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Mechanization of Clay Pebble Making Process

J.L.A.S. Subhashini, Eng. P.R. Dadigamuwa and Mr. V.R. Jayasekara

Department of Mechanical engineering, Faculty of Engineering Technology
The Open University of Sri Lanka, Sri Lanka
subha.jayasekara@gmail.com

ABSTRACT

Clay pebbles form a substrate that can be used in organic farming and drainage, repotting anddecoration. Clay pebbles are great in retaining moisture. It is a great way to retain the water and keep plants hydrated along with any intent minerals or nutrients poured in there. It absorbs water and stores it inside for plants to take in as per their needs.

This project was focused on mechanizing the processes of soil cleaning, mixing, and rolling processes of the clay pebble making process which was done manually. Mixing ratios of soil, clay, cocopeat and water have been analyzed and found proper and suitable mixing volume of each raw material. Soil cleaning process was mechanized by using rotary screening machine. Suitable screw conveyors, mixing units and rolling units were selected by going through literature survey. All suitable design calculations were carried out and prototype model was designed. Prototype model is to be developed very soon.

The manual working process is carried out with 21 labourers and normal output is 2500 units per day. Target production after mechanization is 3300 - 3500 pieces per minute with less number of labourers.

Key words: Clay pebbles, mechanizing, mixing unit, rolling unit

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INTRODUCTION

Clay pebbles form a substrate that can be used in organic farming and drainage, repotting and decoration. Clay pebbles are extremely ornamental for all indoor plants and outdoor garden boxes and pots. It is 100% mineral content and approximate diameter is 1cm – 3cm. Using clay pebbles instead of soil will increase air circulation, protect the roots, and thus favour plant growth. Clay pebbles are one of the most popular substances when it comes to hydroponics [1].

Considering the latest world techniques and high demand of the product, the company has decided to use more technology to convert the manual operation to automated system. Therefore, objective of this project is to mechanize the clay pebble making process. Productionsteps of clay pebble making process are given in Fig. 1.

The manual working process is carried out with 21 labourers and normal output is 2500 units per day. Time consuming for each step is shown in Table-1.

Table -1 Time consuming for each process

Steps/Process	Time	No of labour	Man power hrs	Time consuming %
Removing stone and sand from soil	1hr	5	5	11%
Mixing	2.5hrs	6	15	33%
Rolling	2hr	3	6	13%
Burning	2hr	2	4	9%
Cooling	10hrs	1	10	21%
Packing	1.5hrs	4	6	13%
Total		21	46	100%

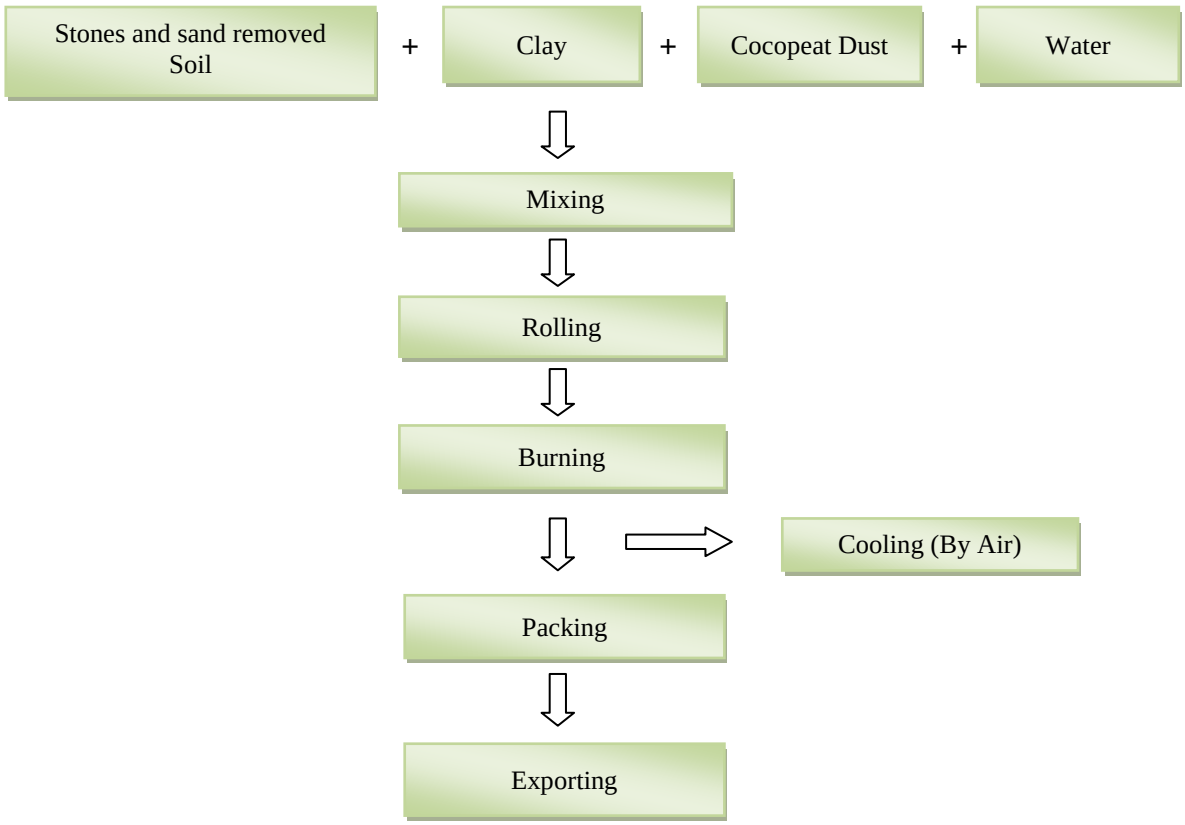

Fig. 1 Production steps of clay pebble making process

RATIONALE FOR STUDY

The company needs to improve working condition of the above highlighted processes by mechanizing. Then the customer expects to integrate the working processes, control (regular) size and shape of clay pebbles and finally to increase productivity.

After burning process, the cooling is done by air cooling as considerable time consumed, when comparing to other stages. But this process will be continued due to limited space and customer budget.

METHODOLOGY

Mixing ratio of soil, clay, cocopeat and water have been analyzed and found proper and suitable mixing volume of each raw material. Considering proper rolling tendency of clay pebbles and raw material availability, the mixing ratio of soil, clay and cocopeat was found as 2:1:1respectively. Raw material requirement per year was calculated targeting 3300 - 3500 pieces per minute as shown in Table-2.

Table -2 Raw Material Requirement

Raw Material Requirement – Per Month		
Soil (After removing stone and sand)	**Clay**	**Cocopeat**
57 m^3 – 60m^3	28.5m^3 – 30m^3	28.5m^3 – 30m^3

Production line andproposed mechanisms are given in Fig. 2 below.

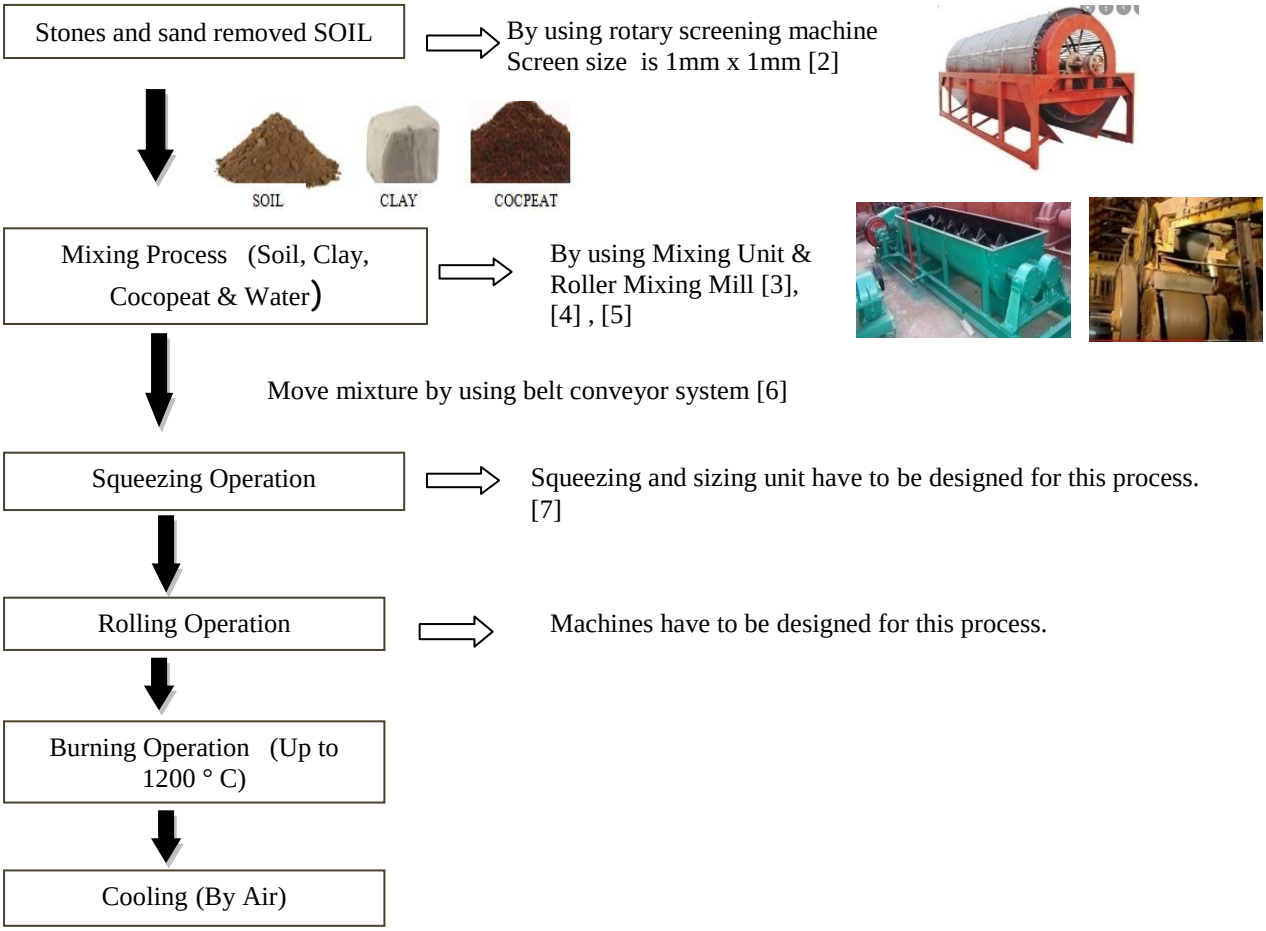

Fig. 2 Production Line and Proposed Mechanisms

Conceptual design of the mechanisms

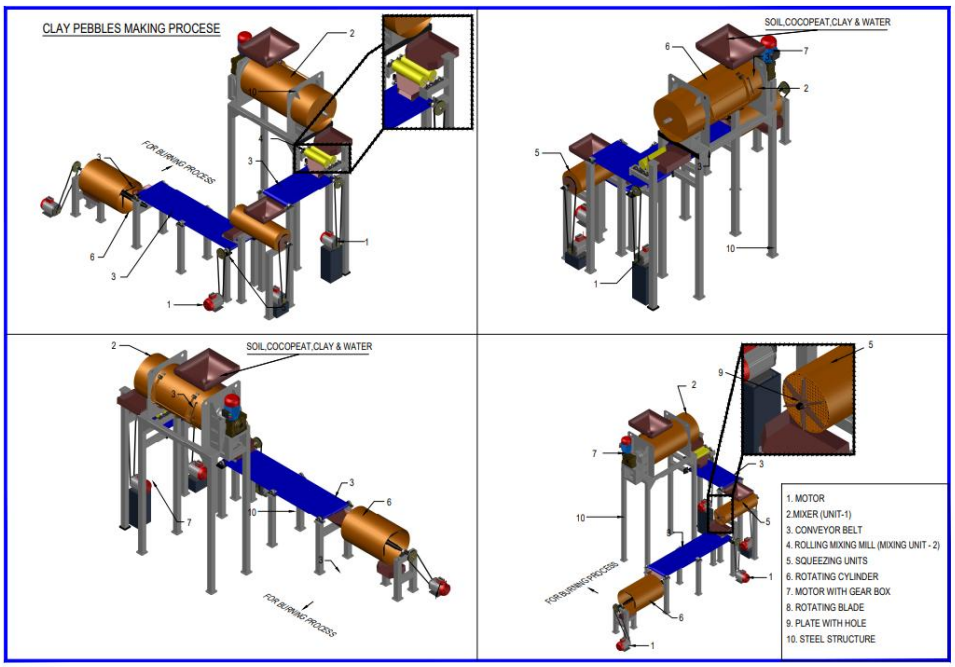

Fig. 3 Conceptual design of the mechanisms

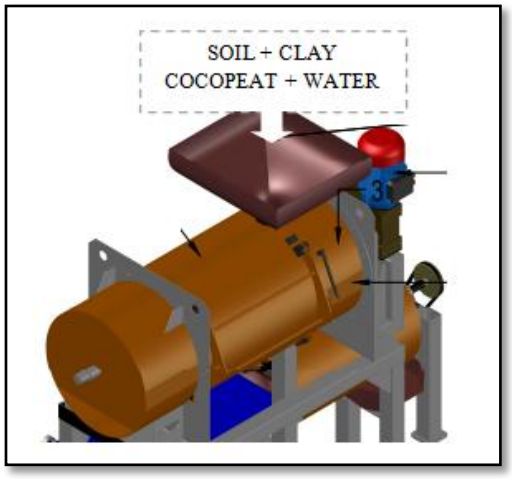

Fig. 4 Mixing Unit 1

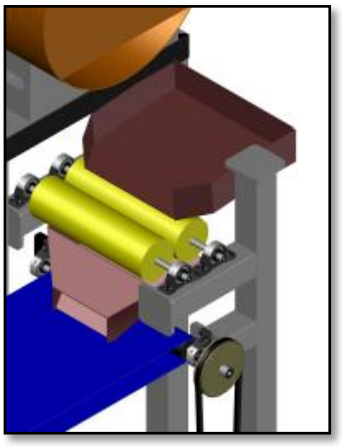

Fig. 5 Mixing Unit 2

First mixing process is done in mixing unit 1as shown in Fig. 4. Peddle screw conveyor system is used to mixed soil, clay, cocopeat and water and the mixture is mixed by 70%. Under second stage of mixing process, 100% mixing is done and the mixture particles will be broken down into less than 1mm and then they will be squeezed easy byusing two rollers which are rotated by motor with belt mechanismas shown in Fig. 5.

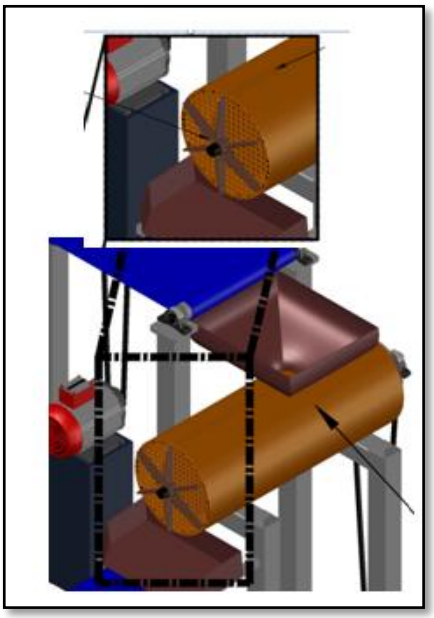

Fig. 6 Squeezing unit

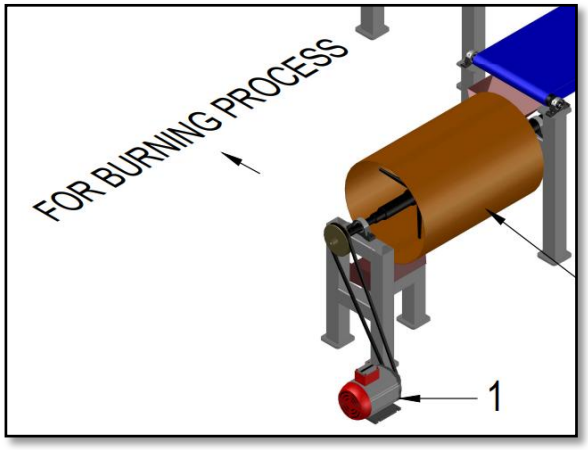

Fig. 7 Rolling Unit

The mixture is moved to the squeezing unit as shown in Fig. 6 by the conveyor, and it is squeezed through the holes drilled end plate of the cylinder and then it is cut in to strips by designed blades which are coupled to the rotating shaft. Clay strips are rolled in the rotating cylinder as shown in Fig. 7 and it is to be operated by motor mechanism. Finally rolled clay pebbles are moved to burning process. All design calculations are done, and prototype model to be developed.

DISCUSSION AND CONCLUSION

The mixing ratio of soil, clay and cocopeat was found as 2:1:1 respectively. Considering the literature survey, Paddle screw conveyor was selected to mix and convey bulk materials and secondly roller mixing mill was selected for mixing process stage 2 [4]. This is a proper mixing operation for clay related material.Final mixture can be obtained with fine particles, so it is easy for squeezing operation andeasy to handle the pebble making process.

As shown in conceptual design in Fig.3, all units of mixing, squeezing and rolling unit calculations were done [7]. Conveyor belt calculations and the speeds of motors and conveyors were done [6]. Prototype model will be developed as soon as possible.

The manual working process is carried out with 21 labourers and normal output is 2500 units per day. Target production after mechanization is 3300 - 3500 pieces per minute with fewnumbers of labourers.

Acknowledgement
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