A Basic Study on the Development of Impact Resistant Water Supply and Sewerage Plastic Pipes by Recycling Waste PVC

Jun-Cong Ge*, Kyoung-Hwan Yoon**, Min-Woo Kim*, Nag-Jung Choi*, Min-Soo Kim*†, Ik-Tae Im*††
*Division of Mechanical Design Engineering, Jeonbuk National University
**ChaHoo S&P Co., Ltd.
†e-mail: kimms@jbnu.ac.kr ††e-mail: itim@jbnu.ac.kr

폐 PVC를 재활용한 내충격 상하수도용 플라스틱 관 개발을 위한 기초연구

갈준총*, 윤경환**, 김민우*, 최낙정*, 김민수*†, 임익태*††
*전북대학교 기계설계공학부
**(주)차후에스엔피

Abstract

Polyvinyl chloride (PVC) is a type of thermoplastic that is strong, easy to color, hard or soft, and not easily worn. Therefore, it is widely used in materials such as artificial leather, records, packaging materials, pipelines, electrical insulators, and flooring[1]. However, the significant consumption of PVC every year leads to the accumulation of a large amount of waste, which puts enormous pressure on environmental pollution. According to reports, approximately 8–11 million tons of waste plastics are discharged into the ocean every year, which will cause serious harm to marine life. Because of their light weight, good toughness and strength, plastics are widely used in plastic bags, packaging, automotive vehicles, electrical appliances, mobile phones and other electronic products. However, plastic (a synthetic resin) is mainly made from fossil oil and gas through polymerization, polyaddition, polycondensation, addition condensation and other polymerization reactions. It has a long life cycle and strong decomposition resistance [2]. With the widespread use of plastics, the pollution caused by waste plastics is gradually threatening the ecological environment and human health. According to relevant data, as of 2016, about 9 to 23 million metric tons of waste plastics per year were discharged into rivers, lakes and oceans and about 13 to 25 million metric tons per year were discharged into the land environment. If not regulated and treated, the discharge of waste plastics is expected to be twice as much as that of 2016 by 2025. Especially PVC, which releases a large amount of harmful gases during incineration, it is necessary to find suitable methods to effectively reuse it. On the other hand, the carbon fiber reinforced polymer (CFRP), as an advanced composite material, is widely used in industries such as aerospace, national defense, military industry, and civil use. It has advantages such as light intensity, light strength, high rigidity, high temperature resistance, corrosion resistance, fatigue resistance, good structural dimensional stability, good design, and large-scale overall molding. CFRP has high fatigue resistance and has a much lower cracking frequency compared to traditional alternatives such as concrete and steel. It can withstand the worst environmental conditions, such as humidity, rainfall, radiation, chemical exposure, etc., and will not corrode or deteriorate. With the rapid development of the economy, the use of CFRP in various fields is rapidly increasing, and the waste resin generated is also increasing day by day. The components in the waste CFRP are not degradable, so it is imperative to recycle and reuse CFRP.

In this study, the physical and chemical properties of waste PVC and waste CFRP were preliminarily investigated, and their thermal decomposition characteristics was analyzed compared with new materials. These data provide certain reference value for the future development of impact resistant plastic pipes. In addition, the large-scale recycling and utilization of discarded PVC, CFRP, and other waste materials have great significance in reducing environmental pollution, increasing added value, and saving resources.

Acknowledgments

This work was supported by project for Collabo R&D between Industry, Academy, and Research Institute funded Korea Ministry of SMEs and Startups in 2023 (Project No. RS-2023-00222728), and the Basic Science Research Program through the Na-tional Research Foundation of Korea (NRF) funded by the Ministry of Education (No. 2021R1I1A3056655).

References

[1] MA, Yuetan, et al. The utilization of waste plastics in asphalt pavements: A review. Cleaner Materials, 2021, 2: 100031.
[2] SCHMALTZ, Emma, et al. Plastic pollution solutions: emerging technologies to prevent and collect marine plastic pollution. Environment international, 2020, 144: 106067.