

Research Article

Novel Product Development for Compact Design with Customer Requirements

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Abstract

A Product design is a process which is set of technical activities within a product development process that work to meet the marketing and business case vision. The design of the manufacturing process, however considered as a part of the product development process. A product development process is the entire set of activities required to bring a new concept to a state of market readiness. Further, each product development process changes over time in response to technological and market forces. There are three phases in product development process. The first phase is to 'Understand the opportunity', second phase is to 'Develop a Concept' and the final phase is to 'Implement a Concept'. Customer requirements help us to identify the critical technical components that require change. The customer requirements, as a list of needs, each need complete with arrange of possible target values, any value of which a design team might aim to meet. The cost effective technique for rust prevention and durability is need of today's competitive engineering world. Many of the processes are used for surface treatment like surface plating, Powder coating, Painting, PVC coating. These techniques were used for coating mechanical components, construction applications, automobile, sports, electronic wires and cables. The advantage of this coatings are rust prevention, anti-bacterial growth protection, better adhesion to steel surface, good scratch finish properties.

Keywords: Product development, customer requirements, design of PVC machine

1. Introduction

The product design we should ensure consideration of each of the elements necessary for successful design and also to stimulate creative and inventive technological solutions to a requirement. (Fang, Eric *et al* 2008). The product development includes everything from the initial inspiring new product vision, to business case analysis activities, marketing efforts, technical engineering design activities, and development of manufacturing plans. A coating is a covering that is applied to the surface of an object, usually referred to as the substrate. The purpose of applying coating may be decorative surface treatment, rust prevention and durability (Nadia Bhuiyan 2011). The coating itself maybe an all-over coating, completely covering the substrate, or it may only cover parts of the substrate. Over 40 years ago, a process was developed to coat galvanized steel with a polyvinyl chloride (PVC) plastic coating to resist corrosion to ductwork in underground and other specialized exposed applications. The mechanical device that coats the outer surface of the component with a thin layer of coating material known as PVC coating machine. It has been an accepted manufacturing practice to utilize PVC

pre-coated steel coil to spin spiral pipe and to use sheets of pre-coated PVC steel to fabricate fittings. Automated PVC coating machine is a new product development in conventional coating machine, to coat the various component. By using this machine, we can coat the various components with in less time span, less man power, and less cost. so due to this machine production rate increases drastically as compared to conventional PVC coating machine. Along with that it also increases the surface finishing quality of components (Wayne *et. al* 2011).

2. Product Development

Many enterprises have been devoting a significant portion of their budget to product development in order to distinguish their products from those of their competitors and to make them better fit the needs and wants of customers. Hence, businesses should promote product scheming that could satisfy the customers' requirements since this will increase the enterprise's competitiveness and it is an essential criterion to earning higher loyalties and profits (Wayne *et al*, 2011). A new product development cannot only be pursuant to the business of the design and manufacturing capability one also has to consider the customer's needs and preferences and translate then in

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to the design map. When underdeveloped recent products, (Nikolaos, T. et al 2004) one must be completely sensitive of the needs of customers, market rivals-hip and the kind of the market as these are exact success element to unworn any product (Senthil K. Chandrasegaran et al 2012).

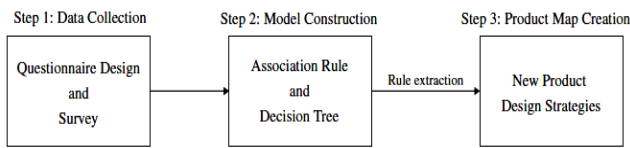


Fig. 1 New Product Development: Research Framework

3. Customer Requirements

Customer requirement is to compact the machine and to increase the production rate and also to reduce the manual labor (Jae Kwon Bae et al 2011). Customer wants the PVC Coating machine to be less bulky and compact and want less labor work to be carried out. Hence they want to increase the production rate drastically and increase the profit of their company (Lan, L., Kannan,P.K. et al 2007). Therefore, to overcome these problems, we designed “Automated PVC coating machine” to coat the various component by using this machine, we can coat the various components with in less time span, less man power, and less cost. So due to this machine production rate increases drastically as compared to conventional PVC coating machine. Along with that it also increases the surface finishing quality of components.

4. Product Details

Automated PVC Coated Machine

4.1 Methodology

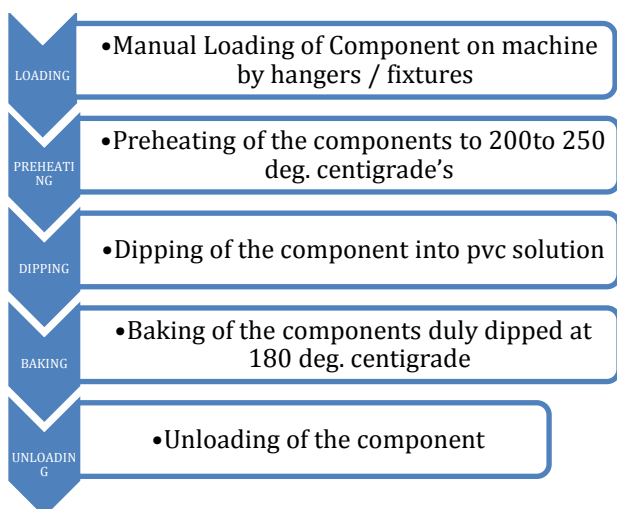


Fig. 2 Flow chart of Automated PVC coating process

4.2 Product Development & Advancement in Automated PVC Coating Machine

We are using following technology for automation of coating machine:

4.2.1 Infrared Heaters

4.2.2 Sensors

A sensor is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output. We are using Proximity sensor in our automated PVC Machine. A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. The maximum distance that is sensor can detect is defined “nominal range”. Some sensors have adjustments of the nominal range or means to report a graduated detection distance. Proximity sensors can have a high reliability and long functional life because of the absence of mechanical parts and lack of physical contact between sensor and the sensed object. Inductive proximity sensors being contactless sensors can be used for position sensing, speed measurement, counting etc. They can be used in extreme conditions such as oily, dusty, corrosive environment. Their applications ranges from automobile industries from steel industries from CNC/NC machines to material handling equipments process automation, conveyor systems, and packaging machines.



Fig. 3 Proximity sensors

4.2.3 Programmable logic control (PLC)

A programmable logic controller PLC is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures (Petruzella et al 2005). The abbreviation PLC and the term Programmable Logic Controller are registered trademarks of the Allen Bradley Company (Rockwell Automation). PLCs are used in many industries and

machines (Erickson, Kelvin T. *et al* 1996). Unlike general purpose computers, the PLC is designed for multiple inputs and output arrangements; extended temperature ranges immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed up or non-volatile memory. A PLC is an example of a hard real time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

Structure of PLC based systems

Basic components of PLC

1. Power supply
2. Central processing unit
3. Input module
4. Output module

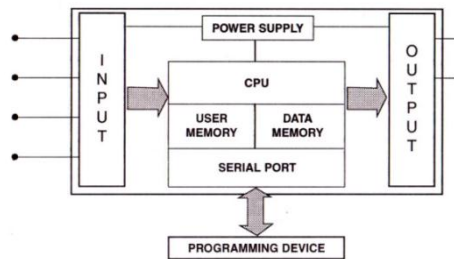


Fig. 4 Basic structure of PLC

5. Compact Design of Automated PVC Coating Machine

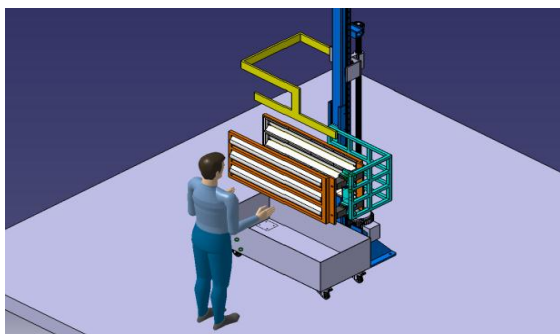


Fig. 1 Front view of Automated PVC coating Machine

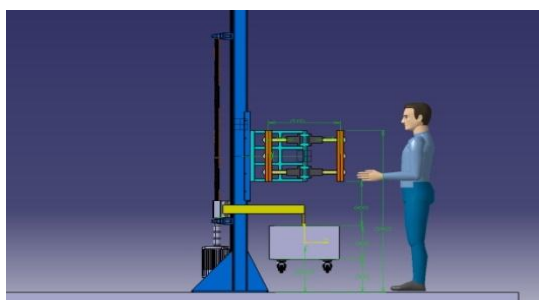


Fig. 2 Side view of Automated PVC coating Machine

6. Working Process

6.1 In-coming inspection

The parts to be coated are checked for quantity, material and surface condition. The production sequence is determined on the basis of customer specifications.

6.2 Cleaning

Cleaning surfaces are essential for the coating adhesion. For this reason, Cleaning takes place in a multi-stage ultrasonic cleaning line using aqueous alkaline baths without environmentally damaging additives.

6.3 Pre-treatment

An additional pre-treatment is required to eliminate material residues in narrow bore holes and remove porous surface layer. For this purpose, we preheat the components to 200 to 250 deg. centigrade.

6.4 Loading

Before coating, the parts are loaded on the hanger. The hanger that we have used can sustain up to 50 kg load. A defined arrangement of the parts ensures reproducible precision.

6.5 Coating

The coating is carried out with a sequence of automatically controlled and documented processes. The following process sequence typifies the automated

6.6 PVC coating technology

Dipping of the component into PVC solution.
Baking of the components duly dipped at 180 deg. centigrade.
Unloading of the components.

6.7 Outgoing inspection

This includes the testing of properties such as hardness, coating thickness and adhesion and visual inspection. In long coating runs, with an agreed number of test parts a statistical process monitoring of agreed parameters is carried out. The automated testing of mass production components is always carried out where this is economically possible.

6.8 Packaging / shipping

The coated parts are usually returned in the packaging in which they were delivered. Considerable savings are achievable if the parts are delivered packed in suitable cleaning baskets.

7. Product figures



Fig. 3 Customer Product 1



Fig. 4 Customer Product 2

8. Comparison

Table 1 Comparison between manual and Automated PVC Coating machine

Conventional PVC coating m/c	Automatic PVC coating m/c
Less production rate	More production rate
Bulky	Less bulky
Time consuming	Less time consuming
Manual operated	Automatically operated
Less accurate	More accurate

Conclusions

All over the world, engineers are in the automotive industry working in a excess of roles, on a difference of components and systems, and in different types of companies. As in many industries, advances in engineering are the essential to fight in the automotive industry. Customer needs and wants are sensible and difficult. If affirm can understand them while developing a new product and make use of all knowledge management concepts make efforts to fulfill purchaser demands and supply favorable service, then customers will be more supportive by using various technologies, we developed the Automated PVC Coating Machine, which can fulfill customer’s requirements.

We here by conclude that this is best technology for compact machine, which can fulfill the objectives such as cost effective technique for rust prevention and durability which is need of today’s competitive engineering world, increase hardness of the component, automatically operated hence time saver, labor reduction, rust prevention & increasing production rate.

References

J. Nadia Bhuiyan (2011), A framework for successful new product development, 4(4), pp. 746-770.

Wayne D. Hoyer, Rajesh Chandy (2011), Matilda Dorotic, Manfred Krafft, and Siddharth S. Singh, ‘Consumer Cocreation in New Product Development’, *Journal of Service Research*, 13(3), pp. 283-296.

Dr. Amue, G.J., Kenneth C. Adiele(2012), New Product Development And Consumer Innovative Behaviour: An Empirical Validation Study, *European Journal of Business and Social Sciences*, 1(6), pp. 97-109.

Senthil K. Chandrasegaran, Karthik Ramani, Ram D. Sriram, Imr’e Horv’ath, Alain Bernard, Ramy F.Harik, Wei Gao(2012), The evolution, challenges, and future of knowledge representation in product design systems, *Computer-Aided Design*, 45, pp. 204-228.

Jae Kwon Bae a, Jinhwa Kim (2011), Product development with data mining techniques: A case on design of digital camera, *Expert Systems with Applications*, 38, pp.9274–9280.

Nikolaos, T., Erik, J.H.,and Susan. H. (2004), Navigating the New Product Development Process, *Journal of Industrial Marketing Management*, 33, pp. 619-626.

Lan, L., Kannan, P.K. and Ratchford, B.T. (2007), New Product Development Under Channel Acceptance, *Marketing Science*, 26(2), pp. 149-163.

Fang, Eric (2008), Customer Participation and the Trade-Off between New Product Innovativeness and Speed to Market, *Journal of Marketing*, 72 (4), pp. 90-104

Temperature sensor and control Devices | Analog Devices, www.analog.com Retrieved 2015-11-24.

Home–Analog Microchip Technology Inc.,www.microchip.com. Retrieved 2015-11-24.

Erickson, Kelvin T. (1996), Programmable Logic Controllers, Institute of Electrical and Electronics Engineers.

Petruzella, Frank D. (2005), Programmable Logic Controllers, Tata McGraw-Hill Education.

Technology Guidebook for Electric Infrared Process Heating ,Cincinnati: Infrared Equipment Association ,1993. Battelle Columbus Division, Electric.

Heraeus, Understanding Infrared Heating, Heraeus Noblelight, Retrieved 25 July 2013.

Nook Industries, Inc., Acme and lead screw assembly glossary and technical data.