ESTIMATION OF THE EFFECT OF SUSPENSION STABILITY ON PRODUCTION OF NANO PARTICLES IN AN ATTRITOR MILL

by

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Certificate

This is to certify that the thesis entitled "**Estimation of the effect of suspension stability on production of nano particles in an attritor mill**" being submitted by **Sakthivel S** to the Department of Chemical Engineering, Indian Institute of Technology, New Delhi, for fulfillment of the requirements for the award of Doctor of Philosophy in Chemical Engineering is Bonafide work carried out by Sakthivel under our supervision. The work done in this report has not been submitted to any other university or institute for any degree.

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Abstract

Nanoparticles are increasingly used in many areas of chemical and pharmaceutical as well as in ceramic and polymer composite industry. The present study attempts to produce nanoparticles by comminution technique in an attritor mill. Preliminary experimental studies on grinding of silica, it shows that there is limitation on minimum particle size achieved in attritor mill because viscous nature of slurry increases with grinding time. Careful analysis of the particles produced revealed that there is a variation in pH of the suspension. The variation of pH is occurred by changes in surface charge of the particle. In order to measure this surface charge measuring instrument was indigenously developed based on potentiometric titration technique. The effect of grinding media density and diameter, pin tip velocity and solid mass fraction on pH variation was studied. The effect of operating variables on product size distribution was studied at constant pH value of the suspension. Rosin Rammeler distribution equation fits the product size distribution of nanoparticles produced in the attritor mill. It is found that the particle size decreases with grinding time and the distribution became narrower. Product median particle size varies linearly with the specific energy input, but could not indicate the optimum operating conditions. The concept of stress intensity was used for analyzing the experimental results. It is observed that there is an optimum value of stress intensity for minimum specific energy consumption, which can be used to estimate the operating parameters such as pin tip velocity, density and diameter of grinding media. Comminution parameters were estimated by back calculation method and are related to operating variables. The developed correlation predicts product size distribution similar to the measured size distribution.

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