ENERGY REQUIRED FOR CUTTING OPERATION OF SOME FIELD CROP RESIDUES

By

SABER SAAD MAHMOD MEGAHED
B.Sc. Agric. Cooperative Sc. (Agricultural Education Studies), 2005

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ABSTRACT

Saber Saad Mahmod Megahed: Energy Required for Cutting Operation of some Field Crop Residues. Unpublished M.Sc. thesis, Department of Agricultural Engineering, Faculty of Agric., Ain Shams University, 2015.

The performance of an experimental crop residues cutting machine has been investigated in this work in order to evaluate the energy requirements for cutting operation of three different crop residues (cotton stalks, corn stalks, and rice straw). The effect of cutting drum speed, knife edge angle and clearance distance on the machine productivity, fuel consumption, required power, specific consumed energy, cutting efficiency and the economical costs at optimum machine operation were, also, studied. The machine evaluated at five cutting drum speeds 1200, 1300, 1400, 1500 and 1600 rpm (8.29, 8.98, 9.68, 10.37 and 11.06 m/s); five knife edge angles (20°, 25°, 30°, 35° and 40°); and five clearance distance (1, 2, 3, 4 and 5mm). The results showed that the maximum cutting efficiency for cotton stalks (20.56% M_{cwb}), corn stalks (25.64% M_{cwb}), and rice straw (14.8% M_{cwb}) were 67.7%, 47.59,% and 62.75%, respectively, at 1600 rpm cutting drum speed, 20°knife edge angle, and 1mm clearance distance.

Key Words: Cutting machine; crop residues; energy requirements; cutting efficiency.

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1. INTRODUCTION

Field crop residues are organic materials which are produced by products from harvesting and processing of agricultural crops. They include all agricultural waste of common crops such as cotton, wheat, corn or maize and rice.

Large quantities of crop residues are produced annually in Egypt. They reached about 18.7 million ton per year and the national income might be increased with 1.6 billion LE/year if we try to recycle it **(El-Berry *et. al.*, 2001 and Awady *et. al.* 2001, cited by El-Hanfy and Shalby,2009).** The area of cotton crop cultivation produced about 9% of the total amount of the crop residues per year. And, the total cultivated area of rice is approximately 1.46 million feddan which is considered one of the most widely cultivated cereal crops in Egypt. It is produced about 3.28 million tons of rice straw per year according to the **Ministry of Agriculture and land Reclamation, 2006**. Consequently, the increase of field crop residues will cause a serious problem facing the agricultural producers because they are burnt or left to decompose, but most of these current practices are not working well because of wasting time, money, energy, and polluting the environment; However, there are many efficient and simplest methods of using the field crop residues, and all of these methods depend on the cutting process which may be chopping or shredding of the field crop residues for size reduction to be suitable for various uses such as food for farm animals, compost to substitute the chemical fertilizers and improve the agricultural soil, traditional source of domestic fuel in rural areas, and it can, also, be used in manufacturing. **Taiab and Imbabi (1995)** proved that the cutting energy and force requirements increased with increasing the stem diameter. **Habib *et al.* (2002)** found that the predominant parameters affecting the cutting process performance of agricultural material were related to the cutting tool, machine specifications and plant material properties. **Suliman *et. al.*(2010)** studied some engineering factors concerning the performance of the affecting tool in crop residues shredder. Their results indicated that cutting drum speed, knife edge angle, and clearance distance are affected the cutting efficiency, fuel consumption and the shredder production. They, also, mentioned that the proper selection of new material leads to decrease the sharp edge angle of modified knives to 20° degree without deformation.

The present work aims to investigate and evaluate the performance of an experimental crop residues cutting machine that is owned by the Arid Land and Agricultural Research and Services Center, Faculty of Agricultural, Ain Shams University to determine the energy requirements for cutting operation of three different crop residues which are cotton stalks, corn stalks and rice straw. It also discusses:

1- The effect of cutting drum speed, knife edge angle and clearance distance on machine productivity, fuel consumption, required power, specific consumed energy and cutting efficiency.
2- The economical costs at optimum machine operation.

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