Technology Introduction

Installation of KMEX CVT Shaft Manufacturing Line

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1 Introduction

The vane pump for CVT is produced by KYB (hereinafter referred to as "pump") has been expanding its deployment overseas in response to the increased global demand, and we have been promoting internal production of major components in order to ensure our competitiveness. We had postponed overseas deployment of the shaft, which is introduced this review, and supplied it from Japan because we considered that it would be difficult to launch its production overseas within a short period of time, due to the facts that it requires sophisticated technologies for cold forging and that there are special processes involved, such as heat processing. In addition, The number of shaft was more than the production capacity on a global scale in FY2014, requiring us to increase the number of manufacturing lines.

The following 3 reasons convinced us to decide local procurement.

(1) KYB Mexico S.A. de C.V. (hereinafter referred to as "KMEX") expects the demand of 100,000 units per month.

(2) The Shaft manufacturing line’s quality has become stable as it was completed a consistent line.

(3) There is a possibility of raw materials being locally procured.

In addition, we needed to improve the productivity while maintaining the quality when deploying overseas, in order to achieve the following aspects.

(1) Secure the production capabilities that meet the demands.

(2) Aim to reduce cost even if the materials are locally procured.

(3) Aim to synchronize with assembly lines.

Due to the above, we established the line by reduce the cycle time (hereinafter referred to as “C.T.”) in KMEX compared to the current domestic line. In this review, I would like to introduce measures that we implemented in each process with the aim of reducing the C.T. The Fig.1 shows the target part for reference.

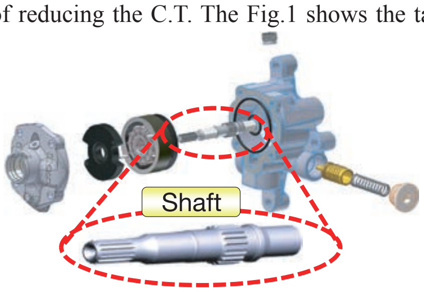

Fig. 1 Shaft for CVT vane pump

2 Implementation Contents

The Shaft manufacturing line is an automated and integrated production line, which consists in lathe process, hardening, shot blast, grinding, polishing, and cleaning process. Before we promoted overseas deployment, we needed to review the production capabilities in order to synchronize with the assembly line. The entire amount of shaft is manufactured by multiple lines and supplied to other bases from Japan, the C.T. is set so that we can maintain the quality and efficiently produce the products.

If a facility with the same production capabilities as Japan was established in KMEX, it would create unnecessary intermediate stocks. In order to avoid this happen, we needed to reduce the C.T. and achieve the production capabilities, which were equal to the integral multiple of the assembly line (Table 1). In order to reduce the C.T., we needed to maintain the quality while limiting the capital investment. We aimed to reduce the machine time of each process (hereinafter referred to as “M.T.”) based on the domestic line process method and process conditions, with which we have experience. We implemented horizontal deployment measures in processes, which had already achieved the target M.T. in Japan, and aimed to reduce the M.T. of processes that had not achieved the target M.T.

In addition, we needed to improve the setup change time in order to produce 2 models in the same line. I will also explain about this initiative.

2.1 Reducing the setup change time

With the line that produces multiple models, we needed to

Table 1 Production capabilities of the assembly line and shaft line

KYB Kanayama				
Line name	Production capabilities (Per line)	Number of lines	Production capabilities (Total)	Remarks
Assembly line	100	3	300	
Shaft line	130	4	520	Including production for overseas supply

KMEX				
Line name	Production capabilities (Per line)	Number of lines	Production capabilities (Total)	Remarks
Assembly line	100	2	200	
Shaft line	200	1	200	

*KYB Kanayama: Production capabilities of the assembly lines as 100 reduce the setup change time to reduce the non-operating time. I would like to introduce the example of this initiative.

The grinding wheels for the centerless unit requires approximately 180 minutes per change. By standardizing the grinding part for both models, we removed the grinding wheels replacement work (Fig. 2). This was something we had already been implementing in Japan, and we deployed the same initiative in KMEX.

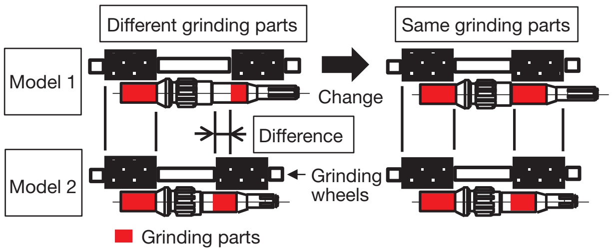

Fig. 2 Standardizing the grinding parts

2.2 Implemented measures to reduce the C.T.

In order to synchronize with the assembly line and improve the productivity, KMEX needed to reduce the C.T. Processes that exceed the C.T. needed to reduce the M.T. (Table 2) I'd like to explain how we reduced the M.T. in each process below.

Table 2 M.T. of each process

Process name	M.T.	Implementation Contents
(1) Lathe process 1		Process division
(2) Lathe process 2		Chuck change, process sequence change
(3) Heat process		Revised the cooling/transportation methods
(4) Shot process		Secured the spray amount per cycle
(5) Grinding process		Reduced the rough grinding allowance
(6) Polishing process		Secured the polishing amount
(7) Cleaning process		Increased the cleaning liquid flow

C.T. ← Reduction

2.2.1 Lathe process 1

This is the process in which the outer diameter, edge face, and center hole are made with lathes.

In order to complete the process with the target M.T., we divided one process which was made by one lathe into 2 processes. We divided the processed parts according to the process sequence, due to the facts that the finished product would be the same and that the object flow would be simple.

The parts with strict dimension accuracy were processed in the one process with the same tool. All of the units were measured within the line to confirm the processed length in order to check for fitting failures. With this step, we prevented quality deterioration caused by dividing the process (Fig. 3).

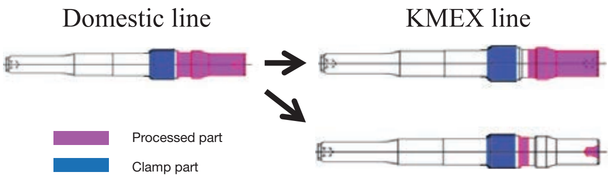

Fig. 3 Lathe process 1

2.2.2 Lathe process 2

This is the process in which the outer diameter, edge face, and center hole are made with lathes.

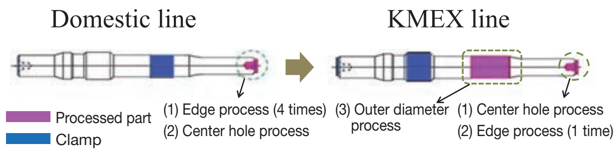

Fig. 4 Lathe process 2

By switching the work chuck mechanism and changing the process order, we reduced the M.T. As a result, we were able to incorporate part of the grinding allowance into this process.

We changed the chuck mechanism from the cam type (jump type) to the collet type, which works faster. By changing the process sequence for the edge process and the center hole process, the number of processes for the edge was reduced (Fig. 4).

Because of the incorporated grinding allowance, we changed the clamp position.

2.2.3 Induction hardening and tempering process

In this process, the surface is heated and rapidly cooled down to harden the surface.

We reduced the M.T. by changing the cooling process to ambient temperature, which is performed after the hardening process. In order to prevent burns on operators, we need to cool down the heated shaft to ambient temperature. We used to use the cooling water, which was sprayed from the hardening coil, but we changed the process so that it is cooled down on the receiving jig during transportation (Fig. 5). By changing the cooling location, we can simultaneously perform the heat process and cooling operation, reducing the M.T.

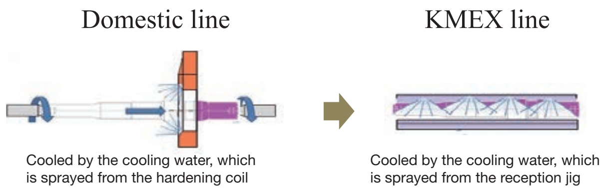

Fig. 5 Explanation of the cooling method after the heat process

2.2.4 Shot blast process

In this process, beads (polishing material) are sprayed on the shaft surface at a high speed, removing the oxide on the surface, which had adhered on the surface during the hardening process.

In order to reduce the M.T., we needed to reduce the time, during which the beads are sprayed. We increased the amount of sprayed beads per period in order to complete the process within the target M.T.

We enlarged the air nozzle diameter on the inside in order to increase the air spray amount. Due to this, the amount of beads sprayed per period also increased (Fig. 6).

This was something we had already been implementing in Japan, and we deployed the same initiative in KMEX.

2.2.5 Grinding process

In this process, the sliding part is ground in order to secure the outer diameter, circularity, straightness, and coaxiality.

We reduced the M.T. by reducing the rough grinding allowance (Fig. 7). The grinding condition, which affects the quality, is the same as the condition in Japan, in which we have already had the experience.

We incorporated part of the grinding allowance into lathe process 2 in order to reduce the grinding allowance.

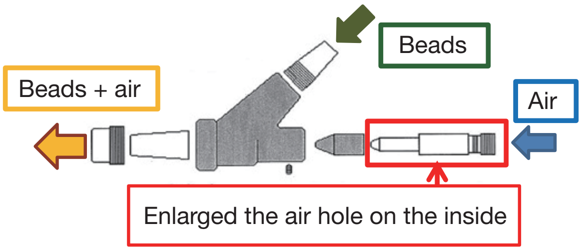

Fig. 6 Improvement method for the shot nozzle

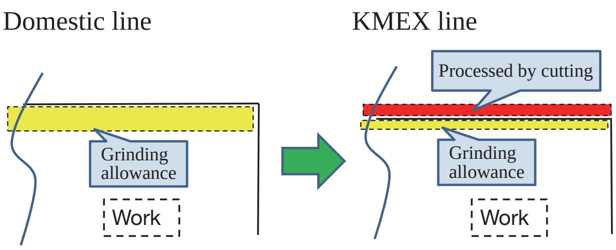

Fig. 7 Changing the grinding allowance

2.2.6 Polishing process

In this process, the outer diameter of the sliding part, which was ground, is polished in order to achieve the surface roughness.

We needed to reduce the polishing time in order to reduce the M.T. In order to complete the process within the target M.T., we increased the RPM to achieve the same polishing amount.

If the RPM is the same, the reduced process time causes deteriorated surface roughness (Fig. 8). If the polishing amount (work RPM x polishing time) is the same, the surface roughness will be the same (Fig. 9).

This was something we had already been implementing in Japan, and we deployed the same initiative in KMEX.

2.2.7 Cleaning and boxing process

In this process, the shaft surface is shower-cleaned with cleaner in order to remove the adhered contaminant.

We needed to reduce the cleaning time in order to reduce the M.T. In order to complete the cleaning within the target M.T., we increased the surface that can be cleaned per period.

The nozzle used to move to clean the entire shaft range. We increased the number of discharge ports and flow volume in order to change the method so that the entire shaft range can be cleaned simultaneously (Fig. 10).

2.3 Result

We were able to achieve the target C.T. by reducing the M.T. of each process. We completed the launch of the line in KMEX in May of 2014 as per the schedule and have had zero market claims and zero line frames.

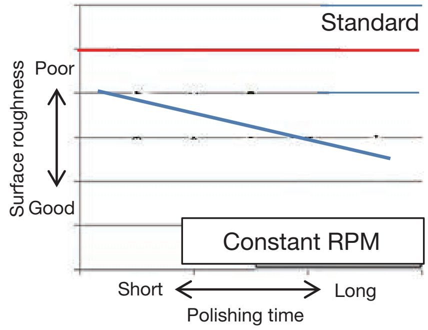

Fig. 8 Relationship between the polishing time and surface roughness

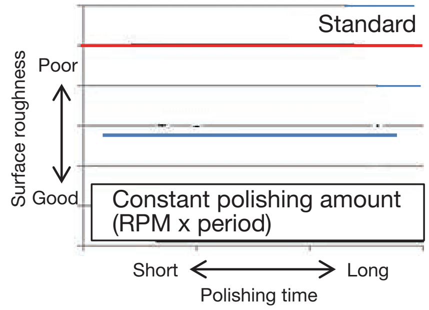

Fig. 9 Relationship between the polishing amount and surface roughness

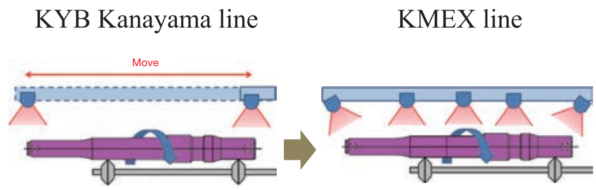

Fig. 10 Comparison of cleaning methods

3 In Closing

After KMEX, we established another shaft line with the same specifications in KYB Industrial Machinery (Zhenjiang) Ltd. (hereinafter referred to as "KIMZ") in April of 2015. With the line establishment in KMEX and KIMZ, we were able to secure the global production capabilities that we had planned. In the future, we will promote cost reduction activities, including local procurement of raw materials.

Finally, I would like to express my the deepest gratitude for everyone involved in this project who provide great support.

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