American-Eurasian J. Agric. & Environ. Sci., 15 (4): 630-639, 2015
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2015.15.4.12603

Development and Evaluation of Jatropha Seeds Shelling Machine for Biofuel Production

[1]Abdelmutalab F. Kheiralla, [1,2]El-Kamil H. Tola, [3]Adil N. Korsha and [1]Abas Y. Eltigani

[1]Department of Agricultural Engineering, Faculty of Engineering,
University of Khartoum, Khartoum, Sudan
[2]Precision Agriculture Research Chair, King Saud University, Riyadh, Saudi Arabia
[3]Faculty of Engineering, University of Blue Nile, Damazin, Sudan

Abstract: *Jatropha curcas* L. has been propagated as a potential source for bio-fuel production in the wake of the world energy crisis. Before the oil extraction from Jatropha seeds, its shelling process is very important and essential. The lack of specialized technology and equipment hindered the development of Jatropha industry and production. This study presents the design, development and evaluation of a small scale Jatropha seeds shelling machine for bio-fuel production in rural areas. Engineering properties for both Jatropha seeds and kernel were studied and evaluated. The Jatropha seeds had average geometric mean diameter, sphericity, crushing force, length, width and thickness of 12.23 mm, 65.79%, 113.99 N.m, 18.59 mm, 11.36 mm and 8.67 mm, respectively. While Jatropha kernel had average length, width and thickness of 8.59 mm, 11.36 mm and 8.67mm, respectively. The developed machine consisted of hopper, frame, drum, fan, kernels and shells delivery. The machine was powered with a 1.0 hp motor and had an overall length of 1100 mm, a height of 1150 mm and a width of 450 mm. Results of the developed shelling machine showed mean values of cleaning efficiency, shelling capacity, shelling percentage and whole seed percentage of 97.05%, 141.78 kg h^{-1}, 46.33% and 48.76%, respectively; while, the shelling efficiency was 100%.

Key words: Biofuel · Jatropha seeds · Engineering properties · Shelling machine

INTRODUCTION

The world's population consumes more oil than any other single energy source. Rising prices, concerns about energy security and global warming impacts have sparked worldwide efforts to replace oil rapidly with alternative energy sources. In particular, Bio-diesel is renewable hydrocarbon energy source and a clean-burning fuel, currently produced from grease, vegetable oils, or animal fats. They can contribute negatively to the environmentally and friendly fuel, threat from exhaust emissions [1].

Bio-fuels developments progress can be classify into three generations. The first type is from the edible crops, like starch, sugar and vegetable oil, which face competition as foodstuff. The second type is from non-edible such as *Jatropha curcas* L and Castor seed, which are suitable for bio-fuels. The third type of bio-fuel is from micro algae. In poor countries, an ad-hoc basis is the rise in prices of vegetable oils; consequently led bio-fuel to be only made from non-edible vegetable oil [2].

Jatropha curcas L., commonly called physic nut or purging nut, is a draught-resistant plant belonging to the tribe Joannesieae in the family Euphorbiaceae. It is grown in many countries in the tropical and sub-tropical regions of the globe. The plant can be successfully cultivated both under irrigated and rain-fed conditions. It is a multi-purpose plant with all the parts being useful for a wide range of products as described by many researchers [3].

Mohammed [4] mentioned that freshly harvested Jatropha dried fruit contains about 35-40% shell and 60-65% seed (by weight). It has nearly 400-425 fruits per kg, 1580-1600 seed per kg weight and the weight of 100 seeds is about 63 g. Jatropha shells are available after de-shelling of the Jatropha fruit; while, Jatropha seed

Corresponding Author: ElKamil H. Tola, Precision Agriculture Research Chair, King Saud University, P.O. Box 2460 Riyadh, 11451, Saudi Arabia.