

## Functionalized High Molecular Weight Polypropylene

### Overview:

Researchers at Queen's University have developed a process to chemically modify high molecular weight (10,000 – 100,000 Da) polypropylene without significantly affecting its melt viscosity. As such, the resulting functional polypropylene derivatives do not suffer from the same limitations (i.e. reduced processability and poor mechanical properties) as those produced using conventional modification chemistry (e.g. maleation, vinylsilane grafting). Consequently, the functionalized polyolefins produced using this process can be used in a wide variety of industrial applications including high pressure/temperature piping, fiber-reinforced composites, heat-shrinking products, pipeline coatings, etc.

### Description:

The process involves the reaction of propylene-rich thermoplastics with functional coagents under solvent-free conditions. The melt-state grafting of these coagents can generate polyolefin derivatives containing a variety of functional groups including: alkoxysilanes, anhydrides, epoxides, carboxylic acids, amides, compounds containing boron or silicon or cyano-containing compounds, sulfates, sulfonates, sulfites, esters, thioesters, dithioesters, ethers, halides, phosphates, phosphines, phosphites, and other compounds containing polar moieties.

The polypropylene modification process utilizes conventional polyolefin processing equipment, and is designed for short residence time, reactive extrusion operations. A leading example of this technology is an alkoxysilane grafted polypropylene homopolymer that can be moisture-cured to high gel content, thereby improving its high-temperature properties. These silane-functionalized polymers can also be bound covalently to siliceous particulates and glass fibers for use in composites. Epoxide-functionalized analogues have also been produced for use in standard ring-opening cure chemistry.

### Advantages:

The functionalized polyolefins produced using this method may have many advantages including:

- High shear viscosity and improved extensional viscosity
- Moisture-curable to high gel content
- Covalently bound to siliceous materials
- Increased modulus and tensile strength
- Decreased compression set
- Produced in single or successive batches with or without solvents

**Intellectual Property:**

The functionalized polyolefins and their methods of production are covered by the following patent applications:

- US 2006/0116480
- CA 2,586,919
- EP 05810143.7
- PCT/CA2005/001683

Entitled “Functionalised Polyolefins, Moisture Curable Polyolefin Resins and Processes of Manufacture Thereof”, the patent applications contain broad claims that cover both the functionalized polyolefins and the processes used in their production.

**Licensing Opportunity:**

PARTEQ Innovations, the technology transfer office of Queen’s University, is currently seeking companies interested in licensing the intellectual property and developing applications for these value-added materials.

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**References:**

1. Parent JS, et al. Radical-Mediated Modification of Polypropylene: Selective Grafting via Polyallyl Coagents. (2005) *J. Polymer Sci. Part A: Polymer Chem.* 43:4882-4893.
2. Parent JS, et al. Terminal Functionalization of Polypropylene by Radical-Mediated Thiol-Ene Addition. (2005) *Macromolecules* 38:5538-5544.