ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 63 43 Number 2, 2015
http://dx.doi.org/10.11118/actaun201563020383

IMPROVEMENTS IN A UNIVERSAL COMPOSTING MACHINE

Hristo Beloev[1], Petar Dimitrov[1], Plamen Kangalov[1], Kaloyan Stoyanov[1], Gencho Popov[1], Dimitria Ilieva[1], Pavel Máchal[2]

[1] Ruse University "Angel Kanchev", ul. Studentska 8, 7017 Ruse, Bulgaria
[2] Department of Project Management, Faculty of Regional Development and International Studies, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic

Abstract

BELOEV HRISTO, DIMITROV PETAR, KANGALOV PLAMEN, STOYANOV KALOYAN, POPOV GENCHO, ILIEVA DIMITRIA, MÁCHAL PAVEL. 2015. Improvements in a Universal Composting Machine. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(2): 383–386.

Designed in Bulgaria for the needs of organic, environmentally-friendly and conventional agriculture, the universal composting machine requires to be attached to the front of tractors when being used in aggregates. However, it is rare to find such tractors. What is more, tractors with front – shaft power take almost do not exist. For this reason the universal composting machine is rather limited from a technological point of view despite its capacity and this made it necessary to improve it through the development and testing of a hydraulic power drive system. The purpose of the present study is to discuss the technical and technological changes in the design of the composting machine which have resulted in increased performance under conditions of sustainable agriculture in Bulgaria.

Keywords: composting, universal composting machine, technological schemes, hydraulic power drive system

INTRODUCTION

For modern sustainable agriculture composting is the most efficient way of utilizing plant residues and other waste. The obtained compost is the most appropriate means of increasing organic matter in the soil, reducing the degradation processes and improving its fertility.

To improve the composting process a team of researchers from Ruse University designed a unique, multifunctional and universal composting machine that has been protected by a patented. This is a machine that is used in agriculture and belongs to the machinery for solid-phase composting of plant and other natural waste. The machine can be used to prepare the residues and feed them into various types of compost devices as well as to mix the composted material obtained at the second stage of composting. The machine allows for on the spot composting of plant residues, i.e. while they are gathered on the field, and spreading the ready compost on the surface of the treated areas. In addition, the composting machine can be included in aggregates for vertical mulching with plant residues and compost or for feeding such aggregates. The machine can be attached to a tractor with the help of three-spot coupling device and is powered by a drive shaft. For the majority of the technological operations and especially when being part of combined aggregates, it is more appropriate for the machine to be attached before the tractor. However, it is rare to find such tractors. What is more, tractors with front – shaft power take almost do not exist. For this reason the universal composting machine is rather limited from technological point of view despite its technological capacity. This made it necessary to improve the machine by developing and testing a hydraulic power-drive system. This in turn has led to improvements in the machine performance and created new technological opportunities for its use.

The purpose of the present study is to discuss the technical and technological changes in the design of the composting machine which have resulted in increased performance under conditions of sustainable agriculture in Bulgaria.

MATERIALS AND METHODS

The design of the hydraulic power drive and the functional tests of the composting machine with the hydraulic power drive system are done in laboratory conditions in the department of "Thermotechnics, hydraulics and ecology" at Ruse University "Angel Kanchev" in 2012. The following parameters were taken into account: power, torque, revolutions per minute and pressure in the hydraulic system. During the same period laboratory and field studies of the ready hydraulic power drive system mounted on the composting machine were carried out in the territory of town of Marten, Ruse region. The machine was tested in two technological and operational modes of work.

RESULTS AND DISCUSSION

On the basis of the research and development activities for designing the hydraulic power drive system and the hydraulic calculations the MLHT160 hydraulic motor produced by "M+C Hydraulic" AD was chosen. This motor has the appropriate characteristics such as pressure p = 155 bar, flow rate Q = 90 l/min, power P = 20 kW, and coefficient of performance (COP) = 85.5%.

It was found out that the hydraulic power system and the mechanic components the composter work appropriately to achieve optimal performance (Fig. 1). The laboratory test results of the hydraulic system parameters are within the project projections.

From the conducted laboratory and field studies of the hydraulic power drive system of the composting machine it can be concluded that it provides reliable performance for a continues period of time under the following two operational modes.

First operational mode – the hydroficated universal composting machine (Fig. 2) is used to first cut the plant residues of the previous crop which are in their last phase of growth. Then they are shredded and the obtained substance is spread into swaths on the field. Under this mode the machine operates with a special rotor cutting device that is mounted on it.

Second operational mode – the universal composting machine works with a hydroficated

1: *Hydraulic power drive system for a universal composting machine during functional research*
Sourse: own

2: *Hydroficated universal composting machine with a rotor cutting device*
Sourse: own

3: *Universal machine for composting with a hydroficated platform for crushing and shredding round and cuboid bales*
Sourse: own

4: *Hydroficated platform for crushing and shredding round and cuboid bales*
Sourse: own

platform for crushing and shredding round and cuboid bales (Fig. 3).

Under this mode the machine approaches the bale, lifts it up with the hydroficated platform (Fig. 4) and feeds it into a screw conveyor where it is crushed and shredded. There the bales can be shredded into pieces with different sizes and after that spread on the field surface or forced into a transporting contained with the help of a feeding device.

CONCLUSION

On the basis of the carried out design and testing activities for improving the universal composting machine it can be concluded that:

1. The hydraulic power drive system of the improved composting machine has a simplified construction which makes the machine reliable and easy to use in all operation modes.
2. The composting machine that has been improved by adding a hydraulic power drive system features front attachment. This is a great advantage from a technical and technological point of view when developing sustainable farming.

REFERENCES

BELOEV, H. I. *et al*. 2012. *Development and testing of the hydraulic power-drive system of a universal composting machine.* Report of Scientific research project under Bulgarian Science Fund. Ruse: RU "A. Kanchev".

BELOEV, H., DIMITROV, P., KANGALOV, P., STOYANOV, K., ILIEVA, D. 2012. Machine Operation Tests on Anti-ErosionMachine – Tractor Agregates for Composting and Vertical Mulching. In: *International scientific conference*. Brno: Mendel University in Brno.

BELOEV, H., KANGALOV, P., DIMITROV, P., STOYANOV, K., ILIEVA, D. 2012. Technological Schemes for Composting Plant Residue on The Field Using an Universal Machine. In: *International scientific conference*. Brno: Mendel University in Brno.

Contact information

Hristo Ivanov Beloev: hbeloev@uni-ruse.bg
Petar Dimitrov: pdimitrov@uni-ruse.bg
Plamen Kangalov: kangalov@uni-ruse.bg
Kaloyan Stoyanov: kes@uni-ruse.bg
Gencho Popov: gspopov@uni-ruse.bg
Dimitria Ilieva: dilieva@uni-ruse.bg
Pavel Máchal: pavel.machal@mendelu.cz