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IMPROVED EXTRUDER FOR PELLETTIZATION MACHINES,
PELLETTIZATION MACHINE PROVIDING SAID EXTRUDER
AND PROCESS FOR PRODUCING PELLETS

5 The present invention concerns to an improved extruder for
pellettization machines, pellettization machine providing said extruder
and process for producing pellets.

 More generally, the invention refers to the technical field of
treatment of high humidity content incoherent materials to obtain
10 dehydrated material in a compact pellet shape. The invention is
applicable in the humid biomass production field.

 As it is well known, this kind of technology developed
during the last years, particularly for treatment of wastes and mud
produced in municipal and industrial depuration systems and like, but
15 also in systems for packaging foodstuffs (particularly animal
foodstuffs), in order to obtain a volume reduction, and at the same
time to obtain a finished product with a set shape, i.e. pellets.

 At present, pellettization machines are known, said
machines being realised according to different processes, all employing
20 an extruder, each time shaped according to the needing.

 Particularly, pellettization machines are known, provided
with at least a linear extruder, horizontally oriented, on which one or
more rolls slide to compress the material, said material consequently
exiting from the bottom through the extruder holes; they are also
25 known other pellettization machines the extruder of which has a
cylindrical shape within which one or more rolls rotate, said roll, by the
compression, oblige the material to exit through the extruder holes;
finally, pellettization machines are known, wherein two cylindrical
extruders are horizontally placed side by side, very close each other
30 and rotating according to opposite directions, in such a way that in the
zone between the same a downward rotative motion is created, the
material to be treated being introduced above this zone and being
subjected to a compression, and partially passing through the holes of
the cylindrical extruders to create the pellets, in a minimal part through
35 the space between the same extruders, to obtain waste product.

 At present, all the extruders used in the various pellettization
machines provide a plurality of holes, all having the same shape and
dimensions, providing, each one, a first inlet section (not necessarily



provided), an operation or pellettization section, having the necessary length, and an outlet section, having a cylindrical or flared shape.

5 Usual problems of all the pellettization machines employing extruders are essentially due to the high operative temperatures and to the high limitations on the fed material, with particular reference to its humidity, in order to be able to obtain a product having commercial features.

10 Main object of the present invention is therefore that of providing an improved extruder allowing to overcome the above mentioned drawbacks.

Further object of the present invention is that of providing an extruder that can be applied on every kind of pellettization machine presently known, and that will be surely also used on other kind of pellettization machines.

15 Another object of the present invention is that of providing a solution of the above kind allowing to feed raw material to the pellettization machine having a humidity content higher than that presently allowed (10 – 15% in weight) to feed the raw material to the extruder.

20 Still another object of the present invention is that of providing a solution allowing reducing the temperature reached within the extruder.

25 The solution suggested according to the present invention allows obtaining a lowering of the extrusion temperature, and to increase the productivity of the same extruder, since the material sent back to the extruder is partially thickened.

30 It is therefore specific object of the present invention an extruder for pellettization machines, characterised in that it provides at least two different kind of holes, respectively first holes having a working or pellettization zone of such length equal to the effective length necessary to the formation of pellets, once that the feeding material has the necessary humidity, and second holes having a length lower than said effective length, from second holes exiting partially or fully dehydrated, but not thickened incoherent material.

35 Particularly, according to the invention, said first and second holes provide an inlet zone to easy the entrance of the material, particularly an uniform section zone.

Furthermore, according to the invention, said inlet section can have a section decreasing from the material inlet side toward the outlet side.

5 Always according to the invention, said first and second holes provide a discharge or counter-perforation for the exit of the material, preferably an uniform section discharge, or a discharge having a crescent section from the material inlet side toward the outlet side.

10 The invention further relates to a system for pellettization of incoherent material, said system providing a pellettization machine comprising an extruder as described in the above, and wherein, downward said pellettization machine, a sieve is provided, said sieve separating still incoherent material from pellets, recirculation means for the still incoherent material toward said pellettization machine, and
15 means to transfer the pellets material toward the further working steps.

Preferably, according to the invention, said sieve is a vibrating sieve.

20 Particularly, according to the invention, said pellettization machine can be a linear, annular or opposed extruders pellettization machine.

The invention further relates to a method for the production of pellets, by an extrusion system, said method comprising the following steps:

- 25 - feeding the material to be subjected to treatment to the pellettization machine provided with an extruder as described in the above;
- extruding the material through holes having different length;
- 30 - sieving the product exiting from the extruder, dividing the dehydrated but still not sufficiently thickened material from the pellets;
- recirculating the dehydrated but still not sufficiently thickened material to the preceding extrusion step;
- reintegrating the recirculation material with new material to
35 be subjected to treatment;
- sending the pellets obtained from the sieving step to the following working steps.

Preferably, before reaching the wished humidity conditions of the material sent to the extrusion step, all the extruded material is recirculated to the extruder and new material to be subjected to treatment is not fed.

5 Furthermore, according to the invention, when the material sent to the extrusion has reached the wished humidity conditions, part of the extruded material is in any case recirculated toward the extrusion step.

10 Finally, according to the invention, humidity of the material to be subjected to treatment is reduced by mixing with material recirculated from the extruder, said recirculated material being already partially or totally dehydrated and having a lower humidity content.

15 The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

 figure 1 is a schematic view of a pellettization system realised according to the invention;

20 figure 2 is a schematic view of a linear pellettization machine provided with extruder according to the invention;

 figures 3a, 3b and 3c show, in section, three embodiments of the extruder according to the invention applied to the pellettization machine of figure 2;

25 figure 4 is a schematic view of an annular pellettization machine provided with extruder according to the invention;

 figures 5a, 5b and 5c show, in section, three embodiments of the extruder according to the invention applied to the pellettization machine of figure 4;

30 figure 6 is a schematic view of an annular pellettization machine provided with extruder according to the invention;

 figures 7a, 7b and 7c show, in section, three embodiments of the extruder according to the invention applied to the pellettization machine of figure 6;

35 figures 8 and 9 show, respectively, a schematic view and two particulars of an annular pellettization machine according to the invention;

figures 10a, 10b and 10c show, respectively, a schematic view and two particulars of a refiner of a pellettization machine according to the invention; and

5 figures 11a, 11b and 11c show, respectively, a top, front and lateral view of the vibrating sieve of a pellettization machine according to the invention.

Making first reference to the figure 1 of the enclosed drawings, it is shown, for illustrative, but not limitative purposes, a pellettization system, that can be used to understand the operation and the advantages of the extruder according to the invention. However, it must be understood that said system is simply illustrative of the invention, and that the same cannot be in any way used to limit the scope of the same invention, the inventive solution being applicable to every kind of pellettization machine.

15 System of figure 1 provides a material feeding system, from which the material is transferred to a crusher 2 and to a metal detector 3. From this point, discharged material is sent outside (point 4 of figure 1), while the material to be pelletised is sent to a refiner 5, an embodiment of which is shown in figures 10a – 10c. Said refiner 5 is not a specific feature of the present invention, and thus it will be not described in further detail in the following.

20 From refiner 5, material is transferred to the pellettization machine 6, by a feeder 7. The pellettization machine can have every kind of features, even if in the following specific reference will be made to three kind of pellettization machine already available on the market.

25 From the pellettization machine 6, material, passed through an extruder according to the invention, and that will be described in greater detail with reference to the following figures, arrives to a sieve 8, an embodiment of which (vibrating sieve) is shown in figure 11a – 11c), said sieve net being necessary to be further described, since its features are not essential for the invention.

30 From the sieve 8, material properly pelletised is sent to the storing, conservation and discharge station 9, while incoherent material, by the cyclone 10, coupled to the aspirator 11, and the hydraulic control 12, is sent back to the pellettization machine feeding system.

This recirculation, once the system works at regime, allows to feed material with a humidity content higher than it was possible with the known systems, since it mixes with recirculation material having a always lower humidity content.

5 In figures 8 and 9, an embodiment of a pellettization machine according to the invention is shown, for illustrative, but not limitative purposes, in this specific case an annular pellettization machine.

10 Coming now to specifically describe the extruder according to the invention, reference will be made to figures 2 – 7.

Particularly, in figures 2, 4 and 6 three specific arrangement of pellettization machines are shown, particularly a linear pellettization machine 6' (figure 2), an annular pellettization machine 6'' (figure 4) and an opposed extruder pellettization machine 6''' (figure 6).

15 Pellettization machine 6' of figure 2 provides a linear extruder 13, horizontally oriented, along which a roll 14 slides for compressing the material, that, consequently exits from the bottom through the extruder holes 13.

20 Pellettization machine 6'' of figure 4 provides a cylindrical extruder 15, within which two rolls 16 rotates, and that by compression, oblige the material to exit from the extruder holes 1.

25 Finally, pellettization machine 6''' of figure 6 provides two cylindrical extruders 17, horizontally placed side by side and rotating according to opposite directions, in such a way that in the zone included between the same, a downward rotatory motion is created, the material to be subjected to treatment being introduced above this zone and being subjected to a compression and partially passing through the holes of the cylindrical extruders 17 to realise the pellets, and a minimal part of the same material passing through the space
30 between the two extruders, to obtain waste material.

In all the three cases, holes of the extruders 13, 15 and 17 provide the innovative solution allowing to obtain the above mentioned advantages.

35 In the following, the structure of the extruder 13 will be described, making reference to figures 3a – 3c, the structure of extruders 15 and 17, specifically shown in figures 5a – 5c and 7a –

7c, being similar, with the unique difference of the specific features necessary for the particular kind of pellettization machine.

Observing first figure 3a (and consequently figures 5a and 7a), it can be noted that extruder 13 has two different kind of alternated holes 18, a first kind 18' providing a working zone, corresponding to the real pellettization needing, and a second kind of holes 18'' having a working zone with reduced sizes with respect to what is necessary to obtain a complete pellettization.

In this way, as exemplified in the figures, from the holes 18' incoherent material will exit, the sieve 8 sending the same back to the feeding system 7 of the pellettization machine, while from the holes 18'', pellets will exit. In case of feeding of very humid material, it is also possible that, during the first operation phase of the system, not completely shaped material exits also from holes 18''.

In the embodiment of figures 3b, 5b and 7b, holes 19' and 19'' have a circular exit section, while in figures 3a, 5a and 7c, the exit section is flared.

Finally, in the embodiment of the figures 3c, 5c and 7c, more evident is the difference between the working zone of holes 20' and of holes 20''.

It is well evident the efficiency of an extruder according to the invention. Method providing the recirculation of part of the material solves at the same time the high operative temperature problem and that of the limitation of the features of the material to be subjected to treatment.

Particularly, providing passages through which a part of the material can pass easily through the extruder, an excessive compression is prevented, thus limiting the temperature increase during the extrusion step.

Furthermore, recirculated material, after the sieving, being already partially or substantially dehydrated, mixes with the new material fed to the pellettization machine, consequently lowering the absolute humidity of the extruded material.

The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be

introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

CLAIMS

1. Extruder for pellettization machines, characterised in that it provides at least two different kind of holes, respectively first holes having a working or pellettization zone of such length equal to the effective length necessary to the formation of pellets, once that the feeding material has the necessary humidity, and second holes having a length lower than said effective length, from second holes exiting partially or fully dehydrated, but not thickened incoherent material.
2. Extruder for pellettization machines according to claim 1, characterised in that said first and second holes provide an inlet zone to easy the entrance of the material.
3. Extruder for pellettization machines according to claim 2, characterised in that said inlet section has a uniform section zone.
4. Extruder for pellettization machines according to claim 2, characterised in that said inlet section has a section decreasing from the material inlet side toward the outlet side.
5. Extruder for pellettization machines according to one of the claims 1 - 4, characterised in that said first and second holes provide a discharge or counter-perforation for the exit of the material.
6. Extruder for pellettization machines according to claim 5, characterised in that said discharge is a uniform section discharge.
7. Extruder for pellettization machines according to claim 5, characterised in that said discharge has a crescent section from the material inlet side toward the outlet side.
8. System for pellettization of incoherent material, characterised in that it provides a pellettization machine comprising an extruder according to one of the preceding claims 1 - 7, and wherein, downward said pellettization machine, a sieve is provided, said sieve separating still incoherent material from pellets, recirculation means for the still incoherent material toward said pellettization machine, and means to transfer the pellets material toward the further working steps.
9. System according to claim 8, characterised in that said sieve is a vibrating sieve.
10. System according to claim 8 or 9, characterised in that said pellettization machine is a linear pellettization machine.

11. System according to claim 8 or 9, characterised in that said pellettization machine is an annular pellettization machine.

12. System according to claim 8 or 9, characterised in that said pellettization machine is a pellettization machine with opposed extruders.

13. Method for the production of pellets, by an extrusion system, said method being characterised in that it comprises the following steps:

- feeding the material to be subjected to treatment to the pellettization machine provided with an extruder as described in the above;
- extruding the material through holes having different length;
- sieving the product exiting from the extruder, dividing the dehydrated but still not sufficiently thickened material from the pellets;
- recirculating the dehydrated but still not sufficiently thickened material to the preceding extrusion step;
- reintegrating the recirculation material with new material to be subjected to treatment;
- sending the pellets obtained from the sieving step to the following working steps.

14. Method according to claim 13, characterised in that, before reaching the wished humidity conditions of the material sent to the extrusion step, all the extruded material is recirculated to the extruder and new material to be subjected to treatment is not fed.

15. Method according to claim 13 or 14, characterised in that when the material sent to the extrusion has reached the wished humidity conditions, part of the extruded material is in any case recirculated toward the extrusion step.

16. Method according to one of the preceding claims 13 - 15, characterised in that humidity of the material to be subjected to treatment is reduced by mixing with material recirculated from the extruder, said recirculated material being already partially or totally dehydrated and having a lower humidity content.