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Chemical Modification of PVC*

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Despite the fact that poly(vinyl chloride) (PVC) has occupied the most important position among general-purpose plastics, its industrial applications are limited due to its inferior thermal stability and mechanical properties. Many studies have been conducted to remedy these disadvantages. This paper reviews these studies from the viewpoint of chemical modification of PVC.

The degradation of PVC at the processing temperature is mostly caused by its abnormal and unstable molecular structures, though partly by oxidative degradation from its normal molecular structure. It has been pointed out that allyl chloride structures play a significant role as abnormal and unstable structures, based on comparative studies of the thermal stabilities of the model compounds and the results of analysis of the polymer structures.

Inasmuch as the allyl chloride structures are markedly more chemically active than the normal structure, selective chemical treatments are applicable to the allyl chloride structures. Accordingly, if a proper selection of the chemical reactions on PVC is made, the thermal stability of PVC can be improved by changing the unstable molecular structure into a stable one.

Most of the thermal stabilizers commercially used to prevent the thermal degradation of PVC show selective reactions on the unstable structures as mentioned above. Therefore, studies on PVC stabilizing

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mechanisms with the use of thermal stabilizers are effective in investigating methods of PVC stabilization by chemical modification.

It has been recently reported that the thermal stability of PVC can be remarkably improved by treating PVC with certain organoaluminum compounds or protic solvents. The results of analyzing the reaction mechanisms with the low molecular model compounds of PVC or the tracer show that the selective stabilizing reaction on the allyl chloride structure takes place. One of these methods has already been commercialized.

On the other hand, the improvement of the mechanical properties of PVC, such as softening temperature, rigidity, anticreep property, impact strength, and tensile strength, is important for practical applications of PVC. Halogenation, graft polymerization, and cross-linking reactions are effective in improving the mechanical properties of PVC to a large extent. The recent studies in this field are also reviewed in this paper.