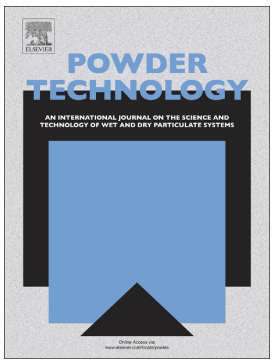

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The effects of viscoelastic properties of the wetting liquid on the kinetics of the disc granulation process

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Abstract The study investigates of rheological properties of the wetting liquid (potato starch solutions). Studies on viscoelastic properties of wetting liquids were carried out using the rotational rheometer Physica MCR 301 made by Anton Paar with the cone-plate measuring system. Rheological parameters of the medium were described using the fractional rheological Maxwell-Wiechert model.

The studies on granulation kinetics were carried out in the laboratory disc granulator with diameter D= 0.5m. The binding liquid was supplied to the pouring bed with a constant flow rate through the nozzle which generated droplets sized approx. 4 – 6 mm. The model raw material was the calcareous flour, whereas as the wetting liquid - water or aqueous solution of potato starch of 3% and 6% concentration was used. Droplets were given at different times - from 2 to 16 min. For particular times of the process its granulometric composition was determined along with the share of ungranulated material in the total mass of the processed bed and its mean diameter. The impact of rheological parameters of the wetting liquid on granulation kinetics was determined and a model was proposed which makes the process constant dependent on viscoelastic parameters of applied liquids.

Keywords Rheological Properties · Wetting liquid · Granulometric composition · Granulation kinetics · Viscoleastic parameters

1 Introduction

The existing studies on the granulation process indicate that it depends on many parameters which may be grouped into the following categories:

a) Apparatus parameters (e.g. diameter D and apparatus length L, disc inclination angle α,) [1-4],

b) Process parameters (e.g.: angular velocity ω_t, factor of filling the apparatus with the raw material φ [2-6],

c) Wetting parameters (e.g. droplets size d_k, humidity w, liquid flow rate V_n,) [7-14],

d) Parameters characterizing the raw material or granulated material (eg. particle size analysis of the raw material e.g. d_s, bulk density ρ_n, porosity, hydrophobicity of the material, tangent of natural angle of the dump $tg\beta$, coefficient of friction f) [15-21],

e) Parameters characterizing the wetting liquid (density ρ_l , temperature t, concentration c, rheological parameters [22-24]).

The first research on granulation made the process kinetics dependent only on time, possibly also on the quantity of revolutions of the disc or tumbler [25], focussing more on specification and analysis of the mechanisms of granules formation [26]. Capes and Danckwerts [27] by analysing the agglomeration process initiated by wetting of the bed with water found out the following mechanisms of granulation: wetting and nucleation, coating, coalescence, consolidation as well as crushing and abrasion. Kinetic correlations were often proposed, which described a change of the medium size of the bed for characteristic stage of the process. It was