Co., Ltd.	Jilin	China	No	No	Yes	Yes	?	?
28	CNPC Jilin Chemical Group Co.	Jilin	China	Yes	No	Yes	Yes	Soon?	Currently T300equiv., Possible T800
29	Dalian Xingke - China	Dalian	China	No	No	Yes	Yes	?	?
30	Anhui Huawan Carbon Fiber	Anhui	China	No	No	Yes	Yes	?	?
31	Weihai Tuozhan Fiber Co., Ltd.	Weihai	China	No	No	Yes	Yes	?	?
32	Jilin TanGu CF Co (Jilin QiFeng)	Jilin	China	No	Yes	Yes	Yes	?	?

Key:
AN: acrylonitrile
AF: Acrylic fiber (min. 85% AN)
PAN: Polyacrylonitrile (min. 93% AN)
SM-CF: Standard Modulus Carbon Fiber
IM-CF: Intermediate Modulus Carbon Fiber

IM fiber spreading from US/EU/Japan to Turkey and Chin Saudi Arabia, India and others are positioned for IM.

Potential Carbon Fiber Producers

	Company	City/State	Country	AN	AF	PAN	SM-CF	IM-CF	Comments
1	JSC Polymir/BelOil/NAFTAN	Various	Belarus	No	Yes				
2	Crylor (Radici Group)		Brazil	No	Yes				Parent company is in Italy
3	Daqing Petrochemical		China	Yes	Yes				PetroChina
4	Daqing Refining & Chemical Co.		China	Yes	Yes				
5	Sinopec SPC	3 sites	China	No	Yes				
6	Hangzhou Bay AF	Hangzhou	China	No	Yes				
7	Zhejiang Jinyong A.F.		China	No	Yes				Closed
8	Fushun PC	Fushun	China	No	Yes				
9	Ningbo Zhongxin AF	Zhejiang	China	No	Yes				Formerly MRC Ningbo
10	Qinhuang Dao Alight AFC		China	No	Yes				Closed
11	Dralon	2 sites	Germany	No	Yes				Dormagen and Lingen
12	Indian Acrylics	Punjab	India	No	Yes				
13	Pashupati Acrylon	Thakurdwara, U.P.	India	No	Yes				
14	Reliance (IPCL)		India	No	Yes				
15	Polyacryl Iran co	Isfahan	Iran	No	Yes				
16	Monte Fiber (MEF)		Italy	No	Yes				Has Jimont JV wt Jilin QiFeng
17	Sudamericana de fibras	Lima	Peru	No	Yes				
18	Fisipe	Lavradio	Portugal	No	Yes				
19	Monte Fiber (MEF)		Spain		Yes				
20	Tong Hwa Synthetic	Chu-pei	Taiwan	No	Yes				Under license from MRC
21	Thai Acrylic Fibre	Sarabuti	Thailand	No	Yes				
22	China Bluestar (ex-Acordis)		UK	No	No	Yes			PAN precursor to SGL and others
23	Navoiazot Prod.		Uzbekistan	No	Yes				

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AN: acrylonitrile
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Any country with acrylic fiber capability can expand to carbon fiber: Belarus, Brazil, Iran, Peru, Thailand, Uzbekistan.

The AF line would need upgrades for PAN and OX/Carb furnaces added for

From: "May, Thomas L" <thomas.l.may@boeing.com>
To: PublicComments@bis.doc.gov
Date: Mon, Feb 7, 2011 10:59 PM
Subject: Notice of Inquiry - CCL

Timothy Mooney, Office of
Exporter Services, Regulatory Policy
Division, Bureau of Industry and
Security, Department of Commerce,
1401 Constitution Avenue, NW., Room
2705, Washington, DC 20230,

ATTN:
Notice of Inquiry-CCL.

The BIS Materials and Transportation TACs sponsor an industry working group known as the Composite Working Group. This is a technical subcommittee comprised of representatives from companies participating in US domestic composites materials and materials processing. Participating members of the CWG have assembled the following in response to the Notice of Inquiry addressing the Commerce Control list that was posted in the Federal Register on Dec. 9, 2010:

Regarding the possible placement of CCL listings in a new tiered structure, the group has determined that global availability and military criticality are valid criteria for the placement of the CCL items onto the new tiers. Licensing policy for the items on the tiers should be strongly dependent on the global availability and military criticality of the item. The CWG appreciates the opportunity to make input on this subject.

As a technical advisory group consisting mainly of representatives from commercial industry, the group had considerable difficulty applying the military criticality criteria provided in the FR directly to the placement of specific composite materials and technologies into a tiered structure. The group, however, did conclude that the application of composite materials and technologies to military items would result in only incremental improvements to the performance of military systems and therefore does not have a substantial impact on capability. In other words, similar military capabilities can generally be achieved through the use of other high performance, globally available materials. Regarding the military capability provided by composite materials processing machines such as automated tape laying and automated tow placement machines, the military criticality is expected to be low because those machines are typically used to achieve production efficiency rather than capability of a military article. The lack of an automated tape layup machine would not greatly hinder the military capability of a foreign power because that country could, in most cases pursue manual layup processing and still achieve a comparable structure.

To support tiering of items using both military criticality and global availability criteria, it may be advisable to integrate the activities and discussions of both the military advisory and Commerce advisory groups into a single discussion in order to gain both the military and commercial perspective in a single forum.

The CWG can make a meaningful input on the subject of global availability because the members are usually aware of materials and technologies being marketed by other firms. In order to support the current and future tiering discussions,

the CWG has undertaken the collection of global availability data relating to key composite Commerce Control List items (see attached PowerPoint file). The availability listing represents the combined current knowledge of companies participating on the CWG but is not necessarily complete. The CWG intends to continue to research availability and will provide updates to BIS if additional availability is identified.

Tom May,
Boeing Commercial Airplanes
BIS Composite Working Group Co-Chair

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