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Eco-Friendly Treatment Process of Rubber Elastomers using Microwave

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Editorial

Since World War II, rubber elastomers, which are polymer materials, have made great strides as various rubber synthesis methods, rubber products suitable for various uses, and production technology have developed [1]. However, the rapid increases in production and consumption of rubbers with the development of the rubber industry inevitably brought environmental pollution caused by waste rubbers. Thus, it is required to find an appropriate solution to resolve the pollution. Unlike general thermoplastic resins, rubber has a three-dimensional network structure, which makes it insoluble in solvent and not melted by heating. It is difficult to recycle rubbers. Therefore, waste rubber has been mainly treated by landfill or incineration. However, it is not the ultimate solution because a treating process through landfill causes soil pollution and lack of landfill, and the other one through incineration of rubber does air pollution. In addition, as the society gets interested in environmental pollution, the disposal methods of waste rubbers through landfill or incineration are not being used [2].

Various studies have been conducted by many researchers to recycle waste rubbers as useful resources. Current studies can be largely divided into methods using heat, prototype, and powder process. For the use of heat, it is used as a heat source for cement kiln or dry incineration, because the heat generated from waste rubber is 9,000 kcal/kg. For the use of prototype, it is used for fish shelter and erosion protection work. For the use of powder process, it is used to manufacture rubber products using crushed rubber powder or is used in rubber or asphalt as filler. As many countries are recently concerned about environmental issues, and the environmental technology is expected to become one of the most important technologies in the 21st century, related manufacturing companies must solve environmental problems in order to export their products.

Rubber regeneration is the process in which the vulcanized rubber is made in a reusable form by reducing elasticity and giving plasticity and adhesiveness through mechanical and chemical treatments. In this process, the devulcanization regeneration process breaks vulcanized bonds such as ~C-Sn-C~ as well as ~C-C~ molecular bonds composed of the main chain of rubber. Thus, mechanical properties are substantially reduced in devulcanized rubber and it has many restrictions in its use as recycled rubber. Therefore, a new devulcanization method has been proposed to solve such problems. There is a required condition in which mechanical properties are not reduced as much as it can be reused at the original temperature used for rubber by breaking only the crosslinking molecular bond between carbon and sulfur without damaging the molecular bond of the main chain.

In general, devulcanization of recycled rubber is performed through chemical treatment. However, some studies are recently conducted on methods using ultrasonic devulcanization and microwave

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devulcanization [3]. For chemical devulcanization, recycled oil or catalyst is added. Hydrocarbons are mainly used as the recycled oil. They do not only act as a heat transfer but also help the diffusion of the catalyst by expanding the rubber. After the regeneration process, they remain in the rubber to improve the processability of the recycled rubber. Alkylated phenol sulfide, aromatic thiol, alkyl amine and aryl amine are mainly used as the catalysts. Ultrasonic regeneration and micro regeneration are classified according to sources of energy.

The microwave regeneration method was developed by Good year in the United States and started to be used in 1977. The recycled rubber is produced by heating the crushed rubber using microwave. As microwave is used as the heat source, it can be heated more uniformly and faster than other methods. Recycled rubber can be obtained in only 5 minutes and it can be immediately used. The principle of desulfurization by microwave is to use the difference in the relative binding energy of C-C, C-S and S-S bonds present in the vulcanized rubber. As the binding energy of C-S and S-S bands is lower than that of C-C bond, it is relatively easily decomposed. The rubber used in this process must have polarity in order to generate the heat required for the desulfurization reaction. If it does not have polarity, the carbon black added to the rubber plays the role. In addition, as the desulfurization process is carried out on a conveyor, a continuous process can be made. Chemical and microwave devulcanization methods have some disadvantages such as chemical harmful to the environment and expensive devices, respectively.

In conclusion, as rubber is a thermosetting resin having elasticity and has physical properties different from those of plastics, there are many limitations in recycling rubber while it keeps its original physical properties. Although research has been conducted on the process of regenerating rubber by various chemical and physical methods, a common low-cost and eco-friendly recycling process is not yet established. However, the microwave regeneration method is one of the most eco-friendly methods compared to other regeneration methods. The regenerated materials have uniform physical properties and high productivity. If the production facility with low cost is equipped, it would be the most suitable method among rubber elastomer treating processes.

References

1. Kim JK, Park JY, Hwang SH (2000) Study on Rear Door Fixed Glass Weather-strip for Automobiles Using EPDM/Polypropylene Blend (I), Elastomers Compos 35(2): 115-121.

2. Adhikari B, De D, Maiti S (2000) Reclamation and recycling of waste rubber. Progress in Polymer Science 25(7): 909-948.

3. Myhre M, Mackillop DA (2002) Rubber Recycling, Rubber Chem. Technol 75(3): 429-474.