Abstract

This research aims to study a development of two pellet die organic fertilizer compression machine. The pellet system consisted of 4 rollers which divided into 2 rollers of each side using electrical motor 3 hp, transmit to gear of walking tractor. A foreword and reverse gear are used for transmitting power into shaft pellet compression. Diameter of cylinder compression was 254.00 mm, with the hole size on the pellet die is 5.0 mm, the diameter of rollers was 70 mm, the length was 130 mm. at the speed of shaft pellet compression was 250 rpm. Speed of shaft feeder was 225 rpm. The average bulk density of pellet is 745.40 kg m\(^{-3}\). The average compression capacity of the machine was 504.43 kg/hr. The percentage of durability of pellet and broken pellet were about 91.73 % and 8.27 % respectively.

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Keywords: Pellet fertilizer; Compression machine; Organic fertilizer; Two pellet compression

1. Introduction

At present, Agriculturalists are aware of the danger of using fertilizer. The soil condition deteriorated quickly. Farming does not work as expected and the cost of buying chemical fertilizers is more expensive. So, farmers became interested in using organic fertilizers instead of using chemical fertilizers because organic fertilizers are cheaper than chemical fertilizers. Organic Fertilizer or bio-fertilizer was made from animal’s’ dung such as cow, chicken, which these dung have microorganisms which are useful for soil and plant, increase microorganisms to soil and maintain soil. The organic fertilizer is made and then be compressed into pellets.
It can be made easily, low cost, can be used easily and be able to reduction of spreading. Former researches, the capacity was not much and consumed high power e.g. the capacity of Manure organic fertilizer compression machine was 79 kg/hr. and using electric motor 3 hp. [3]. The capacity of disc molding fertilizer compression machine was 62 kg/hr. and using electric motor 6 hp [4]. The capacity of pressing fertilizer machine was 150 kg per hour and using diesel engine 10 hp [5] and the factors influencing to the organic fertilizer pellets using compression roller mechanism are a density of board, size and number of rollers [2] can get the best quality of pellets, etc. Therefore, the development of two-pellet organic fertilizer compression machine to provide higher capacity, more useful but consume the same power or less than, encouraging farmers to produce organic fertilizer tablets that are good quality, cheaper and reduce in the production period.

2. Equipment and experimental methods.

2.1 Materials and principles

Cow and chicken’s dung manure are used for experimental mixed with a mixed fermented plant of farmers’ group in Phang Khon district. Sakon Nakhon province. The fertilizer is fed into the tank and then enters the second operation to transport fertilizer, rolled into the section with a spiral compression cylindrical hole. Roller squeeze organic fertilizer through the hole of the cylinder out and the cutting blade pellet fertilizer with a diameter 5 mm. As shown in (Fig.1) shows the structure of two pellet organic fertilizer compression machine.

2.2 The Transmission system

Data of research and development pilot plant production of organic fertilizer (Suriya Sasanarakkit and others, 2549: 29-30) chose to use a 3 hp motor rotational speed 1,450 rpm driving systems and accessories carry the force of the various sections consisted of the drive shaft that drives the motor for such devices as power using pulley and conveyor belt. Therefore, this study uses the structure of the Siam Kubota tractor with a used transmission gear and speed available on demand is forward 3 gear; gear 1, gear 2, gear 3 and one back gear. Selection to change speed using Sliding gear including shaft gear forward is six axles and one axle return gear. (Fig. 2) shows a transmission gear and conveyor belt. (Fig.3) shows a position of gear 1.

2.3 Calculation of size of conveyor belt’s wheels, ratio and length of conveyor belt

Diameter of the wheel tracks, ratio and the length of the conveyor belt can be calculated by using (Eq. 1, 2 and 3) respectively [6].

\[
\begin{align*}
  n_2 &= n_1 \times \frac{d_1}{d_2} \\
  i &= \frac{d_1}{d_2} \\
  L &= 2C + 1.57(d_2 + d_1) + \frac{(d_2 - d_1)}{4C}
\end{align*}
\]
Fig. 2 shows a transmission gear and conveyor belt.

Fig. 3 Shows a position of gear 1.

2.4 The Testing and evaluation of the machine

The prepared organic fertilizer is fed into mixer and then the weight to be 15 kg per tank, 5 tanks for testing five times. The density is measured before compression; timing of fertilizer pellets and then takes the organic fertilizer pellets to reduce the moisture by using solar energy. Then, weight the total of fertilizer and sampling of organic fertilizer pellets to find The particle density and bulk density of pellet, the compression capacity of machine and the durability of pellet using method of Particle size analysis using sieve No. 4 and No. 8.

3. The experimental Results

3.1 The particle density and bulk density of pellet

The average particle density and bulk density of pellet organic fertilizer were about 393.33 kg m\(^{-3}\) and 745.40 kg m\(^{-3}\)
3.2 The compression capacity of the machine

The organic fertilizer was fed into the first header compression 15 kg, spent time 3.19 minutes with the average weight of fertilizer pellets was 13.53 kg, the average operation of the machine was 254.87 kg/hr. The second header compression was 15 kg spent the average time 3.23 minutes, average weight 13.73 kg, the average operation of the machine was 249.56 kg/hr when a combined capacity of the machine operation was 504.43 kg/hr as shown in Table 1.

Table 1. The experimental result of the machine.

<table>
<thead>
<tr>
<th>No.</th>
<th>Average weight (kg)</th>
<th>Time (s)</th>
<th>Capacity (Kg/hr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>13.12</td>
<td>12.74</td>
<td>3.13</td>
</tr>
<tr>
<td>2</td>
<td>14.20</td>
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<tr>
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<td>13.68</td>
<td>13.35</td>
<td>3.35</td>
</tr>
<tr>
<td>4</td>
<td>12.45</td>
<td>13.44</td>
<td>3.06</td>
</tr>
<tr>
<td>5</td>
<td>14.22</td>
<td>14.18</td>
<td>3.20</td>
</tr>
<tr>
<td>average</td>
<td>13.53</td>
<td>13.73</td>
<td>3.19</td>
</tr>
</tbody>
</table>

Notes: A = 1st, B = 2nd (header compression)

3.3 The durability of pellet

The percentage of durability of pellet and broken pellet were about 90.70 % – 92.78 % average 91.73 % and 7.22 % – 9.30 % average 8.27 % respectively

4. Conclusion

The two pellet organic fertilizer compression machine found that The average particle density and bulk density of pellet organic fertilizer were about 393.33 kg m⁻³ and 745.40 kg m⁻³ the average compression capacity of the machine was 504.43 kg/hr. The density of pellet was 745.40 kg/m³. The percentage durability of pellet and the percentage of broken pellet were 91.73 % and 8.27 % respectively.

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References