Environmentally Friendly Usage of Post-consumed Plastic

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Introduction

The huge amounts of wastes were produced nowadays. Among the solid waste stream, the waste plastic portion is about 20 % in weight, over 50 % in volume. But the most of waste plastics were incinerated or land filled. Only a bit of waste plastics were recycled and reused. On the view point of current energy crisis, this will be an extravagance of beneficial resource. So we should consider the waste plastics as a beneficial raw material. Also need to develop the field of reusing and recycling of post-consumed plastic.

From the view point of reusing plastic recyclates, in particular of polyethylene which is the most abundant polymer in the solid waste stream, the effectiveness of its application to civil engineering and construction usage depends mainly on enhancing the related mechanical properties of recyclates to the level similar to or better than that of virgin polyethylene. In this context, present paper describes the methodology for enhancing or improving the specific properties by way of using inorganic filler waste. Also develop the product from these post-consumed plastic.

Materials and Methods

The materials utilized in this study were post-consumed polyethylene recyclates. The nature of inorganic filler material blended into polyethylene is proprietary information of the manufacturer and it was received in a powder form. The scanning electron microscope revealed the powder is spherical particulate in some size distribution(Figure 1). For the mechanical property determination, polyethylene and inorganic fillers were compounded in a modular intermeshing corotating twin screw extruder and pelletized. Filler contents were increased in step of 10 % up to 50 weight %. The pellets were injection molded to ASTM specification to produce tensile, notched impact specimens and environmental stress cracking resistance specimens. Some compounded pellets were also used for making products, such as spiral drainage pipe, drainage pipe fitting, cable trough, and tree safeguard benches. In case of drainage pipes, three extruders were simultaneously utilized to obtain characteristic hybrid pipe wall structure shown in Figure 2c. The pipe wall consists of an outer wall, core wall and the core. The materials for the outer and the core wall can be either same or different recycled polyethylene, and the core is a composite material having polyethylene matrix and inorganic filler. Pipe manufactured were tested on the basis of GR M 3006 and prEN 13476-1 specification. Also drainage pipe fittings were compression molded and tested on the basis of ISO/DIS 21138-1, ISO 13966.

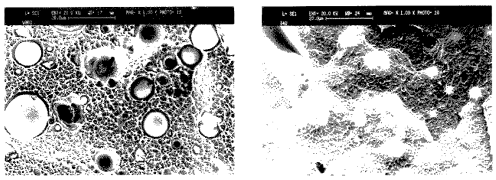

Figure 1. SEM microphotograph of spherical particulate powder inorganic waste.

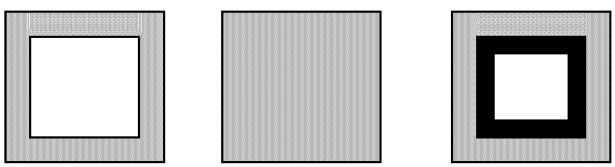

Figure 2. The characteristics of pipe walls (a) double (b) solid (c) hybrid

Results and discussion

Drainage Pipe The methodologies we have taken to produce high stiffness drainage pipes made totally from the waste materials, were hybridization of materials as well as the wall design. The former was achieved by incorporating fillers for stiffening and the latter by changing the area and the moment of inertia of the wall rather than the generally available double wall profile.

Drainage Pipe Fitting The fitting we made was designed for not allowing the deformation(figure 3). Which means fitting is not deformed, bended, tilted at any circumstances. Also dimensional stability is the best among the all fitting. The recycled polyethylene composite materials made it possible. Leak resistance was tested based on the ISO standards and KS M 3500.

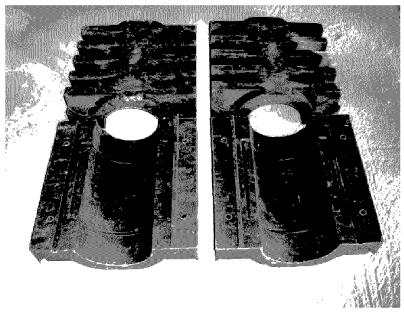

Figure 3. Pipe fitting made of post-consumed polyethylene

Tree Safeguard Bench. The current compounding technology can utilize the tree safeguard bench from recycled polyethylene film. Its main purposes were preventing tree stem and root from the damages. So the SUS band and steel pole was used and sometimes wood and concretes were used. But those were not environmentally friendly structure. In that sense, the post-consumed plastics coupled with waste inorganic fillers were perfectly fit to those purposes.

Conclusions

Recycled polyethylene and environmentally friendly inorganic waste fillers were compounded and successfully used in the manufacture of the drainage pipe, pipe fitting, trough and tree safeguard bench. The key factors in making those were identified to be the modulus of composite and the design.

We need to develop the application of massively consuming the product from post-consumed plastic. In that sense, the civil engineering field will be the best.

References

[1] ISO/DIS 21138-1, 2, 3
[2] European Norm prEN 13476-1, 2, 3
[3] GR Standard of Korea, M 3006
[4] ISO 13966