Rosti's In Mould Decoration (IMD) Journey

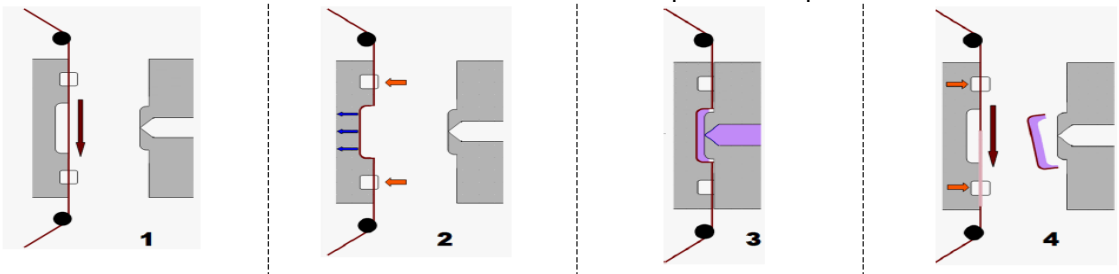
Rosti demonstrates its concept to reality philosophy with in mould decoration (IMD) manufacturing

Within the field of injection moulding, in mould decoration is not a new technology. In fact it has been used for decades in a number of industries, typically within the automotive and electronics sectors.

For Rosti the journey into this realm started with a close analysis of the significant resources dedicated to post process decoration. This activity resulted in a much longer supply chain and increased the potential for defect risks into the process. Engineers at Rosti turned their attention to in mould decoration (IMD), a vertically integrated decoration process that could achieve the current part specifications, reduce operational costs and streamline the production process.

What is IMD?

Essentially in mould decoration (IMD) is a process for decorating injection moulded plastic parts or components during the plastic injection moulding cycle. The decoration is an integral part of the final product, creating a fully decorated item at press. In this process, (1) a pre-printed label or decorated film is inserted in the open plastic injection mould and (2) held in place via vacuum ports, electrostatic charge, or other method. (3) When the mould is closed, plastic resin is injected into the mould, encapsulating the artwork permanently within the finished part. (4) A new pre-printed label or decorated film is inserted as the decorated plastic component is released.



Difference between IMD and IML

There is a certain degree of misalignment surrounding in mould decoration and in mould labelling and the terminology used between customers and suppliers tend to differ. Rosti's approach is very clear;

- In mould decoration (IMD) – is a reel to reel process with a continuous printed ink on a polymer carrier.
- In mould labelling (IML) – is the application of die-cut labels that are introduced to the moulding process.
- The critical difference is that decoration material for IMD is a continuous process and for IML it is part by part.

The engineering challenge

The Rosti way was to assess risks and potential failure modes and effects, the outcome yielded significant challenges which lead to Rosti treating this initiative as an exploratory technical development project completely separate from the usual main stream new product introduction programs.

The main challenges revolved around: stretch ratio, resin and part flow length.

	Design guide	Rosti part
Stretch ratio	≤20%	≈45%
Resin	High flow Low temperatures	Low flow High temperature
Flow length	1.0:50	1.0:175

Table1: critical to quality (CTQ) factors

1. Stretch ratio: percentage increase of part profile with reference to the flat foil
2. Resin: component substrate, optimal condition is to enter as slow and as cool as possible to reduce ink defects at the gate location.
3. Flow length: this is a ratio of the component wall section against the length from gate to end of fill. The optimal is to be as short as possible so the temperature and pressure gradient is as uniform as possible over the decoration length.

Overcoming the challenges

These challenges were overcome by Rosti pulling together all partners involved, resin suppliers, equipment suppliers and decoration foil suppliers. The critical to quality items above were overcome through digital simulation and analysis. This reduced physical resource and costs to optimize the development cycle to reach market as quickly and cost effectively as possible.

1. **Stretch ratio:** Rosti part had complex three dimensional curves both in line of flow and cross flow. Geometric splices were made to assess the high and low stretch areas;
   - High stretch areas are important to understand how Rosti can reduce the impact on the foil
   - Low stretch also important to understand how to prevent wrinkles where the geometry transitions from high to low stretch sections
2. **Resin:** Rosti part was a Polybutylene terephthalate (PBT) + glass fibre content, this is a high temperature engineering polymer.
   - The resin was considered as a constant, the critical to success factor here was Rosti's advanced injection mould flow simulation ability, optimizing the temperature and pressure at the gate area. Iterations and optimizations on cooling/gate design/etc. were verified digitally at a fraction of the cost/time of traditional physical trials.
3. **Flow length:** Rosti part was 1.2mm wall section over a length of 210mm.
   - The thin wall geometry coupled with the resin resulted in high injection temperature and pressures. Rosti's digital analysis experience was again a major advantage in this feasibility analysis. Key actions were to profile injection conditions to ensure uniform filling conditions to simulate the decoration performance with foil.

Rosti's conclusion of the digital development and the hundreds of scenarios that were run delivered a high success confidence to be achieved which enabled physical tooling and development to be started. From point of launching steel tooling to having proof of concept and production part process approved was less than 3 months. This was only possible through the deep understanding of the process difficulties and building robust simulation models to work through all potential scenarios to optimize tool, process and automation design. This process/project shows the commitment to innovative technology development and the boldness to proceed into a project like this when the experienced market leaders were openly stating that this is a high risk low success application. With attention to detail and the drive of the development team the result was a perfect example of Rosti's concept to reality philosophy.

Customer advantages of IMD

- Freedom of design – with IMD customers can achieve much more elaborate and bespoke patterns than can be achieved with mass production painting
- Due to the continuous process that is employed by Rosti and the elimination of secondary operations the supply chain can be significantly reduced
- No secondary operations are required, eliminating post moulding decorating labour and equipment costs
- Each product is a saving upwards of $1.5US, given the volumes this represents a significant customer saving
- High tech solution that is difficult to copy/counterfeit, this process requires significant development and the production tolerances are very tight