The Journal of System Engineering and Technological Innovation (JISTI)
ISSN: 2828-4003, Vol. 03, No. 01, pp. 172-176
Faculty of Engineering-Wijaya Putra University

EFFECT OF HEAT AND TIME ON A 5 KG CAPACITY CLOTHES DRYER MACHINE

Meki Alfonsus Ferdinan Boki[1,a], Muharom Muharom[2,b], Slamet Riyadi[3,c], Siswadi Siswadi[4,d] and Gatot Setyono[5,e]

Mechanical Engineering Study Program, Wijaya Putra University [1,2,3,4,5]

Raya Benowo-Rd No. 1-3 Surabaya, East Java, Indonesia [1,2,3,4,5]

[b]muharom@uwp.ac.id

Abstrak.

Pemanfaatan sumber energi dari alam seperti energi panas matahari dan panas bumi dirubah menjadi energi listrik melalui teknologi tepat guna sudah banyak digunakan itupun tidak lepas dari iklim tersebut. Salah satunya adalah proses pengeringan pakaian Proses pengeringan Pakaian yang dilakukan banyak orang masih bersifat sederhana yaitu dengan metode penjemuran secara langsung dibawah sinar matahari. Metode ini kurang efektif karena membutuhkan waktu yang lama dan masih tergantung pada cuaca. Maka dari sini kami akan melakukan inovasi pembuatan suatu alat pengering pakaian yang mana menggunkan elemen pemanas sebagai sumber panas dan kipas angin.Tujuan penggunaan elemen pemanas dan kipas angin adalah untuk membantu mempercepat proses pengeringan pakaian dengan waktu yang singkat tanpa harus menunggu lama dan dapat mengontrol temperature panas pada pakaian.

Kata kunci: panas, waktu, kapasitas 5kg dan mesin pengering.

Abstract.

Utilization of natural energy sources such as solar thermal energy and geothermal energy converted into electrical energy through appropriate technology has been widely used and cannot be separated from the climate. One of them is the process of drying clothes. The drying process used by many people is still simple, namely by drying directly under the sun. This method is less effective because it takes a long time and still depends on the weather. So from here, we will innovate in making a clothes dryer that uses a heating element as a heat source and a fan. The purpose of using a heating element and fan is to help speed up the process of drying clothes in a short time without having to wait a long time and to be able to control the temperature of clothes.

Keywords: *heat, time, 5kg capacity and drying machine.*

Introduction.

Indonesia is a region that has two climates, namely a rainy climate and a hot climate. Both climates have an influence on daily life, both in the family environment and society in general. Utilization of natural energy sources such as solar thermal energy and geothermal energy converted into electrical energy through appropriate technology has been widely used and cannot be separated from the climate [1]. The use of appropriate technology is beneficial for improving small and medium businesses, especially in the West Surabaya area [2]–[7][8]–[17]. Therefore, many manufacturers have created equipment related to appropriate technology, but it still lacks consumer demand because it is still less efficient and has minimal use. So from here, we will innovate to make a

clothes dryer that uses a heating element as a heat source and a fan. The purpose of using a heating element and a fan is to help speed up the process of drying clothes in a short time without having to wait a long time and to be able to control the temperature. Heat on clothes [18].
Conduction heat transfer is the transfer of heat from a high temperature area to a low temperature area in one medium (solid, liquid and gas), or between different media that are in direct contact with each other. In solid objects heat transfer occurs due to the movement between atoms in high temperature, so that these atoms can transfer heat. Convection heat transfer is the transfer of energy with the combined work of heat conduction, storage, energy and mixing motion. Heat transfer occurs by convection from the surrounding plate or vice versa. Convection heat transfer is divided into 2, namely free convection and forced convection [19].
Drying clothes can be done in two ways, namely natural drying and artificial drying. People in general can practice natural drying by direct exposure to the sun (drying), while artificial drying is a drying method using tools that utilize heat sources from sunlight (solar energy), oil stoves, or electric power. Drying tools that use a power source electricity is usually in the form of a furnace [20]. The drying process that many people use is still simple, namely by drying directly under the sun. This method is less effective because it takes a long time and still depends on the weather. Considering the lack of effectiveness of this method, it is necessary to look for a method that can help dry clothes more quickly. The effort to save clothes from drying is by drying them. The principle of drying clothes is an effort to evaporate water because there is a difference in water vapor content between the air and the material being dried [21]. Air has a smaller water vapor content than the material, so that it can absorb water vapor from the dried material. One factor that speeds up the drying process is wind or flowing air. With airflow, saturated air can be replaced with dry air so that the drying process can continue continuously [22].
The effective drying process begins by hanging the clothes in a drying machine at a distance so that the air can circulate so that the heat from the elements is distributed evenly so drying will be maximized in a fast time. Apart from that, so that drying doesn't take a long time, we separate clothes according to fabric, thickness, and dry time, because this can make drying more straightforward and smoother. Then, the heating element and fan will be turned on at a predetermined fan speed and temperature within a specific time. Certain things are capable of drying the clothes.

Research Methods

In this planning system, as previously explained, drying uses heating elements and fans as heat spreaders, so that in the room there is a convection heating process for the clothes being dried [9], [17], [23]. At this stage, the required parameters are first determined, namely the temperature of the heating element and the temperature in the drying room, the type of fabric to be dried, the model of clothes, the thickness and thinness of the fabric and the planning of the drying system with this drying element refers to considering factors, namely using a simple system. Easy to operate, saves time and energy, speeds up the drying process, uses easily available materials and is easy and cheap to maintain.
A planning system is created and realized in the form of operations. In the drying process, several steps are required, including the step of arranging wet clothes in order of how long they take to dry. In this step, the clothes are arranged starting from the thickest or those that take the longest to dry. The clothes that take the longest to dry are placed at the front or closest to the heat source, followed by the next clothes until the last or last are clothes that dry quickly (t-shirts). Separation of clothes that smell. In this case, it is necessary to pay attention to which clothes, when exposed to heat from the elements, can cause odors so that they do not affect other clothes that are dried simultaneously in the drying chamber, such as clothes made from elastic or rubber because of the temperature. Certain clothes will experience expansion.
The testing location is carried out in a room. The testing process consists of preparing the tools and materials that will be used in the testing and choosing the type of clothing material that will be dried; before drying, the clothes are washed first and wrung out by hand or in a washing machine

[24]. It can speed up the drying process; it is best to dry it using a washing machine, arrange the clothes that have been washed and wrung into the drying room, as in Figure 1, measure the mass of the material and record the temperature changes that occur every hour, at the ambient temperature and drying room and test it until the desired moisture content is reached or the clothes are dry.

Figure 1. Clothes Dryer Machine Capacity 5 Kg.

Results and Discussion.

Before the clothes dryer machine is tested, it must first be ensured that the equipment system installation is neat and ready to be operated. The initial trial was carried out by preparing the clothing materials before washing and sorting them according to the type of clothing. Each type of clothing has a different load period due to the effect of water absorption. As in table 1

Tabel 1. Capacity of clothes used.

Type of clothing	**Clothes capacity before washing (gr)**	**Clothing capacity after washing (gr)**
Cloth jacket	600	1200
Cloth trousers	500	1100
Shirt	300	550
T- Shirt	250	450
Batik dress	300	550

The clothes drying machine that has been made has a capacity of 5 kg or 12 – 15 clothes. During the drying process, temperature changes that occur in the clothes drying machine are observed and recorded every 30 minutes or 60 minutes, and the clothes are checked. According to the trial data that has been carried out, wet clothes take a maximum of 3 hours according to the type of clothing material, as shown in table 2.

Tabel 2. Drying time and fan level used.

Type of clothing	**Time (h)**	**Level Fan**	**Time (h)**	**Level Fan**
Cloth jacket	3	1	2.5	2
Cloth trousers	3	1	2.5	2
Shirt	2	1	1.5	2
T- Shirt	2.5	1	2	2
Batik dress	2	1	1.5	2

Clothing drying test, time, and fan rotation speed influence the drying results, also due to the type of clothing material. For this type of cloth jacket, it takes 3 hours at fan speed one, and it takes 2.5 hours at fan speed 2

Conclusion.

From the results of planning, manufacturing, and testing of this clothes dryer, it can be concluded that this clothes dryer can be said to be quite good in terms of drying clothes. This clothes-drying machine can be used as a means of supporting laundry entrepreneurship and batik SMEs. The drying process can take place over night without depending on the weather and is more efficient without damaging clothes. During the clothes drying process, fan speed settings, drying room temperature, and outside room temperature have an effect. In the process of drying clothes, the type of clothing material dramatically influences the drying time. To be more efficient, do the washing machine drying process first.

References.

[1] K. Ravi Kumar, N. V. V. Krishna Chaitanya, and N. Sendhil Kumar, "Solar thermal energy technologies and its applications for process heating and power generation – A review," *J. Clean. Prod.*, vol. 282, p. 125296, Feb. 2021, doi: 10.1016/J.JCLEPRO.2020.125296.

[2] A. F. D. Bagas, M. Muharom, M. Muchid, A. Nugroho, and N. Kholili, "Design Of A Heating System In A Plastic Injection Molding Machine With A Working Temperature Of 250 C," *J. Syst. Eng. Technol. Innov.*, vol. 2, no. 01, pp. 100–105, Apr. 2023, doi: 10.38156/JISTI.V2I01.39.

[3] H. Siswanto, S. Riyadi, S. Siswadi, G. Setyono, D. Khusna, and W. Nugroho, "Design And Build The Appropriate Technology Machinery For Shredded Fish Processing," *J. Syst. Eng. Technol. Innov.*, vol. 2, no. 01, pp. 106–110, Apr. 2023, doi: 10.38156/JISTI.V2I01.38.

[4] D. Khusna, G. Setyono, S. Siswadi, S. Riyadi, N. Kholili, and A. Nugroho, "Investigasi Efek Debit Fluida Dan Karakteristik Pembebanan Disk Valve Terhadap Performa Water Hammer," *J. Syst. Eng. Technol. Innov.*, vol. 1, no. 02, pp. 38–43, Oct. 2022, doi: 10.38156/JISTI.V1I02.25.

[5] M. S. Gunawan, M. Muharom, M. H. Abdullah, F. G. Dewi, A. J. Suwondo, and O. Purnamayudhia, "Perancangan Proses Kondensasi Pada Pengolahan Limbah Plastik Menjadi Bahan Bakar Minyak Menggunakan Sistem Pirolisis Dengan Kapasitas 10 Liter," *J. Syst. Eng. Technol. Innov.*, vol. 1, no. 02, pp. 65–70, Oct. 2022, doi: 10.38156/JISTI.V1I02.28.

[6] A. R. Dewananta, R. A. Rahmadhani, D. M. Fantoja, M. Muharom, and G. Setyono, "Rancang Bangun Rombong Listrik Dengan Menggunakan Pembangkit Listrik Tenaga Surya (PLTS) Kapasitas 200 Watt," *J. Syst. Eng. Technol. Innov.*, vol. 1, no. 01, pp. 1–6, Apr. 2022, doi: 10.38156/JISTI.V1I01.9.

[7] Y. M. Prasetyo, S. Budiarto, M. P. Perdana, and S. Siswadi, "Rancang Bangun Ulang Motor Listrik Berbasis Android Dengan Sistem Motor Brushless Direct Current (BLDC) 3 Phase Kapasitas 1000 Watt," *J. Syst. Eng. Technol. Innov.*, vol. 1, no. 01, pp. 13–18, Apr. 2022, doi: 10.38156/JISTI.V1I01.11.

[8] G. Setyono, N. Kholili, and D. Khusna, "Implementasi Minyak Wijen Sebagai Bahan Bakar Alternatif Untuk Kendaraan Matic Terhadap Pelaku Bengkel Di Sambi Kerep Surabaya," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 1, no. 02, pp. 35–39, Oct. 2022, doi: 10.38156/DIMASTEK.V1I02.30.

[9] S. H. H. Kusumo, S. Siswadi, and G. Setyono, "Pemberdayaan Mesin Teknologi Tepat Guna Pembuat Dan Pengering Mie Pipih Berkapasitas 5kg/Jam Untuk Peningkatan Produksi UKM Di Gresik," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 1, no. 01, pp. 23–28, Apr. 2022, doi: 10.38156/DIMASTEK.V1I01.19.

[10] H. Siswanto, S. Riyadi, and I. Muhandhis, "Pemanfaatan Teknologi Tepat Guna Mesin Abon Kapasitas 25 Kg/ Jam Untuk Peningkatan Produksi UKM Di Sidoarjo," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 1, no. 01, pp. 17–22, Apr. 2022, doi: 10.38156/DIMASTEK.V1I01.18.

[11] R. Alparazi, S. Riyadi, and S. Siswadi, "Strategi Peningkatan Produksi UKM Di Sidoarjo Dengan Mesin Pembuat Dodol Multifungsi Kapasitas 5 Kg," *Pengabdi. Masy. dan Inov.*

Teknol., vol. 1, no. 01, pp. 7–12, Apr. 2022, doi: 10.38156/DIMASTEK.V1I01.16.

[12] S. Siswadi, S. Riyadi, and W. Nugroho, "Penerapan Mesin Teknologi Tepat Guna Penggiling Bumbu Pecel Kapasitas 5 Kg/Jam Bagi UMKM Sambi Kerep Surabaya," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 1, no. 02, pp. 47–52, Oct. 2022, doi: 10.38156/DIMASTEK.V1I02.32.

[13] H. Tampubolon, S. Sigit, and M. Muharom, "Peningkatan Kapasitas Produksi Dengan Mesin Teknologi Tepat Guna Pembuatan Kue Bakpia Untuk UKM Di Surabaya," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 1, no. 01, pp. 1–6, Apr. 2022, doi: 10.38156/DIMASTEK.V1I01.15.

[14] S. Mubarokah *et al.*, "Pemanfaatan Mesin Teknologi Tepat Guna Untuk Meningkatkan Produksi UMKM Kue Kembang Goyang Pada Di Daerah Sidoarjo," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 2, no. 01, pp. 72–77, Apr. 2023, doi: 10.38156/DIMASTEK.V2I01.44.

[15] I. Muzaki, S. Subaderi, O. A. W. Rijanto, K. Hariyanto, F. G. Dewi, and A. J. Suwondo, "Mechanism Of Spiral Potato Crips Machine For Increasing MSMEs Production Capacity In Mojokerto," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 2, no. 01, pp. 78–83, Apr. 2023, doi: 10.38156/DIMASTEK.V2I01.45.

[16] T. Pratomo, M. Muharom, N. Kholili, A. Nugroho, M. Muchid, and D. Khusna, "Efforts To Increase Tempe Slicing Capacity Through The Implementation Of Appropriate Technology Machines For MSMEs In West Surabaya," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 2, no. 01, pp. 66–71, Apr. 2023, doi: 10.38156/DIMASTEK.V2I01.43.

[17] A. W. Nugroho, S. Riyadi, S. Siswadi, G. Setyono, and W. Nugroho, "Application Of Appropriate Technology Automation Systems For Making Martabak Manis Machine For Capacity Building In MSMEs In The Gresik Region," *Pengabdi. Masy. dan Inov. Teknol.*, vol. 2, no. 01, pp. 60–65, Apr. 2023, doi: 10.38156/DIMASTEK.V2I01.42.

[18] Y. Wei, R. H. Gong, L. Ning, and X. Ding, "Enhancing the Energy Efficiency of Domestic Dryer by Drying Process Optimization," *Dry. Technol.*, vol. 36, no. 7, pp. 790–803, May 2018, doi: 10.1080/07373937.2017.1356329.

[19] J. Lee, C. Yun, and C. H. Park, "Effect of Fabric Characteristics and Drum Rotation Speeds on the Movements and Drying Performances of Clothes in a Tumble Dryer," *Fibers Polym.*, vol. 23, no. 6, pp. 1741–1752, Jun. 2022, doi: 10.1007/S12221-022-4802-Z/METRICS.

[20] Q. Jian and L. Luo, "The improvement on efficiency and drying performance of a domestic venting tumble clothes dryer by using a heat pipe heat recovery heat exchanger," *Appl. Therm. Eng.*, vol. 136, pp. 560–567, May 2018, doi: 10.1016/J.APPLTHERMALENG.2018.03.029.

[21] M. Ahmadi, K. R. Gluesenkamp, and S. Bigham, "Energy-efficient sorption-based gas clothes dryer systems," *Energy Convers. Manag.*, vol. 230, p. 113763, Feb. 2021, doi: 10.1016/J.ENCONMAN.2020.113763.

[22] J. Xu and Z. Liu, "Radiance-based retrieval of total water vapor content from sentinel-3A OLCI NIR channels using ground-based GPS measurements," *Int. J. Appl. Earth Obs. Geoinf.*, vol. 104, p. 102586, Dec. 2021, doi: 10.1016/J.JAG.2021.102586.

[23] M. Rasti and J. H. Jeong, "A Review of Models for Estimation of Moisture Evaporation Rate from Clothes Inside a Clothes Dryer," *https://doi.org/10.1142/S2010132521300019*, vol. 29, no. 1, Jan. 2021, doi: 10.1142/S2010132521300019.

[24] G. Setyono, S. Riyadi, Muharom, O. A. W. Riyanto, and S. Pratama, "Effect of Cutting Parameter Toward The Surface Roughness Applied In Turning Tool Steel Material," *Infotekmesin*, vol. 13, no. 2, pp. 233–238, Jul. 2022, doi: 10.35970/INFOTEKMESIN.V13I2.1533.