Effectiveness of Cotton Spinning Machines for Yarn Craftsmen

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Abstract. A cotton spinner is a tool used to spin cotton fibers into stronger threads and can be used for various purposes, such as making clothes and fabrics. A traditional cotton gin usually consists of several components, such as a spinning wheel, a spinning table, and a human hand or foot mover. However, nowadays cotton spinning tools have also been developed that use machines, such as electric motors or DC motors, which allow cotton spinning to be faster and more efficient. These modern cotton spinners usually have a spin speed setting feature that can be adjusted according to the user's needs and desires. The purpose of this research is to get effectiveness in saving time in order to produce the maximum quantity.
The fixed variable in this study is the rotation (RPM) of the spinning wheel, while the independent variables are quantity in terms of weight and effectiveness in terms of processing time. The speed variable (RPM) is set at 50 RPM, 100 RPM, 150 RPM, 200 RPM and 250 RPM. Analysis using descriptive method. the test results can be generalized where H_1 or the test results correspond to H_0. The effectiveness of the spinning process in terms of weight is 97.31% and in terms of spinning process time is 78.06%. Tools can function according to the needs of farmers

Keyword: spinners, cotton, yarn, effectiveness.

1 INTRODUCTION

Cotton plants are thought to originate from Asia, Africa, Australia and America. Cotton plants have long been known and cultivated since prehistoric times as evidenced by the cultivation of this plant in the Indian region more than 5000 years ago [1]. The cotton plant is becoming increasingly known and growing in China and areas around the Mediterranean. Intensive and continuous development of cotton plants is still being carried out, especially on several continents such as America and Australia. Cotton is a sub-tropical plant that can grow well in tropical areas [2]. Cotton imported into Indonesia has spread to various regions and adapted to climate and soil conditions as well as planting procedures in those areas. Cotton plants have been developed since the

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Dutch colonial era [3]. Cotton is still maintained as one of the country's mainstay commodities until now, although it has been abandoned by many farmers because prices tend to be low and uncompetitive in the global market. The policy of increasing cotton fiber import tariffs has not been able to increase cotton fiber production, especially in accordance with the cotton fiber production target set by the Ministry of Agriculture of 63 thousand tons in 2014. However, this policy still has a positive impact on increasing the welfare of cotton fiber farmers in Indonesia. domestic. The combination of import tariff policies with the expansion of cotton plantations has a positive impact on increasing domestic cotton fiber production, although the impact is relatively small on the welfare of cotton fiber farmers compared to other policies in the future. This combination of policies is important in order to anticipate the current trend to reduce the imposition of import tariffs and at the same time encourage Indonesia's independence to produce cotton fiber domestically. The trend of rising world prices for cotton fiber has had the biggest positive impact on the welfare of cotton fiber farmers, even without implementing a policy of import tariffs on cotton fiber. The world price of cotton fiber is a positive signal and incentive for farmers to increase their production [4]. Research results from the Center for Soil and Agro-climate Research provide recommendations for potential land for the development of cotton fiber plants that are still available in an area of 1.30 million hectares spread across Central Java, the Special Region of Yogyakarta, East Java, Bali, West Nusa Tenggara, East Nusa Tenggara and Sulawesi. South [5].

Spinning tools originated from the human need for clothing and textiles. This tool arranges the cotton fibers parallel and regularly so that they can become long threads. The simplest spinning tool is a cotton spinning wheel, or "spinning wheel". During the Industrial Revolution, spinning machines were discovered that used steam power, which could spin in large quantities and quickly, for example the "Spinning Jenny" which was invented in 1764 by James Hargreaves. Since ancient times, humans have used various natural materials such as leaves, hemp, and feathers to make clothes. However, with the development of technology, humans began to look for ways to make thread more quickly and efficiently. Basically, the process of spinning yarn is to create continuous and fixed strands of fibers with a predetermined diameter and twist. First, the fiber undergoes a mixing, opening and cleaning process in a blowing machine, and will produce a lap roll. Yarn spinning tools began to be developed as a solution to make yarn quickly and easily. Along with technological developments, yarn spinning machines are becoming more sophisticated and can be used to make yarn from various materials, such as natural and synthetic fibers. Today thread spinning machines are used in the textile industry and also in handicraft activities.

The process of making yarn can vary depending on the type of material used, but generally involves several stages, namely sorting the material, washing, drying, dampening, smoothing, splicing, spinning, re-sorting, and finally, storage. The yarn that is ready for use is then stored in good condition and safe for use in the textile production process[6].

In an increasingly modern era, many cotton farmers still use traditional spinning equipment. Therefore, a problem arises that is less effective in saving time, the use of traditional spinning equipment requires quite a lot of time and effort which results in ineffective time saving if a large amount of production is needed.

2 Research Methods

2.1 Design

Abang District is one of the areas in Karangasem district. This sub-district stretches on the east side of the district with areas covering hills and beaches. The north side of the sub-district is the slope of Mount Agung. The characteristics of this area are land of former volcanic eruptions and is dominated by dry land. The Regent of Karangasem has a special policy for this area. The regent's optimism in efforts to improve the standard of living of his people was manifested by the appointment of Karangasem as a center for cotton farming. Seeing the geographical conditions of the region, cotton plants are very suitable for cultivation in this region. The cotton planting center is centered in Datah Village. The Datah, Tulamben and East Seraya Village areas have potential and the agro-climate or climate, weather, soil, altitude is suitable for growing cotton or developing cotton. Joint Cotton Planting Movement simultaneously with 3 (three) farmer groups on land belonging to the Merta Sari Bulakan Farmer Group, Banjar Dinas Tegallanglangan, Datah Village, Abang District as proof of the realization of the district program [7]. Agri Kanesia type cotton seeds were planted by the Merta Sari Bulakan Farmers group on 5 Ha of land, the Adi Merta Farmers Group on 5 Ha of land and the Pula Sari Farmers group on 5 Ha of land.

Farmers, especially in Langlangan Hamlet, still use conventional tools as in Figure 1. These tools are moved by hand to rotate a disc connected to a spinningshaft. The use of this hand will certainly affect the quantity of results because it still uses human power. Rotation stability also affects the quantity where over time the operator will experience fatigue.

Fig 1. Traditional spinners.

2.2 Research Instrument

The cotton spinner will be implemented using the same operator. Alternating dc motor driven spinning device with low power and rotation. DC motors are electric motors that require a direct current supply to the field coil to be converted into mechanical motion energy[8]. The field coil in a dc motor is called the stator (the non-rotating part) and the armature coil is called the rotor (the rotating part). Direct current motors, as the name suggests, use direct unidirectional current. DC motor is an electronic device that converts electrical energy into mechanical energy in the form of rotational motion. In DC motors there is an armature with one or more separate coils. Each coil ends in a split ring (commutator). With an insulator between the commutators, the split ring can act as a double pole switch (double pole, double throw switch). DC motors work on the principle of the Lorentz force, which states that when a current-carrying conductor is placed in a magnetic field, a force is created between the two directions. magnetic field and direction of current flow [8]. Low power so that it can be applied to PLN electricity sources for households. Low rotation due to spinning requirements is required with a small RPM [9]. The resulting yarn is a Tukelan type. Tukelan thread is a type of coarse thread made from cotton with a simple spinning method. The need for this type of yarn in Bali is very high because it is closely related to traditional and religious ceremonies related to religious principles. Tukelan thread on the daksina symbol of the dragon in the process of playing the Mandara Giri to seek Tirta Amertha as a tool/media liaison between the worshiper and the worshiped[10].

1. Speed control
2. Reverse switch
3. Swicth on
4. Swicth off
5. Plate
6. DC motor
7. Gear box
8. Bearing
9. Frame
10. Spinner wood

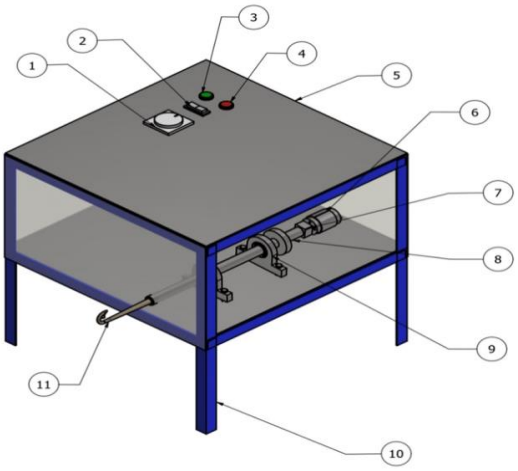

Fig 2. Spinning tool design.

The working principle of a thread spinning machine utilizes the rotating force of a DC motor to spin the spinning wood. Rotary force is a force that moves rotationally about its axis[11]. The rotation is obtained from a DC motor which is directly connected to the spinning shaft. This tool consists of several main parts, such as spinning wood, DC motor, stepped shaft, bearings, and control system. The clean cotton fibers are placed on the spinning table and gathered together to form yarn. This process is carried out repeatedly until the desired thread is formed. The DC motor will rotate constantly and stably, so that the results obtained are faster and more consistent compared to conventional yarn spinning machines. The control system allows the rotation speed of the spinning wood to be regulated, making it easier for craftsmen to achieve the desired thread thickness and quality.

The fixed variable in this research is the rotation (RPM) of the spinning machine, while the independent variable is quantity seen from the amount of weight and effectiveness seen from the processing time. Variable rotation (RPM) is set at 50 RPM, 100 RPM, 150 RPM, 200 RPM and 250 RPM.

Analysis is using descriptive method. Descriptive analysis is a form of research data analysis to test the generalization of research results based on one sample [12]. This descriptive analysis was carried out by testing the descriptive hypothesis. The result of the analysis is whether the research hypothesis can be generalized or not. If the null hypothesis (H0) is accepted, it means that the research results can be generalized. This descriptive analysis uses one or more variables but is independent, therefore this analysis does not take the form of a comparison or relationship. H0 of this study is an increase in productivity with an increase in the quantity of product yields. Calculating the increase in productivity is done by comparing the use of conventional tools [13]. Calculated based on weight and production time.

The word effective comes from English, namely effective which means successful or something that is done successfully[14]. Effectiveness can be viewed as a cause of other variables. Effectiveness means that previously planned goals can be achieved or in other words targets are achieved because of the activity process. The word effectiveness cannot be confused with efficiency, because both have different meanings, even though in various uses the word efficiency is closely related to the word effectiveness. Efficiency implies a comparison between costs and results, while effectiveness is directly related to achieving goals. The Popular Scientific Dictionary defines effectiveness as the accuracy of use, effectiveness or support for goals. Effectiveness is one dimension of productivity, which leads to achieving maximum performance, namely achieving targets related to quality [15].

3 Results

3.1 Calculation

Calculations are made so that the tools are made according to the needs and work safely. Calculations are made on the power requirements of the motor used and the diameter of the shaft made.

The motor power is calculated by plotting the design power.

$$P = F \times fc \tag{1}$$

$$F = m \times g$$

$$F = 1\ kg \times 9{,}8\ m/s^2 \tag{2}$$

$$F = 9{,}8\ kgm/s^2$$

The correction factor used to ensure the motor in a safe condition is 1,2.

$$P = 9{,}8\ kgm/s^2 \times 1{,}2(2)$$

$$P = 11{,}76\ N = 0{,}016\ Hp$$

The torque that occurs on the shaft is :

$$T = \frac{P}{n} \tag{3}$$

$$T = \frac{11,76\ kgm/s^2}{250}$$

$$T = 0{,}047\ kgm$$

The allowable tensile stress and allowable shear stress of the ST37 material are:

$$\tau_t = 640{,}8\ \frac{N}{m^2}$$

$$\tau_g = 566{,}02\ \frac{N}{m^2}$$

ST37 flexure correction factor (Cs) = 2
ST37 shock correction factor (Kt) = 1.5
The shear stress that occurs in the shaft is :

$$\tau_g = \frac{640{,}8\ N/m^2}{6 \times 2}$$

$$\tau_g = 53{,}4\ N/m^2$$

Then the shaft diameter can be calculated by :

$$d = \sqrt[3]{\left(\frac{\tau_t}{\tau_g}\right) \times Cs \times Kt \times T} \tag{4}$$

$$d = \sqrt[3]{\left(\frac{640{,}8}{53{,}4}\right) \times 2 \times 1{,}5 \times 0{,}047}$$

$$d = 0.018\ cm$$

The spindle diameter obtained is very small because the spinning load for cotton is very light. To spin yarn you only need a load of 1 kg.

The test was carried out by comparing the spinning process between using traditional tools and tools that already use a motor drive and are equipped with rotation

control. The traditional spinning process is carried out by the operator by turning a wheel connected to a rope to the thread spinning axle. The playback process is carried out using the right hand in a hanging position. This process takes a long time with the rotation back and forth as needed to spin and wind the thread causing unstable spinning. The operator's left hand is in the position to control the direction of the cotton being spun.

The spinning process using a motor-driven spinning machine is carried out by adjusting the rotation on the speed control as needed. Reversible rotation is carried out by pressing the rotation reversing switch. The right hand is placed in a comfortable working position such as a work desk to eliminate fatigue. The left hand is in the position to direct the cotton to the spinning place.

Fig 3. Spinning tool driven by a DC motor.

The test was carried out 20 times to obtain the required data. Each test is carried out by operators from farmers so that it can be measured and assumed to be the same in spinning skills.

3.2 Weight Testing

Spinning is done without using tools and using tools that are made. The spinning process time is set at 10 minutes for each process. The test results data can be seen in figure 4.

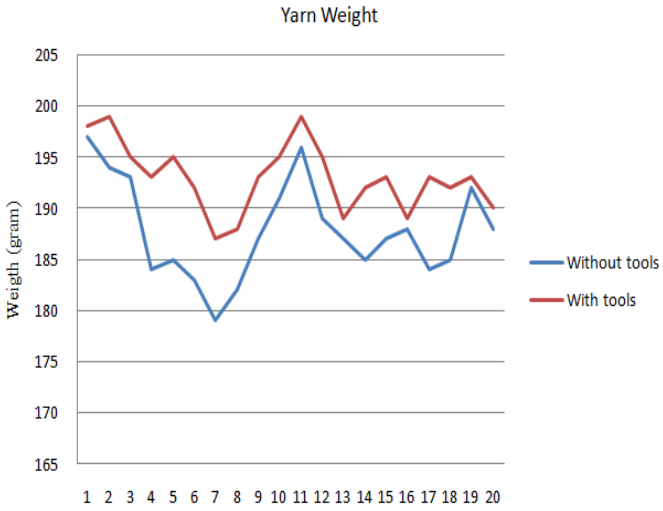

Fig 4. Weight test results.

There was a severe instability of the results obtained from each test. This is caused by the operators are still not used to the use of the tools provided. Need adjustments to the tool and require a relatively long time. The difference is quite clear can be described. There was a significant increase in the amount of spinning results from the process without tools compared to the process with tools. This is because the process is carried out without the use of human power to rotate the spinner. The fatigue factor that affects the stability of the spinner speed is very influential [16]. The operator only moves the spin select switch to carry out the spinning process. Stable rotation of the tool is very influential on the results. The rotation has been set according to the needs. The average weight resulting from the spinning process with traditional tools is 187.80 grams while with a DC motor driven tool it is 193.00 grams.

The spinning tool tested was able to provide an effective increase in the number of results by 97.31% compared to the traditional spinning tool used.

3.3 *C. Testing Against Time.*

The test is carried out by determining the weight of the clean cotton to be spun. The spinning process was compared between using traditional tools and DC motor driven tools. Test results data can be seen in figure 5.

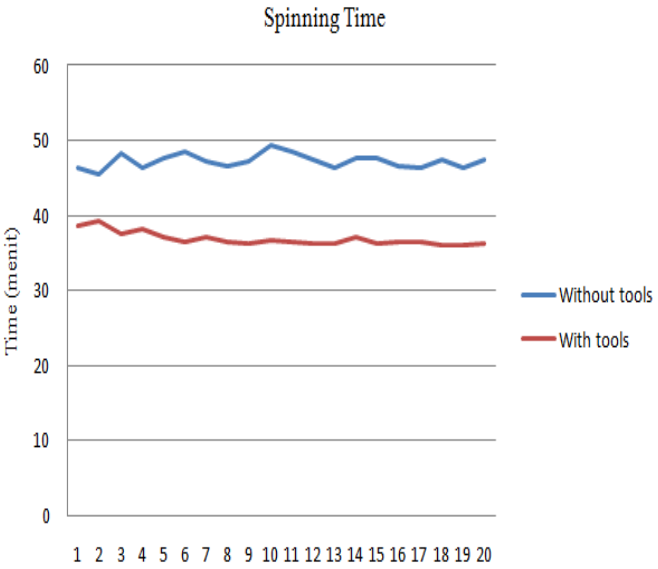

Fig 5. Time testing results.

The fatigue factor of operators who operate traditional tools by rotating the wheels is very influential in the spinning process. To spin cotton with a certain amount of weight in each process, it takes a relatively long time compared to using a DC motor driven spinning machine. The average time needed to spin yarn with traditional tools is 47.24 minutes, while using a DC motor driven tool it takes 36.87 minutes. The effectiveness of the spinning process time is 78.06% of the spinning process with traditional tools compared to tools driven by DC motors.

4 Conclusion

The results of comparative testing between the spinning process using traditional tools and tools driven by DC motors can be concluded that the test results can be generalized where H1 or the test results correspond to H0. The effectiveness of the spinning process in terms of weight is 97.31% and in terms of spinning process time is 78.06%. Tools can function according to the needs of farmers.

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