Introduction

Development of Nakanojo Factory

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1 Introduction

After a business tie-up with Kayaba Kogyo Co. Ltd. (currently KYB Co. Ltd., hereinafter referred to as KYB) in 1972, KYB-YS Co. Ltd. (hereinafter referred to as YS) began production of hydraulic cylinders in 1973. Since then, the company has been manufacturing self-distributed products. In 2009, the company shifted its main cylinder products to KCM (KYB-Cylinder-Medium pressure) products, and the current sales of the hydraulic cylinders count for about 35% of total sales of the company. So the hydraulic cylinders are now the company's core product.

The hydraulic cylinders manufactured by YS are mostly for mini shovel machines and small shovel machines and are delivered to domestic and overseas construction machinery manufacturers. The current situation of the cylinders for small construction machines is as follows:

① The company has been losing its advantage because of the improvement of the basic quality of foreign products.

② A considerable productivity increase is necessary to survive in the global market because domestic construction machinery manufacturers have begun to employ more foreign products due to the strong yen.

A new factory construction project was launched in FY2011. In FY2012, the project changed to a hydraulic cylinder CHC (Challenge to Half Cost) project. This project aimed not only to improve production processes but also to construct the world's best cylinder production factory with attention paid to the entire process from receiving materials to shipping products. In February 2016, the existing line was re-organized and a new production line was launched (Photo 1).

2 Overview of factory

The land for the new factory was bought in September 2008. The capital investment plan was suspended and re-examined after the Lehman Shock. Since March 2011, the old buildings have been dismantled, the land has been developed, and the production lines have been constructed (Table 1).

The land area is 45,576 m^2 and total floor area including product storage and material storage is 11,432 m^2 (Photo 2).

The withstanding load of the floor is 2 ton/m^2 and there are about 150 production machines in operation.

For the air conditioning of the factory, EHP (Electric Heat Pump) is used. The temperature is controlled to be 20°C in winter and 28°C in summer.

Table 1 Timeline

Item	Month/Year
Start of construction	11/2012
End of construction	7/2013
Start of A line	3/2014
Start of C line	9/2015
Start of B line	2/2016

Photo 1 Exterior of plant building

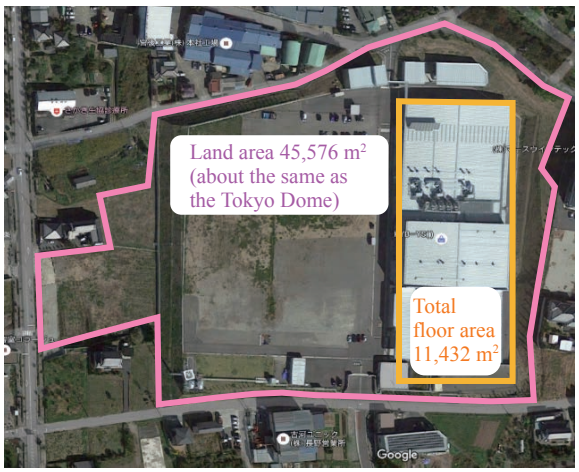

Photo 2 Complete view of plant (Google Map)

3 Concept of Nakanojo Factory

Under the concept of aiming to be the world's best hydraulic cylinder factory, the following four items were focused on.

① Organizing logistics in the factory
② Shortening production lead time and reducing intermediate products in progress
③ Energy saving at the factory
④ Making the factory environment clean

3.1 Organizing logistics in the factory

For organizing the logistics in the factory, the factory layout was determined so that materials are delivered from the south of the factory and products are shipped from the north (Fig. 1).

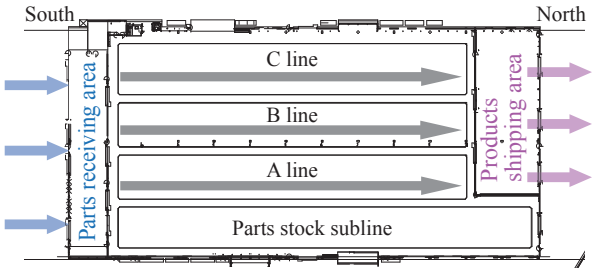

Fig. 1 Logistics line in plant

The rule of the logistics is determined as follows:

① Fixing the time of receiving and shipping items
② Setting the timing of line feed of each part
③ Bare parts transfer Note 1)
④ Parts supply from the corridor using the feed lane (Photo 3)

With the rule, we could reduce the transfer loss and decrease the number of handling steps.

Note 1) A method of feeding parts without using a tote box to avoid unnecessary empty box management (Photo 3).

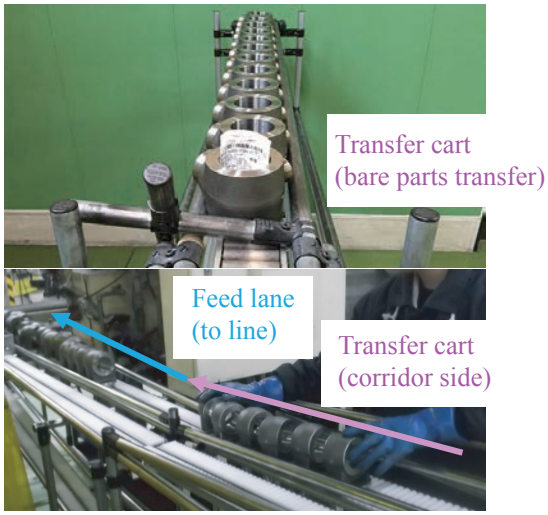

Photo 3 Bare parts transfer cart and feed lane

3.2 Shortening production lead time and reducing intermediate products in progress

The conventional type of factories have separate tube processing lines, piston rod processing lines, assembly lines, and painting lines and there are branches and confluences that could cause a lot of intermediate in-process inventory.

To solve this problem, the development of a "straight line" with the tube, rod, assembly, and painting processes being integrated was aimed at (Fig. 2).

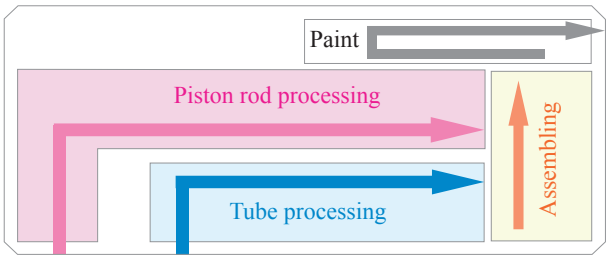

Fig. 2 Straight line layout

The following are necessary to develop a straight line.

① Leveling of facility MT
② Reduction of handling time
③ Reduction of setup time
④ Optimization of production direction (on the number of lots and timing)

A balance sheet was created for each of the products and improvement points were identified in advance. Then the existing facilities were remade to meet the specifications of new facilities.

Collaboration of the associated departments realized improvement of handling and setup processes and achievement of the target of the production line.

The tube processing line and the rod processing line were placed face-to-face to check the status of the production at any time.

As a result, the straight line (Photo 4) could be constructed. With the line we could considerably reduce the production lead time (by 85%) and intermediate in-process workpieces, which resulted in the decrease of the transport carts by more than 90%.

Photo 4 View of straight line

3.3 Energy saving at the factory

① Installation of solar power generation panels on the roof (Photo 5)
② Use of LED for factory lighting (Photo 6)
③ Installation of a compressor room on the second floor of the central factory to reduce loss of factory air pressure

The factory energy is thus saved.

Current solar power generation is up to 10 kW/h and more panels can be installed to achieve 50 kW/h.

Photo 5 Solar power generation panels on the building roof

Photo 6 LED light in plant

3.4 Making the factory environment clean

As a countermeasure against contamination, air supply and exhaust balance was taken for plating and painting and a system of keeping the room pressure positive (Photo 7) was installed to prevent dust from entering the room when the doors or shutters were opened.

A top plate was installed above the assembly line to prevent foreign objects from falling. Internal seal assembling was made in the integrated line (inside partitions) to prevent contamination.

Photo 7 Air supply system outside and inside the plant

4 Newly employed Technology Introduction

Here we introduce a technology we employed for the first time for YS hydraulic cylinders in the new production line at Nakanojo Factory.

4.1 Friction welding after plating of piston rod

Friction welding of the piston rod and rod head needs to be made after the plating to develop a straight line (Fig. 3). So the following two measures were taken.

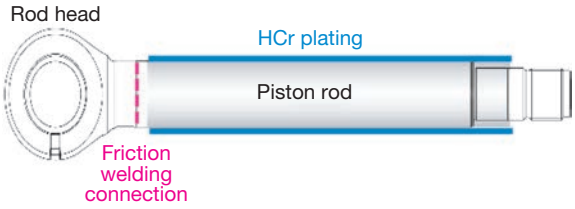

Fig. 3 Illustration of piston rod

(1) Establishment of power feed method for piston rod plating

In conventional plating, the connected width across the flat area of a rod head is used as the power feeder.

A power supply method for plating in a single item state at the new factory was studied by designing the power supply unit and power supply jig and masking shapes. After trial and error, a single-item power supply method shown in Fig. 4 was developed.

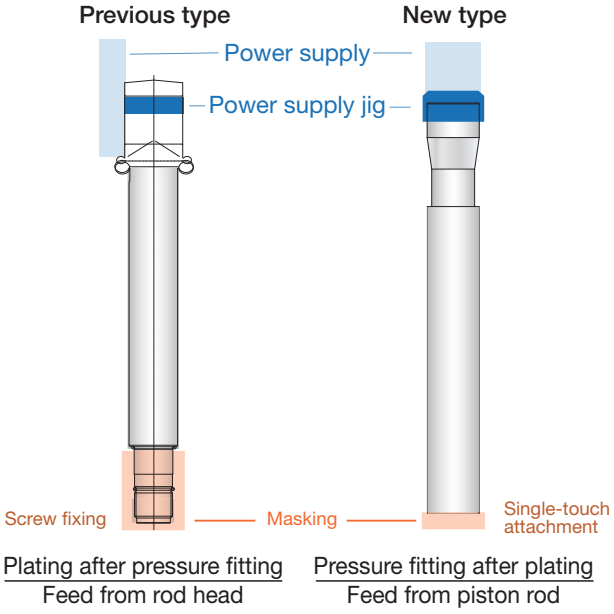

Fig. 4 Plating feeder

(2) Prevention of indentation of plated sliding part

We were concerned about the occurrence of indentation on the sliding part in the friction welding after plating.

However, indentation was prevented by changing various conditions and the material and shape of the jig.

4.2 In-house processes of induction hardening and tempering

In-house processes were developed to reduce variable expense.

Setting of the facility specifications and conditions and quality check could be done in collaboration with staff from associated departments in the KYB group and the system was launched immediately with the quality target, MCT target, and schedule target being satisfied (Photo 8).

Photo 8 High-frequency hardening and tempering

4.3 In-house manufacturing of major components of hydraulic cylinders

In-house processing of four kinds of components, namely, rod heads, pistons, cylinder heads, and cylinder bottoms was developed (Fig. 5).

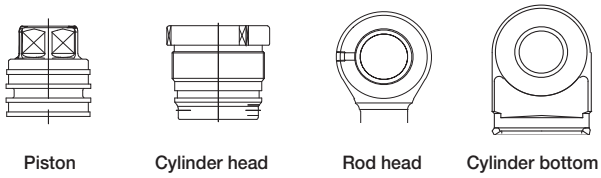

Fig. 5 Four major components

The specifications of the facilities were determined for mold turning in the mass production process by referring to the case of KYB Gifu Higashi Factory, and the group members collaboratively worked on the development of the facilities.

We followed a trial-and-error process for the way and mechanism of giving production direction so that we could establish a production system paying attention to the entire process from receiving materials to parts supply to each line (Fig. 6).

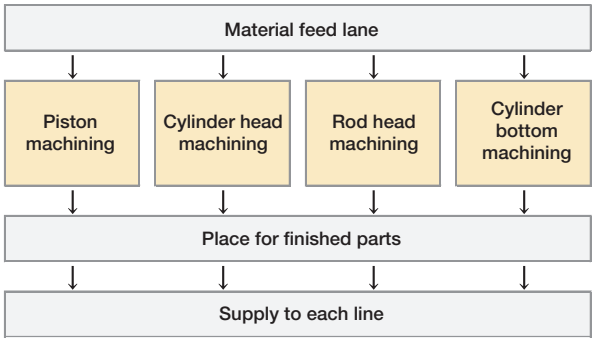

Fig. 6 Layout of component machining processes

5 In Closing

The factory construction of YS was the first one since the construction of the valve factory in 2006. However, there were no preceding cases of factory construction involving land development, line development, and line transfer. The construction project was so large and took about eight years from purchasing the land to starting mass production in all the production lines.

The entire production of hydraulic cylinders had to be maintained during the construction and launching of the factory. So, the production department manufactured the cylinders for stock and many staff members collaboratively worked on the transfer of the existing facilities in a short period of time.

In the factory construction, various laws including the building act could be complied with thanks to the support of many departments. I would like to thank NIPPO Corporation and department staff of the KYB group for their considerable support.

Author

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Joined the company in 1982.
General Manager, Product Engineering Dept., KTB-YS Co., Ltd.
Engaged mostly in production technology development for building machine cylinders and development of production systems.