

Development of Scientific Packing/Packaging Process for the Dispatch of Machined Castings for Export Market

Sushil Astekar

KLS Gogte Institute of Technology, Udyambag, Belagavi, Karnataka, India

Abstract: *Packaging is a technology of enclosing and protecting the product during sale, distribution, storage and use. Packaging is very essential to any and every type of industry. Whether in the food business, clothes manufacturing or in the technology industry, packaging is crucial. It protects the product from any potential damage that will deem the product useless. Packaging facilitates material handling, transportation and various other activities. Thus, a good packaging system is a must. The entire production activity is a waste if the product is damaged due to the inexistence of a good packaging system.*

Keywords: Cell packing, Sacrificial anode, VCI packing, Corrosion, Reusable

1. Introduction

Packaging is the art, science and technology of preparing products for market. The Packaging Institute International (PII) defines packaging as the enclosure of products, items or packages in a wrapped pouch, bag, box, cup, tray, can, tube, bottle or other container form to perform one or more of the following functions: containment, protection, preservation, communication, utility and performance. If the device or container performs one or more of Industrial packaging is used to package a product during or after the manufacturing process. Industrial packaging differs from other types of packaging in the level of protection it provides for extended storage. Attention is given to the thickness and strength of the material that is used, as well as to closure and secure locking mechanisms. Overseas packaging is geared towards the protection, handling and transport of commodities by air or sea freight and, as such, shares many characteristics with export and transport packaging. There are variety of functions of packaging like, to keep the product together, to identify the product, protect it during transport, stacking and storage, printed information and cost-effectiveness. In whole packaging process is mainly classified into three parts: Primary Packaging[It is the packaging in direct contact with the product itself and is sometimes referred to as consumer or retail packaging], Secondary Packaging[This contains two or more primary packages and protects the primary packages from damage during shipment and storage], Tertiary Packaging[This packaging facilitates the protection, handling and transportation of a series of sales units or secondary packaging in order to group everything into unit loads during transit].

2. Indian Packaging Industry

India has the second largest GDP among the emerging economies based on purchasing power parity (PPP). The country is the 4th largest economy in terms of purchasing power parity (PPP). The packaging industry in India is one of the fastest growing industries which has its influence on all the industries, directly or indirectly. The Indian packaging

industry is growing continuously. The total worth is about USD 24.6 Billion. The average annual growth rate is about 13-15%. However, there is great growth potential since India's per capita consumption of packaging is only 4.3 kg whereas the neighboring Asian countries like China and Taiwan show about 6kg and 19 kg, respectively. This clearly indicates that there are many commodities which need to be marketed in packaged condition and thus, a great business opportunity stands for the Indian Packaging Industry. Package development considerations in India are, environmental considerations, percentage cost of packaging and shipping environment hazards.

I carried the research in Allied Founders PVT. LTD. is an ISO 9001:2015 certified company producing high quality industrial castings since 1968. They are one of the oldest foundries in a city of Belgaum, Karnataka India. They are manufacturers and exporters of Cast iron, Ductile iron precision machined components and assemblies to original equipment manufacturers (OEM'S) throughout the world. They offer ready to assemble or assembled sub-assemblies to our customers. They export 95% of our production to several countries. They have been exporting to USA, Germany, Canada, Spain, France Brazil, UK, Dubai, etc. On paying visit to the above industry several times and going through their packaging process we decided to makes in improving their packaging of 5 series bracket and 2 inch NRV products. We selected these products because the bracket and the NRV are available in various sizes, the same packing process can be extended to the different sizes by varying the box sizes or the number of components per box. The present status of packaging in this industry was use of wooden planks, nails and PVC bags to prevent products from corrosion. The packaged castings are placed in the carrier with the help of an overhead crane. Requirements of export market were nail-less boxes, non-corroded products, no external damage to the box, no fungus on the box, no oily substances to be applied on products, air tight packing. Some other requirements from cargo perspective include limitations on box size and net weight of the box with components.

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3. Packing Material

Wood [it is the porous and structural tissue found in the stems and roots of trees and other woody plants. It has been used for ages as fuel, construction and packaging material], Plywood [it is a sheet material manufactured from thin layers or "plies" of wood veneer that are glued together with adjacent layers having their wood grain rotated up to 90 degrees to one another], Corrugated fiberboard [it is mostly used as a material for one-way packaging mainly because of its fairly low price. Corrugated fiberboard consists of a corrugated layer called fluting, glued by a material usually made from maize starch to the liners], Plastic, Crates and Pallets[they act as secondary wrapping and keep the actual goods safe until they are delivered], Shrink wrap [it is used as both/either primary and secondary packaging], Vacuum packaging and cushioning materials[foam,coir].

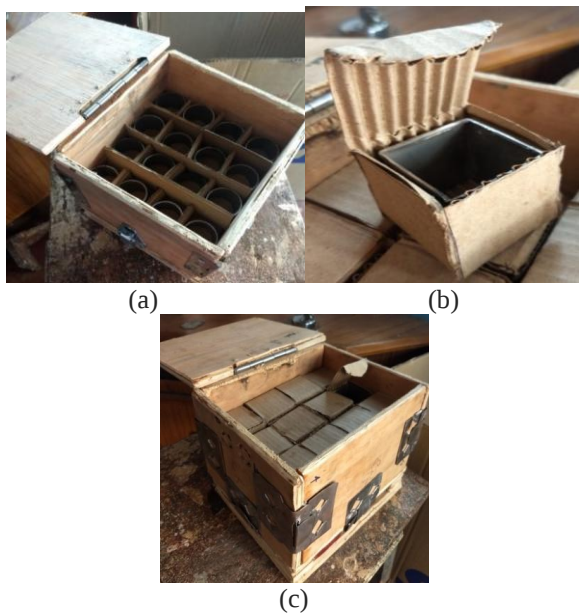


Figure 1: (a) Individual Component Packing (b) Many Cells Packed Together in One Cell (c) Partition Using Corrugated Cardboard

4. Methodology

4.1 Study of Different Castings

The Allied Founders Pvt. Ltd. Belgaum manufactures various Cast iron, Ductile iron precision machined components, assemblies and sub-assemblies for Pump components, Elevator castings, Valve castings, Gear Box castings, Compressors, Pulleys, Wheels, etc. All the different components were studied and information on each component regarding its export, design considerations, sizes, etc was gathered.

4.2 Selection of Part Families

Products were selected based on factors like maximum export, destination, company, packaging requirements, box dimension. Keeping these factors in mind, the following components were selected: 5 Series Motor Bracket and 2" NRV (Non-Return Valve).

4.3 Limiting the Box Dimensions

Since there is a limit to the weight of the box from cargo perspective i.e. the box cannot exceed 900kgs, the number of castings per box was calculated as
And accordingly the size of the box was finalized as

$$\text{No. of castings} = \frac{900 - \text{Weight of the box}}{\text{Weight of one casting}} \quad (1)$$

36x36x32 for the 5 series bracket
38x36x24 for the 2" NRV

4.4 Identification of the Problem

The careful examination of the current packing process brought us to a conclusion that the nails used to make boxes could lead to damage of the box itself and be injurious to the worker. It also prevents the box from being reused. The VCI is quite expensive resulting to the overall increase in cost of packing process.

4.5 Study and Selection of Packing Materials

I studied the various packing materials that could be employed by carrying out research through the internet and various other sources but since the alternatives available turn out to be expensive, add to the existing inventory and also the fact that customers do not pay for expensive packing, I decided to use wooden boxes to pack the components.

4.6 Study and Selection of the Packing Patterns

On studying the various packing patterns available like Cell Packing and use of corrugated sheets for portioning and decided to employ these in our proposed packing process.

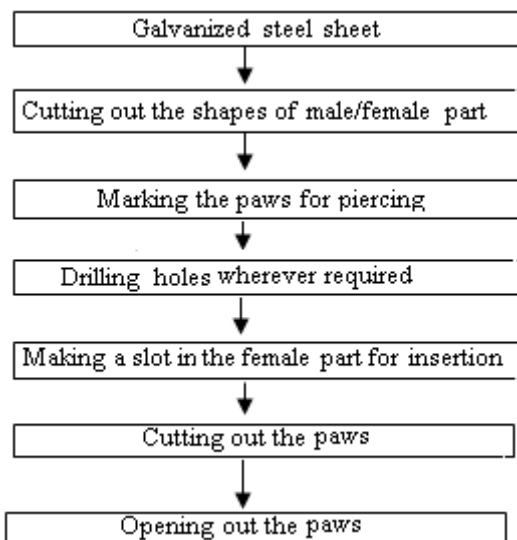
4.7 Fabrication and Test

To eliminate the use of nails I discovered that I could substitute nails with clamps. I used galvanized steel to make these clamps. Further we scaled down the box by a factor of 5 for modeling it. The fabrication was carried out in the college premises at the basic workshop. Steel pipes of appropriate dimensions were used as dummies to represent the castings in the packaging process. To prevent corrosion I have proposed the use of zinc anode to be connected with the casting. This process is termed as Sacrificial Anode Method.

5. The Proposed Process

5.1 Elimination of Nails

Since the problems associated with nails are quite a lot as discussed earlier, an alternative suggested is the use of clamps. The clamps are made using Galvanized steel.



Flowchart 1: Flow Chart showing the process of making clamps

5.2 Fabrication of Clamps

A rectangular sheet of Galvanized steel is cut out. The male part shape and the female part shape are drawn and cut out. Commercially this can be done using a combination press tool designed for blanking and piercing.

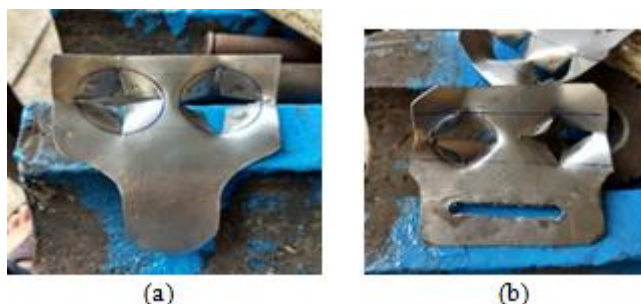


Figure 2: (a) Male Part of the Clip (b) Female Part of the Clip

5.3 Piercing Clamps to the Plywood

This can be commercially done using a hand press tool. As this was not available, so I used a bench vice to do the same.



Figure 3: Clamps Fitted to the Plywood

5.4 Assembling the Box

All the sides that make up the box should be fitted with correct pairing of clamps. This ensures that each corner gets one male and one female part to mate. Such pairs must be present at the four corners of the box to make up the four sides. Also, the same must be present for the base. Once all

the sides match the protruding male part of each clamp is to be inserted into the slot present in the female part. Then the protrusion should be bent backwards to ensure secure bonding and a close fit of the sides. The number of clamps per side depends on the size of the box.

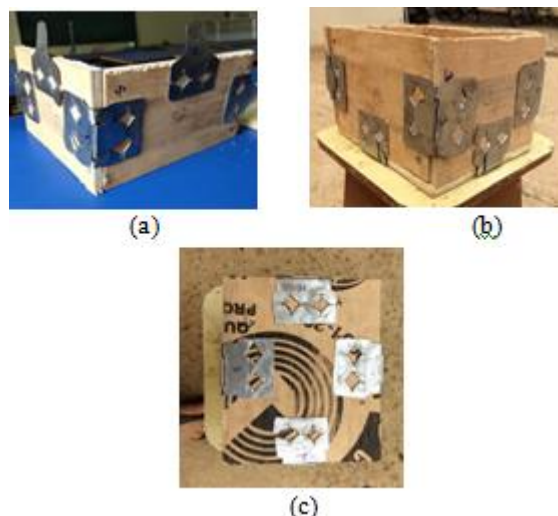


Figure 4: (a) Assembled Sides of the Box (b) Assembled Sides and Base of the Box (c) Assembled Base of the Box

6. Elimination of VCI bag

Due to the high cost of VCI bags my proposal is to use the sacrificial anode method where the anode which is connected to the component gets corroded instead of the product getting corroded. Sacrificial Anodes are highly active metals that are used to prevent a less active material surface from corroding. Sacrificial Anodes are created from a metal alloy with a more negative electrochemical potential than the other metal it will be used to protect. The materials used for sacrificial anodes are either relatively pure active metals, such as zinc or magnesium, or are magnesium or aluminum alloys that have been specifically developed for use as sacrificial anodes

6.1 Experiment

To analyze the effect of the sea water on the packed box, I tried to simulate the sea conditions. 30litres of Sea Water was placed in a tub. The top of the component in the box was connected to the zinc anode to protect it from corrosion. The box was sealed and kept close to the sea water tub for 30 days in a room with less light and a fan. After 30 days the box was opened and inspected to check if the component was intact.

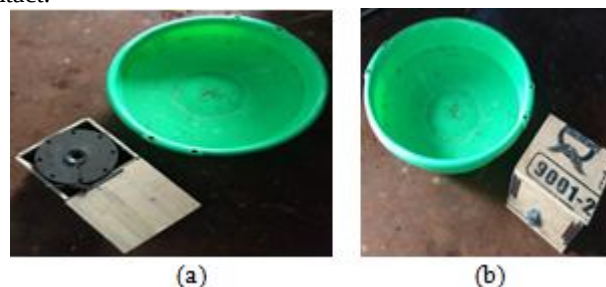


Figure 5: (a) Experimental Setup with Box Open. (b) Experimental Setup with Box Open

6.2 Result of Experiment

When the box was opened after 30 days the following results were found:

The zinc anode had corroded.



Figure 6: Corroded Zinc Anode

The top of the component which was connected to the zinc anode was free from corrosion, whereas the bottom which was not connected to the zinc anode had corroded.



Figure 7: Corroded Base of the Casting

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7. Results

The proposed box results is less use of plywood, eliminates the use of nails making it reusable. The clamps used can be easily opened using the right tool and is not hazardous to the worker. Also, the use of a sacrificial anode eliminates the use of VCI bag to avoid corrosion. Cell packing and the use of partitions protect the components from damage due to metal to metal contact. This makes the packing Contactless, Clean, and Corrosion-free.

8. Conclusion

The conventional packaging system was studied and analyzed. The need for an improved scientific packaging process was realized. Providing scientific packaging solutions for the product rejections problem is the idea of this project. Providing scientific packaging solutions involves extensive analysis of the packaging materials and raw materials, packaging process presently followed container design options, etc. It is concluded that by implementing the proposed packaging container, there was significant improvement in the packaging function in terms of various parameter