Automated Vacuum Impregnation Enables Transmission Production

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As consumer expectations have become increasingly sophisticated, luxury automotive manufacturers have pushed the envelope on what's possible. Include government regulations that have become more stringent and it is a challenging, increasingly competitive landscape. With that, it's a landscape that rewards companies who can identify opportunities to adapt appropriately.

One such example is a manufacturer's new 7-speed transmission case. The focus of its development is to increase its efficiency, reduce fuel consumption and CO_2 emissions. While this transmission has significant benefits, there is a challenge with the aluminum alloy used in its manufacture: porosity which could lead to field failures.

The Challenge

When the transmission case program was launched, the automotive manufacturer required 100% of the parts to be sealed through vacuum impregnation. If the porosity is not sealed, fluids or gases may seep from the part when under pressure. Parts that leak fluids or gases would be rejected, increasing costs and causing production delays.

Cleanliness standards require no sealant on the part surface or machine features. This is very difficult to achieve since the transmission case has over 1,500 machined features. The automotive manufacturer needed a solution that would meet the quality and cleanliness requirement while being able to meet global production.

The program was launched with a vertically integrated tier 1 European supplier who pours the metal, machines the components, and then sends the components to the OEM for assembly. Similar programs were previously outsourced to local vacuum impregnation vendors. This new program could not be outsourced due to the following two challenges that previous impregnation vendors could not address:

Logistics

Outsourcing vacuum impregnation is not viable since it will cause difficulties in transportation costs and part handling. The volume of parts being sent between the foundry and impregnation vendor will inhibit the production flow.

Part Contamination

The previous impregnation vendor used a standard vacuum impregnation batch system. A common problem with batch systems is part contamination. After impregnation sealant remained on the surface and machined features.

To the OEM and tier 1 supplier, the sealing technology previously used limited what was possible in vacuum impregnation. With the impending launch of this new transmission case, a better approach was needed.

The Solution

The tier 1 supplier reached out to Godfrey & Wing, and presented its vision. Godfrey & Wing responded with the Continuous Advanced Powertrain Impregnation (CAPi) System.

The CAPi is custom designed system based on Godfrey & Wing's Advanced Powertrain Impregnation (APi) and Continuous Flow Impregnation (CFi) systems. The technology of these patented systems permits integration of a fully automatic impregnation process into a modern, lean production environment. This is done without any manual intervention. This concept is a departure from the manual approach of existing batch impregnation systems. The CAPi enables the part manufacturer to bring vacuum impregnation in-house, rather than relying on a third party vendor.

***Figure 1** – The CAPi is a fully automatic impregnation system that enables manufacturers to bring vacuum impregnation in-house.*

The CAPi system requires 22 square meters without any infrastructure changes. In comparison, a standard batch system requires 743 square meters in an excavated space. The CAPi is capable of processing over 200,000 parts per year, while a standard batch is capable of processing approximately 15,000 parts per year.

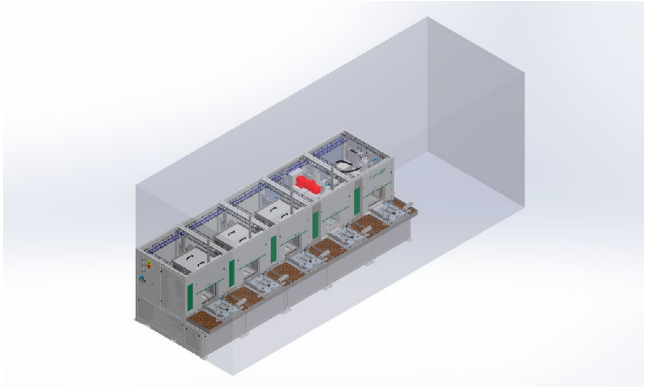

***Figure 2** – The CAPi requires 22 square meters, while a standard batch system (highlighted as the grey box) requires 743 meters.*

The CAPi uses Godfrey & Wing's patented Dry Vacuum and Pressure (DVP) impregnation process. Demonstrated to be the most effective process in the world, the CAPi DVP process incorporates a fast, deep vacuum to evacuate the air from the casting porosity. This enables the sealant to completely flow into the porosity without any interference. Once the part is submerged in sealant, the system applies high pressure to allow the sealant to thoroughly penetrate deep into the casting.

To further help the customer achieve its goals, the CAPi featured:

Automated Production

The system was designed with a 7-axis robot for parts handling. It forms the interface between the impregnation system and processing line. After impregnation, the parts are fed by the robot directly to fine washing. The automation enables a shorter cycle time and eliminates the risk of part damage due to operator mishandling.

Since the CAPi is self-contained for quality, the castings do not leave the system until meeting all of the pre-determined conditions. If acceptable, then the robot will move the castings from the CAPi to the next process.

Single Piece Part Flow

Fixtures are designed so that sealant can flush from blind holes and taps, and protect critical machined features. The spray-flood cleaning technology in combination with media filtration ensures residue-free, clean components. Processing one part per fixture ensures that the part is sufficiently washed. This ensures that all 1,500 machined features are free of contamination.

Part Traceability

The process data for each transmission is processed and attached to the part serial number. This enables product traceability throughout production.

***Figure 3** – The CAPi's single piece flow ensures all 1,500 machined features are free of contamination.*

During the first year after installation, the initial data shows that the CAPi is achieving the OEMs goals.

- Scrap from porosity has been virtually eradicated with the CAPi delivering a First Time Through (FFT) rating of over 99%. The standard FFT of a batch is approximately 85%. This means that 99 out of 100 parts impregnated are acceptable after the first impregnation cycle.
- The CAPi has completely eliminated part contamination. The single piece part flow and fixture design flush sealant from the 1,500 machined features. This ensures that sealant residue is not on any critical features.

In addition, the CAPi has had a positive financial impact:

- Fixed cost savings are realized since the system requires minimal square footage, and reduces floor space required to house WIP.
- Operating cost is 70% less then when outsourced.

***Figure 4** – The CAPi is delivering a First Time Through (FFT) rating of over 99%.*

Closing

Godfrey & Wing's automated CAPi system is the only system that can meet the stringent quality and production demands. The system creates a competitive advantage by achieving nearly 100% sealing rate of porous aluminum casting that are clean and damage free.

The CAPi reflects Godfrey & Wing's goals of modern vacuum impregnation systems are being tailored to meet its customer's demands. Companies can take control of porosity sealing and integrate vacuum impregnation into their production flow to ensure quality and the integrity of their bottom line. The CAPi reflects an approach consistent with the manufacturer's principles of forward thinking designs.

About the Author

Andy Marin is the Marketing Coordinator for Godfrey & Wing. He received a B.S. in marketing from John Carroll University and an MBA from Cleveland State University. He joined Godfrey & Wing in 2016, and manages the company's marketing operations and communication.