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Surface modification of ultrafine precipitated silica with 3-methacryloxypropyltrimethoxysilane in carbonization process

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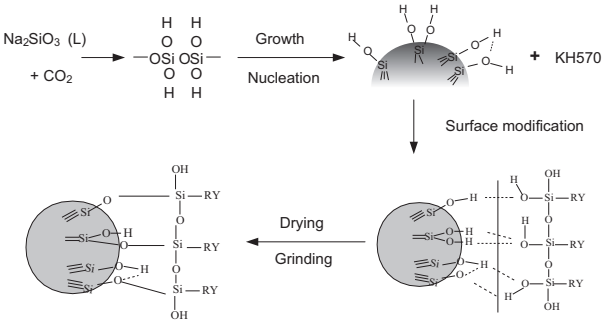
HIGHLIGHTS

- The optimum synthesis condition of silica was obtained by carbonization process.
- KH570 was grafted to the silica surface by chemical bond mainly.
- Completely hydrophobic precipitated silica was obtained for KH570 dosage of 1%.
- After modification, the BET surface area and DBP absorption value become smaller.
- After modification, the median diameter of precipitated silica becomes smaller.

GRAPHICAL ABSTRACT

Ultrafine precipitated silica was obtained from Na_2SiO_3 solutions and simulative lime kiln gas (30% CO_2) by carbonization process. The surface hydroxyl of precipitated silica can be replaced by KH570 in surface modification. Notably, the physicochemical performance and surface chemistry structure of precipitated silica have been improved.



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ABSTRACT

Ultrafine precipitated silica was obtained from Na_2SiO_3 solutions and simulative lime kiln gas by carbonization process. The surface modification of ultrafine precipitated silica using 3-methacryloxypropyltrmethoxysilane (KH570) at the rear stage of carbonization process was investigated. The optimum synthesis condition of precipitated silica was obtained from the orthogonal tests: reaction temperature of 80 °C, limekiln gas flow rate of 1.2 L/min, sodium silicate concentration of 40 g/L and polyethylene glycol 6000 (PEG6000) concentration of 4 g/L. The modification degree and basic physicochemical properties of precipitated silica were analyzed by Fourier transformation infrared spectroscopy (FT-IR), thermogravimetry (TG) and X-ray diffraction (XRD). The result demonstrates that KH570 is mainly grafted to the silica surface by chemical bond rather than physical adsorption. Average activation index of precipitated silica is nearly 90% for KH570 dosage of 1%. After modification, the BET (Brunauer–Emmett–Teller) specific surface area and DBP (dimethyl terephthalate) absorption value of precipitated silica become smaller, while the average pore diameter becomes larger.

1. Introduction

Ultrafine precipitated silica which has novel physical and chemical properties is widely used in rubber, paint and varnishes, medicine, toothpaste, catalysts and electronic industry [1–3].

Recently, the influence of CO_2 greenhouse gas on the global environment has attracted widespread concern. Preparation of precipitated silica by using CO_2 instead of inorganic acid with the

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