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Application of In-Mold Decorative Injection Technology in Cosmetic Containers

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Abstract

Recently, with the improvement of living standards, cosmetics have gradually become a part of the necessities of life, and are inseparable from life.Due to the increasing consumption demand; the appearance quality and design of cosmetic containers have a great influence on whether products are popular with consumers. In order to achieve a diversified view, traditional cosmetic containers need to be processed after product forming, such as baking paint, electroplating, bronzing, printing, and so on. It depends on a lot of manpower. In addition to increasing production costs and time, these post-processes also have a great impact on environmental pollution.

In this study, the in-mold decorative injection molding technology was used to develop a cosmetic container with a beautiful appearance. Through the injection molding process, the product has the advantages of wear resistance, scratch resistance and color diversity, and enhances the added value of the product. It conforms to the development trend of green manufacturing technology.

●Economic efficiency:

1. The output value increased by 15%.

2. The yield increase is 90%.

3. Reduce costs by 20%.

● Industrial benefits:

1. In-mold decorative injection technology.

2. Computer-aided analysis technology.

3. Mold processing technology.

Keywords: Cosmetic Containers, In-Mold Decorative, Injection Molding, green manufacturing

Introduction

At present, due to the appearance and the design requirements of the inner panel, the thickness of the cosmetic powder box is large, and the product is likely to cause shrinkage, dent, surface spray, poor assembly and molding cycle in the production process. Long-term problems will also affect the subsequent surface treatment such as baking varnish, electroplating, bronzing, printing and other post-process treatments, resulting in improved appearance defects and easy peeling of the oil film. Therefore, this study was applied to in-mold decorative injection molding (IMD). The research of cosmetic powder box, in order to increase the product competitiveness, improve the technical ability of the manufacturer, and also meet the green manufacturing technology, the advantages of the product appearance, wear resistance, scratch resistance, color diversity change, and no post-surface treatment are required development trend.

Research Purposes

In this study, the in-mold decoration injection molding technology was developed to develop cosmetic powder box products with beautiful appearance, scratch resistance, high yield, low cost and compliance with green manufacturing technology. The purpose of the research is following:

1. Establishing in-mold decorative injection molding technology.
2. Computer Aided Analysis Technology Research.

3. Optimized injection molding technology.

Research Framework

The structure of this research program is as follows (*Fig 1*):

1. Plastic mold design: cooperate with CAE analysis technology to explore and establish flow channel, waterway system, positioning system and mold structure.

2. Injection molding experiment: Different parameters experiments were carried out through experimental planning method to explore the influence of film material, thickness and ink type on the deformation and extension of the film to establish advanced injection molding technology.

3. Product testing: appearance inspection, dimensional testing, strength testing.

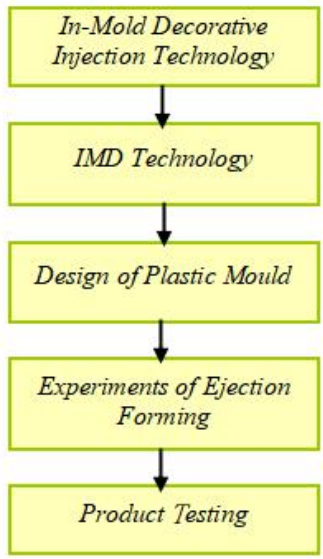

Fig. 1 Framework

Theoretical Background

IMD technology

In recent years, the in-mold decorative injection molding technology developed is to put a pre-printed film into a mold, and then perform the injection operation after the mold is closed, and the process is regarded as a pre-processed product, which not only eliminates the cost required for secondary processing. It also has the advantages of making the surface of the molded product wear-resistant, scratch-resistant, bright in surface color, diverse in pattern,

exquisite and beautiful. The entire process steps are as follows:

1. Film multi-color printing, printing processing is to print multi-color ink onto 2D-film.

2. 3D modeling high pressure molding, HPF is a 3D-film that uses high pressure air to compress the 2D-film above modeling.

3. Stamping and cutting is the use of stamping equipment to cut the excess film material of 3D-film shape.

4. 3D-film modeling is manually placed into the mold, and then injection processing, the molding process is shown in (*Fig 2*). This technical feature is capable of producing a variety of appearance patterns, high color contrast, permeable, no secondary processing, reducing waste disposal costs, avoiding solvent and volatile contamination, chemical resistance, and EMI prevention.

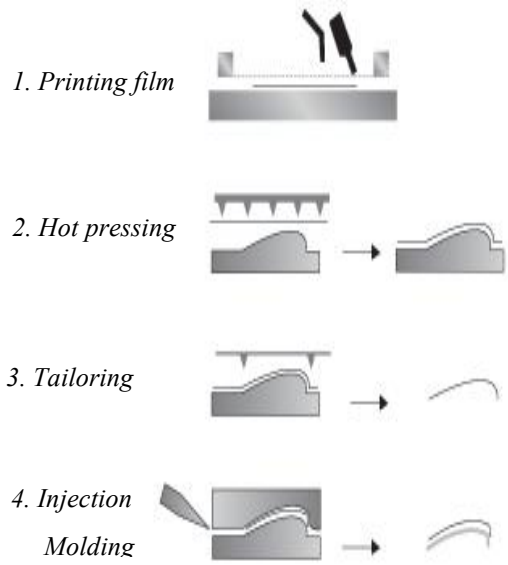

Fig. 2 Decorative injection moulding process

Design of Plastic Mould

The simulation analysis software is used to carry out the simulation analysis. From the analysis results, the optimal die design can be found, as shown in *(Fig 3, Fig 4, Fig 5 and Fig 6)*. According to the results of the flow analysis, the design, manufacture and hot-pressing die for the upper and lower cover were carried out, and the die assembly design and manufacture were completed, as shown in *(Fig. 7, 8, 9 and 10)*.

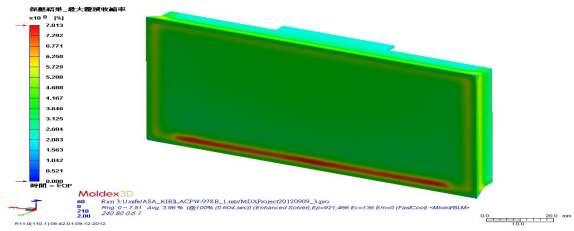

Fig. 3 Maximum volume shrinkage of the upper cover

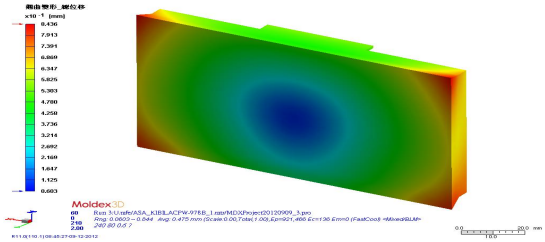

Fig. 4 Warpage Deformation Displacement of Top Cover

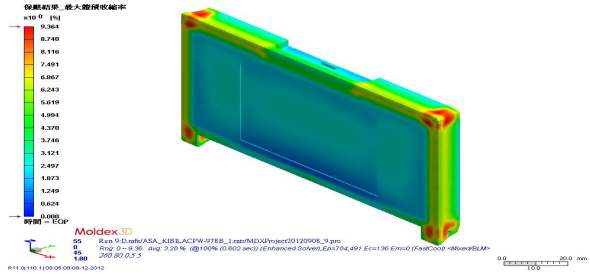

Fig. 5 Maximum volume shrinkage of lower cover

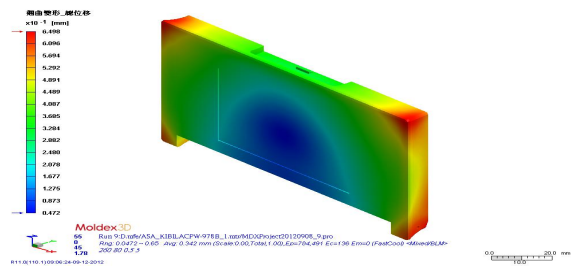

Fig. 6 Warpage Displacement of Cover

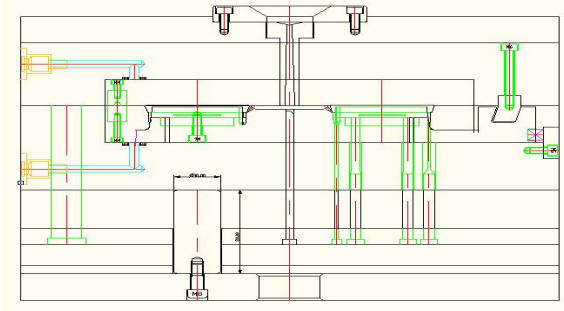

Fig.7 Die Group Drawing

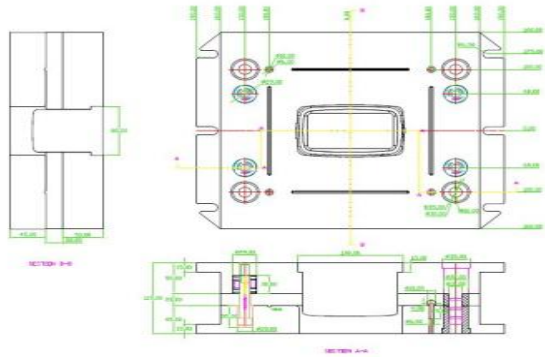

Fig. 8 Hot-pressing Die 2D

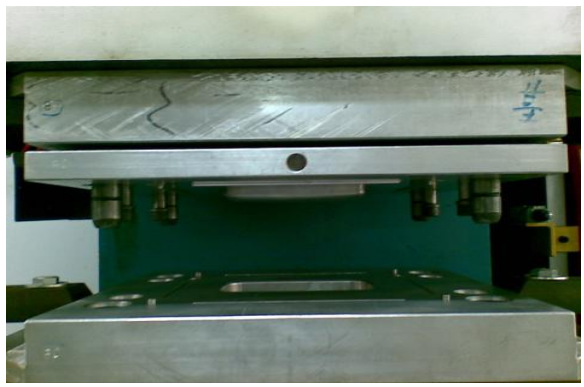

Fig. 9 Hot-pressing Die

Fig. 10 Plastic Mould

Execution Performance

Experiments of ejection forming

The parameters and samples of the completed injection process are shown below (*Table 1 and Fig. 11*).

Product testing

The product is tested by appearance, size and strength. The test method is 150 groups and 10 groups. The sample results of this product do not conform to the size specifications in one group. The scouring area of appearance test ink is less than < 0.2%. The opening force of strength test assembly is 0.8 kg (*Fig. 12*). The yield of size test is 93%(*Fig. 13*).

Table 1 Emits process parameters

Exp.	A Material Temperature (℃)	B Mould temperature (℃)	C Ejection velocity (s)	D Pressure holding time (s)
1	240	60	0.4	5
2	240	70	0.5	6
3	240	80	0.6	7
4	250	60	0.5	7
5	250	70	0.6	5
6	250	80	0.4	6
7	260	60	0.6	6
8	260	70	0.4	7
9	260	80	0.5	5

Fig. 11 IMD Emission Products

Fig. 12 Strength test (opening force 0.8kg)

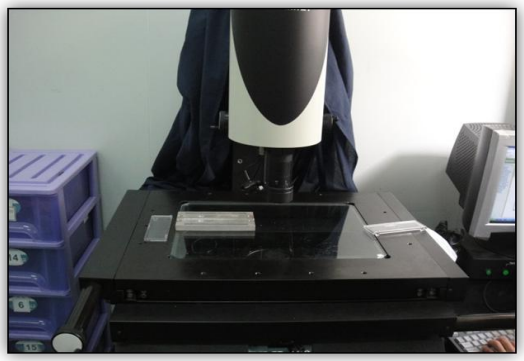

Fig. 13 Dimension Test

Conclusion

Through printing and injection moulding of advanced plastic film patterns, the defects of traditional injection appearance can be improved, the processing process can be simplified, the production cost can be reduced, the product quality can be improved and the environmental pollution can be reduced. Through product design, die design and manufacturing, hot pressing and IMD injection molding, this research develops products that

meet the needs of the green energy industry and the changeable appearance design. The research results are as follows:

Economic Benefit: Output value increased by 15%. 2. Increase the ratio by 90%. 3. Low cost 20%.

Industrial Benefits: 1. In-mold decorative ejection technology. 2. Computer-aided analysis technology. 3. Mold processing technology.

1. Establishment of in-mould decorative injection moulding technology: Through printing film, hot pressing, cutting and injection moulding, the bad appearance of injection products can be improved, and products with wear-resistant, scratch-resistant, diversified colors and high color contrast can be developed.

2. Computer-aided analysis technology research: Through computer-aided die analysis, the actual co-injection molding process is simulated, and the problems and potential risks during the forming process are observed directly on the computer, so that the optimal design can be obtained by modifying the die, product or forming conditions, so as to save the number of test moulds and improve the quality of products.

3. Establishment of optimum injection molding technology: In the process of decorative injection molding in die, different process conditions, such as filling time, injection pressure, injection speed, melt temperature, die temperature and holding pressure, will affect the distortion of printing pattern and product yield. This project changes the parameters of injection process by experimental plan. Optimizing the combination of forming parameters can improve the quality of the process and reduce the manufacturing cost.

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