The Research Reports of the Faculty of Engineering, Kagoshima University, No.48 (2006)

Doctoral Dissertation, Graduate School of Science and Engineering, Kagoshima University, Doctorate No.215

Development of Additives for Long Life of Polymers and Antifouling Paints

Kazuki KATSUYAMA

1. Introduction

The development of new additives effective to the long life of polymers, of antifouling paints for ship and of fish-net is discussed in the thesis. The outline of the past development of the additives for the stability of polyolefin and vinyl chloride resins was described. Furthermore, it is described that the mechanisms of the decomposition of resins in oxygen atmosphere and the mechanism of the action of the additives for the prevention of the polymer decomposition. It is well known that the antifouling paint for ship and fish-net is important to prevent the adhesion of organisms living in sea. When the organisms are adhered on the ship bottom, the increasing of the resistance between water and ship results in decreasing of the ship speed. Since the organic tin compound is used for the adhesion prevention. However, the organic tin compound gives serious effect for the ecosystem in sea, the use of the compound was prohibited several years ago. From these considerations, the purpose of the present investigation is described.

2. Results and Discussions

In order to improve the antioxidative effect of polypropylene and polyethylene resins, two kinds of antioxidant with a similar structure of vitamin E were synthesized. The antioxidative activity of the compounds mixed in polypropylene as 0.005wt% was examined by melt index and yellow index technique. The compounds had the anti-oxidative activity solely. The antioxidative activity significantly increased mixing with phenolic or phosphoric antioxidant. The mechanism for the antioxidative activity revealed that hydrocarbon radicals produced by the thermal decomposition of polypropylene immediately reacted with the anti-oxidant to a stable product. The antioxidants were regenerated by the reaction between the anti-oxidant radical and phenolic or phosphoric antioxidants.

Date of Conferment of the Degree: March 24, 2006
API Corporation

To improve the thermal decomposition of vinyl chloride resin, which has a different decomposition mechanism compared with polyolefin resins, salicylphosphite compounds were tested. Since the vinyl chloride resin is usually used in outdoor, such as trough or roof, the much lasting is required than the polyolefin resins. From these results, the addition of salicylphosphite additives was carried out in commercial process.

The relationship between the chemical structure of additives and the function to prevent the adhesion of organisms in sea are discussed. Recently, the self-polishing type paint is developing. Although the organic tin compound was mixed in the paint, the use of the additives was prohibited as described above. New type additives having triphenylboran were tested in the preliminary studies. The new type additives with triphenylboran were effective for the purpose. Furthermore, the antifouling of the resins with a pendant of triphenylboran were also tested.

3. Conclusions

In this study, the type of antioxidant with a similar structure of Vitamin E was synthesized to improve the life of for poly-olefins. The addition of a minute amount of the antioxidants (0.005wt%) was effective to prevent the degradation of poly-ethylene and poly-propylene. The other type of antioxidant was developed for the retardation of oxidation of poly-vinyl chloride. Since the mechanism of the degradation of poly-olefin and pol-vinyl chloride, the salicylphosphite compounds were significantly effective for poly-vinyl chloride.

The additives for antifouling paint for ship and for fish-net were also developed in this study. Since the anti fouling additives mixed with polymer and painted to ship bottom or fish net were dissolved to the surface of ship bottom or fish net, the adhesion of organisms was effective prevented. The new type additives with triphenylboran were effective for the purpose. Furthermore, the antifouling of the resins with a pendant of triphenylboran were also tested.