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RESEARCH PAPER

Physical properties of farmyard manure at different depths of manure pit

Sarveshwar
Department of Farm Machinery and Power Engineering, College of Technology and Engineering, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan) India
(Email: sarveshtarnalli@gmail.com)

Abstract : Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. On an average well composted farmyard manure contains 0.5 per cent N, 0.2 per cent P_2O_5 and 0.5 per cent K_2O (Reddy, 2005). Farmyard manure is the nutrient enriched organic manure used for agriculture in order to increase the fertility of soil. The manure consist of dung, urine, and fodder waste. The main purpose of this research was to examine the physical properties like *viz.,* bulk density, moisture content, angle of repose, angle of friction of farmyard manure at different depth of manure pit. Study was conducted along the five different depth of manure pit from 0 to 50 cm at 10 cm distance each. The bulk density value along the five depth of manure pit was 230, 248, 248, 286 and 300kg/m^3, respectively. The moisture content value along the five depth of manure pit was 15.73, 16.8, 18.5, 19.3 and 21.2 %, respectively. The angle of repose along the five depth of manure pit was 41.9, 43.2, 47.13, 44.4 and 52.1°, respectively. The angle of friction along the five depth of manure pit was 30.7, 32.8, 33.7, 36.2 and 36.53°, respectively.

Key Words : Farmyard manure, Physical properties, Manure pit

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INTRODUCTION

Farmyard manure is one of the major valuable organic fertilizer maintaining soil fertility in the systems of alternative agriculture. The application of FYM significantly increases the contents of phosphorus and magnesium in the soil (Malle *et al.,* 2017). Application of farmyard manure promotes organic farming which is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. India has witnessed a change from organic to inorganic agriculture and now, it is time to a move towards organic again (Sathyanarayana *et al*., 2002). The evenly spreading of manure on farm fields is extremely important to achieve better effect but in the present context, the application of farmyard manure is carried by the farmers using spade and manual broadcasting, which requires more labours and more time for application. The partial mechanization of manure spreading is need of hour and requires suitable machinery. In order to develop proper machine for handling manure application to achieve maximum

efficiency the physical properties of manure must be considered so keeping this an objective present study has been conducted.

MATERIAL AND METHODS

Physical properties of farmyard manure:

The physical properties such as bulk density (kg/m^3), moisture content (%), angle of friction (°) and angle of repose (°) for farmyard manure were studied and measured. The manure used for the study was consisted of heterogeneous mixture and moisture content varies at different depths stored in manure pit. For measuring the physical properties, five depths of manure pits *viz.,* 0-10, 10-20, 20-30, 30-4 and 40-50 cm were used.

Bulk density:

Bulk density influences the handling of manure in the applicator and plays major role in designing of manure box. The bulk density was found out by measuring the volume of given weight of the sample. The manure samples were collected by using core cutter method at different depths in manure pits. Bulk density was calculated by using the following equation (Manisha *et al.,* 2020).

$$\text{Bulk density, kg/m}^3 = \frac{\text{Mass (kg)}}{\text{Volume (m}^3\text{)}}$$

$$BD = \frac{Wt}{L \times \left(\frac{\pi d^2}{4}\right)}$$

where,

BD = Bulk density, (kg/m^3),

W_t = Weight of sample, (kg),

L = Length of cylinder, (m),

d = Diameter of cylinder, (m).

Moisture content

Moisture content of FYM was determined by oven drying method. The farmyard manure samples were weighed with crucible and placed in the oven at 110°C for 24 hours. Moisture content was calculated by using the following equation (Reddy *et al.,* 2014).

$$Mc, \% = \frac{W_2 - W_3}{W_3 - W_1} \times 100$$

where, Mc = Moisture content, %

W_1 = Weight of crucible, g

W_2 = Weight of crucible + wet sample, g

W_3 = Weight of crucible + dry sample, g.

Angle of repose:

Angle of repose is the maximum angle measured upwards from the horizontal at which a pile of a farmyard manure will remain stable without any of the FYM sliding downward. It was calculated by pouring the FYM on a plate of 45 cm diameter from height of 50 cm, the material will form a heap. After the material gets settled the height of heap is measured by using measuring scale and the angle of repose was calculated by using following relationship (Landry, 2005).

$$A = \tan^{-1}\left[\frac{H}{R}\right]$$

where, A = Angle of repose, degree

H = Height of cone, cm

R = Radius of base of cone, cm.

Angle of friction:

Angle of friction is the angle of a plane to the horizontal when FYM is placed on the plane will just start to slide. The value of the angle of friction of FYM is measured using the inclined plane method (Mohsenin, 1986). A rectangular frame which is filled with FYM was placed on a MS sheet kept on flat surface. One end of the MS sheet is tilted until the frame containing farmyard manure just tends to slide. The angle formed by the sheet with horizontal is the angle of friction of FYM and it was calculated by using following relationship (Manisha *et al.,* 2020).

$$B = \sqrt{L^2 - H^2}$$

$$F = \tan -1\left(\frac{H}{B}\right)$$

where, B = Base width of triangle formed, cm

L = Length of MS sheet, cm

H = Vertical height of free end of sheet from ground, cm

F = Angle of friction, degree.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physical properties of farmyard manure spreader :

Physical properties of farmyard manure was studied at different depths of manure pits. The physical

properties of farmyard manure are shown In Table 1. The manure samples were heterogeneous mixture and its moisture content varied at different depths of manure pits. For measuring the physical properties, five depths of manure pits *viz.,* 0-10, 10-20, 20-30, 30-40 and 40-50 cm were used. The results of measured physical properties of farmyard manure are in close agreement with the results of Thirion *et al.* (1997), Landry *et al.* (2004), Singh and Singh (2006) and Chowdareddy and Dronachari (2014).

Bulk density:

The bulk density measured for farmyard manure is 230, 248, 248, 286 and 300kg/m^3 at different depths of manure pit. bulk density at different depth of manure pit is shown in Fig.1. The bulk density varied with each manure sample and also at different depths of manure pits. It was observed that bulk density increases as the depth of manure pit increases.

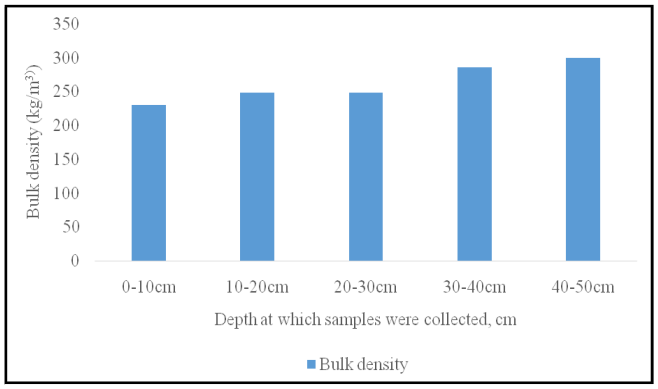

Fig. 1 : Bulk density of farmyard manure measured at different depth of manure pit

Moisture content:

Moisture content observed for farmyard manure is 15.73, 16.8, 18.5, 19.3 and 21.2 % at different depths of manure pit. In Fig. 2 moisture content at different depth of manure pit is shown. It was noted that moisture content was higher at the bottom of manure pit. The moisture varied from each manure sample also.

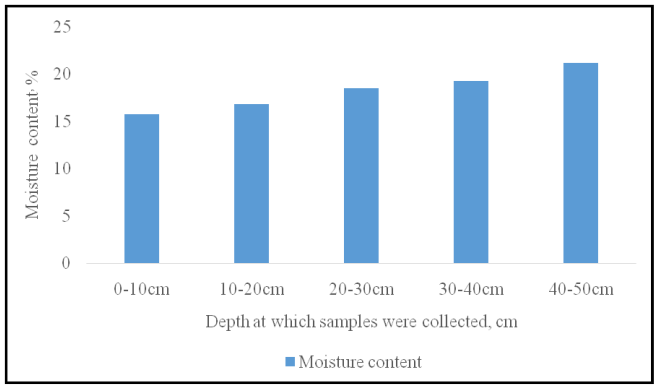

Fig. 2 : Moisture content of farmyard manure measured at different depth of manure pit

Angle of repose:

The angle of repose for farmyard manure are 41.9, 43.2, 47.13, 44.4 and 52.1° at different depths of manure pit. The angle of repose of manure samples at different depths of manure pit are shown in and Fig. 3. The angle of repose is the inevitable parameter for the design of manure box.

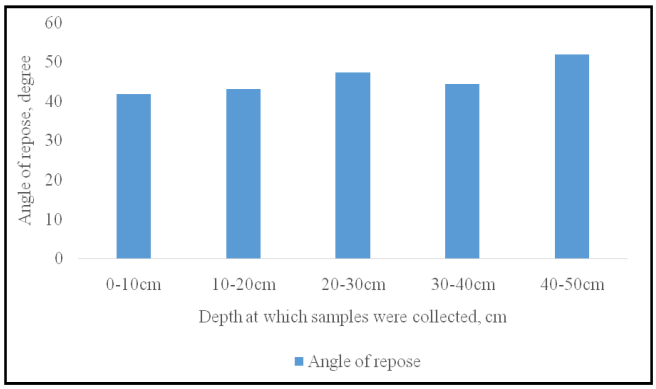

Fig. 3 : Angle of repose of farmyard manure measured at different depth of manure pit

Angle of friction:

The angle of friction observed for the farmyard

Table 1: Physical properties of farmyard manure at different depths of manure pit

Depth at which Samples were collected (cm)	Bulk density (kg/m^3)	Moisture content (%)	Angle of repose, degree	Angle of friction, degree
0-10	230	15.73	41.9	30.7
10-20	248	16.80	43.2	32.8
20-30	248	18.5	47.13	33.7
30-40	286	19.3	44.4	36.2
40-50	300	21.2	52.1	36.5

manure were 30.7, 32.8, 33.7, 36.2 and 36.53° along the depths of manure pit. The angle of friction of manure sample at different depths of manure pit is shown in Table 4 and Fig. 4. The angle of friction influences selection of the material for the design of manure box.

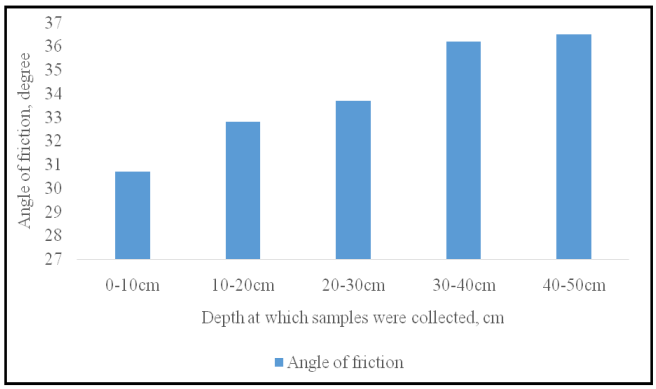

Fig. 4 : Angle of friction of farmyard manure measured at different depth of manure pit

Conclusion:

Based on laboratory study of physical properties of farmyard manure it is concluded that for the design of manure box and agitator bulk density and moisture content of farmyard manure plays an important role and for the material selection for the design of manure box result of angle of friction is necessary and agitator mechanisms in solid manure spreaders. Angle of repose effects the flow characteristics of farmyard manure in the manure box and will help for the design of manure spreaders. It was noted that along the depth of manure pit moisture content was increased as a moisture content of the manure increased, bulk density angle of repose and angle of friction were also increased.

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