



# Spheroidal Magnesium Chloride-Ethyl Alcohol Adduct Support: Prospects and Challenges

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## Introduction

The increasing comfort, facility, and versatility of today's human life result from the tremendous volume of research and development in materials science. This short communication combines the following three inter-related materials: support, catalyst, and polyolefin. The major support is silica; magnesium chloride is devoted to polypropylene catalyst. The catalysts list conventional Ziegler-Natta, metallocene, post-metallocene and late transition metal compounds. Polyolefins include polyethylene and polypropylene homo- and copolymers. Millions of us use the huge varieties of polyolefin end-products. But we cannot name all of them.

The catalyst research, since the break-through discovery by Nobel laureates Karl Ziegler and Giulio Natta in early 1950s, continues to thrive over the last more than 60 years. Commercial technologies that make different grades of polyolefins exist. A similar remark applies to silica support. However, process technologies, manufacturing various grades of commercial  $MgCl_2$  adduct supports (having varying properties), are not available. Such supports can synthesize novel and advanced olefin polymerization catalysts which will prepare new and improved grades of crystalline and amorphous functional and nonfunctional polyolefins (that will further expand their end-uses and applications). Hence, this contribution focuses on spheroidal magnesium chloride-alcohol adduct support, which makes the referential framework of this communication.

Spheroidal catalyst support is needed for several reasons. First, it is a prerequisite to produce spheroidal catalyst, which in turn develops fairly similar polymer morphology. This happens so because the growing polymer particles, during polymerization, replicate the morphology of the catalyst used. Second, the commercial polyolefin processes are mostly slurry and fluid bed. Either process becomes more efficient if the supported catalyst has spheroidal morphology with reduced size. Third, spheroidal polyolefin is highly demanded to improve polymer processing. Finally, such morphology increases reactor throughput, minimizes reactor fouling and fines formation, and enhances polymer particle flow properties and bulk density.

Melt emulsion of  $MgCl_2$ -alcohol adduct with quench crystallization has been reported to make spheroidal morphology with varying success. Here, in the first reactor, anhydrous  $MgCl_2$  synthesizes the polar adduct by reacting usually with anhydrous ethanol at about 50 °C in the presence of a nonpolar hydrocarbon oil. Finally, the polar/non-polar (W/O) emulsion is made at 110-125 °C under vigorous stirring. The molten emulsion is very rapidly transferred (through a tube maintaining the same temperature) to the second reactor having sufficient non-solvent alkane at -10 to -40 °C. This quenching process separates the  $MgCl_2$ -alcohol adduct particles formed during emulsification.

The above particle-forming process can be classified as follows: surfactant-free, surfactant-aided, and surfactant- and oligomer-aided. Experiments in our laboratory as well as the literature confirm that the development of the spheroidal morphology critically depends on factors such as the inter-component ratios, emulsion viscosity, hydrodynamics of mixing in both reactors, and thermal conditions. Only for some very specific factorial values, spheroidal particles are formed. Even a minor deviation produces non-spheroidal particles. This contradicts the fundamentals of emulsion particle formation and quench-mediated particle separation. Finding the cause and remedy to this situation is imperatively needed. Therefore, more research should be directed to this important subject.

$MgCl_2$ -alcohol spheroidal adducts, synthesized through novel Lewis acid complexation-cum-cocrystallization agents, can vary micro-domains, structural defects, particle size, particle size distribution, and overall catalyst Lewis acidity. This can finally develop the next generation high-performance supported polyolefin catalysts.

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