Fine Sector θ
– Achieving ultrafine powder classification

EarthTechnica Co., Ltd. has developed a new powder classifier, Fine Sector θ, using its technological know-how cultivated through years of experience in developing toner production equipment. Fine Sector θ is capable of eliminating particle size of 4 μm or less, especially the particle size of 2 μm or less, which is defined as ultrafine powders in pulverized toner material. Specially designed classification-rotor and dispersion air enable to achieve this high classifying performance with superb accuracy.

Preface

Demand for higher printing quality in laser printers, copiers and other such devices is growing by the year. In order to meet such demand, it is necessary to reduce quantities of particles with diameters of approximately 4μm or less—especially those with diameters of approximately 2 μm or less, which are known as ultra-fine particles—during classifying processes on toner production lines.

1 Background

EarthTechnica Co., Ltd. is a comprehensive crushing/grinding equipment manufacturer that focuses on crushing, pulverizing and classifying as its key technologies. Their products include crushers and grinders, environmental equipment, and powder processing equipment, which can be utilized to reduce large masses several meters in size to small particles several micrometers in size. EarthTechnica's array of powder processing equipment lines are used in a wide range of powder-based production processes in fields including medicine, chemicals, food products and others. One such product line is the KRYPTRON series of powder processing units—grinders designed for use in toner production—which have received high praise from users over the years.

The standard production process for pulverized toner is outlined in Fig. 1. After grinding, the toner particles have a maximum diameter of approximately 10 μm with an average diameter of approximately 6–7 μm. Particles approximately 4 μm or less in size are separated out during the classifying process, and an external additive (surface coating) is added to the remaining particles to complete the toner product.

During classifying, it is difficult to sufficiently remove ultra-fine particles (those measuring in at approximately

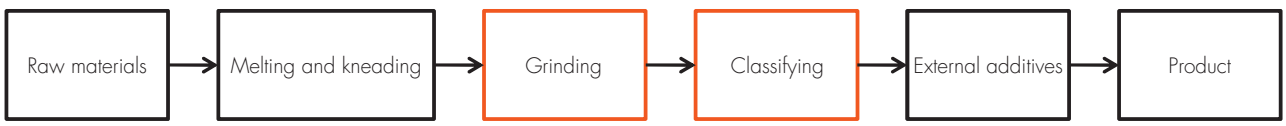


Fig. 1 Manufacturing process of pulverized toner

2 μm), which means that these particles become mixed in with the final product. This is problematic because the use of toner containing large quantities of ultra-fine particles leads to lower printing quality. Therefore, demand for complete removal of these particles during toner production is on the rise, which is why we developed the Fine Sector θ series of fine-powder classifier products.

2 Product lineup

Table 1 provides an overview of Fine Sector θ models. Designed with consideration for market needs and a maximum processing capacity of 200 kg/hour, we have created three production models as well as one laboratory-use model (EFS0Q) for developing powder products.

3 Structure

Figure 2 provides a cross-sectional view of a Fine Sector θ product. It comprises casing elements, which create the overall product form, as well as internal components including a high-speed-rotation classifying rotor in the upper section and louvers in the lower section for the intake of outside air. Raw materials are fed in from the top of the device and move from there to the peripheral areas surrounding the classifying rotor. At this point, which

Table 1 Fine Sector θ models

Model	EFS0Q (laboratory model)	EFS00	EFS10	EFS20
Total airflow volume (m^3/min.)	1.5–2.0	6.0–8.0	15–20	30–40
Max. processing capacity (kg/h)	10	40	100	200

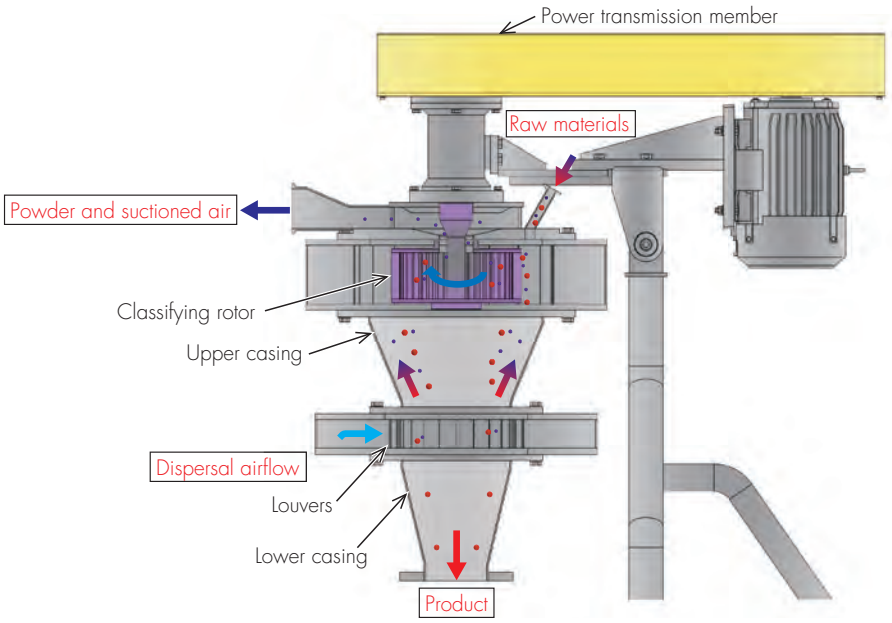


Fig. 2 Cross section view of Fine Sector θ

represents the primary classifying process, coarse and fine powders are separated by the rotor. Ultra-fine particles not separated out due to insufficient dispersal during primary classifying fall down toward the product output end, where they are redispersed by air taken in through the louvers for separating and elimination.

4 Advantages

The Fine Sector θ was designed based on technologies cultivated over many long years in the development of toner production equipment, and the latest in computational fluid dynamics (CFD) analysis technologies have been used to offer the following advantages to users.

(i) Removal of ultra-fine particles

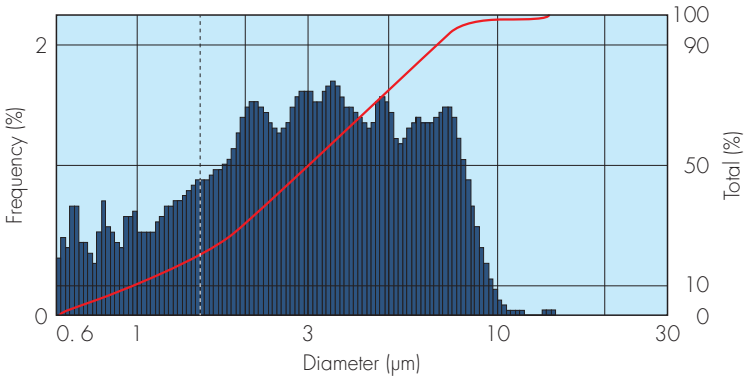
The classifying rotor plays a major role in determining classifier performance, and its form has been optimized to achieve airflow conditions suitable for classification of ultra-fine powders. Excellent classification performance makes it possible to effectively remove ultra-fine particles, which in the past was very hard to achieve.

(ii) Excellent classifying results via secondary dispersions

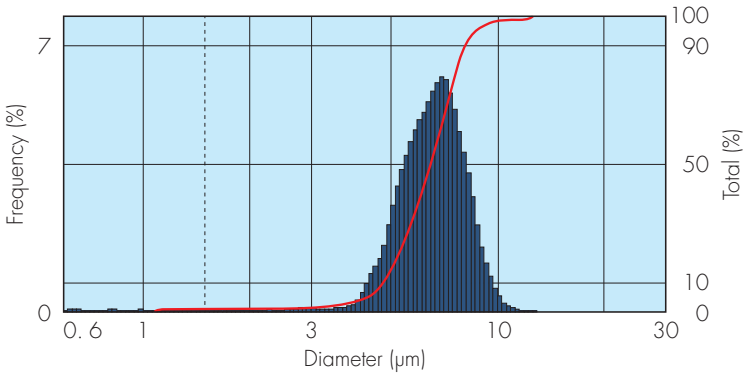
Particles that are not successfully separated fall down toward the product output end where air introduced through the louvers in the lower portion of the device creates an internal rotational airflow to thoroughly redisperse and remove said particles. This redispersal and classifying process helps users achieve high-quality finished products.

(iii) Easy control over particle size

By controlling the rotation speed of the classifying rotor, it is possible to adjust the centrifugal force acting on the particles, facilitating easy control over particle size.



(a) Before classifying



(b) After classifying

Fig. 3 Particle size distribution of classified toner material (based on the number of particles)

(iv) Design that facilitates internal equipment cleaning
Large-sized models from EFS10 upward come equipped with a casing open/close mechanism that can be operated with the press of a single button. Furthermore, the equipment casing is designed to provide easy access to the inside, making for smooth and effective internal cleaning operations when switching between the production of different powder types and so forth.

5 Classifying examples

Figure 3(a) shows number-size distribution measurement results for a standard grinded toner material, and Fig. 3(b) the same results for a classified toner material using one of our Fine Sector θ models. (Results were measured using a Malvern Instruments FPIA-2100). Before classifying, the percentage of grinded particles with diameters of 4 μm or less was 63.9%, and the percentage of ultra-fine particles with diameters of 2 μm or less was 30.2%

After classifying the particles using Fine Sector θ, the respective percentages for particles measuring in at 4 μm or less and 2 μm or less had dropped to 3.5% and 1.7%. The amount of product (classified powder) collected at the end as a percentage of the total amount of raw material loaded into the classifier was 77%, demonstrating that Fine Sector θ products offer excellent classifying performance while efficiently separating out only the ultra-fine particles.

Postscript

Thanks to the development of EarthTechnica's Fine Sector θ series of products, it has become possible to separate out ultra-fine particles with greater efficiency than ever before. These products achieve toner product quality that fully satisfies customer requirements, and we have received much praise from users following new installations of Fine Sector θ equipment in their production facilities. Moving forward, we will strive to improve classifying performance further and meet all of our customers' needs.

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