Research Progress in Mechanical and Manufacturing Engineering Vol. 3 No. 1 (2022) 812-823
© Universiti Tun Hussein Onn Malaysia Publisher's Office

RPMME

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/rpmme
e-ISSN : 2773-4765

Development of Batik Pen Canting Tool using CNC Machine

Muhammad Ezzad Firdaus Roslan[1], Zazuli Mohid[1]*

[1]Faculty of Mechanical Engineering and Manufacturing,
Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/rpmme.2022.03.01.086
Received 01 Dec 2021; Accepted 01 April 2022; Available online 30 July 2022

Abstract: Batik is Malaysia artwork that has become hereditary culture from generation to generation. One of the problems faced by batik industry recently is increasing demand of batik products. Nowadays, overall processing time of batik from sketches to batik products may take around 2 to 3 days, where the batik process itself may take one full day to complete. On the other hand, the number of batik craftsmen is increasingly limited, many young people are less interested in becoming batik craftsmen. This paper describes how to development of a batik pen canting tool at CNC machine to increases production canting batik. The development is divided into several parts: design batik pen canting tool, three -axis CNC machine, temperature, wax and fabric. Next, the project is to design and create a Canting Batik Tool and integrate it with a CNC machine. Furthermore, this test is based on the observation of design batik pen canting tool, consistency of wax learning, temperature and the feed rate of the CNC machine in batik processing. Therefore, this research can be done to fulfil all the industries requirement in each product batik such as good surface finish, good accuracy and saving cost.

Keywords: Batik, Batik Pen Canting Tool, CNC, Consistency Of Wax, Temperature, Feed Rate

1. Introduction

Since the 15th century AD, the technique of producing batik has historically been experienced [1]Batik is a method of cloth decoration that use wax as a resist. Batik is an old form of art originating from the Javanese words Amba (to write) and titik (to decorate) (to dot). Hand-drawn batik is often created in lengths of 4 or 2 metres [2]. Women's clothing is made from hand-drawn batik that is 4 metres in length, while men's clothing is made from hand-drawn batik that is 2 metres in length. These clothes are often worn for formal occasions. Apart from garments, hand-drawn batik is also used to create scarves, handicraft, and framed art. The Malaysian batik is one of the prized heritages of Malaysian society. Malaysian Batik is mostly manufacturer of Kelantan, Terengganu and Pahang on the east coast of Malaysia. In compliance with local Islamic doctrine, to prevent representation of human and animal representations as idolatry, the motifs used in Malaysian batik mostly are flora and leaves. As to today,

**Corresponding author: zazuli@uthm.edu.my*
2022 UTHM Publisher. All right reserved.

batik clothing is not only worn by Malaysia, it is still the cultural identity and also the government obliges government officials to wear Batik on Thursday [3]

In addition, there are many stages involved in creating batik, the first of which is drawing the design on white cloth with a pencil. The second stage, draw a pencil pattern on a white cloth using a canting tool loaded with hot wax, as this technique involves the use of hot wax using a canting tool to follow the pencil design[4]. Hot wax will hide the design and retain the white color even after the fabric has been dyed. The third step is to paint the fabric with color[5]. Once the wax is attached to the fabric, it’s time to paint it. There are two ways to paint fabric. The first step is to dip the fabric into the dye to make sure all the fabrics are the same color; this is called a "Dip." The second method is that some artisans paint the cloth with dye using a brush; this is referred to as "Colet." Colet is usually used when the final batik fabric pattern has a large amount of color[6].

Following that,the biggest issue with the batik industry today is that it is attempting to solve the problem of canting, which necessitates trained labour and takes a long time, resulting in a higher price than artificial batik[7]. Furthermore, conventional methods are a time-consuming procedure that leads to batik makers' inability to meet consumer demand. Some batik makers have announced that it has been difficult to attract professional batik staff because they must be highly skilled, innovative, and dedicated[8]. Batik artisans specialise in creating unique compositions of wax lines produced by a constant flow of wax from canting. The difficulties that the batik industry faces have piqued this researcher's curiosity. Due to the limited supply of handmade batik, it is critical to integrate technology into the batik manufacturing process in order to fulfil the demand of the worldwide batik market[9]. One of the technical uses in the batik process is the usage of CNC machines[10]. As a result, the majority of application manufacturers create machine components, materials, and finished products using computer numerical control machines.

Finally, the development of a batik canting tool using a CNC machine is divided into several parts: the batik canting tool, the three-axis CNC device, the temperature, wax and the fabric form. The aim of this project is to design and create a Batik Canting Tool and integrates with CNC machine. Furthermore, the test would primarily be based on observations of wax width consistency in batik processing. Based on the findings of this report, we may use a CNC machine to manufacture batik canting pens, which will result in a lot of consistency, such as lower manufacturing costs, a better working climate, and higher quality performance.

2. Design of experiment

The objective should be clear that the relationship between CNC machining parameters and batik canting tools needs to be observed. Also, note the effectiveness of the tool on various canting parameters such as speed, temperature and diameter of the canting tool hole. next, note the shape of the wax on the fabric because the distance is even and the conditions of penetration of the wax are the same. By defining project objectives, a general statement or plan to achieve the objectives can be easily implemented.First, design the machining parameters required in the experiment such as performance wax flow according to wax temperature, feed rate and nozzle measurements. The wax flow pattern can be analysed after the experiment is completed. It should be clear that the result of the formation of a wax flow is either the formation of a desired or unwanted wax flow. Analyse wax flow patterns by length, roundness, temperature and characteristics of wax flow patterns. The most important is the structure of the wax flow formation as the result will determine the perfect or imperfect batik canting result.Next, the feed rate on the batik canting tool needs to be clarified. In any case. because the size of the nozzle as well as the feed rate will also affect this experiment. The explanation for this must be revealed in the analysis, since the findings may give knowledge and information necessary to ensure the tool's effective usage.

2.1 Machine and equipment

The experiment will be conducted using batik canting machines and equipment. The batik canting process will then be done using a CNC machine as in figure 1. The experiment required to use a controller temperature, and a thermocouple during the batik canting process as shown in figure 2 below. From the combined results of these items, this experiment will be easier to perform by melting the wax and also controlling the wax temperature. In addition, figure 3 Heating pads are pads that are used to heat an object. Batik pen canting tool will also be used as a batik canting tool and also melt wax automatically. Therefore, using batik canting tools can also run this experiment successfully.

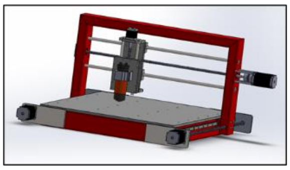


Figure 1: CNC machine

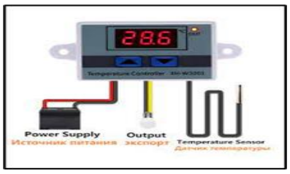


Figure 2: Controller & thermocouple

Figure 3:Heater pad

Below show the detail batik canting tools from Figure 4, Figure 5 and Figure 6. This picture shows several views, namely front view, half body view and exploded view.

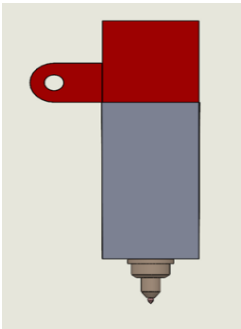


Figure 4 : Front view

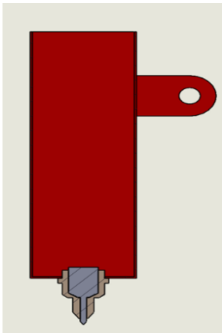
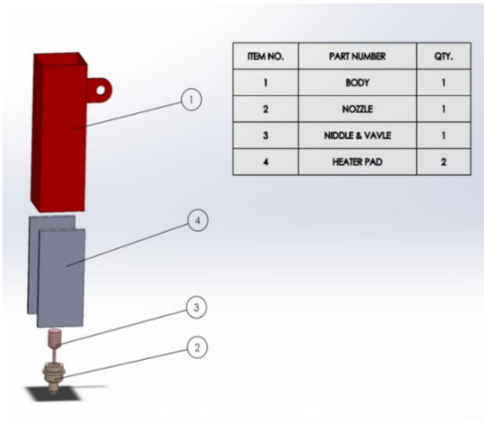


Figure 5: Half body



ITEM NO.	PART NUMBER	QTY.
1	BODY	1
2	NOZZLE	1
3	NIDDLE & VAVLE	1
4	HEATER PAD	2

Figure 6: Exploded view

In addition, the nozzles specified to be used in this experiment have various holes with varying sizes, the first being a 3mm nozzle hole while the second nozzle is a 1mm nozzle hole as shown in Figure 7 and figure 8 below referring to the nozzle sketch.

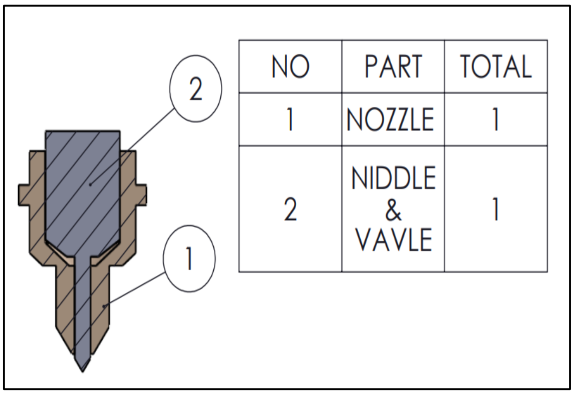


Figure 7: Nozzle size 3mm

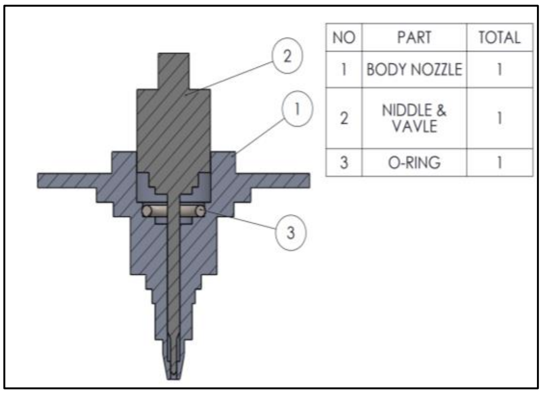


Figure 8 :Nozzle size 1mm

Lastly, with the combination of batik canting tool and CNC machine it will be easier to launch this experiment. Here is a sketch of the merger between batik canting tool and also CNC machine in detail Figure 9.

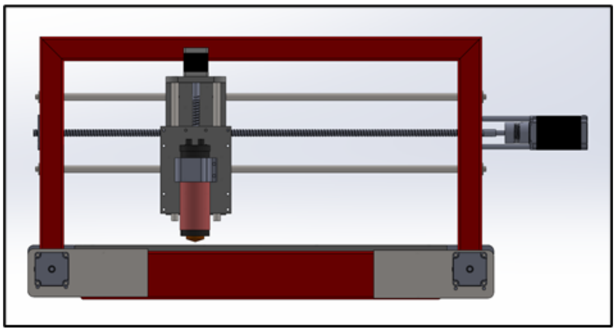


Figure 9: Batik canting tool with CNC machine

2.2 Factor control

In factor control, common machining parameters will be used such as feed rate. Next the temperature control for the wax is also used to make it easier to melt the wax and also to control the set temperature after melting. In addition, the use of different nozzle sizes should also be done in this process in order to differentiate the penetration rate of batik wax. The feed rate has also been set from 100 to 700 mm/minute. The Table 1.0 below will show the preparation of the best machining parameters in this experiment based on the machine specifications and the capability of the batik canting tool.

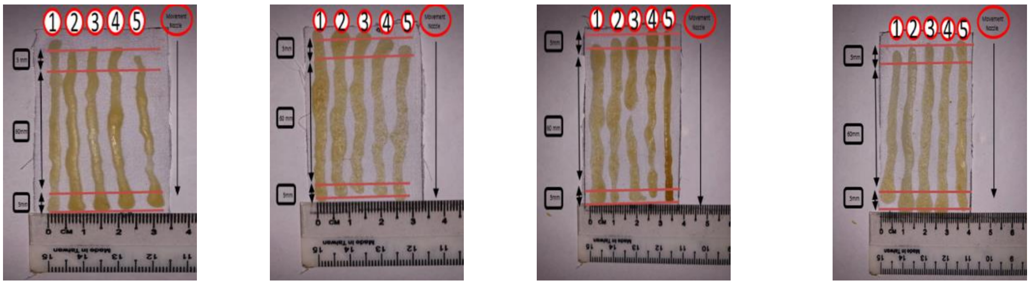
Table1.0: Batik Canting Tool Formation Based on Machining Parameter

Parameters	**Level/range**	**Output**
Travel speed, v(mm/min)	3 levels/ 100 – 700	Wax width (start, middle, end), penetration, line continuity.
Temperature, T (°C)	2 levels/ 70 – 120 °C	
Nozzle diameter, D_n (mm)	2 level/ 1mm – 3mm	
Fabric	cotton	

3. Results and Discussion

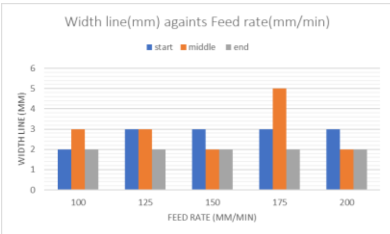
3.1 Nozzle 3mm (ND 1)

3.1.1 Flow wax for nozzle 3mm

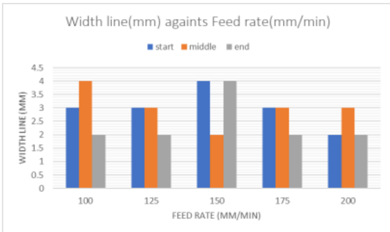


(a) (b) (c) (d)

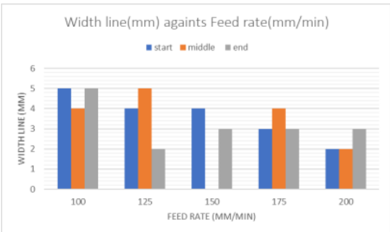
Figure 10: Width line at temperature (a) 90°C, (b) 100°C,110°C, (d)120°C



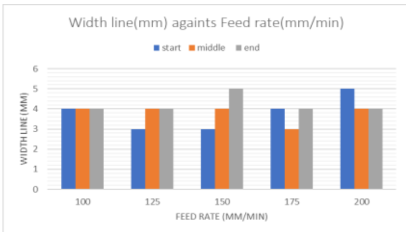
(a)



(b)



(c)



(d)

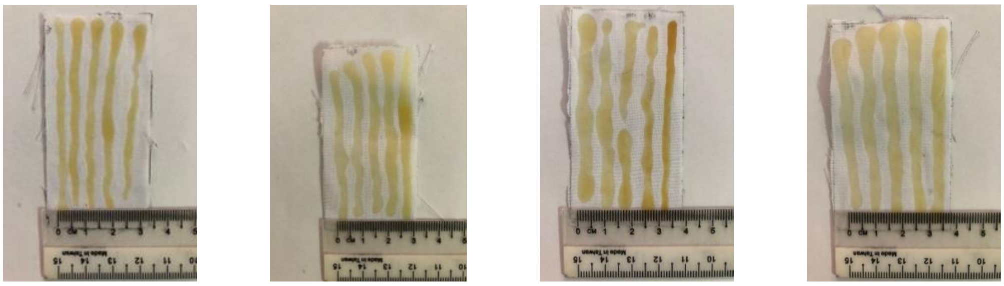
Figure 11: Width line at temperature (a) 90°C, (b) 100°C,110°C, (d)120°C

As observed in the first experiment, the wax line's consistency is not very excellent. Since figure 11 (a) shows a thicker line and (b) shows a larger wax width, none of which is suited for producing batik canting. Additionally, figure 11 shows a degree of consistency in the production of wax lines. As seen in Figure 11 at (c), a slight consistency of wax lines is seen at a feed rate of 200 (mm/min). While at (d) illustrates a slightly more uniform line with a wider line width due to the increasing temperature used.

3.1.2 Penetration rate at different temperature

The figure 12 at (a) and (b) illustrates the findings of observations of batik and wax penetration at set temperatures of 90°C and 100°C. As the feed rate increases, the resultant pattern becomes thicker and small. The arrangement of lines creates an unattractive appearance, but since it is transparent, the resultant wax is not readily apparent, as the wax is still thick and implying a low penetration rate.

The figure 12 at (c) and (d) depicts the results of observations made during the canting test using a fixedpoint temperature at 110°C and 120°C for the wax. The findings reveal that decreasing the viscosity of the wax leads in thicker lines while increasing the feed rate will results thinner lines. Additionally, the transparent results indicate that the wax penetrates the cloth is consistent. There are sections with thin and thick line patterns due to the uneven surface of the board, which causes the canting to have a depth level.



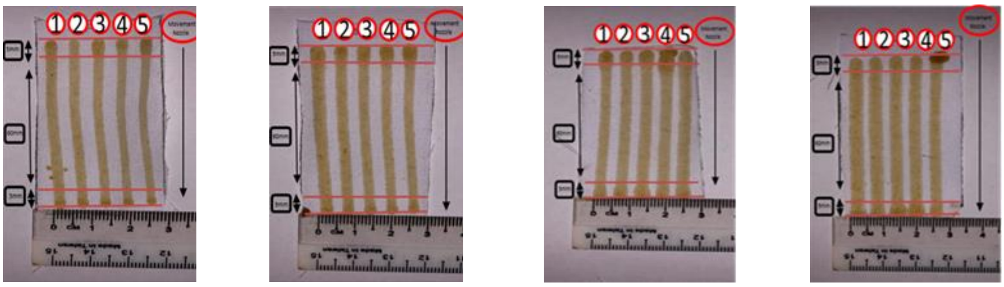
(a) (b) (c) (d)

Figure 12: Penetration rate at different temperature (a) 90°C, (b) 100°C,110°C, (d)120°C

At temperature 110°C, it produces a line pattern with a thin thickness in the canting test. At 110°C and a feed rate of 200 mm/min, it produces a line pattern that is better compare to other feed rate variations. However at 110°C, liquid wax does permeate the cloth but not steady at each feed rate, making it unsuitable for use in batik. Each feed rate has an excellent and equal penetration rate against a temperature of 120°C. On the top cloth, an wax design has been drawn. At a temperature of 120°C and a feed rate of between 100 and 125 mm/min has a more distinct pattern line than other changes in feed rate with translucency excellent and even.

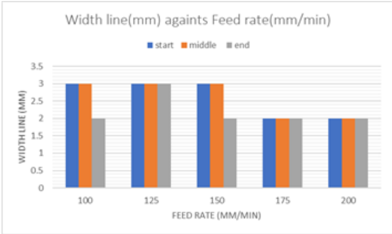
3.2 Nozzle 1mm (ND 2)

3.2.1 Flow wax for nozzle 1mm

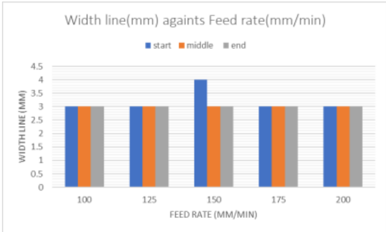


(a) (b) (c) (d)

Figure 13: Width line at temperature (a) 90°C, (b) 100°C,110°C, (d)120°C



(a) (b)



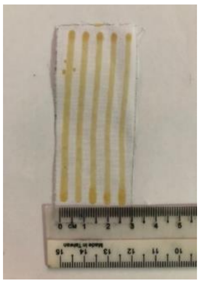
(c) (d)

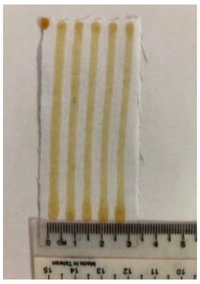
Figure 14: Width line at temperature (a) 90°C, (b) 100°C,110°C, (d)120°C

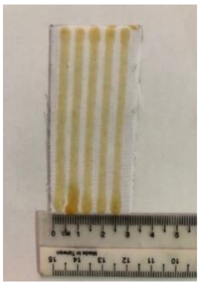
This experiment was replicated using a nozzle of 1mm. As seen in Figure 14 at (a) to (d), this method achieves better consistency and is also ideal for producing batik canting. Following that, it can be observed that the optimal temperature for wax production is 110 degrees Celsius, as shown by the resultant width and thickness being balanced. For figure 14 at (d) illustrates the consistency of the lines created, yet the width produced exceeds 3mm at a low input rate

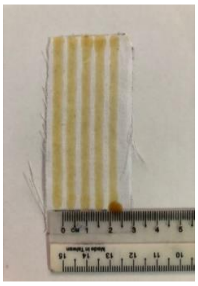
3.2.2 Penetration rate at different temperature

The figure 15 at (a) and (b) shows the results of a canting test conducted at a temperature set point of 100°C. As can be observed, the faster the feed rate is increased, the more line patterns formed shrinking and becoming slimmer. Straight-line patterns are well-formed. Transparent wax penetrates at a nice and uniform rate. The figure shows the test results using a 120°C wax temperature, the resultant pattern line is thicker than the pattern line shown in Figure. This is because the viscosity of the wax is so low.









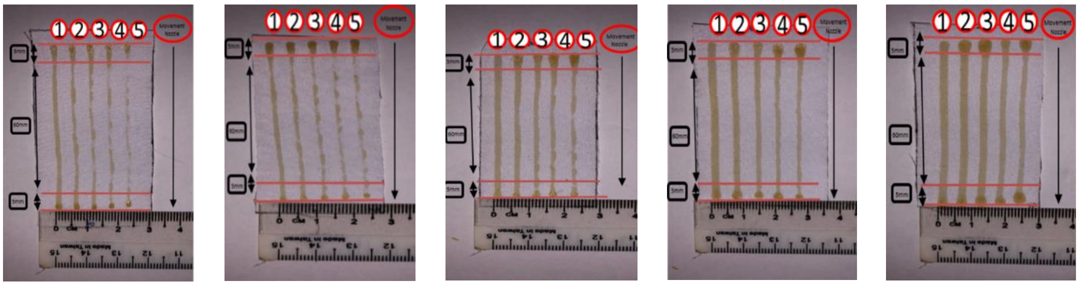
(a) (b) (c) (d)

Figure 15: Penetration rate at different temperature (a) 90°C, (b) 100°C,110°C, (d)120°

The test results are shown in Figure15 (c) and (d). This test demonstrates a high amount of penetration and consistent heating at 120°C. At 120°C, a straight pattern is more visible in the canting test with a 1mm nozzle. The resultant pattern is consistent in thickness across all feed rates. At a temperature of 120°C and a feed rate of 200 mm/min, it produces a better pattern line than other feed rate variations, making it ideal for batik patterns. It also produces a high level of translucency and evenly distributed colour.

3.3 Design selected

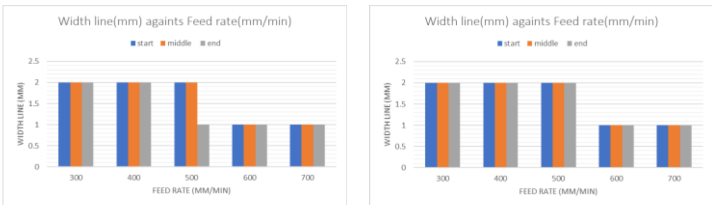
Following two experiments with nozzles of different diameters are ND 1 and ND 2 nozzles. The findings show that experiments with 1mm (ND 2) nozzles are the most suitable for producing lines in batik fabric production, as the canting line width does not exceed 4 mm. The following tests were carried out by increasing the feed rate from 300 to 700 mm/min to determine the form of the line at a length of 60 mm and the rate of penetration of the wax into the fabric.



(a) (b) (c) (d) (e)

Figure 16: Width line at temperature (a) 70°C, (b) 80°C,90°C, (d)100°C, (e)110°C

(a) (b) (c)



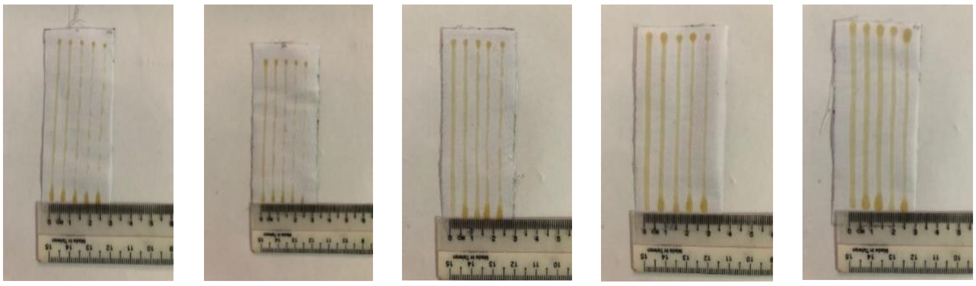
(d) (e)

Figure 17: Width line at temperature (a) 70°C, (b) 80°C,90°C, (d)100°C, (e)110°C

After completing experiments 1 and 2, proceed with the experiment by increasing the feed rate to 300–500 mm/min. Figures 16 at (a), (b) and (c) illustrate the stability of the wax line at this feed rate. However, at a feed rate of 600–700 mm/min, inconsistent wax line rates were observed in certain areas. further by raising the temperature of the wax, as seen in Figures 16 at(d) and (e), where the resultant wax line is balanced and travelling at a speed of 300–700 mm/min.

3.3.1 Penetration rate at different temperature

The figure 18 (a) and (b) shows the results of a canting test conducted at a temperature set point of 70°C, 80°C and 90°C. As can be observed, the faster the feed rate is increased, the line patterns formed become a dash-dotted line. Transparent wax penetrates shown is in not uniform rate. The figure 18 (e) shows the test results using a 110°C wax temperature, the resultant pattern line is thicker than the pattern line shown in Figure (d). This is because the viscosity of the wax is so low and the feed rate used is 700 mm/min.



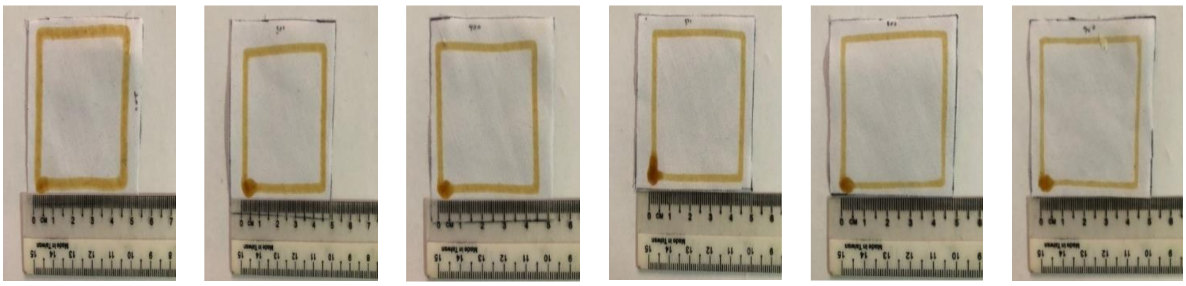
(a) (b) (c) (d) (e)

Figure 18: Penetration rate at different temperature (a) 70°C, (b) 80°C,90°C, (d)100°C, (e)110°C

The test results are shown in Figure 18 at (e). This test demonstrates a high amount of penetration and consistent heating at 110°C. At 110°C, a straight pattern is more visible in the canting test with a 1mm nozzle. The resultant pattern is consistent in thickness across all feed rates. At a temperature of 110°C and a feed rate range from 300 to 700 mm/min, it produces a better pattern line than other temperature variations, making it ideal for batik patterns. It also produces a high level of translucency and evenly distributed colour.

3.4 Experiment for continuity line

This experiment is carried out to observed the penetration rate of the wax and the line of continuity produced by the machine automatically using a temperature 110°C and feed rate range from 200 to 700mm/min.



(a) (b) (c) (d) (e) (f)

Figure19 : Continuity line at speed (a) 200mm/min, (b) 300mm/min, (c) 400mm/min, (d) 500mm/min, (e) 600mm/min, (f) 700mm/min

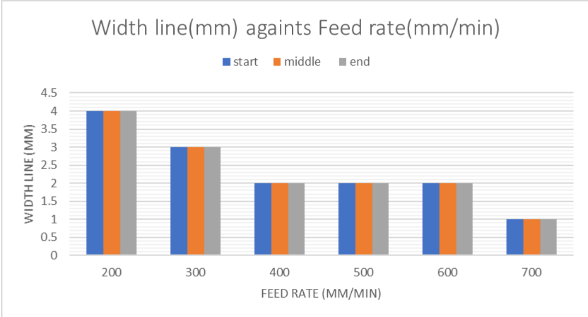
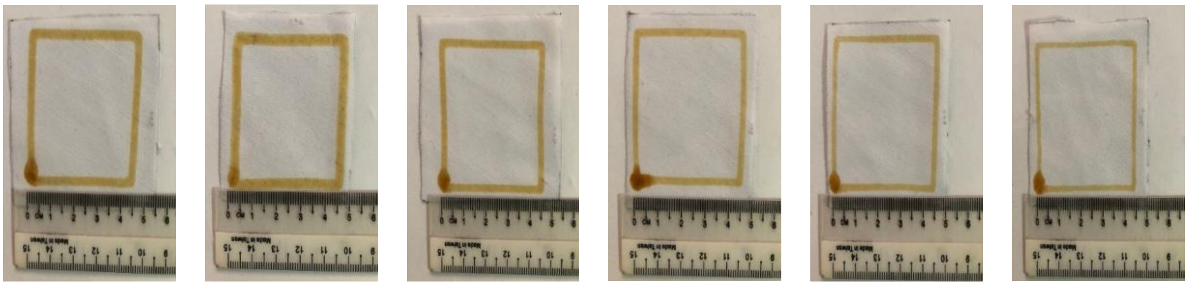


Figure 20: Width line & Feed rate for continuity line

The minimum feed rate at range of 200 to 300 mm/min the result shown the penetration rate and line produced is thicker. While at feed rate range from 500 to 700 mm/min produced a thinner line and also the penetration rate.



(a) (b) (c) (d) (e) (f)

Figure 21: Penetration line at speed (a) 200mm/min, (b) 300mm/min, (c) 400mm/min, (d) 500mm/min, (e) 600mm/min, (f) 700mm/min

As the conclusion, the result shown that by using a feed rate at 700 mm/min and at constant temperature at 110°C produced the most stable line and penetration rate for producing a canting batik. After choosing the suitable feed rate and temperature, the last experiment is being carried out with different patterns. In this experiment, figure 22 below the basic flower design is produced.

Figure 22: Basic design of batik

4. Conclusion

The following conclusions are taken from the analysis's findings: Because the community of batik workers is so used to using conventional batik production equipment, it will be difficult for them to be invited to utilize the new innovative tools. The batik community will adopt innovative tools if they really give more comfort or efficiency than conventional batik equipment. The advancement of batik production tools is mostly focused on enhancing the efficiency of the manufacturing process, rather than on improving the quality of batik items. Batik producers should be actively involved in the invention process of batik production tools so that they can identify existing difficulties and the outcomes of the innovation may be approved and implemented to batik production activities. The innovation of batik production equipment should also lead to improving product quality, not just to increase the efficiency of the production process.

In accordance to objective of this study, the following conclusions were drawn:

1. The design and fabricate pen canting tool for CNC machine is successfully done.
2. Design 3mm (Nd1) not selected being in this study because the wax line is not consistency. Due to the nozzle 3mm size is large and not suitable.
3. The nozzle design selected is a 1mm nozzle (Nd 2). Because the wax line is continuous, the optimal feed and penetration rate is 700mm/min at 110 ° C. Meanwhile, at 70 ° C, the weak feed and penetration rate are 700mm/min. Thus, a wax temperature that is too low prevents the wax from penetrating the cotton.
4. The consistency of wax flow for nozzle 1mm (ND 2) is steady. The thickness of the wax is thin and width not exceed 4mm.

Acknowledgement

The authors would like to thank the Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia for its support.

References

[1] Abdullah Z, Musa Khan S, Yahaya S R and Manap M R (2019), Ciri-Ciri Keindahan Dalam Penghasilan Rekaan Batik Kontemporari Berinspirasikan Motif Abstrak *J. Pengaj. Melayu* **30** 236–69

[2] Aljeboree A M, Alshirifi A N, Alkaim A F, Dye K, Workshop M, Features G, Methods A, Podstawczyk D, Witek-Krowiak A, Chojnacka K, Sadowski Z, Zulfikar M a., Novita E, Hertadi R, Djajanti S D, Abdel-Raouf N, Al-Homaidan a. a., Ibraheem I B M, El Haddad M, Regti A, Laamari M R, Slimani R, Mamouni R, Antri S El, Lazar S, Shi H, El-Molla M M, Badawy N a., AbdEl-Aal a. Y, El-Bayaa a. a., El-Shaimaa H M G, Uddin K, Hossain S, Jabli M, Baouab M H V, Sadok M, Aghleb R, Rashidi H R, Sulaiman N M N, Hashim N a., Legino R, Oparinde S S, Luk C J, Yip J, Yuen M C, Kan C, Lam K, Reviewed P, Access O, Quarterly P, Article O, Kaur R, Correspondence A F, Simu G M, Chicu S A, Morin N, Das N, Karthika P, Vimala R, Vinodhini V, Duruibe J O, Ogwuegbu M O C, Egwurugwu J N, Ruff K J, Endres J R, Clewell A E, Szabo J R, Schauss A G, Xing W, Ngo H H, Kim S H, Guo W S, Hagare P, Chinta S K, Vijaykumar S, Kolonko K, Zuraida S, Halim K, Hamid K, Karnib M, Kabbani A, Holail H, Olama Z, Deepika R, Venkateshprabhu M, Pandimdevi M, Abioye O P, Mustapha O T, Aransiola S a, Savin I I, Butnaru R, Bhat R P, Park D, Yun Y-S, Park J M, Jaikumar V, Kumar K S, Prakash D G, et al. (2012), Malaysian Batik Sarongs: A Study of

Tradition and Change *Malaysian Batik Sarongs A Study Tradit. Chang.* **2** 1–214

[3] Ashykin N, Aziz A, Aien N, Noor N, Muhamad S F, Hanim A and Pazil M (2016), Determining the Factors to Engage in Batik Business: A Study among Batik Entrepreneurs in East Cost Malaysia *Int. J. Manag. Sci.* **7** 273–86

[4] Haron N, Rahman N H S N A, Ramli Z, Wahab M R A, Hassan H, Zakaria R M A and Hassan S N I S (2014), Evolusi Penggunaan Blok dan Teknik Pembuatan Batik di Malaysia: Satu Pengenalan *Isu-Isu Sains Teknol. di Alam Melayu* 254–70

[5] Nordin M (2012), DESIGN AND DEVELOPEMENT OF SEMI AUTOMATIC CANTING TOOL (BODY DESIGN AND MECHANISM) 32

[6] Indarti, Rahayu I A T and Peng L H 2020 Sustainable Batik Production: Review and Research Framework **390** 66–72

[7] Nurainun N (2008), Analisis Industri Batik Di Indonesia *Fokus Ekon.* **7** 124–35

[8] Noor Haslina M A and Normaz Wana I (2015), Permasalahan Dalam Pembangunan Industri Batik Di Terengganu *Persidang. Kebangs. Ekon. Malaysia* **10** 239–46

[9] Razali H M, Ibrahim M, Omar M and Hashim S F M (2021), Current challenges of the batik industry in Malaysia and proposed solutions *AIP Conf. Proc.* **2347**

[10] Dwinugroho T B, Kumarajati D Y H, Kurniawanti and Hapsari Y T (2019), Design and Implementation of CNC (Computer Numerical Control) Based Automatic Stamp Batik Machine Program with Automatic Gripper Using Mach 3 *J. Phys. Conf. Ser.* **1254**