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PROBLEM ON PRODUCTION OF HIGHLY DISPERSED EXTRA PURE POWDERS

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INTRODUCTION

In solving many material science problems there appear necessity for producing extra pure highly dispersed powders. Milling effect affects the product properties essentially. Milling materials of various properties including the ones used in hydride technologies, at production of fullerene-like materials, and carbon nanomaterials themselves is expedient to carry out in the jet disintegrators or ball planetary mills in the special reactors at cryogenic temperatures.

PRINCIPLE OF THE WORK AND ADVANTAGES OF THE JET DISINTEGRATOR

Principle of the work of the jet disintegrator which structural scheme is given in Fig. 1, consists in the following.

Two opposing gas jets of air carry off the starting bulk material at the expense of ejection. In the accelerating tubes the particles are mixed and speeded. In the zone of the jet meeting the intensive milling of the starting material occurs at the expense of collisions and intensive friction of particles. The rising flows carry off material to the zone of preliminary separation of rough fractions and then to the separator where the final fine fraction is separated. At first it is caught in the cyclone and finally in the filter. The rough fractions are continuously returned from the separator to the milling chamber for further milling.

Advantages of the milling method using opposing jets are:

a) due to the absence of friction elements entry of impurities into the milled material is excepted, and losses from friction decrease (specific energy consumption per unit of ready products decreases);

b) possibility for milling practically all materials: superhard abrasive materials (diamond, boron nitride) and viscous easily fusible plastics (caprone, fluoroplastic etc.);

c) mechano-chemical activation of material and milling occur simultaneously. Cement produced in this disintegrator is tougher than it should be according to standard; abrasive materials abrade to powder without particles in the form of needles and plates which hinder polishing; sintering temperature decreases for ceramics.

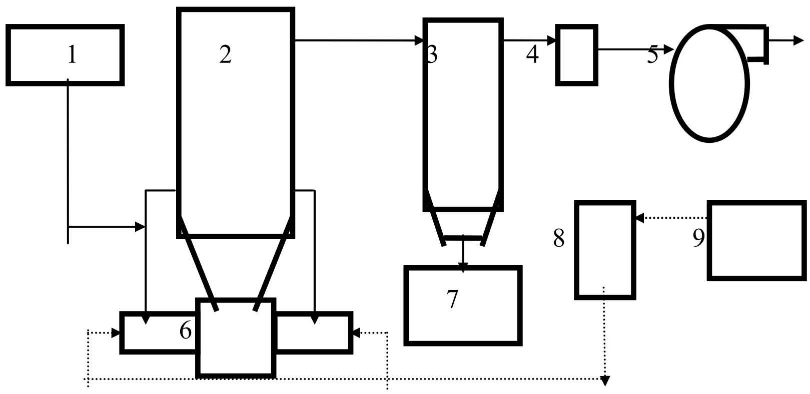

Fig. 1. Structural scheme of the jet disintegrator.
1 - loading unit; 2 - separator; 3 - cyclon; 4 - filter; 5 - ventilator; 6 - milling unit; 7 - container for ready product; 8 - system for air preparation; 9 - compressor.

Authors have even undertaken an attempt to use the real disintegrator for milling food products. It has been used for the fine milling (particle dispersity of 5-200 μm) of fruit and vegetable products having low specific weight. Milling of dry vegetables and fruit (about 40 sorts) occurs without cellulose destruction what favors the maximum conservation of biologically natural fruit structure, i. e. maximum conservation of initial product value for the human organism. Tableting powders of fruit and vegetable products promote radionuclide removal from the human organism. Such powders may be used as additives to baked goods.

The work on the experimental and theoretical investigation of the transfer processes in opposing jets was carried out long time ago [1-3]. Many empirical dependences describing these processes were obtained.

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However, in conducting practical calculations there appeared some difficulties.

Method for gas dynamic calculations has been developed. Geometric parameters of the construction elements in the milling unit have been optimized. They largely depend on properties of the material milled and parameters of gas flows. Specific weight of starting material and the gas flow velocity control a value of real concentration of dispersed material in the zone of the jet meeting and consequently the intensity of material milling.Geometry of ejectors and accelerating tubes, distance to the place of the jet meeting are changed to mill the material having higher specific weight. Output is regulated by consumption of air entering from the compressor.

If necessary the milling process using the opposing jets may be carried out in the inert medium to prevent oxidation of the material milled.

THE BALL PLANETARY MILL

To solve problems on mechano-chemical material activation two special reactors have been designed for the ball planetary mill. One of the reactors provides milling at cryogenic temperatures. The second one is designed for material milling in different gases (including hydrogen) under raised pressures.

CONCLUSIONS

Method for highly dispersed extra pure material milling using the opposing jets may be successfully applied in the hydride technologies and at the individual stages in the industrial production of carbon nanomaterials.

The use of special reactors to mill materials in the ball planetary mills at cryogenic temperatures and high gas pressures gives possibility for producing materials showing new original properties.

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