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AUFBEREITUNGS TECHNIK
MINERAL PROCESSING

High Quality Graphite by Fine-Milling and Fine-Classifying

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NETZSCH

High Quality Graphite by Fine-Milling and Fine-Classifying

Thomas Schneider, Hanau*)

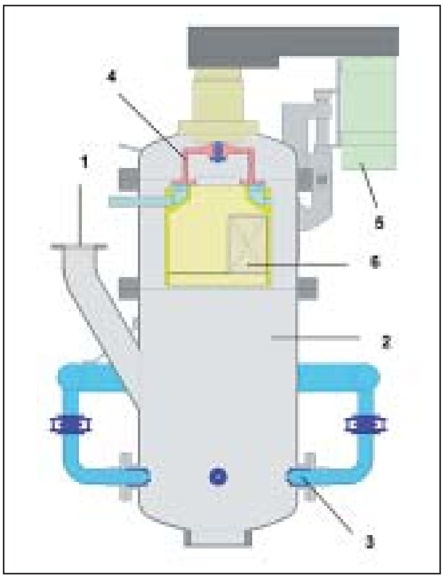
In addition to its well-known blackening ability, the other notable characteristics of graphite are its high temperature and oxidation stability, its resistance to chemical acids, its excellent lubricity as well as its electrical conductibility. Aside from“natural graphite”, a particularly typical kind mined from deposits, which is processed after extraction, graphite can also be produced synthetically. The “natural process” is carried out within several days or weeks in resistance furnaces using carbon carriers, such as petroleum coal.

Pic. 1: Condux CGS Fluidized Bed Jet Mill

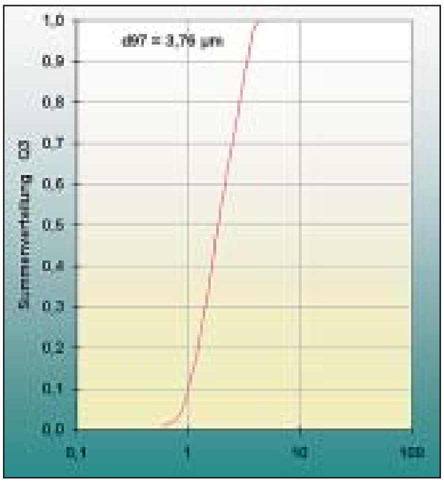
The above mentioned characteristics of graphite open up many new and interesting applications, which often require fine-milling and/or a limited particle size distribution of the powder to be produced.
Today these application problems can generally be solved economically using state-of-the-art machine construction in mechanical process technology.
NETZSCH-CONDUX Mahltechnik’s extensive range of fine-milling equipment and high-performance air classifiers offer multiple solutions.

Fine-Milling in Fluidized Bed Jet Mills

Fine-milling to obtain graphite powders with a definite upper-particle size limit from both natural and synthetic graphite can be carried out without difficulty using the Condux CGS Fluidized Bed Jet Mill **(pic. 1).** The highest possible final fineness can be obtained using only one classifier wheel. **Pic. 2** shows the functioning of this mill. The product to be milled is fed via a double flap valve on the flanged inlet (1) above the milling nozzles. In the milling chamber (2) gas streaming from the milling nozzles (3) creates a fluidized bed with the product. Particles of product are then accelerated to high velocities. Milling occurs by particle to particle impact in the gas streams and in the center of the milling chamber. The particle laden milling gas rises through the center of the chamber to the classifier wheel (4). The classifier wheel is driven by a variable speed motor (5) with v-belt drive. Coarse particles are rejected by the classifier wheel and returned directly to the fluidized bed; fine particles together with the milling gas exit the Fluidized Bed Jet Mill via a fines outlet (6) and are then separated from the milling gas by a suitable high-performance cyclone and/or dust filter.



Pic. 2: Operating principle of the Condux CGS Fluidized Bed Jet Mill



Pic. 3: Achievable final finenesses for milling natural graphite

The principle of milling in a bed jet ensures the best possible use of energy. The advantages become even greater through the use of a few, but large, exactly-positioned nozzles. Losses in the milling gas supply are avoided due to the optimal geometry of all compressed-gas carrying parts. In comparison to conventional air jet milling (+ 20°C), the efficiency of the machine is further increased by 40% by using hot gas (+ 170°C) and at the same time reducing the final fineness considerably.
The CGS 50 **(pic. 3)** can easily achieves a final fineness of d_{50} = 1,8 µm of natural graphite, at a gas flow rate of approx. 440 Nm^3/h. A suitable milling system design can be conceived according to the particular requirements of the operator. Components, such as feeding system, high-performance-cyclone separator and fine dust filter, which are exactly designed to suit the product, contribute as much to ensuring a reliable product processing as a mill suitable for the desired range of fineness. **Pic. 4** shows an example of such a milling system: The feeding of the product to be milled into the bed jet mill (2) is carried out via a doseaging device (1) via a double flap valve. The milled product leaves the mill via the fines outlet, into a high-performance cyclone (3) where it is separated from the grinding air and discharged into suitable vessels via a double flap valve. Residual dust is removed from the central air by a fully-automatic dust filter (4) con-

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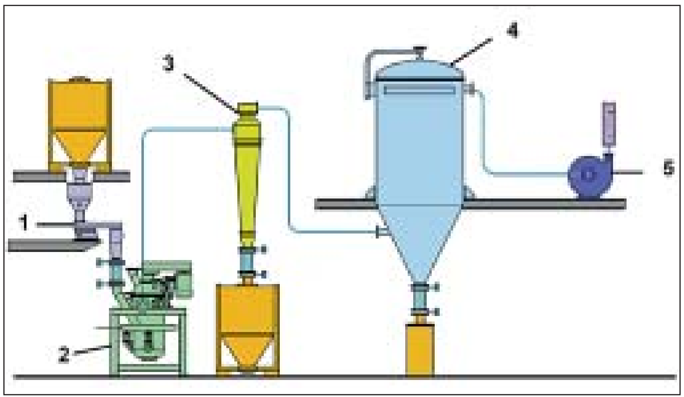


Pic. 4: Milling system for processing graphite

nected to the cyclone, and subsequently blown out via a radial ventilator (5).

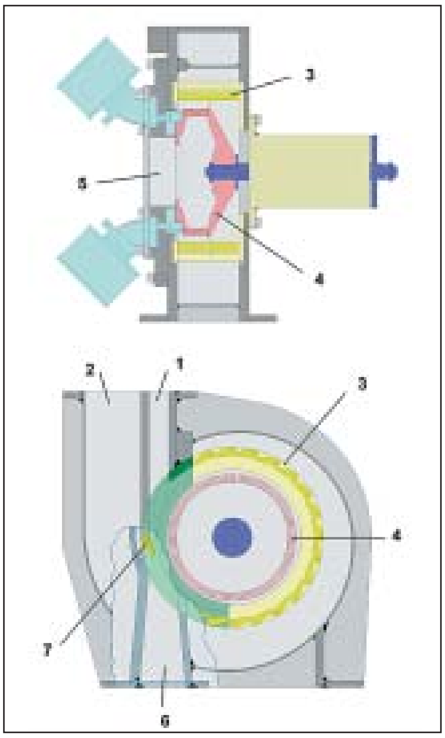
Classifying in Fine-Classifiers

For the fine-classifying of previously milled graphite – e.g. to eliminate unwanted fines – high-performance CFS/HD-S fine classifiers **(pic. 5)** are used successfully. Due to the high predispersion when feeding the milled product, an optimal separation effect can be achieved at maximum yield. **Pic. 6** shows the functioning of this high-performance classifier:

The product is fed into the machine from above via the product inlet (1). Air from the air inlet (2) disperses the feed product through many adjustable guide vane slots of the static guide vane basket (3) and then presents it to the classifier wheel (4). The classifier wheel separates coarse and fine particles according to the preset and infinitely adjustable speed of the classifier wheel. The “fine particles” are discharged via the classifier wheel mounted on a horizontal shaft in the center (5) of the classifier. “Coarse particles” are rejected by the classifier wheel and discharged through the helical machine housing with separating wall, on the reverse side of the classifier, via the coarse particle outlet (6) on the bottom of the housing. During difficult coarse separation processes, the discharge of coarse material can be adjusted by the position of the so-called coarse material flap (7) and thus the “cleanliness” of the coarse material be influenced.

In this way, using a CFS 85 HD-S fine classifier with a feed amount of 160 kg/h and a feed product of d_{50} = 12,3 µm, a coarse particle separation of 78 weight % with a d_{50} of 18,2 µm can be obtained.

Here also, suitable peripheral equipment plays an important role for reliable operation. The use of suitable components is just as important for the operation of a classifying plant as it is for a milling plant. A plant example is shown in **pic. 7**. The feeding of the product to be classified is carried out via an injector (1) on the product feed connection piece of the fine classifier. The classifying air is fed into the machine via a suction connection piece (2). After the product stream has been separated in the high-performance classifier (3), the coarse particles are discharged via a double flap valve (4) in the lower area. The classified fines are separated from the process air via a high-performance cyclone (5) and the connected fully-automatic dust filter (6). An exactly designed blower (7) provides the negative pressure within the complete system.

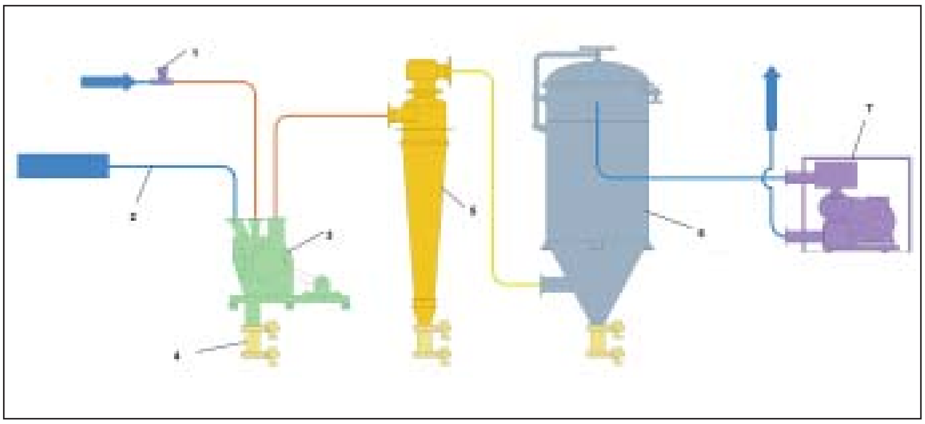


Pic. 6: Operating principle of the High-Efficiency Fine Classifier

Future Prospects

Machine manufacturers in the area of mechanical process technology take into account the requirements of users for the solution of new, product-related application problems and for the technical design of machines. In the future ever changing application problems and requirements are bound to lead to a continuing development in innovation activities in the area of mechanical engineering. ▲

Pic. 5: High-performance CFS/HD-S fine classifiers



Pic. 7: Typical set-up of a High-Efficiency Fine Classifier