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(54) Title: MACHINE FOR WOOL STERILIZATION

(57) Abstract: Machine for wool sterilization including a chamber with a drum where the wool that needs to be sterilized is placed. The drum can rotate, and when the machine is in operation, the air in the chamber can be heated to a temperature of up to 100°C and enter the drum. Additionally, the present machine for wool sterilization includes a fan, air passage openings, and an ozone generator. When the machine is in operation, the ozone generator produces a high concentration of ozone in the chamber, which then enters the drum with the wool, and simultaneously the wool in the chamber is mixed by rotating together with the drum, ensuring that the ozone affects all parts of the wool in the chamber.

INVENTION DESCRIPTION: MACHINE FOR WOOL STERILIZATION

FIELD OF THE INVENTION

The present invention belongs to the field of devices and machines used for wool sterilization as well as the process of wool sterilization itself.

TECHNICAL PROBLEM

The inventor is engaged in the processing of sheep wool and the production of fertilizers for plant nutrition in the form of pellets. In connection with this, the inventor has already protected an invention called "Pellets for plant nutrition." During the production of these pellets, it was found that despite the planned production procedures, one hundred percent sterility of such pellets was not achieved. To ensure one hundred percent sterility of the pellets, it was necessary to find a solution that would enable one hundred percent sterilization of sheep wool from bacteria, fungi, viruses, and their spores. The solution to this problem was found by the inventor in the form of a machine for wool sterilization, disclosed herein.

Namely, raw wool is contaminated with various microorganisms. Some of these microorganisms are sources of infectious diseases. A particular problem is the presence of virus spores in the wool, making it impossible to sterilize it using some standard methods, such as exposure to hot air under pressure. Another problem is that sheep wool cannot be subjected to high temperatures for sterilization because it leads to the degradation of valuable organic compounds.

Chemical methods of sterilization are not acceptable because it is an organic fertilizer, and no chemical substances, especially toxic ones, are used in the process of producing such organic fertilizer, as they would remain in the wool if used. Therefore, it was necessary to find a method of sterilizing the wool that does not involve the use of chemical agents.

PRIOR ART

It is not known to the inventor that there are any patents or patent applications that would provide a complete solution for the sterilization of sheep wool based on the use of ecological procedures or organic materials.

There are techniques for sterilizing air using ozone generators, or for sterilizing metal objects in healthcare and veterinary medicine using autoclaves, where sterilization is carried out under pressure at high temperatures. However, none of these techniques alone ensures one hundred percent sterilization of sheep wool, and none of these methods has been used by itself for the sterilization of sheep wool.

BRIEF SUMMARY OF THE PRESENT INVENTION

The inventor acquired knowledge from prior art that ozone is a suitable agent for air sterilization. Using this property of ozone, the inventor considered the possibility of utilizing ozone as an oxidizing agent to destroy various types of bacteria, viruses, molds, fungi, and insects that can be found in sheep wool. He also noticed another useful property of ozone: it removes most unpleasant odors. By searching the internet, the inventor learned that various studies have investigated the efficiency of ozone in sterilization. One study reports that the success of ozone treatment lies in a setup where a larger number of Petri dishes with microorganism cultures were placed on a bed covered with a sheet, and it showed that more than 99.96% of Colon Bacillus was destroyed, while the effectiveness was 99.92% for Staphylococcus Aureus and 99.91% for White Moniliasis. In another study on the effectiveness of ozone treatment of a wool carpet, it was found that the efficiency against coliform bacteria ranged from 95.7% to 99.3%, while the efficiency against S. Aureus ranged from 98.6% to 99.5%. These data indicated to the inventor that there is a good potential for applying ozone sterilization to sheep wool, with the significant importance that the sterilization efficiency must be raised to 100%. This can only be achieved by exposing the wool to the oxidative action of ozone from all sides. Therefore, it was necessary to design a system in which different parts of the wool would be exposed to ozone from all sides. This led the inventor to a solution where the wool would constantly change its exposure to ozone and would rotate inside a drum.

Therefore, the key part of the machine for wool sterilization disclosed herein is a multifunctional chamber with a rotating drum. The process of wool sterilization occurs through four phases, as follows:

PHASE ONE – wool heating

The first phase begins by loading the wool into the multifunctional chamber. When the loading is complete, the chamber is sealed, and the machine for wool sterilization is activated. The chamber rotates and mixes the material while heaters simultaneously heat the wool to a set temperature, which does not exceed 100°C. The built-in automatic control of the machine for wool sterilization mixes the wool at the set temperature for a selected time. The usual mixing time at a temperature of 100°C is one hour.

PHASE TWO – cooling and ventilation

In the second phase, after the heating has been completed, the heating of the multifunctional chamber is turned off, air passage openings are opened, and a fan is activated which blows air through the chamber, reducing the wool's temperature to 40°C. This ventilation lasts for a few minutes, usually 4 minutes. Then, the fan is turned off and the air passage openings are closed.

PHASE THREE – ozonation of wool

The third phase begins by activating the ozone generator, which creates a high concentration of ozone in the chamber. Simultaneously, the wool in the chamber is mixed to ensure that ozone affects all parts of the wool present in the chamber. The duration of this phase is adjustable, usually lasting for 15 minutes.

PHASE FOUR – ventilation of the chamber

After the ozone generator is turned off, air passage openings are opened, a fan is activated, and the chamber is ventilated to remove any remaining ozone. The duration of the ventilation is adjustable, usually lasting three minutes. After the ventilation is completed, the chamber is opened, and the sterilized wool is removed from the chamber.

DETAILED DESCRIPTION OF AT LEAST ONE WAY OF CARRYING OUT THE INVENTION

The present machine for wool sterilization is made of 50 mm thick PIR panels, fireproof up to 120 °C. The external dimensions of one embodiment of this machine are 350 cm in width, 350 cm in depth, and 250 cm in height. The internal volume of the chamber

is 8 cubic meters. The dimensions of the drum in the chamber are 125 cm x 125 cm x 300 cm. So far, testing has shown that the best results are achieved when the drum has an octagonal shape, which ensures optimal mixing of the wool. The volume of the drum is 4.50 cubic meters. The drum's rotation speed is adjustable to 3 ½ revolutions per minute. The machine is electrically powered, three-phase, with a power rating of 32 kW. The drum's position is adjusted via buttons to facilitate easier positioning for filling or emptying the drum with wool. The ozone generator has a power rating of 480 W. The total power of the installed heaters is 27 kW, however, a total of 12 heaters are installed, each with a power of 2.22 kW. The heaters have large ribbed surfaces to enable easier and faster heat exchange.

The fans are designed as two air turbines, each with a capacity of 1,000.00 cubic meters per hour. The turbines have variable airflow and pneumatic flaps are integrated to regulate the airflow through the chamber, depending on the process phase. The weight of the chamber in one embodiment is approximately three tons. In a further embodiment, UV lamps can also be used for sterilization. Monitoring of the sterilization process is achieved through audible and visual signals. Automatic control manages and regulates the actions of chamber heating, ventilation, ozonation, and the opening and closing of the turbine flaps. The pneumatic system opens and closes the flaps to regulate airflow in both the turbines and the ventilation. The weight of this machine in a typical embodiment is approximately three tons. The wool sterilization process occurs in four phases. In the first phase, wool is loaded into the multifunctional chamber, which, once filled, is sealed from the outside. The machine for wool sterilization is then activated, causing the drum in the chamber to start rotating and mixing the wool while simultaneously heating it. After the completion of wool heating, the automatic system initiates the second phase of the process, which involves cooling and ventilating the wool using air. This is achieved by a fan blowing air through the chamber, reducing the wool temperature to 40 °C. After the wool has cooled down, the process moves to the third phase, which involves ozonizing the wool by activating an ozone generator that creates a high concentration of ozone in the chamber, while simultaneously mixing the wool in the chamber. This ensures that the ozone acts on all parts of the wool in the chamber. After the ozonisation of the wool is completed, the fourth phase begins, which involves ventilating or aerating the chamber to remove any remaining ozone.

The duration of ventilation is adjustable, usually lasting three minutes. Once the ventilation is complete, the chamber is opened, and the sterilized wool is removed from the chamber.

PATENT CLAIMS

1. The machine for wool sterilization characterized in that it comprises a chamber with a drum that can rotate wherein when the machine is in operation, the air in the chamber is heated to a temperature of up to 100 °C.

2. The machine for wool sterilization as claimed in claim 1 characterized in that the drum has an octagonal shape.

3. The machine for wool sterilization as claimed in any of the previous claims characterized in that it further comprises a fan, air passage openings, and an ozone generator, wherein when the machine is in operation, the ozone generator produces a high concentration of ozone in the chamber, and simultaneously the wool in the chamber is mixed, ensuring that the ozone affects all parts of the wool in the chamber.

4. The wool sterilization process for manufacturing pellets for plant nutrition, conducted in a chamber, characterized in that it involves four phases, wherein in the first phase, the wool is heated while simultaneously being mixed, in the second phase, the chamber is cooled and ventilated, in the third phase, the wool is exposed to a high concentration of ozone while being mixed in the chamber and in he final fourth phase, the chamber is ventilated to remove any remaining ozone.

5. The wool sterilization process as claimed in the previous claim characterized in that it is conducted in the machine for wool sterilization as claimed in any of the claims 1 to 3.

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER

INV. D06L4/50 D06M11/34
ADD. C05G5/12 C05G5/14 D06B5/14 D06F35/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06L D06B D06F C05F C05G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 313 811 A (WASINGER ERIC [US] ET AL) 24 May 1994 (1994-05-24)	1-3
A	column 1, lines 6-12; column 2, line 38 - column 3, line 29; column 4, lines 48-68; claims; figures	4,5
A	US 2017/144943 A1 (GOLD BRIAN D [US] ET AL) 25 May 2017 (2017-05-25) paragraphs [0001], [0002], [0018], [0022], [0035] - [0038]; claims; figures	1-5
A	US 10 526 748 B2 (JEANOLOGIA TEKNOLOJI A S [TR]) 7 January 2020 (2020-01-07) the whole document	1-5
A	US 2 143 468 A (AVERY HENRY C) 10 January 1939 (1939-01-10) the whole document	1-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5313811 A	24-05-1994	NONE	
US 2017144943 A1	25-05-2017	CA 2948723 A1	25-05-2017
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US 10526748 B2	07-01-2020	NONE	
US 2143468 A	10-01-1939	NONE	