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Methylaluminoxane as activator for olefin polymerization From invention to commercial use

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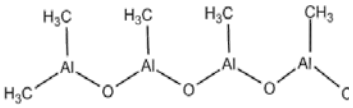
About 150 million tons of polyolefin, the half of all polymers, are produced worldwide per year, the major with the help of Ziegler-Natta and Phillips catalysts. Containing only carbon and hydrogen atoms, polyolefin is a sustainable material, light in weight and with a wide variety of properties. A new development in olefin polymerization was the discovery of methylaluminoxane (MAO) as activator for metallocene and other transition metal complexes. MAO can be prepared by the carful hydrolysis of trimethyl aluminum and is a cluster of different unit structures. Metallocene/MAO catalysts are soluble in hydrocarbons, show only one type of active sites (single site catalysts), can easily be modified in their chemical structure, and are very active in olefin polymerization. These catalysts allow the synthesis of tailored polyethylene, different copolymers, isotactic, isoblock, syndiotactic or atactic polypropylenes as well as polyolefin composite materials with superior properties and a low content of extractable[1,2].



Unit structure of MAO

Today the mayor part of ethylene-1-octene copolymers, used as flexible low density polymers or high module polyethylene fibers are produced by MAO activated catalysts. Metallocene based ethylene/propene copolymers are characterized by a uniform comonomer distribution and a glass transition temperature of less than -60°C used as rubber. Isoblock polypropylene can be found as one layer in packaging for juice and milk because of the high flexibility and the low part of extractable.

In solution MAO can be absorbed perfectly on the surface of particles or fibers especially nanomaterials. After adding the metallocene and ethylene or propene polyolefin nanocomposites are formed. In the future polyolefin nanocomposites and copolymers with polar groups open up the approach to new classes of materials with great property combinations. These materials show exciting physical and chemical properties such as improved stiffness, high gas barrier properties, and significant flame retardancy.

References

1) W. Kaminsky, Macromolecules, 45, 3289-3297 (2012)
2) W. Kaminsky, Macromol. Symposia. Vol 360, 10-22 (2016)