Current production of nano-silica

Current nano-silica is produced by the neutralization of water glass and by the pyrogenic process. Both processes are quite expensive, because of the price of the raw materials and the energy requirement of the process steps. Nano-silica could be applied even more if a new industrial production process of lower costs would be available.

Silicas are mainly used for reinforcing, thickening and flattening purposes. In 1999, the world precipitated silica production capacity was 1.1 million tons [1]. The total market for specialty silicas, which includes precipitated silica, fumed silica, silica gel and silica sol, will rise 6.3 % per year to 2.7 million tons in 2014 [2].

Production of olivine nano-silica

The dissolution of olivine in acid is a new and innovative method for producing nano-silica at relatively low costs. The production costs are lower due to the low price of the raw materials and the low energy requirement (temperature around 70 °C and reaction exothermic).

The dissolution of olivine neutralizes the acid yielding a mixture of a magnesium/iron salt solution, precipitated silica, unreacted olivine and inert minerals. After the neutralization is completed, the unreacted olivine and inert minerals are removed from the reaction suspension by gravitational separation. Subsequently, the silica can be separated from the resulting mixture by washing and filtering. Finally, the silica is redispersed to produce an stable colloidal suspension.

Experimental Method

The nano-silica was produced in an isothermal batch lab-scale stirred reactor with olivine of various particle sizes (between 125 to 600 µm), in the temperature range 50 to 90 °C and with sulphuric acid 3 M. The produced nano-silica was characterised by gas physisorption, ICP-ES and TEM microscopy.

Results

The specific surface area of olivine nano-silica against the particle size of olivine for experiment at 70 and 90 °C.

Comparison of silicas (d: particle size and d_p: diameter of pore).

Conclusions

- The olivine route is a feasible process to produce nano-silica.
- The properties of this nano-silica can be tailored by changing the initial reactor conditions.
- The produced nano-silica has a particle size between 10-30 nm, a SSA between 100-300 m²/g and an impurity content below 2%.

Reference