

Recycled glass fiber from waste solar panel cover glass

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[Background]

Circularity and sustainability are essential issues for the composite which is widely used for the Automotive industry, and a glass fiber which is the most common reinforced fiber for composite is also required to contribute to this demand. Regarding the aspect of sustainability, the glass fiber is originally a low environmental impact material, the carbon foot print is lower than other materials. On the other hand, to achieve “Recycled Glass Fiber” which has both a high circularity and economic sense is the big issue.

[Recycle options of a glass fiber]

Post Industrial recycle(PIR) and Post consumer recycle(PCR) are the recycle options for a glass fiber, which is same as plastic industry. Regarding PIR, the major feedstock is glass fiber waste which is generated when a glass fiber producing stopped by cutting and product mix changing and defective product. These feedstock return to glass fiber furnace after removing the surface treatment and crushing for the powder. There are two options for PCR, the representative initiative is recycling from a composite, which is called the “Closed Loop Recycle”. However, the cost of the separating process is significantly higher than the raw material, thus the current situation is basic research and limited prototype trial. Therefore, we currently focused on the soda-lime glass (likely a bottle, plate and solar panel cover glass), which the initiative’s position is the “Open Loop Recycle”. These glass compositions are different from a glass fiber composition as represented by the E-glass, but the amount of feedstock is relatively abundant, and the cost is reasonable. Also, waste solar panels are expected to be discarded in large quantities all over the world, so it is highly meaningful from the perspective of a circular economy.

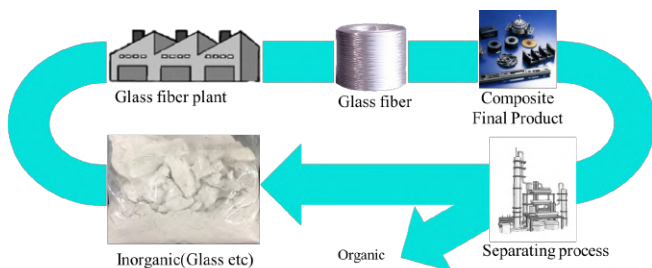


Fig 1, Closed loop recycle

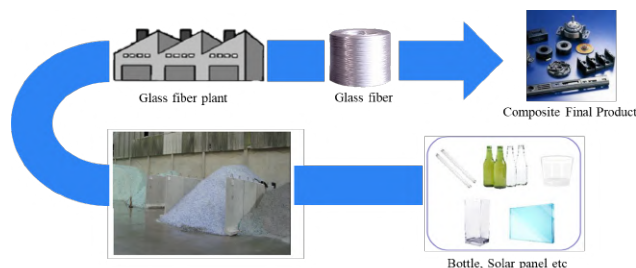


Fig2, Open loop recycle

[Trial test of recycled glass fiber from solar waste cover glass and property evaluation]

We made a prototype glass fiber chopped strand which is adjusted recycle ratio to 25%. The recycled feedstock is waste solar panel cover glass which is removed ingredients other than glass such as Aluminium and EVA film. The glass fiber’s cut length is 3mm and surface treatment is specialized for this recycle glass fiber design. By using this chopped strand, PA6 and PBT resin, we made composite test piece by injection molding. Table1 shows the evaluation result. The “Virgin glass” mechanical property of soda-lime glass is 25%~30% lower than E-glass, but by adjusting the recycle ratio and using specialized surface treatment, the composite mechanical properties are very similar with E-glass composite.

Tabla 1, Composite properties of PA6 and PBT GF30wt%

	PA6 GF30wt%		PBT GF30wt%	
	E-GF	Recycled GF 25%	E-GF	Recycled GF 25%
Tensile Strength (MPa)	190	180	125	125
Tensile Strength 24hr PCT (MPa)	90	85	80	80
Flexural strength (MPa)	285	280	195	195
Flexural modulus (GPa)	9.0	9.0	9.0	9.0
Notched Charpy Impact Strength (KJ/m ²)	12.0	11.0	9.5	9.0

[Conclusion]

We succeeded the trial test of recycle glass fiber from waste solar panel cover glass, and the composite properties are similar with E-glass composite by adjusting recycle ratio and using specialized surface treatment. Also this result would indicate that there is the possibility to use the soda-lime glass feedstock for the glass fiber. The plate glass used for automotive industry is soda-lime glass too, so by establishing properly collecting system, these glass could recycle for glass fiber and possible to achieve the open type automotive to automotive closed loop recycle scheme.