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Ergonomic analysis of modified sweet potato washing machine

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A B S T R A CT

Sweet potato is included in the type of palawija plant. Sweet potato (Ipomoea batatas L.) is a source of carbohydrates and sweet potato is widely consumed as a staple food to replace rice. Cilembu Village, Pamulihan District, Sumedang Regency is a center for the production of Cilembu sweet potato which has been exported to several countries. Cilembu sweet potato production, especially in the washing process of Cilembu sweet potato, can reach 30 kg/hour. However, the washing process is still done manually in a sitting and bowing position. In order to increase the cleaning capacity of Cilembu sweet potato, a Cilembu sweet potato washing machine was made. The machine has been modified, but the machine that has been modified needs to be analyzed for its ergonomic feasibility. The purpose of this study was to perform an ergonomics analysis on a modified Cilembu sweet potato washing machine to make it suitable for mass marketing. The method used in this study is a descriptive analysis research method, namely measuring, observing and calculating the modified sweet potato washing machine and then analyzing the data so as to obtain machine ergonomics feasibility data. The results showed that the analysis of anthropometric data on machine height was appropriate because the machine height did not exceed the calculated value of the 2.5th percentile, but for machine width there was still a difference between the machine width and the operator's shoulder width because the machine width was smaller than the shoulder width. 50th percentile. The results of the analysis of work postures using the REBA method found 3 postures with a moderate risk level of safety, 2 postures with a high level of security and 1 with a negligible level of safety. On noise and vibration measurements it was found that the machine could only be operated for 3 hours in one day.

1. Introduction

Sweet potato (*Ipomoea batatas L.*) or known as sweet potato is a dicot plant belonging to the family*Convol-vulaceae* and is a plant that belongs to the type of palawija plant [1]. West Java Province is one of the sweet potato production centers in Indonesia with an average total production from 1993-2015 reaching 415,151 tons/year or 20.73% of the average total production in 1993-2015 of Indonesian sweet potatoes [2]. The following is a picture of sweet potatoes in Figure 1.

Figure 1. Sweet potato

Sweet potato is the most widely cultivated food crop group as an agricultural commodity sourced from carbohydrates after wheat, rice, corn and cassava. The main reason many people cultivate is because this plant is relatively easy to grow, resistant to pests and diseases and has a fairly high productivity. Sweet potatoes are also a good food ingredient, because their starch has a very rich nutritional content, including high carbohydrates. Therefore, in some areas, sweet potato is also used as a staple food. It also contains protein, vitamin C and is rich in vitamin A (*beta carotene*) [3]. The handling process in the form of grains (*cereal/grain*), cassava and legumes which generally can last longer in storage, aiming to maintain the commodities that have been harvested in good condition and are fit and still good for consumption. Handling that can be done in the form of shelling/threshing, stripping, cleaning, drying (*curing/drying*), packaging, storage, prevention, attack of pests and diseases [4].

The process of washing sweet potatoes in Pamulihan District, Cilembu Village is currently still being carried out

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manually, namely washing by washing the sweet potatoes one by one by hand. The process of cleaning cassava in this way requires a relatively long time, namely 30 kg/hour and requires 4 workers who are carried out in a sitting position with the body position and head bent over a long period of time. So that the washing process is not effective. Currently there is a sweet potato washing machine and modifications have been made. However, after modifying the machine, an ergonomic feasibility analysis has not been carried out yet. It is hoped that from the ergonomic feasibility analysis of the modified sweet potato washing machine this can reduce injuries when working with the machine.

2. Research methods

This study used a descriptive analysis research method, namely measuring, observing and calculating the modified sweet potato washing machine and then analyzing the data so as to obtain the ergonomic feasibility data of the machine.

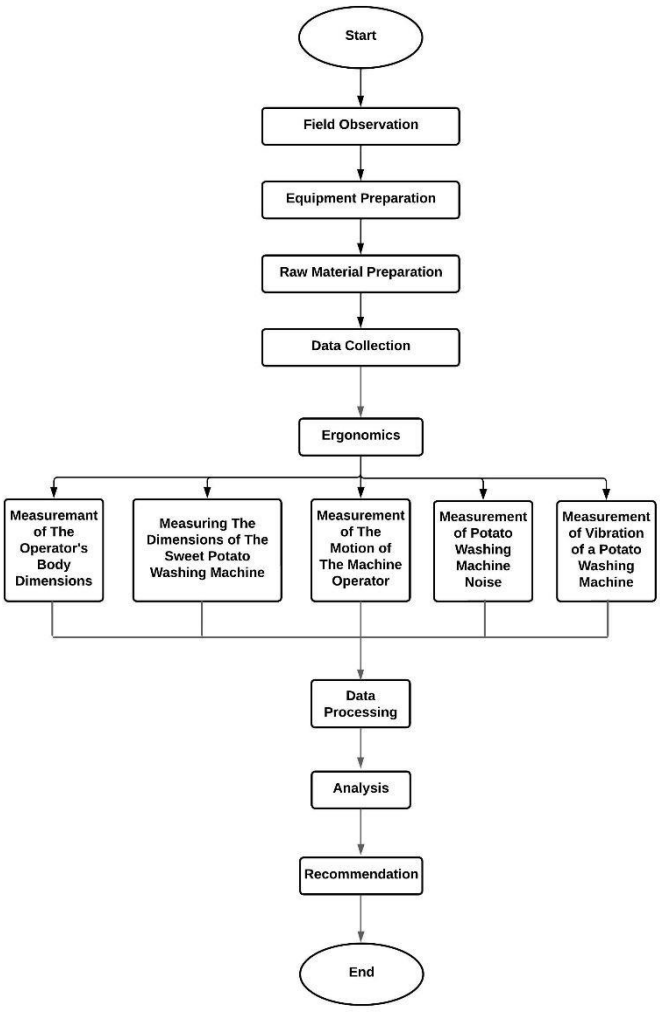

Figure 2. Ergonomic Analysis Research Stages Flowchart

An explanation of the research stages in Figure 3 is as follows:

1. Field observation

Field observations in the form of surveys and conducting interviews with local companies in Cilembu Village, Pamulihan District, Sumedang Regency, West Java Province regarding the research to be carried out.

2. Equipment Preparation

Prepare tools such as tape measure, ruler,*stopwatch*, scales, cameras, tripods,*sound level meter* and*vbration meter* which will be used in ergonomic analysis activities, and ensure that these tools can function properly.

3. Raw Material Preparation

Preparing raw materials to be used in ergonomic analysis activities in the form of measuring the initial weight of sweet potatoes.

4. Data collection

Data collection for ergonomics analysis in the form of; measurement of the operator's body dimensions using the anthropometric method, measurement of the dimensions of the modified sweet potato washing machine, recording of the machine operator's work movements, measurement of machine noise and also measurement of machine vibration.

5. Data processing

Processing the collected data is processed by adjusting the format or tidying up the data by copying it in Microsoft Word format to facilitate the analysis process.

6. Analysis

Perform analysis of the data that has been done. Ergonomic analysis in the form of analyzing anthropometric data, biomechanical analysis of noise analysis and vibration analysis. The anthropometric data that has been processed is then analyzed for percentile values where in this study the 5th, 50th, and 95th percentiles are used. The results of the analysis are grouping percentile data. Biomechanical analysis using the REBA method. The operator's motion video data which is converted into a photo format is analyzed by measuring the angle between the worker's limbs when operating the machine using assistance*software AutoCAD*. Generated data*software* is the value of risk in work. Noise and vibration analysis by comparing the values obtained from noise and vibration measurements with the permitted threshold values.

7. Recommendation

The results obtained from this study will be summarized into a recommendation whether the machine is suitable for mass marketing or the machine needs to be modified so that the machine's performance increases.

3. Results and Discussion

3.1. Machine Altitude Anthropometric Data Analysis

Anthropometric data used to adjust the dimensions of the modified Cilembu sweet potato washing machine with the operator's body dimensions are static anthropometric data. The static anthropometric data includes shoulder height in an upright position and shoulder width (can be measured while standing or sitting). The anthropometric data used is secondary anthropometric data of the Indonesian people obtained from the Regulation of the Minister of Health of the Republic of Indonesia, Number 48 of 2016, Concerning Office Occupational Safety and Health Standards. Anthropometric data for body dimensions for shoulder height in an upright position and shoulder width can be seen in Table 1.

Table 1
Anthropometric Data of Shoulder Height and Shoulder Width (units in cm)

No.	Parameter	5th percentile	50th Percentile	95th percentile	SD
1.	Shoulder height	119,03	137,1	155,16	10,98
2.	Shoulder width	32,97	41,88	50,79	5,42

Static anthropometric data in Table 1. The dimensions of shoulder height for the 5th percentile, 50th percentile (mean value) and 95th percentile are 119.03 cm, 137.1 cm and 155.16 respectively cm with a standard deviation value (*standard deviation*) of 10.98 cm. . In anthropometry, the 95-th size will describe the "largest" human size and the 5-th percentile, on the other hand, will show the "smallest" size [5]. The height of the modified Cilembu sweet potato washing machine is 85 cm measured from the wheel of the modified Cilembu sweet potato washing machine to the top of the washing container.

Based on the literature, if you want dimensions to accommodate 95% of the population, 2.5 and 97.5 percentile are the limits of space that can be used [6]. Analysis of adjustment of anthropometric data for shoulder height to machine height uses data from the 2.5th percentile so that operators who have shoulder height below or equal to the 2.5th percentile can operate the modified sweet potato washing machine. The 2.5th percentile value can be calculated using the 2.5th percentile equation and it is necessary to use data from the 50th percentile value (mean) as well as the standard deviation value (*standard deviation*).

The height of the modified Cilembu potato washing machine is 85 cm while the results of calculating the anthropometric data for the 2.5th percentile shoulder height are 115.57 cm. From the data on the machine height and the 2.5th percentile shoulder height, there is a difference of 30.57 cm. The difference shows that the modified Cilembu sweet potato washing machine is lower than the anthropometric data of shoulder height. It can be concluded that the modified Cilembu sweet potato washing machine can be used by most Indonesian people, both women and men.

3.2. *Anthropometric Data Analysis for Machine Height*

Shoulder width anthropometric data is used to adjust the position of the arm so that the working attitude when moving the machine operator feels comfortable. The operator's working attitude when moving the modified Cilembu sweet potato washing machine can be seen in Figure 3. The position of the operator's arm when moving the machine is on the side of the machine frame, this position makes it easy for the operator to move the machine because if the operator's arm is in the tub of the sweet potato washer it can cause the machine to overturned because the load point when pushing the machine is above. The width of the arm when moving the machine should also not be too wide because it can make the operator feel uncomfortable and when moving the machine the load feels heavier.

Figure 3. Posture When Moving the Modified Cilembu Sweet Potato Washing Machine

Static anthropometric values of shoulder width for the 5th percentile, 50th percentile (mean value) and 95th percentile in Table 16 are 32.97 cm, 41.88 cm, 50.79 cm respectively with a deviation value default (*standard deviation*) of 5.42 cm. Meanwhile, the width of the modified Cilembu sweet potato washing machine is 40 cm. The analysis of the adjustment of the anthropometric data of the shoulder width to the width of the modified Cilembu sweet potato washing machine will use the 50th percentile shoulder width anthropometric data because it is an average value. The 50th percentile shoulder width anthropometric value is 41.88 cm. It can be compared with the width value of the modified Sweet Potato Washing machine with the anthropometric value of the 50th percentile shoulder width which has a difference of 1.88 cm.

This difference indicates that the width of the modified Cilembu sweet potato washing machine does not match the anthropometric data of shoulder width. In order for the machine to adapt to the operator's shoulder width, it is necessary to modify or repair the machine. One of the improvements that can be made is to add a handle to the machine in the form of a handle bar that extends from the right side to the left side of the machine. The handle bar makes it easier for the operator to place his hand when he wants to move the machine. The handle bars are made to be measured to the 95th percentile so that operators with a large or small shoulder width can adjust the arm position to be comfortable when moving the machine.

3.3. *Analisis Metode REBA (Rapid Entire Body Assessment)*

When operating a modified Cilembu sweet potato washing machine, there are many movements made by the operator, this needs to be considered for comfort and safety to reduce the risk of work accidents. Biomechanical measurements were carried out by observing the movement of the operator when operating the Cilembu sweet potato washing machine. Observations were made when lifting dirty Cilembu sweet potatoes, when putting dirty Cilembu sweet potatoes into the washing container, position when opening the water tap, position when opening the exit door for washed Cilembu sweet potatoes and position when lifting clean Cilembu sweet potatoes for storage. The results of these observations will be processed using*software*

Ergofellow so that the results obtained in the form of classifying the category of security level.

When operating the Cilembu Sweet Potato washing machine, all members of the body feel the impact when doing work. The position of the operator who is standing, the position of the head that sees the object in front of him when carrying the load, the position of the hands that lifts the weight of the material, the position of the waist that adjusts the position of the body and the position of the feet that supports the body.

3.3.1. *Evaluation of Working Posture for the Position of Lifting Dirty Sweet Potatoes*

The working attitude when lifting dirty Cilembu sweet potato is the initial position when operating a modified Cilembu sweet potato washing machine. You can see the attitude of the operator when they want to lift a container containing dirty sweet potatoes in Figure 4. The attitude of the work done is in a bent body condition. In this movement the hands function to lift the weight, the back follows the movement of the body and the legs hold the weight.

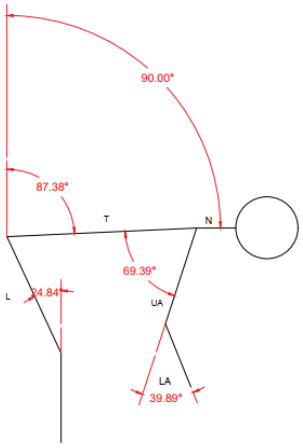

Figure 4. Mannequins When Lifting Sweet Potatoes

Figure 4 shows the movement of the operator when he bends over to pick up a container containing dirty sweet potatoes which will be lifted and put into the washing container. The operator is in a bent posture at an angle of 87.38°. The position of the hand is lifting the weight with the angle between the upper arm and the body is 69.39°, while the forearm and upper arm form an angle of 39.89°. The load lifted is 10 kg. The angle and load will be entered into*software Ergofellow* and processed using the REBA method. The data is processed using*software Ergofellow* will produce a safety level value from the work posture carried out and this value is used to consider the modified Cilembu sweet potato washing machine is safe or not for use. Parameters tested using*software Ergofellow* can be seen in Figure 5.

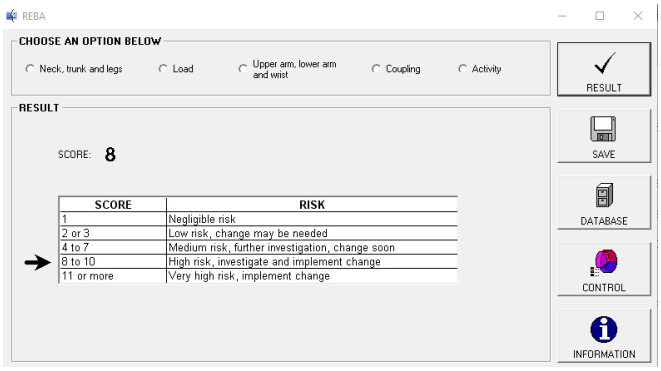

Figure 5.REBA Security Observation Results of the Yam Lifting Movement

The results obtained from biomechanical analysis using the REBA method show that the movement when bending down to pick up Cilembu Sweet Potatoes has a safety value of 8. A value of 8 in safety testing using the REBA method means that it has a high level of security risk so it is necessary to carry out an investigation and implementation in the form of changes in work posture and environment work [7]. Improvement in working posture when lifting dirty Cilembu sweet potato can be done by making a storage table next to the machine for dirty Cilembu sweet potato at approximately the hip height of the average anthropometric population of Indonesia. This can improve the working posture which was initially bent by 87.38° to become more upright so that the operator will not experience back pain.

3.3.2. *Evaluation of Work Posture for Inserting Dirty Sweet Potatoes*

Body posture when putting Dirty Cilembu Sweet Potatoes into the washing container. The movement of the hand is to put the dirty Cilembu sweet potato into the washing container, with an upright posture, head slightly bent to watch the dirty Cilembu sweet potato enter and the feet support the operator's body weight as well.

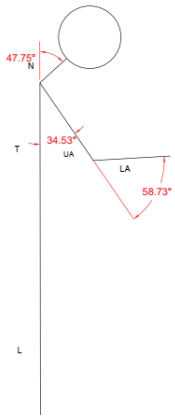

Figure 6. Mannequins When the Movement of Inserting Dirty Cilembu Sweet Potatoes

Figure 6 shows the first movement when putting dirty Cilembu Sweet Potatoes into the washing machine. Posture when carrying out these activities, the posture of the body is

standing straight with the thighs and calves forming an angle of 0°. The angle formed is also 0° because the back is in an upright position. The position of the raised hand while lifting the weight with the angle formed between the upper arm to the body is 34.53°, while the lower arm to the upper arm forms an angle of 58.73°. When doing this posture, the head is also bent down to see the fall of the sweet potato into the washing container and forms an angle of 47.75°. The load lifted when carrying out these activities is 10 kg. The angles and loads obtained are then processed using the REBA method by inputting them inside*software Ergofellow*. From*software* From this, the value of the security level is obtained from the work posture carried out, this value becomes one of the safety considerations for the machine to be used. Result of*software* This can be seen in Figure 7.

Figure 7. REBA Security Observation Results of the Movement to Enter Dirty Cilembu Sweet Potatoes

The results obtained from biomechanical analysis using the REBA method show that movement when inserting dirty Cilembu Sweet Potatoes has a safety value of 4. A value of 4 in safety testing using the REBA method means that it has a moderate level of security so it is necessary to carry out further investigations and change work posture as soon as possible. 7]. These results can be caused by the operator being in a static position by lifting a load that is heavy enough to cause soreness in the hands. One of the improvements that can be made is by adding the Cilembu sweet potato little by little so that the operator does not feel any pain in his hands due to lifting too heavy a load.

3.3.3. *Evaluation of Working Posture for Opening the Water Faucet Position*

The body posture when opening the water faucet is the movement made by the hands, turning the faucet lid, with an upright posture, the head is slightly bent to see the water coming out and to see the limit of the water that has filled the washing container. This posture can be seen in Figure 8.

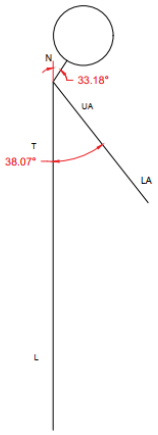

Figure 8. Mannequin When Movement Opens Water Faucet

Figure 8 shows the posture when the operator makes the movement to open the water tap. The work attitude carried out by the operator is the body standing upright with the thighs and calves forming an angle of 0°. A straight back posture forms the same angle as the feet, which forms an angle of 0°. The position of the arm when opening the water faucet is raised with an angle between the arm and the body of 38.07°. When this posture the head is also slightly bowed to form an angle of 33.18. The angle formed from the working attitude of opening the water tap is processed using the REBA method by inputting it to*software Ergofellow* which produces a safety level value that is used to consider whether the machine is safe to operate or not. Result of*software Ergofellow* can be seen in Figure 9.

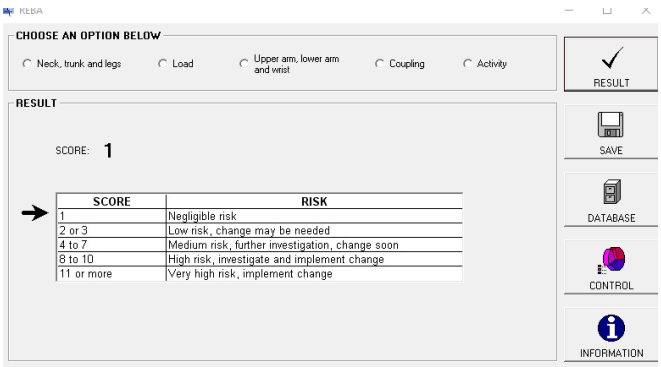

Figure 9.REBA Security Observation Results Movement of Opening Water Faucets

REBA security observation results using*software Ergofellow* for the working attitude of opening the water tap, the value shown in Picture 26 shows a value of one. Based on*software Ergofellow* a value of one means that the risk is ignored. If the risk is ignored, there is no need for improvement for the work attitude [7].

3.3.4. *Evaluation of Work Posture to Open the Door for Exiting Washed Sweet Potatoes*

The working attitude when opening the exit door for Cilembu sweet potatoes that have been washed can be seen in Figure 10. The work attitude is in a bent body condition. In this

movement the hands function to lift the weight, the back follows the movement of the body and the legs hold the weight.

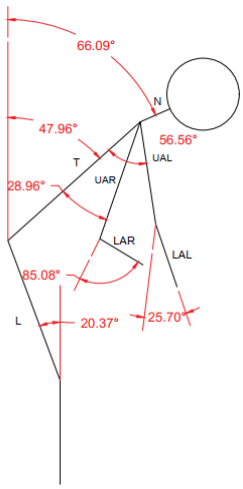

Figure 10. The Mannequin When the Movement Opens the Door for Cilembu Sweet Potatoes that have been Washed out

In Figure 10 it is explained that the movement when opening the door leaves Cilembu sweet potatoes that have been washed. The operator's working attitude when carrying out this movement bends the back to form an angle of 47.96° and the head is slightly bent more than the back. The angle formed by the head is 66.09°. When this movement is also the hand raised while lifting the weight. The angle formed for the upper right hand to the body is 28.96° and for the angle formed in the lower right hand to the upper arm is 85.08°. On the upper left hand to the body an angle of 56.56° is formed and on the forearm to the upper arm it forms an angle of 25.70°. The position of the foot in this work attitude forms on the thigh forming an angle of 20.37° to the calf. The angle formed from the working attitude is processed using the REBA method by inputting it to*software Ergofellow* which produces a security level value that is used to consider whether the machine is safe to use or not. Result of*software Ergofellow* can be seen in Figure 11.

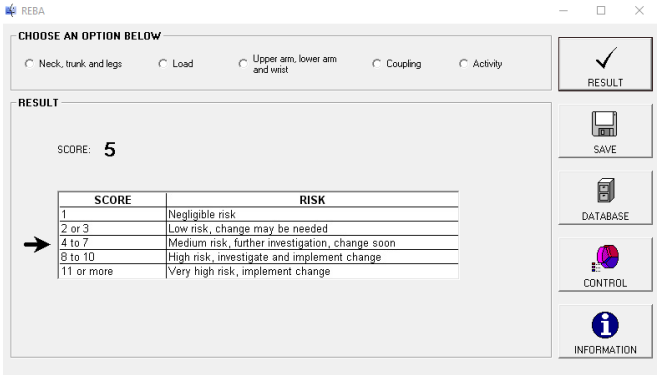

Figure 11.REBA Security Observation Results Movement to Open the Exit Door for Cilembu Sweet Potatoes that Have Been Washed

The results obtained from biomechanical analysis using the REBA method show that when bending over to open the exit door for Cilembu sweet potato has a safety value of 5. A value of 5 in safety testing using the REBA method means that it has a moderate level of security so it needs further investigation and changes in work posture. as soon as possible[7]. This is because the operator is slightly bent causing fatigue in the back. Improvements can be made by modifying the way to open the Cilembu sweet potato exit door so that the operator does not have to bend over.

3.3.5. Evaluation of Working Posture for the Position of Lifting Washed Sweet Potatoes

The body posture when lifting Cilembu Sweet Potatoes that have been washed is the body in a bent state. In this movement the hands function to lift the weight, the back follows the body's movements, and the legs support the body's weight and body weight. An overview of body posture when lifting Cilembu Sweet Potatoes that have been washed can be seen in Figure 12.

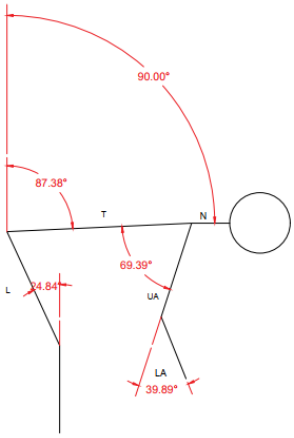

Figure 12. Mannequins When Lifting Cilembu Sweet Potatoes That Have Been Washed

In Figure 12 you can see an illustration of the movement when lifting the Cilembu Sweet Potatoes that have been washed. The working attitude is that the back is bent and forms an angle of 87.38°. Head slightly bowed and forms an angle of 90°. The leg that bends and makes the thigh to the calf is 24.84°. When the working attitude is also raised and forms an angle. The angle formed on the upper arm to the body is 69.39° and for the forearm to the upper arm it forms an angle of 39.89°. The angle formed from the working attitude is processed using the REBA method by inputting it to*software Ergofellow* which produces a security level value that is used to consider whether the machine is safe to use or not. Result of*software Ergofellow* can be seen in Figure 13.

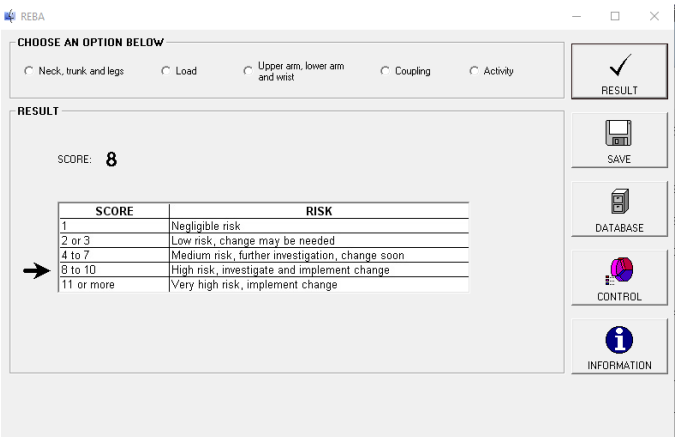

Figure 13. REBA Safety Observation Results of the Movement of Lifting Cilembu Sweet Potatoes that Have Been Washed

The results obtained from the biomechanical analysis using the REBA method show that the movement when lifting the washed Cilembu Sweet Potatoes has a safety value of 8. A value of 8 in the safety test using the REBA method means that it has a high level of security risk so it is necessary to carry out an investigation and implementation in the form of changes in work posture and work environment [7]. This result occurred because the operator bent over to lift the bucket containing Cilembu sweet potato which was clean. Handling that can be done, one of which is the operator uses a storage container for sweet potatoes that are clean using a container that has wheels so that the operator does not need to lift the bucket by simply pulling or pushing the storage container.

3.3.6. Evaluation of Working Posture for the Position of Opening the Drain Faucet

The posture of the body when opening the drain valve is that the body is in a bent state. In this movement the hands function to open the faucet for disposal of dirty water, the back follows the body's movements, and the legs support the body's weight and body weight. An overview of body posture when lifting Cilembu sweet potatoes that have been washed can be seen in Figure 14.

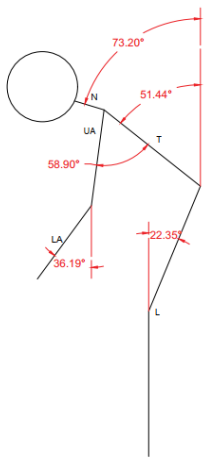

Figure 14. Mannequin When Movement Opens Drain Faucet

In Figure 14 you can see an illustration of the movement when opening the drain valve. The work attitude is that the back is bent and forms an angle of 51.44°. The head is slightly bowed and forms an angle of 73.20°. Legs that bend and make an angle between the thighs to the calves of 22.35°. When the working attitude is also raised and forms an angle. The angle formed on the upper arm to the body is 58.90° and for the forearm to the upper arm it forms an angle of 36.19°. The angle formed from the working attitude is processed using the REBA method by inputting it to*software Ergofellow* which produces a security level value that is used to consider whether the machine is safe to use or not. Result of*software Ergofellow* can be seen in Figure 15.

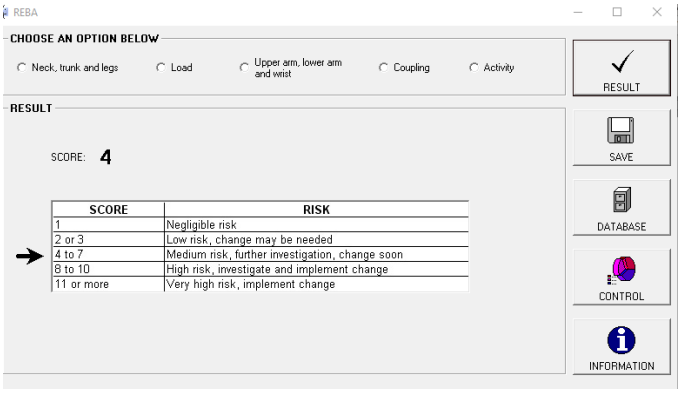

Figure 15.REBA Security Observation Results Movement Opens Drain Faucet

The results obtained from biomechanical analysis using the REBA method show that movement when inserting dirty Cilembu Sweet Potatoes has a safety value of 4. A value of 4 in safety testing using the REBA method means that it has a moderate level of security so it is necessary to carry out further investigations and change work posture as soon as possible. 7]. In these circumstances the operator's posture is bent but because the frequency and duration of bending when opening the faucet is not long, the work attitude can not be changed.

3.4. Engine Noise Analysis

Noise testing of the modified Cilembu sweet potato washing machine was carried out when the machine was operating. Measurements are carried out in two conditions, namely conditions when the machine is operating with a load and when the machine is operating without a load. Measuring tool used is*Sound Level Meter*. Measurements can be made at several points on the machine. The results of the noise measurement are then compared with the noise threshold value and the length of time allowed for exposure according to the Regulation of the Minister of Health of the Republic of Indonesia Number 70 of 2016.

Measurement of the noise of the modified Cilembu sweet potato washing machine was carried out at 4 points, namely at the exit path for the Cilembu sweet potato that had been washed, on the electric motor, at the drain, and at the faucet where the water enters. Measurements were repeated 5 times at each test point. At the first point, namely on the exit path of Cilembu sweet potato without load, the average of five repetitions was 100.136 dB. At the second point, namely the

electric motor section, the average of five repetitions of noise is 101.512 dB. The third point, namely in the sewer section, obtained an average of 99.704 dB. At the fourth point, namely the part of the faucet where the water enters, the average is 99.16 dB. Measurement of the noise of the modified Cilembu sweet potato washing machine at 4 points with a load when operating it for the first point obtained an average value of 90.888 dB. At the second point, an average of 89.192 dB was obtained. The third and fourth points obtained an average value of 90.928 dB and 88.028 dB respectively.

Based on the results obtained from the noise test, the noise value at no-load engine conditions is greater than that of the load. One of the influencing factors is that the washer container is empty, causing the sound from the vibration of the moving brush to be increasingly reflected by the walls of the washer container and making the sound from the engine increase. Another factor that can influence is the sound that comes from the rotation of the belt and pulleys when the machine is operated. So that the sound from the rotation of the belt and pulley does not cause noise, you can use a damper on the electric motor.

The value of the noise level generated under conditions with a load is below 90 dB and without a load it produces 100 dB. Based on the duration of noise exposure per day stated in the Regulation of the Minister of Health of the Republic of Indonesia Number 70 of 2016, for a noise intensity of 90 dB the duration of noise exposure allowed per day is 3 hours. As for the duration of noise exposure that is allowed for a noise intensity of 100 dB, that is for 15 minutes. Thus no-load operation of the machine is not permitted for more than 15 minutes in one day. However, for the use of the machine with a load it can be operated for 3 hours in one day by the operator.

3.5. Machine Vibration Analysis

Measurements are made by placing*vibration meter* at a predetermined point. These points include the washer tube, on the machine frame and on the electric motor. Measurements are carried out in two conditions, namely when there is a load and when there is no load. Measurements at each point were repeated five times.

Measurements in no-load engine conditions on the washing container tube obtained an average vibration of 15.32 m/s^2. In the machine frame, the average vibration is 18.19 m/s^2. The electric motor section obtained an average vibration value of 18.84 m/s^2. In the condition that the machine is loaded for the washing container tube section, the average value of vibration is 17.61 m/s^2. In the machine frame under load conditions, the average vibration value is 11.91 m/s^2. At the last point, namely the electric motor section with load conditions, the average vibration value is 11.34 m/s.^{2}. Based on the results of the average vibration measurement when the engine is no load it is 17.45 m/s^2 and with a load of 13.62 m/s^2. The average vibration value does not meet the vibration threshold value listed in table 12, but the length of working time can be calculated using the formula contained in equation 4 and the permitted working time based on the calculation results is 39 minutes for no load and with load of 65 minutes. In using the modified Cilembu sweet potato washing machine, the operator does not have to touch the machine while the machine is in operation. Then the vibration assessment is only used as a reference to the operator. So that the machine does not produce more than the threshold value, you can use a vibration absorber or shock absorber on the electric motor which is the source of the vibration that occurs.

4. Conclusion

The results of the ergonomics analysis show that the modified Cilembu sweet potato washing machine has mostly fulfilled the ergonomic principles of the several methods used, namely work posture analysis using the REBA method, noise and vibration. The results of the analysis of work postures using the REBA method found 3 postures with a moderate risk level of safety, 2 postures with a high level of security and 1 with a negligible level of safety. On noise and vibration measurements it was found that the machine could only be operated for 3 hours in one day. Anthropometric data analysis on machine height is appropriate, but for machine width there is still a difference between the machine width and the operator's shoulder width. For future research, it is hoped that the machine will be modified again based on the results of the ergonomic analysis that was carried out in this study, especially in the 2 working postures that have a high level of safety at risk. What can also be done is to add a handle to the machine so that it is easy for the operator to move the machine.

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