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[54] **PROCESS FOR THE SIZE REDUCTION OF EXPANDED PLASTICS**
2 Claims, 2 Drawing Figs.

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[50] Field of Search ..... 241/3, 27, 29, 154, 158, 235 (Cursory), 239 (Cursory), 243 (Cursory), 25

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ABSTRACT: A process for the size reduction of expanded plastics, comprising preliminary size reduction of expanded plastics blocks by shearing action between rollers armed with shear blades and stationary blades and further size reduction by continued shearing action.

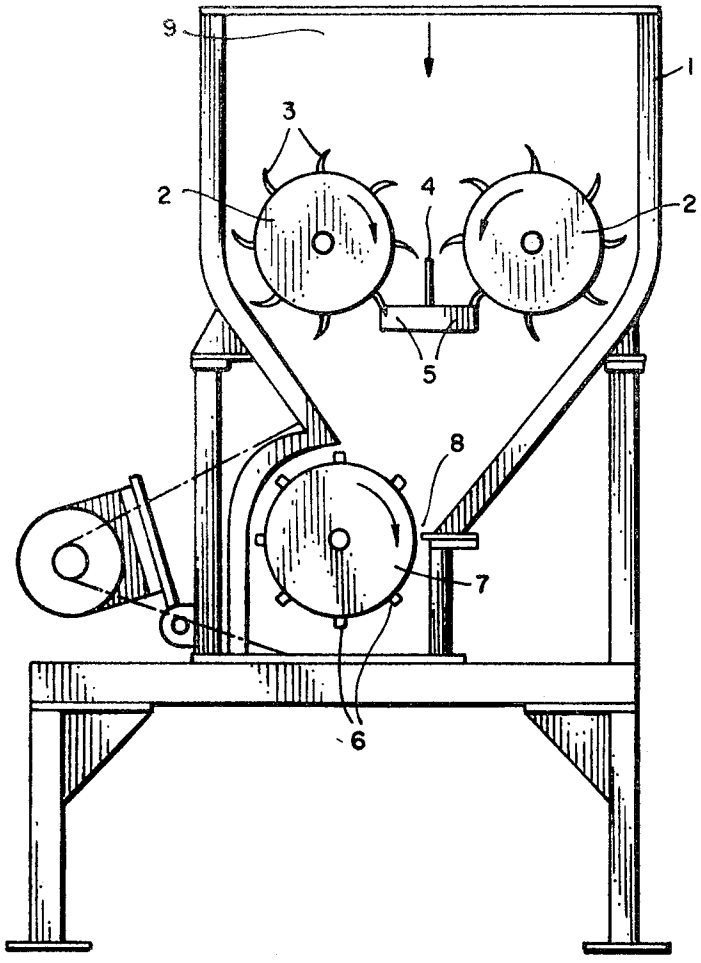


FIG. 2

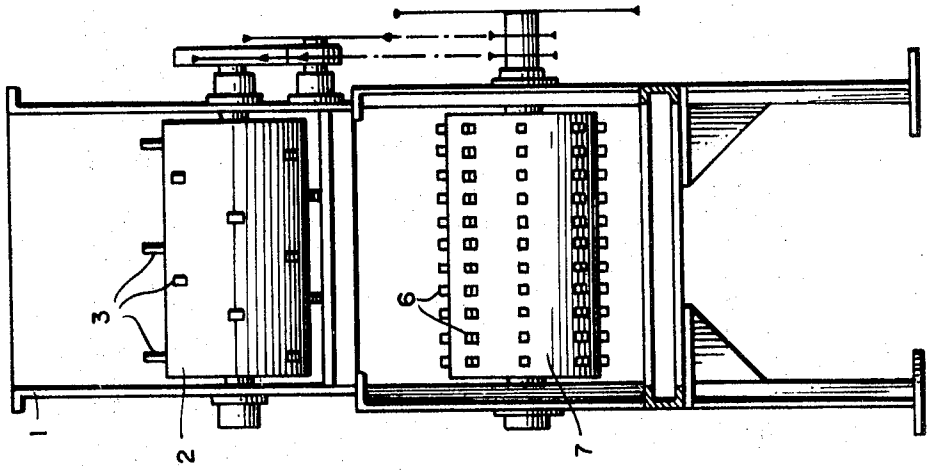
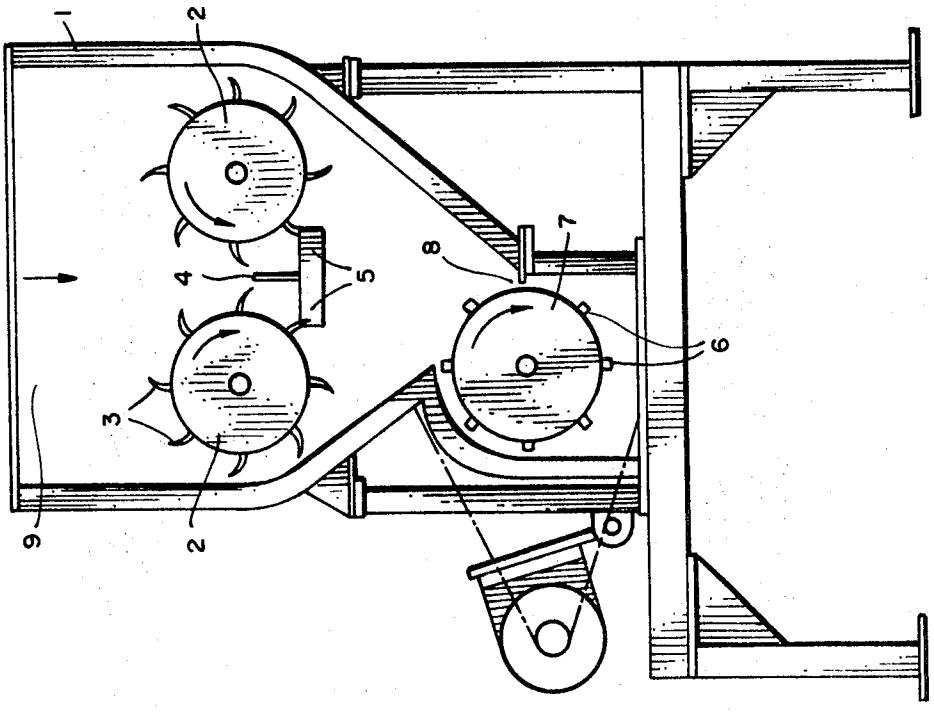


FIG. 1



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PROCESS FOR THE SIZE REDUCTION OF EXPANDED PLASTICS

This invention relates to a process for the size reduction of aminoplastics in block form.

Expanded aminoplastics, particularly expanded urea-formaldehyde condensation products, are widely used as insulating materials against heat and cold. Moreover, in particulate form they are frequently mixed with garden and agricultural soils because they improve the heat retaining properties of the soils, provide satisfactory aeration and possess a certain water retentivity. Finally their ability to soak up oils makes them particularly useful for absorbing oil from oil-water mixtures, condensable oil vapors from gases or oily contaminants from floors and the like. This property is due to the structure of the expanded material which consists of a multitude of openpored cells which have a very pronounced capillary action.

It has been found that in many cases such expanded materials do not develop a sufficiently powerful action unless they are in a specific particulate form. When added to soils, which may consist of clay, sand and peat, it is essential that the expanded material should be added in flocculent form, the average size of the flocks being between 2 and 15 mm. to avoid impairing the water retentivity and volumetric yield of the mixture of soil and expanded material. For the absorption of oil expanded aminoplastics in flock form have proved to be particularly useful provided they contain little flock having diameters below about 1 mm.

It is technically nearly impossible to reduce expanded aminoplastics mechanically to particles of uniform size by grinding, ripping or cutting. The brittleness of the expanded aminoplastics, particularly of expanded urea-formaldehyde condensation products, when subjected to conventional methods of size reduction, for instance in mills, in beaters fitted with spiked rollers or in blower-type chopping machines, particularly when the throughputs are large, results in flock of very unequal size or containing an excessively high proportion of fines. The quality of comminution is usually checked by a screen analysis and the yield by weight of floccules that are within the desired range of sizes is determined as a proportion of the total weight of material that has been comminuted.

The primary object of the present invention is the mechanical size reduction of expanded aminoplastics to particles of uniform size without the generation of an excessive portion of fines.

This object is achieved by a process for the size reduction of blocks of expanded aminoplastics, particularly urea-formaldehyde condensation products, in two or several consecutive zones of progressive comminution, the proposed process comprising the following steps:

a. in a first stage the blocks are cut into strips at a shearing speed of 0.3 to 5 meters/second by a pair of rollers armed with shear teeth and mounted for contrarotation about their respective longitudinal axes, said strips being forced
   aa. over a shear blade and through shearing combs arranged below said blade, and
b. the fragments thus obtained, without being allowed to accumulate, fall into a zone in which they are further comminuted in a second stage at a shearing speed of 2 to 17 meters/second, by a roller armed with shear teeth cooperating with a shearing comb, the possible throughput through the second zone being at least equal to the throughput through the first zone to avoid any accumulation of material.

Apparatus for performing the proposed method comprises

a. two parallel rollers which are mounted for contrarotation about their horizontal longitudinal axes and which convey the blocks of expanded material to the center, each of said rollers being armed at intervals of arc of between 70 and 150 mm. about their peripheries with radially projecting an possibly relief-ground shear teeth which are 20 to 40 mm. wide and disposed helically around the roller peripheries,

   aa. a shear blade extending parallel to the roller axes between the rollers and, below said shear blade, shear combs of a first comminution zone which may be adjustable to provide a desired depth of engagement, and
b. below the rollers of the first comminution zone a horizontally disposed roller armed at intervals of arc of between 70 and 150 mm. about its periphery with radially projecting shear teeth, 3 to 8 mm. wide, disposed in rows parallel to the roller axis and cooperating with a shearing comb through the gaps of which said shear teeth pass, the shearing comb possibly being adjustable to a desired depth of interengagement and being located vertically below the shear blade of the first comminution zone, the minimum lateral clearance between the shear teeth and the shearing comb and the minimum clearance in depth between shear teeth and shearing comb in the two disintegration zones being between 3 and 13 mm. and 1 and 7 mm. respectively.

The process and apparatus suitable for performing the process according to the invention will be hereinafter described in more detail with reference to the drawing.

From blocks of an expanded aminoplastics, preferably of a urea-formaldehyde condensation product, entering a casing **1** through an opening **9**, the shear teeth **3** of a pair of contrarotating rollers **2** cut out strips which have cross-sectional dimensions between 2 and 10 cm., and which are forced between the rollers across shear blades **4** and shearing combs **5** which cut the strips into shorter lengths. Without being allowed to accumulate these lengths fall into a second comminution zone which the shear teeth **6** of a roller **7** force them through the gaps of a shearing comb **8** for a further reduction in size of the lengths of expanded plastics. Further comminuting zones may follows. Instead of one roller the second or additional comminuting zones may contain a contrarotating pair of rollers. The flock is discharged by gravity and may then fall on a conveyor belt. The shearing speed in the first comminution zone is 0.3 to 5 meters/second, and in the second 2 to 17 meters/second. However, the possible throughput which is determined by the speed of the rollers in each consecutive zone should be equal to or greater than that through the preceding zone. Shearing speed is understood to be the peripheral speed of the centers of the shear teeth during rotation of the rollers. Throughput is understood to mean the quantity by volume per unit of time of the expanded plastics that is to be comminuted and will usually be given in cub.m./h.

Since the liability to brittle fracture generally increases with rising bulk weight of the expanded aminoplastics and shattering more readily occurs when the shearing speed is too high, the shearing speed should be related to the bulk weight of the expanded aminoplastics. For a bulk weight of about 15 kg./cub.m. of the expanded aminoplastics the shearing speed in the first comminution zone should be 1 to 5 m./sec., preferably between 1 and 3 m./sec., and in the second comminution zone 5 to 17 m./sec., preferably 8 to 13 m./sec., whereas for a bulk weight of about 30 kg./cub.m. the shearing speed in the first comminution zone should be 0.3 to 2 m./sec., preferably 0.45 to 1.0 m./sec., and in the second comminution zone 2 to 10 m./sec., preferably 2.5 to 6 m./sec. Besides the bulk weight of the expanded plastics another factor which governs the shearing speed that should be chosen for the second comminution zone is the size of the fragments produced in the first shearing zone. According to the size of the flock that is desired this must be determined by trial and error. For example, if the size of the pieces obtained in the first comminution zone is of about 50 mm. diameter, than the diameter of the floccules obtained at the stated shearing speeds in the second comminution zone will be between 2 and 15 mm.

FIG. **1** is a cross section of a preferred apparatus for performing the proposed process, FIG. **2** being a sectional side elevation of the apparatus. The preferably horizontal parallel contrarotating rollers **2** of the first comminution zone, which convey the expanded plastics blocks entering the casing **1**

through an opening 9 towards the casing center are armed with possibly relief-ground radially projecting shear teeth 3 of a width between 20 and 40 mm., preferably between 24 and 30 mm., disposed helically around the periphery of the rollers at intervals of arc between 70 and 150 mm., preferably between 80 and 100 mm., and in a preferred embodiment they are forwardly curved in the direction of rotation. Naturally the shear teeth might also be disposed in rows parallel to the roller axis. Centrally between and below these rollers a shear blade 4 extends parallel to the roller axes, the edge of the blade pointing upwards. Shearing combs 5 of which the depth of engagement may be adjustable and through which the shear teeth 3 pass are disposed parallel to the roller axes. The minimum lateral clearance between the shear teeth and the shearing comb is preferably 3 to 13 mm., preferably between 4 and 10 mm., and the minimum clearance in depth is preferably 1 to 7 mm. and, more particularly, 2 to 6 mm. Vertically below the shear blade 4 is a horizontal shearing comb 8 which may likewise be adjustable to a desired depth of engagement, and through which the shear teeth 6, preferably having a width of 3 to 8 mm., and particularly between 4 and 6 mm., of a roller 7 of a second comminution zone pass. These shear teeth are preferably disposed in rows parallel to the roller axis and spaced the same distances of arc apart as in the first disintegration zone. The minimum lateral clearance and the minimum clearance in depth between the shear teeth and the shearing comb are the same as those specified for the first comminution zone.

The distance of arc between the shear teeth is understood to be the length of the arc between lines parallel to the roller axes on the roller periphery containing neighboring teeth.

In the proposed process the expanded plastics is comminuted and conveyed through the machine without forming local accumulations and without rotary motion about their own axes being imparted to the fragments, since this will always lead to the formation of a considerable proportion of fines by abrasion. A major advantage of the proposed process resides in that even at high rates of throughput the quality of comminution will always be high, i.e. a flock size distribution within a desired range will be obtained.

EXAMPLE 1

Blocks of an expanded urea-formaldehyde condensation product having a bulk weight of 30 kg./cub.m. are cut into strips in a first comminution zone by rollers which are 500 mm. long and have a diameter of 267 mm., and which at intervals of arc of 80 mm. are provided on their peripheral surfaces with radially projecting relief-ground shear teeth 30 mm. wide and 50 mm. high disposed helically about the roller peripheries, the strips being forced over a 1.5 mm. thick shear blade through shearing combs 50 mm. wide with gaps 50 mm. in depth and providing a clearance in the depth of engagement between shear teeth and shearing comb of 6 mm., to be thereby further disintegrated. The fragments thus obtained fall by gravity without accumulation of material into the second comminution zone which comprises a roller of 500 mm. length and 250 mm. diameter armed at intervals of arc of 80 mm. with radially projecting shear teeth 6 mm. wide and 10 mm. high disposed in rows parallel to the roller axis and they are forced through a shearing comb located vertically below the shear blade in the first zone and having a width of 14 mm. and gaps that are 10 mm. deep to provide a clearance in depth of engagement of 2 mm. The minimum lateral clearance between the shear teeth and the shearing comb in the first comminution zone is 10 mm., and in the second zone 4 mm. The speed of rotation in the first comminution zone is 27 r.p.m. and in the second 240 r.p.m. The shearing speeds are 0.52 m./sec. and 3.25 m./sec. respectively. A screen analysis gives the following particle size distribution.

42.4 percent by weight having diameters between 10 and 15 mm.

43.5 percent by weight having diameters between 5 and 10 mm.

10.5 percent by weight having diameters between 2 and 5 mm. 3.6 percent by weight having diameters of less than 2 mm.

4.5 cub.m. of expanded plastics in block form are fed into the machine per hour and 8.5 cub./m. per hour of expanded plastics in flock form are obtained.

By comparison a conventional blower-type chopping machine produces an expanded plastics flock which a screen analysis proves to have the following particle size distribution:

39 percent by weight having diameters between 15 and 50 mm.

15 percent by weight having diameters between 5 and 10 mm.

16 percent by weight having diameters between 2 and 5 mm.

20 to 30 percent by weight having diameters of less than 2 mm.

The numerical analysis clearly shows the less regular particle size distribution and the high proportion of fines. Similarly unsatisfactory results as those obtained with a blower-type chopping machine are also obtained when using spiked rollers and ripper beaters.

EXAMPLE 2

Blocks of an expanded urea-formaldehyde condensation product having a bulk weight of 15 kg./cub.m. are cut into strips in a first comminution zone by rollers which are 700 mm. long and have a diameter of 318 mm., and which at intervals of arc of 100 mm. are armed on their peripheral surfaces with radially projecting relief-ground shear teeth 30 mm. wide and 50 mm. high, arcuately bent in the direction of rotation and disposed helically about the roller peripheries, and then comminuted by being forced over a 1.5 mm. thick shear blade through shearing combs that are 50 mm. wide with 50 mm. deep gaps providing a clearance in depth between the shear teeth and the shearing comb of 6 mm. The fragments thus obtained fall freely, without accumulating, into the second disintegration zone which comprises a roller 700 mm. long and of a diameter of 428 mm., armed at intervals of arc of 100 mm. on its peripheral surface with rows parallel to the roller axis of shear teeth 6 mm. wide and 10 mm. high, and vertically below the shear blade of the first zone a shearing comb 14 mm. wide with 10 mm. deep gaps providing a clearance in depth of 2 mm. The minimum lateral clearance between the shear teeth and the shearing blade in the first comminution zone is 10 mm., in the second zone 4 mm. The speed of rotation in the first comminution zone is 61 r.p.m. and in the second zone 540 r.p.m., the shearing speeds being 1.33 m./sec. and 12.4 m./sec. respectively. The screen analysis gives the following particle size distribution:

44.5 percent by weight having diameters between 10 and 15 mm.

41.5 percent by weight having diameters between 5 and 10 mm.

10.8 percent by weight having diameters between 2 and 5 mm.

3.2 percent by weight having diameters of less than 2 mm.

25 cub.meters of expanded plastics in block form are fed into the machine per hour and 51 cub.m./h. of expanded plastics in flock form are obtained. A disintegrator comprising a spiked roller produces expanded plastics flocks which a screen analysis proves to have the following particle size distribution:

5 percent by weight having diameters between 10 and 12 mm.

18 percent by weight having diameters between 5 and 10 mm.

37 percent by weight having diameters between 2 and 5 mm.

40 percent by weight having diameters of less than 2 mm.

We claim:

1. A process for the size reduction of blocks of expanded aminoplastics in two or more zones of progressive comminution wherein:

a. in the first stage the blocks are cut into strips at a shearing speed of 0.3 to 5 meters per second by a pair of rollers provided with shear teeth and mounted for contrarotation about their respectively longitudinal axes, said strips being forced

aa. into a shear blade and through shearing combs below said blade to form fragments, and

b. the fragments thus obtained fall, without accumulating, into a zone in which they are further comminuted in a second stage at the shearing speed of 2 to 17 meters per second by a roller provided with shear teeth cooperating with a shearing comb, the possible throughput through the second zone being at least equal to the throughput through the first zone to avoid any accumulation of material.

2. A process as claimed in claim 1 wherein the expanded aminoplastics is an expanded urea-formaldehyde condensation product.