International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-8; Aug, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI:https://dx.doi.org/10.22161/ijaers.108.3

Ergonomics and Anthropometry in the Design of Doyo Leaf Fiber Softener Machine

Dwi Cahyadi[1], Suparno[2], Ratna Wulaningrum[3], Imam Rojiki[4], Ferry Bayu Setiawan[2]

[1]Design Department, Politeknik Negeri Samarinda, Samarinda, Indonesia
Email: dwicahyadi@polnes.ac.id.
[2]Machine Department, Politeknik Negeri Samarinda, Samarinda, Indonesia
[3]Accounting Department, Politeknik Negeri Samarinda, Samarinda, Indonesia
[4]Pokan Taqak, Tenggarong, Kutai Kartanegara, Indonesia

Received: 25 Jun 2023,
Receive in revised form: 27 Jul 2023,
Accepted: 03 Aug 2023,
Available online: 12 Aug 2023

***Keywords*— Ergonomic, anthropometry, softener machine, ulap doyo.**

***Abstract*—** *One of the production processes for making weaving from doyo leaf fiber is the process of softening the dry leaf fiber before it is spun into yarn. This softening process is done so that the dried leaf fibers become more flexible and elastic so they can be easily spun into yarn. One aspect of machine design is reviewing machine design from ergonomic factors so that the machines used by workers are safer and more comfortable. This study aims to design a doyo leaf fiber softener machine in terms of the ergonomics of the machine's products. The analysis used in this study is an ergonomic analysis using anthropometric data tables using the sex of adult women, aged 18-45 years with a size of 50 percentile, from the Indonesian ethnic group. The results of the analysis show that the ergonomic machine height for workers is 100 cm, with a width of 100 cm and a machine height of 70 cm. The contribution of this research is to provide a design and build of doyo leaf fiber softener machine to the softener machine manufacturing industry so that the machine becomes ergonomic for the safety and comfort of the user.*

I. INTRODUCTION

Doyo weaving is woven made from the leaves of the doyo plant (Curliglia Latifolia), which grows in the Kalimantan region and is commonly used as fashion and handicraft products. Doyo weaving comes from doyo leaf fiber which is processed into yarn. The yarn made from doyo leaf fiber has different characteristics from other thread materials such as cotton and silk [1,2]. As a handicraft of ancestral cultural heritage for people in the province of East Kalimantan in Indonesia, this typical weaving has been exhibited and sold to national and international markets [3]. Doyo weaving has long been known since the 17th century and has been done from generation to generation by the Dayak tribe in East Kalimantan Province, Indonesia.

Based on data from the industry and trade service in East Kalimantan Province, East Kalimantan, in 2019 there were more than 60 doyo weaving craftsmen who continued to produce. The increasing number of enthusiasts of this weaving makes doyo weaving craftsmen experience problems in fulfilling so many market needs. This is because the process of making doyo weaving is done manually by hand which takes a long time.

In general, the process of making doyo weaving can be seen in Figure 1. The process of making doyo weaving starts with taking fresh doyo leaves, then washing the leaves and taking the fiber by rinsing while combing it in river water and then drying it in the sun to dry [4]. Furthermore, after the leaf fibers become dry, the process of softening and spinning the dried doyo leaf fibers into yarn is carried out. This softening and spinning process

takes the longest of all processes, to become one spool of yarn takes 2 days.

After it becomes yarn, it is given a dye that can be obtained from natural dyes to produce patterned woven fabrics through the process of weaving into cloth using tools that are still manual using human power to produce attractive woven fabrics [5,6].

Fig 1. The Process of Making Doyo Woven Fabrics [7]

The production process of processing dried leaf fibers into yarn is a process that takes a long time to turn into yarn with a thickness of less than 2 mm. For this reason, techniques or methods are needed to speed up the production process in this section by using tools in the process of making yarn. One of these processes is the process of softening the dry fiber of doyo leaves. This process is necessary so that the dried doyo leaf fibers become softer and more elastic before being spun into yarn. So it is necessary to design a machine that can help the efficiency and effectiveness of the production process of softening doyo leaf fibers into woven threads that still have the same quality.

This machine is specifically designed for doyo leaf fibers which have a stronger character and have more flexible properties than silk or cotton based threads. In designing this softener machine one of the main factors in designing the machine is the factor of safety and comfort when using this machine. To design an ergonomic doyo fiber softener machine, the analysis that will be applied in this study is an ergonomics analysis using anthropometric data as a basis for determining ergonomic machine sizes.

Ergonomics as a science that discusses user safety and comfort as interactions between humans and machines is a necessity in developing product designs today. One area of ergonomics that focuses on discussing product sizes that are safe and comfortable when used is anthropometry [8,9]. Anthropometry discusses the dimensions of the human body which are recorded based on age, gender, ethnicity, type and job position as a basis for making the size of a product or machine according to its user [10,11,12].

Anthropometry is the measurement of the human body that can be used as a basis for determining the size of the minimum or maximum limits of products, equipment or ergonomic machines based on ethnicity, gender, disability, body position and posture during activities, as well as the type of work performed [13,14,15].

II. OBJECTIVES

This study aims to design a doyo leaf fiber softener machine with a review from the ergonomics point of view of the machine product. The contribution of this research is to provide a design of doyo leaf fiber softening machine to the softener machine manufacturing industry so that the machine becomes ergonomic for the safety and comfort of the user.

III. METHODOLOGY

Ergonomic doyo leaf fiber softener machine design design, then the analysis used is ergonomics analysis using anthropometric data tables. The anthropometric data used is anthropometric data adjusted to the worker.

The anthropometric data used as the basis for determining the size of the machine uses the sex of an adult female, aged 18-45 years with an average size of the 50th percentile adult female, from the Indonesian ethnic group. Data obtained from Indonesian anthropometric data [16].

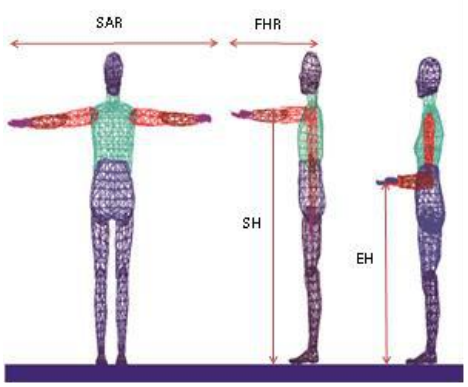

Fig 2. Anthropometric data

The data to be used are shoulder height, forward arm reach, side arm span, and elbow height. The figure 2 is the anthropometric data that will be used in this study.

The data to be used are shoulder height, forward arm reach, side arm span, and elbow height. The figure 2 is the anthropometric data that will be used in this study.

IV. RESULTS AND DISCUSSION

To design an ergonomic softener machine, the thing that must be considered first is to determine what kind of work the worker will do later. For the work of the doyo leaf fiber softening process, this is the type of work that is done while standing. The standing position in this process is so that workers can see better at the softening process of doyo leaf fibers. For this reason, the machine that is designed must have a height below the eye of the worker.

For the height of the machine, data from the anthropometric table of shoulder height of Indonesian adult women is used, which has an average height or 50 percentile. From anthropometric data, the shoulder height (SH) when standing for an adult woman aged 18-45 years is 129.74 cm. the data in this anthropometric table is data for the maximum size for machine height. In designing this machine the machine height used is 100 cm. This height is adjusted to the needs and comfort of workers when operating the machine and watching the machine grinding process in softening the dry fiber from doyo leaves.

The width of the machine is designed so that workers can reach the end of the machine while standing without difficulty. The width of the machine is based on anthropometric data from the forehand reach (FHR).

From Indonesian anthropometric data, it is found that the reach of the hand forward for Indonesian women is on average 71.13 cm, this size is the maximum width of the machine. Furthermore, in designing this machine, the width of the machine is 70 cm of the arm to the side (SAR). The data in the Indonesian anthropometric table is 154.87 cm. To make the machine more ergonomic and aesthetic, the width of the machine designed is 100 cm so that it is not too long.

The length of this machine still pays attention so that the machine works well, is safe and comfortable for workers. For the ergonomics of the machine, the main system of the machine and the construction of the machine frame are inside the machine casing to provide worker safety when operating the machine. Figure 3 and 4 is a prototype of the dry doyo leaf fiber softener machine designed in this study.

Fig 3. Prototype machine front view

The switch button to turn on and turn off the machine and the emergency button to stop the machine work are designed to be within reach of the worker's hands. The design of this button is positioned so that it is easily visible and uses a striking color. The colors used on the machine casing are bright colors that look more aesthetically pleasing. The design of this machine is made in a box shape to make it easier to move the machine.

The material input process in the form of dry doyo leaf fiber enters through a door that can be opened and closed again with the door positioned above the machine.

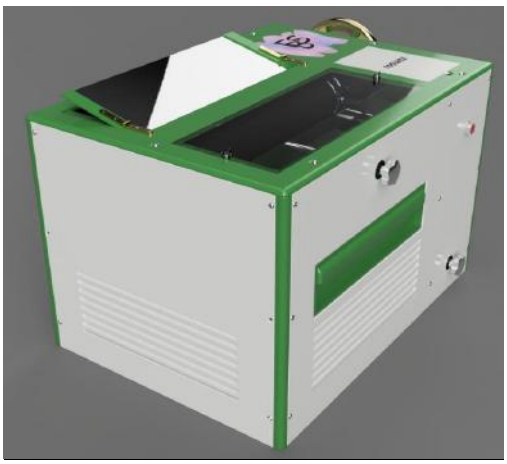

Fig 4. Prototype machine perspective view

This machine is also equipped with a transparent door cover so that workers can see from above the work process of softening doyo leaf fibers from above so that the eyes are not exposed to loose and flying particles when the machine is softening. After the production process is complete, the result is doyo leaf fiber which is soft and

ready to be spun into yarn which can be picked up at the front of the machine.

V. CONCLUSION

One of the production processes for making weaving from doyo leaf fiber is the process of softening the dried leaf fiber before it is spun into yarn. This softening process is done so that the dried leaf fibers become more flexible and elastic so they can be easily spun into yarn. This machine is specifically designed for doyo leaf fiber which has a stronger character and has more flexible properties than silk or cotton-based threads.

From the results of the analysis it was found that the ergonomic machine height for workers is 100 cm, with a width of 100 cm and a machine height of 70 cm. This machine is designed with a box shape that has a bright color. This machine has a transparent cover on it so workers can see the machine work directly.

Besides that, the placement of the switch button to turn on and turn off the machine and the emergency button is placed on the front of the machine which is easily accessible by workers with a striking color. It is hoped that this doyo leaf fiber softener machine can facilitate and provide safety and comfort to workers.

ACKNOWLEDGEMENTS

Acknowledgments to the Direktorat Jendral Pendidikan Vokasi, Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi Indonesia for financial support provided in 2023 through the Vocational Product Research Program, also to the Samarinda State Polytechnic and Pokan Taqak who have helped a lot in this research.

REFERENCES

[1] Kriya Kubar, Sekretariat Dekranasda Kabupaten Kutai Barat, Kalimantan Timur, Edisi Pertama Hut Kubar ke-17, 2016.
[2] Buku Profil Serat Doyo, Disperindagkop dan UMKM, Provinsi Kaltim, 2014.
[3] Atmoko Tri, Gunawan Wawan, Emilia Fransisca, Mukhlisi, Prayana Angga, & Arifin Zainal, Budaya Masyarakat Dayak Benuaq dan Potensi Flora Hutan Lembonah, Balai Penelitian Teknologi Konvervasi Sumber Daya Alam, November 2016.
[4] Indriastuti Herning, Ulap Doyo : Produk Regiosentris Kalimantan Timur, JP Publishing. Sidowarjo. Jawa Timur, 2021.
[5] Purbasari Mita, & Rahardja Anita, "Warna Tenun Doyo Sebagai Expresi Masyarakatnya (Tanjung Isuy-Kutai Barat)", Dimensi, Vol.14, No.2, Feb 2018.
[6] Meilita, Yuwono Elisabeth Christine, & Yusuf Vanessa, "Perancangan Strategi Promosi Kain Tenun Ulap Doyo Pemayuq", Jurnal DKV Adiwarna, Vol 1, No 16, 2020.
[7] Cahyadi Dwi, Suparno, Wulaningrum Ratna, Rojiki Imam, "Doyo Weaving Production Process as A Culture Herutage in East Kalimantan, Indonesia", International Journal of Engineering Technology Research & Management, Vol 06, Issue 07, July 2022.
[8] Nurmianto, E. Ergonomi Konsep Dasar dan Aplikasinya, Guna Widya, 1998.
[9] Letho M & Landry, S. J. Introduction to Human Factors and Ergonomics For Engineering, CRC Press, 2013.
[10] Lee, Y., Kim, Y. M., Lee, J. H. & Yun, M. H, "Anthropometric mismatch between furniture height and anthropometric measurement: A case study of Korean primary schools", International Journal of Industrial Ergonomics, 68, 260-269, 2018.
[11] Wang, C. Y. & CAI, D. C., "Hand tool handle size and shape determination based on hand measurements using a contour gauge", Human Factors and Ergonomics in Manufacturing & Service Industries, 30, 349-364, 2014.
[12] Cahyadi, D., Fibrianie, E., Irwan, M., Susandari, H. & Tantrika, C. F. M, "Design of workstation in the home industry of Amplang crackers production", iCAST-ES, Journal of Physics: Conference Series, 2019.
[13] Adnan, N. & Dawal, S. Z. M, "Applied anthropometric for wheelchair user in Malaysia", Measurement, 136, 786-794, 2019
[14] Lee, W., Yang, X., Jung, D., Park, S., Kim, H. & You, H. "Ergonomic evaluation of pilot oxygen mask designs", Appl Ergon, 67, 133-141, 2018.
[15] Cahyadi, D, Aplikasi Mannequin Pro Untuk Desain Industri Leutikaprio, 2014.
[16] Antropometri Indonesia, Available: https://antropometriindonesia.org [Accessed 17 Mei 2023], 2023.