FRITSCH GMBH, Manufacturers of Laboratory Instruments
Industriestrasse 8, D-55743 Idar-Oberstein, Germany

Dipl.-Ing. (FH) Gerhard Bär, Dipl.-Phys. Wolfgang Simon

General Topics

Two-stage Cutting Mill for Size Reduction of Heterogeneous Materials

1. DASA System "PROTECTA"

The new technical directive on residential waste requires a speedy analysis of the delivered refuse before this is taken to a landfill or incinerator. The law has not been applied yet, however, since the state of the art of technology has not yet caught up to the drafts of standards. In 1996 this inspired DASA to develop a complete system for rapid analysis of waste. The system consists of one size reduction container and one analysis container with division into 3 main procedural steps:

- representative sampling
- size reduction to analysis fineness of 250 µm
- speedy analysis as per the technical directive on residential waste and the technical directive on waste

Sampling is conducted with a drill designed for this specific purpose. The drill is suspended from an excavator arm mounted on one corner of the size reduction container. It can be used to take samples from the arriving trucks at various points and depths. Altogether, 5 samples of 10 litres each are taken, moved into a coarse crushing unit through the container roof and then precrushed to a grain size of about 30 mm. The sample is then mixed and divided into 2 litre fractions. One of the 2-litre samples is then fed into the fine grinder.

2. Fritsch Cutting Mill Combination 'pulverisette 19" and "pulverisette 25"

The fine grinding from about 30 mm to an analysis fineness of about 250 µm was handled by Fritsch GmbH. During fine grinding of completely heterogeneous samples such as domestic waste, rubble or shredder light fraction from automobile recycling, it must always be assumed that there will be some elastic materials such as plastics. Fine grinding in a reasonable scope is therefore only possible with cutting mills. The disadvantage of cutting mills, however, is that the blades are subjected to high

2/…

load due to abrasive minerals or tough metal pieces, particularly where rubble is involved. Furthermore, there is a danger that the mill will be blocked and plugged when overloaded. The following major requirements were therefore established for the mill:

- feed amount 2 litres, analysis amount about 0.15 litres
- feed grain size 30 mm, end fineness 250 µm
- speedy size reduction - in 5 minutes
- no (or few) personnel are to be employed to operate the mill
- collection of the entire sample in a sample glass for analysis

These requirements resulted in the development of the new Fritsch cutting mill combination. A laboratory instrument of limited size and power cannot reduce 2 litres of sample from an initial sample size of 30 mm to the final fineness < 250 µm within 5 minutes in a single step. Since PROTECTA required an analysis amount of just 0.15 litres, however, it was possible to have the plant feature 2 size reduction steps with interposed sample division.

- size reduction of 2 litre sample to 4 to 6 mm end fineness in the "pulverisette 25"
- division 1:13 in an interposed representative sample splitter. 1/13th of the sample is fed to a fine grinder. The remainder can be used, for example, to produce eluate.
- reduction of size of approx. 0.15 litre sample to 250 µm in the "pulverisette 19".

With normal cutting mills the material to be ground is always fed in radially, i.e. it strikes the cutting edges of the blades from the outside and is hurled away from them again due to the rotational movement. To prevent the material from being immediately hurled back out the feed opening, the sample is always to be moved into the blades mechanically. The material is introduced by special sluices or pushed into the blades by the operator with pressing and feeding devices. As no operators were available at PROTECTA and automatic pressing and feeding devices are both very expensive and very unreliable in operation, Fritsch selected a new procedure.

The crushed sample is drawn through the entire system by a suction unit. In this case it is vital that the speed of the flow of air be faster than the circumferential speed of the blades so that the sample will be drawn into the blades. A careful adjustment of the cross section of flow enables the transport of the sample while simultaneously preventing a separation into light or heavy

Phone: (0)6784/70-0 E-Mail: Info@FRITSCH.de Registergericht: Idar-Oberstein HRB 148 VAT No.
Fax: (0)6784/70-11 Internet: http://www.FRITSCH.de managing director: Robert Fritsch DE811189307

and large or small particles. It was also important to optimise the control of the particles in the air flow, where preference can be given to the extraction of relatively small and light particles. The sample is collected in a cyclone dust chamber and transferred to a 500 ml glass bottle.

Selection of suitable materials for the size reduction tools enables size reduction which is largely free of contamination. There are to be no disruptive components (e.g. heavy metals, hydrocarbons) in the grinding materials, sieves or other components. Suitable blade materials are hardened steel, tungsten carbide in a cobalt matrix or silicon carbide ceramics (by way of exception). On the other hand, the sieves are only to be fashioned of metallic materials. For PROTECTA, structural steel sieves and tungsten carbide tools were selected, as the subsequent analysis was not to be falsified by heavy metals.

The sample residue in the mills is optimised by minimising the dead spaces. Likewise, both mills are easy to clean completely and can be dismantled quickly. After the cover is opened and the top folded out of the way, rotor and sieve can be removed without any tools. The entire grinding chamber is then freely accessible and can be cleaned in a minimum of time. The entire system is patented.

Naturally, the universal cutting mill "pulverisette 19" and the power cutting mill "pulverisette 25" can also be ordered as separate units. Many accessories are available to adapt to various applications. The units can be easily accommodated to a broad range of requirements by adapting them with items such as the funnel for powdered solids with cyclone sample extraction to the long material funnel and the standard funnel.

Phone: (0)6784/70-0 E-Mail: Info@FRITSCH.de Registergericht: Idar-Oberstein HRB 148 VAT No.
Fax: (0)6784/70-11 Internet: http://www.FRITSCH.de managing director: Robert Fritsch DE811189307