Position Paper: Carbon Fiber in the Proposed End-of-Life Vehicles Directive

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The Japan Carbon Fiber Manufacturers Association (JCMA) welcomes the objective of the ELV Directive to restrict on materials that have a significant impact on human health and the environment, as well as to improve the circularity of the automotive industry. However, it is crucial to recognize that carbon fiber is essential for realizing a hydrogen society and reducing CO_2 emissions, with no significant impact on human health confirmed.

Contribution of Carbon Fiber to Automotive Application

Carbon-Fiber-Reinforced-Plastic (CFRP) combines carbon fiber, as a reinforcing fiber, with matrix resin (thermoplastic or thermoset resin). These high-strength and high-modulus materials contribute to significant vehicle weight reduction, making CFRP insatiable for both racing cars and commercial vehicles. The parts where carbon fiber is used in structural components (e.g. monocoque) and outer panels (e.g. hood, trunk lids). In addition to being lightweight, carbon fiber offers corrosion-resistant and excellent fatigue properties, contributing to longer vehicle lifetimes. The benefits of weight reduction are also recognized in the life cycle assessment (LCA) of automobiles, reducing CO_2 emissions.

Carbon fiber plays a significant role in the automotive industry's efforts to strengthen CO_2 emission regulations. Particularly for fuel cell vehicles (FCVs), carbon fiber is applied to high-pressure vessels for storing hydrogen and to the gas diffusion layers of fuel cells that generate electricity from hydrogen. Carbon fiber is essential for achieving the carbon-neutral society that the world aims for.

Although carbon fiber is sometimes considered difficult to recycle, applications of recycled carbon fiber have been expanding. For example, waste material from aircraft wings has been used in laptop casings. Furthermore, carbon fiber waste is used in chemical recycling as a carbon additive in electric furnaces, contributing to CO_2 reduction in the steel industry.

Carbon fiber can reduce CO₂ emissions through high-performance applications and by being used as a recycled material due to its high durability. Additionally, carbon fiber is utilized in water purification and soil improvement, making it indispensable for achieving carbon neutrality.

JCMA's Position on the EP's Amendment Draft of ELV Directive

JCMA believes that the following considerations are necessary in the EP's amendment draft proposal to the ELV regulation:

Amendment 77 Article 5, Paragraph 3 Amendment 78 Article 5, Paragraph 4 subparagraph 1 – point a Amendment 79 Article 5, Paragraph 4 subparagraph 1 – point c

JCMA asserts that <u>"carbon fibres" should be removed from Article 5</u>, as they are not equivalent to lead, mercury, cadmium, or hexavalent chromium under the RoHS Directive.

- 1. **Carbon Fiber is Indispensable for a Hydrogen Society:** In manufacturing FCVs that contribute to the realization of a hydrogen society, carbon fiber is indispensable for essential components such as pressure vessels and gas diffusion layers. Restricting the use of carbon fiber will delay the arrival of a hydrogen society that supports carbon neutrality.
- 2. **Carbon Fiber is Indispensable for the High-Performance Automobiles:** In high-performance sports cars in Europe, high-strength and high-modulus carbon fiber is indispensable. Restricting the use of carbon fiber will halt the production of these automobiles.
- Carbon Fiber is Indispensable for Europe's Key Industries: Carbon fiber is an indispensable material in Europe's key industries, including structural components of aircraft, motor cases of launch vehicle and wind blades. The proposed restrictions will suppress innovative technological developments in these industries.
- 4. **Carbon Fiber is a Recyclable Material:** Waste carbon fiber is already being chemically recycled as a carbon additive in electric furnace steelmaking. Furthermore, recycled carbon fiber parts are being applied in BMW front roof reinforcement. (Annex I: Example of recycled carbon fiber application).
- 5. Insufficient Evidence of Health Impacts: Carbon fiber is intentionally manufactured with fibers approximately 5µm or more to avoid WHO fiber regulations (diameter less than 3µm) (Figure 1). Moreover, PAN-based carbon fiber, widely used in automobiles, is less prone to cleavage and does not significantly thin even when cut. Recent studies have not found any papers indicating toxicity. Additionally, carbon fiber itself is biocompatible and has water purification properties (Annex II: Literatures for health impact of carbon fiber).



(Created picture with reference to Prepared based on Determination of airborne fiber number concentrations, A recommended method, by phase-contrast optical microscopy, World Health Organization Geneva 1997)

Figure 1 Diameter and length range of WHO fibers and carbon fibers

About JCMA

The Japan Carbon Fiber Manufacturers Association (JCMA), currently a committee in Japan Chemical Fibers Association (JCFA), was established in 1978 as the Japan Carbon Fiber Conference with the aim of contributing to the development of the carbon fiber industry in Japan.

JCMA continues to address the sound development of the carbon fiber industry through the dissemination activities and the promotion of international standardization, contributing to the achievement of Sustainable Development Goals (SDGs) by 2030 and the 2050 Carbon-Neutral goal set by Japanese Government.

ANNEX I: Example of recycled carbon fiber application

Toray Carbon Fiber Recycled from Boeing 787 Wing Production Process Applied in Lenovo ThinkPad X1 Carbon Gen 12 (December 15, 2023) https://www.toray.com/global/news/article.html?contentId=v1wibzlx

Thermoset Recycling Technologies https://www.cf-composites.toray/aboutus/sustainability/recycling.html

World's First Fully Recycled Thermoplastic Component Takes Flight! (2016) https://www.toraytac.com/media/story/WpW5/Worlds-First-Fully-Recycled-Thermoplastic-Component-Takes-Flight

CMA Excess Prepreg Used in Newly Expanded Aquatic Center (October 23, 2020)

https://www.toraycma.com/cma-excess-prepreg-used-in-newly-expanded-aquatic-center/

CMA Celebrates Earth Day 2017 https://www.toraycma.com/cma-celebrates-earth-day-2017/

Tokai University Solar Car Team Unveils New Machine for BWSC 2023 Participation (in Japanese) (September 6, 2023) https://www.carbonmagic.com/news/news 20230906.html

MITSUBISHI CHEMICAL CORPORATION

Collaboration with the Japan Windsurfing Association on Carbon Fiber Recycling Conclusion of a sponsorship contract with professional windsurfer Takuma Sugi (September 30, 2022) https://www.mcgc.com/english/news_release/01374.html

MITSUBISHI CHEMICAL CORPORATION New brand of Carbon Fiber Pellet with lower environmental impact PYROFIL[™]NEO https://www.m-chemical.co.jp/carbon-fiber/pdf/pellet/neo.pdf Teijin and Fujitsu agree to jointly develop blockchain-based commercial platform to promote sustainable use of recycled materials https://www.teijin.com/news/2022/07/12/20220712_01.pdf

Fujitsu and Teijin start joint trials with V Frames and Advanced Bikes to enhance environmental value of recycled carbon fiber used in the manufacturing process of bicycle frames https://www.teijin.com/news/2023/01/19/20230119 01.pdf

Teijin's TenaxTM and PAN to Earn ISCC PLUS Certification for Bio-based and Circular Raw Materials https://www.teijin.com/news/2023/06/29/20230629_01.pdf

Teijin Carbon presents the new environmentally friendly Tenax Next[™] R2S P513 6mm carbon fiber short cut at JEC World 2025 (March 4,2025) https://www.teijincarbon.com/de/blog/blog-detail/pioneering-sustainability-teijincarbon-showcases-new-eco-friendly-tenax-nexttm-r2s-p513-6mm-short-carbonfiber-at-jec-world-2025/

ANNEX II: Literatures for health impact of carbon fiber

Owen Peter E, Glaister John R, Ballantyne Bryan, Clary John J. "Subchronic Inhalation Toxicology of Carbon Fibers" Journal of Occupational Medicine. 1986, 28(5): 373-376

Rats were exposed to inhalation of CFs measuring 7 μ m in diameter and 20 to 60 μ m in length for up to 16 weeks.Phagocytosis was confirmed, but there was no lung function, pneumonia, or fibrosis.

Thomas R Martin, Stephen W Meyer, Daniel R Luchtel. "An evaluation of the toxicity of carbon fiber composites for lung cells in vitro and in vivo". Environmental Research. 1989-08; 49 (2): 246-261

CF with a diameter of 3 μ m or less, 99.9% of which was 10 μ m or less, was administered intratracheally to rats, and the rats were dissected one month later. Significant increase in neutrophils in the lungs/less toxic than quartz

Nakano Makiko, Nagataki Yoko, Omae Kazuyuki. "Toxicity of Carbon fiber". Occupational health journal. 2008; 31(6): 74 - 77

The shape of respirable fibers that reach the alveoli is less than 3 μ m in diameter, less than 80 μ m in length, and has an aspect ratio of 3 or more. The previously reported CF did not meet this requirement and was not chemically modified, so no toxicity was observed.

Jing Wang, Lukas Schlagenhauf, Ari Setyan. "Transformation of the released asbestos, carbon fibers and carbon nanotubes from composite materials and the changes of their potential health impacts". Journal of Nanobiotechnology. 2017; 15

CFs with diameters between 5 and 10 μ m are not considered to be respirable (from WHO).During release from the composite, they may split along the fiber axis, generating smaller respirable fibers.