Technologies to Achieve Production Innovation

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1. Introduction

The needs for the servo motor market are diversifying and changing to include high performance, high-mix low-volume production, and short turn-around times. The demands are expected to expand even further in the future, so in order to achieve customer satisfaction on servo motors, linear motors, and FA stepping motors, the construction of the new Kangawa Works was planned with the aim of becoming the No. 1 motor factory in the industry. The following describes the technologies to achieve production innovation that were used for planning the new factory.

2. Background of Efforts

The market needs are Q (quality), C (cost), and D (delivery). When planning for the new factory, we worked towards the goal of improving product quality and management level through achieving an integrated production system and revolutionizing the production control system by integrating production into a production base and supporting increased production to meet the increase in demand.

Photograph 1: 300 ton press

Photograph 2: Stand-alone automatic depository

3. Overview of Efforts

3.1 Newly introduced equipment

3.1.1 Pressing machine

In order to handle large model developed products and multiple processes on the specification side of a pressed product, a 300 ton pressing machine (photograph 1) has been added to the existing press power, which consists of ten 50 to 200 ton pressing machines. With this support, all of the pressing on manufactured products can be performed internally at Kangawa works. This eliminates the separation process and the transport of pressed products, which in turn improves productivity and greatly shortens the production lead time.

The pressing device and a stand-alone automatic depository (photograph 2) were installed at the same time. The stand-alone automatic depository performs management of loading and unloading stored press hoops and management of cutting die. By establishing the stand-alone automatic depository, management of materials and cutting die is performed correctly. In addition to improving the quality of management, this equipment helps to improve the two S's (space and safety) for the corresponding workplace by greatly contributing to effective usage of space and safe handling of heavy materials.

3.1.2 Shaft cutting / heat treating

The customer demands for motors cover a wide range of issues. In particular, there can be many different types of motors with the same functions, but with different shapes for the motor output shaft depending on the shape of the connector and the connection method. In the past, the length was set to meet the customer' s individual specifications and pre-cut materials were purchased from the material manufacturer. Therefore, management became quite complex and a vast storage space was required to store the materials that were cut to the specific lengths.

Customers demand performance from the motors that can handle the operating environment and have specifications that prevent water, oil, or dust from entering the motor. In order to achieve these specifications, a contact oil seal is usually applied between the motor output shaft and the flange. The rubber lip on this oil seal comes into direct contact with the shaft, preventing water, oil, and dust particles from entering the motor. There are restrictions on the hardness of the shaft surface and the surface roughness when installing the seal. In order to maintain the surface hardness, a heating process was required, and this process was entrusted to a cooperating company.

With the new facilities at Kangawa Works, new cutting machines (CNC circular saw (photograph 3) and CNC band saw) and high-frequency quenching machines (two different sizes, photograph 4) were installed.

A system was established so that the shaft material is stored in lengths of 6 m raw material, and the shaft is cut to the appropriate length based on the production design. Furthermore, there is verification for the workmanship of high-frequency quenching and tempering process. A microscope for verification of the metallic structure, hardness tester, and magnetic particle inspector were introduced at the same time for evaluation of the heat treatment conditions. This system was established in order to ensure the condition settings for heat treatment and the quality of heat treatment.

After cutting materials, integrated production is possible for all of the other processes, including edge processing, edge turning processing, high-frequency quenching and tempering, and grinding. This shortens the lead time and reduces the storage for cut materials, thus also reducing the material costs.

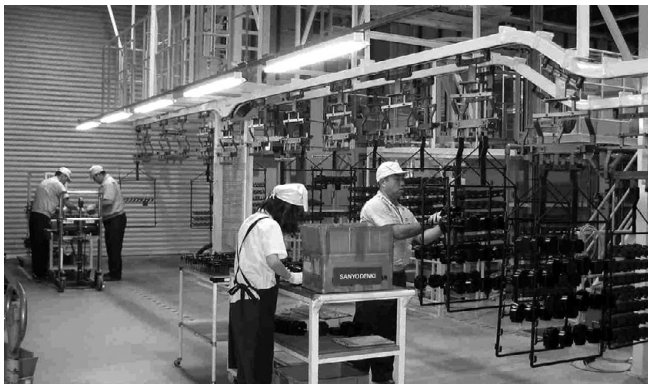
Photograph 3: Circular saw for shaft cutting

Photograph 4: Shaft high-frequency heat-treating device

3.1.3 Electrodeposition coating

Demands on the appearance of the motor are strict due to the fact that the appearance affects the value of the product. Furthermore, depending on the environment where the motor is used, there can be strict demands on the anti-erosion performance of the product. In order to solve this problem, cation electrodeposition coating is used as surface processing on parts that make up the motor, such as die-cast parts, cast metal, sheet metal, and stator cores.

The applicable targets for coating are iron and aluminum, while the size can range from a very small size to a large model. From a technical standpoint, it is very difficult to ensure coating quality with only a single device. Therefore, from the initial planning stage, we collected information about equipment or coater manufacturers and the equipment specifications, and we decided to install a cation electrodeposition coating device (photograph 5). Since we are able to handle cation electrodeposition coating internally, we can achieve stable quality in terms of coating



Photograph 5: Cation electrodeposition coating device

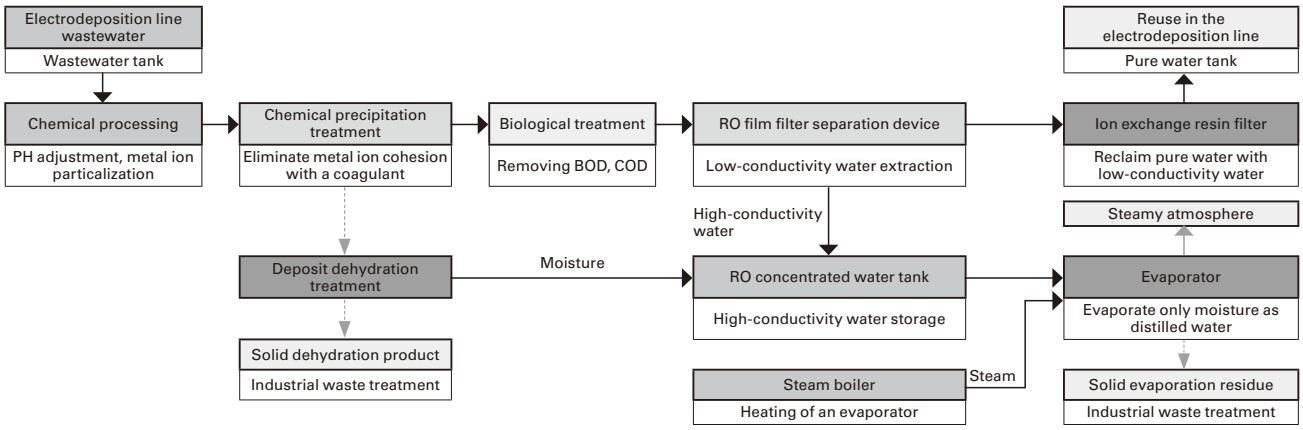


Fig. 1: Work flow for electrodeposition wastewater treatment

Photograph 6: Parts warehouse guidance system

appearance and shorten lead time.

Furthermore, by installing a device to reuse the drained water from the electrodeposition coating line (Fig. 1) and deodorization equipment on the exhaust from the baking and drying process, we created a system that takes the environment into consideration.

3.2 Development of a production control system

3.2.1 Production guidance system

The production guidance system has been expanded even further for production lines without equipment with the goals of eliminating defective products and creating a line that will not make or ship defective products.

Production guidance is a system that can create an electronic outline of operations and then display the operation procedure on the computer screen. The process starts by using a barcode reader to select the production model and input the data into a computer, where it references registered model data. The parts that are used are gathered in the special stocker set near the work space and each part is retrieved one at a time while simultaneously referencing the part and verifying the required number. Furthermore, the work procedure can be verified as the display clearly shows the tool that needs to be used in addition to displaying the operation procedure. Operations are completed after using that tool.

The above system is connected to a central production control system for the entire company. Information about the start and end of production is sent through the production control system, and the production information can be viewed in real time through this central production control system.

3.2.2 Cycle operation guidance system

In order to perform effective high-mix low-volume production for part processing using NC lathe and tapping center, we created a system that guides operators in operation order through display lamps. Processing operators remove a processed part from the chuck or tool of a device with a flashing display and place it in the next station. By looking at the relationship between the production schedule and the stock, the system analyzes which part process is required next and uses the display lamps to guide the operators in the order of pressing priority. This helps prevent problems where a part is out of stock when an operator tries to perform the next process, and it ensures that only the required number of the required parts is created at the required time. By improving the efficiency of both the devices and the operators, we realized planned production.

3.2.3 Parts warehouse guidance system

In conventional part warehouses, workers at the part warehouse collected and checked the shelf name,

shelf number, part number, and quantity based on the warehouse ticket output from the production control system. Therefore, there was a large discrepancy in the time and quality from the warehouse depending on the experience of the individual warehouse workers.

At Kangawa Works, we took the parts warehouse guidance system that was used in part at Midorigaoka Works and expanded on this system. We introduced a brand new parts warehouse guidance system (photograph 6) that combines display lamps on the rows of shelves, display lamps on each individual shelf, and PDAs (mobile information terminals). This system displays warehouse instructions on the PDA. By reading the warehouse ticket number (barcode), the worker is guided on the path towards the shelf where the required materials that were registered beforehand are stored, and then the shelf lighting guides the worker to the specific storage shelf. The worker in the part warehouse delivers the number of parts displayed on the PDA and then uses the PDA to complete the delivery. In each area, seven colors of display lamps are used so that up to seven workers can perform deliveries simultaneously. With the guidance of the display lamps, the movement distance between the rows of shelves and between the shelves is kept as short as possible, making it unnecessary for the worker to constantly check with the warehouse ticket. Even beginning workers can perform accurate delivery without confusion.

The parts warehouse guidance system is connected to the production control system, so when the process is completed on the PDA, the delivery is automatically performed. This process eliminated the need for a receipt and removes stock disparities due to oversights in the warehouse process.

3.3 Factory layout

The factory layout was designed around the following concepts: lines that flow smoothly, shortest possible movement distances from work flow analysis, and integrating redundant devices.

At Kangawa Works, the first and third floors are the production floors. A partition-less floor plan is used in consideration of the flows of materials and processes. We also used the transfer to the new factory as a chance to change the layout of all of the devices and processes. From the layout creation stage, we performed repeated analysis with the goal of improving production efficiency and set up a layout based on this concept, thus improving the flow of processes, shortening the movement distances, and improving material flow. Furthermore, the redundant devices from each factory were consolidated in order to improve both management and production efficiency.

In order to help perform layout improvements due to changes swiftly and cost-effectively, the third floor roof is shaped like a grapevine trellis (latticework roof) so that changes to the wiring and piping, such as for power and air, can be performed easily.

4. Conclusion

This document has introduced the technologies to achieve production innovation. The introduction of new equipment has started up according to plan and it has obtained effective results. The production guidance and warehouse systems are expected to develop even further throughout the factory.

We continue making efforts to become the No. 1 motor factory in the industry with the goal of improving customer satisfaction even further.

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