Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2013, 5(11):352-356

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Research on reversing design of cavity mould for simulating shelled shrimp product

Wei HE[1], Jing-fu JIA[1] and Yang LIU[2]

[1]Ocean College of Hebei Agricultural University, Qinhuangdao, Hebei, China
[2]Mechanical and Electrical Engineering College of Hebei Agricultural University, Baoding, Hebei, China

---

ABSTRACT

This article is devoted to study simulating shelled shrimp product. Surface reconstruction is completed in reverse engineering based on CATIA V5, It sets up the shrimp solid model realistically, and then completed the design of shaped parts of cavity mould.

Keywords: simulating shelled shrimps product, shape simulation, cavity, reversing design, CATIA

INTRODUCTION

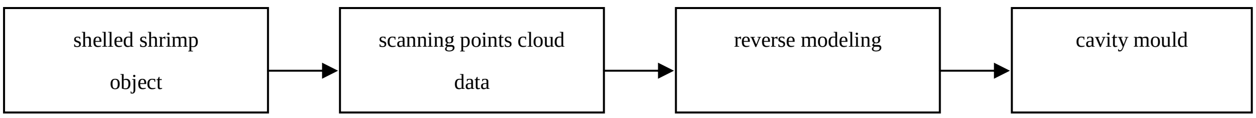
The fish imitation engineering food (for short--imitation food) is a new type of high quality surimi products, which is produced through an advanced technology and equipment, using some cheap marine fish and fresh water fish as main material, is more similar to natural animal food in its shape and nature, our country takes the imitation food as an important development direction in intensive processing of aquatic product industry. Research activities on imitation food are mainly focused its internal quality as taste, compactness, gel elastics, chewiness, etc [1,2].Any comprehensive and systemic reports about outline simulation and design of mould cavity has not been found until now.

Using reverse engineering technique based on CATIA V5, we establish the shrimp solid model and then complete the design of shaped parts of cavity mould.

EXPERIMENTAL SECTION

Technical route of solid modeling

Based on CATIA V5 R16, the product of Dassualt System, we adopt reverse engineering technique to do surface reconstruction. Specific technical route is as follows:



First, using Kreon laser scanning system, we scan shelled shrimp and then achieve points cloud data (the ASC format) as shown as Fig.1

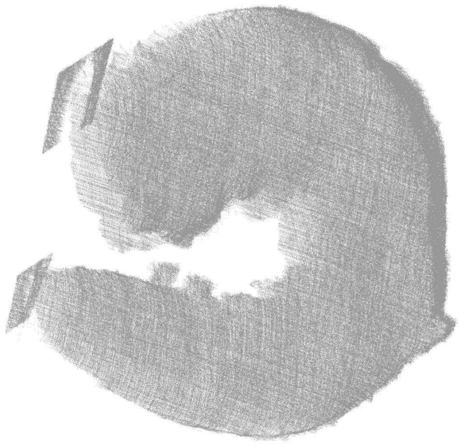


Fig.1 Shrimp cloud

On this basis, adopting the three main function modules of CATIA(DSE,GSD,PD), the shrimp solid model is completed[3,8] as shown as Fig.2

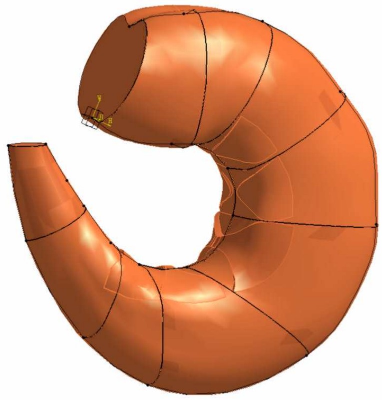


Fig.2 shrimp solid model

Overall embedded combination cavity mould is standard design, we obtain cavity shrimp surface by Core & Cavity Design workbench of CATIA V5[9] as shown as Fig.3.

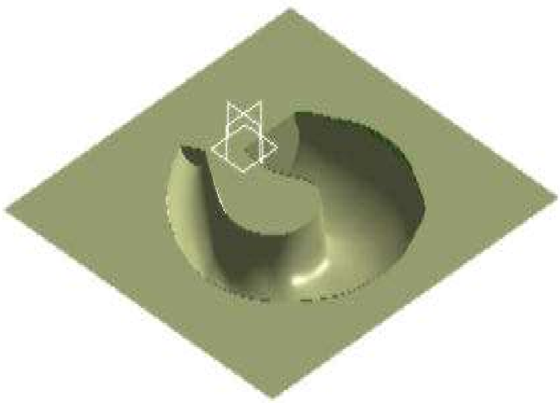


Fig.3 Cavity surface

Calculation of the cavity working size

Cavity is a mould part for molding object shape. The precision of working size directly affects the precision of object.

First, object shrinkages will influence the precision. Due to the reason of expansion on heating and contraction on cooling, the object is smaller than cavity mould as the mould cooled. Second, manufacturing tolerance of the cavity working size will influence the precision too. It directly affects size tolerance of the object. Conventionally, we take $\frac{1}{3} \sim \frac{1}{6}$ of the object′s tolerance as the manufacturing tolerance, and $R_a\, 0.8 \sim 0.4 \mu m$ as the values of surface roughness; Third, the cavity's wear and restoration is another factor to influence the precision. It can make inclusion size gradually increase [10,14].

We can ignore the influence of object shrinkages because shrimps will be sent into freezers immediately after the mould is opened. As for the cavity's wear, we should leave room for mould's repair. So, we take the lower limit for inclusion size, and upper deviation for tolerance. Specific calculation is as follows [10]:

The calculation formula for the cavity radial dimensions:

$$L_C = \left[L_O - (3/4)\Delta\right]^{+\delta} \tag{1}$$

Here, L_C is the cavity radial dimensions, L_O is the object nominal size, Δ is the object tolerance, δ is mould cavity dimension tolerance, we take $\frac{1}{3} \sim \frac{1}{6}$ of the object′s tolerance.

The calculation formula for the cavity depth dimensions:

$$H_C = \left[H_O - (2/3)\ \Delta\right]^{+\delta} \tag{2}$$

Here, H_C is the cavity's depth dimensions, H_O is the object's height size.

Shrimp size: $L_0 = 48.704^{0}_{-3.9}$, $H_0 = 31.93^{0}_{-3.3}$

Put them into the formula(1) and (2) ; calculate the volume in formula, we can get

$$L_C = \left[48.704 - (3/4) \times 3.9\right]^{+3.9 \times 1/3} = 45.779^{+1.3}$$

$$H_C = \left[31.93 - (2/3) \times 3.3\right]^{+3.3 \times 1/3} = 29.73^{+1.1}$$

Cavity wall thickness S is determined by experimental formula:

$$S = 0.20 L_C + 17 \tag{3}$$

$$S = 0.2 \times 45.779 + 17 = 26.156$$

Cavity plate thickness h is determined from experimental formula:

$$h = (0.12 \sim 0.13) b \tag{4}$$

$h = 0.12b = 0.12 \times 50 = 6$ （$b = 50 mm$, cavity width）

Finally, we calculate the size of cavity plate:

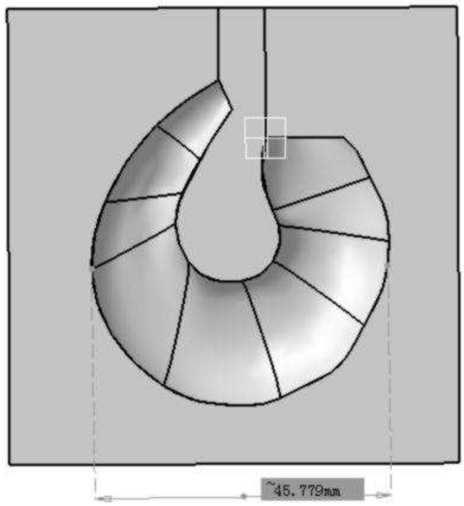
cavity plate length, $L = L_C + 2S = 45.779 + 2 \times 26.156 \approx 98$

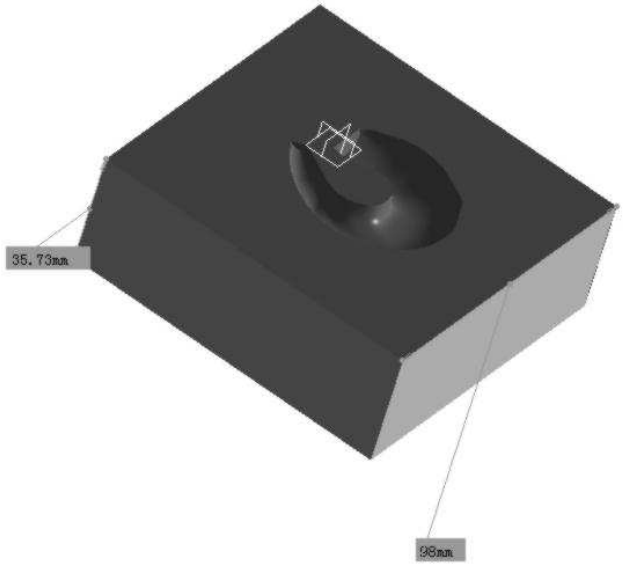
cavity plate thickness, $H = H_C + h = 29.73 + 6 = 35.73$

RESULTS AND DISCUSSION

According to the calculation results, we get the cavity, shown as Fig.4.

(a) cavity depth dimensions





(b) cavity radial dimensions (c) cavity plate

Fig. 4 Parameters of cavity

Because simulating shelled shrimps product should have colorful stripes, before getting shrimps product, we can coat the inside surface of mold cavity with stains. In addition, in order to demould the shrimp smoothly, we spray PTFE membrane (About $0.5mm$ thick) on the inside surface of cavity and the interface of the two plate.

About mould material selection, we have to take several factors into consideration, such as food safety, shrink of products, stains, PTFE membrane and absorbent of the cavity surface material. We choose stainless steel OCR18NI9(304)or1CR8NI9TI(321) as cavity plate[15].

CONCLUSION

The simulating shrimp cavity is a key molding part of shrimp forming machine. The research opens up a new direction for deep processing of surimi. The technology, perhaps coupled with middle and small domestic food processing equipment, will bring good economic benefit and social benefit to Hebei province.

Acknowledgements
We kindly acknowledge financial support by the science and technology research and development Program of HeBei province (No. 94572134). the author is also very grateful for the support provided by the science and technology research and development Program of Qinhuangdao city (No 200901A048).

It is also important to note the first two authors (Wei HE and Jing-fu JIA) contributed to this paper equally and should be regarded as co-first authors.

REFERENCES

[1] Lili Song. **2008**. *China Fisheries*, (8) :75-76.
[2] Bai Fuyu, Zheng Hua. **2007.** *Academic Periodical of Farm Products Processing*, (4):76-79.
[3]Yan Shan, Longhan Xie. CATIA V5 Reverse Modeling Design. Tsinghua University Press, **2004**; 14-189.
[4]Chen Xue-fang, *Journal of Suzhou Vocational University*, **2002**, 17(2): 64-66.

[5]Liu Bao jia, XU Zong jun, WANG Wei. *Machinery and Electronics*.**2001**, 5: 49-52.
[6]Zhengyu Yang, Siqin Chang. *Die and Mould Technology*.**2008**, 3:7-31.
[7]Liu Lin, Xu Tian-min, ZHANG Yi. *Stomatology*.**2005**, 25(6):345-347.
[8] Xu Haili, Wang Heng, Zhu Longbiao. *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(9):420-427
[9]Xuewen Zhang, Wu Zheng. *Injection Mould Design. Chemistry Industry Press*, **2007:** 32-67.
[10]Guangli Zhu, Jinbao Wan. *Plastic Mould Design*. Tsinghua University Press, **2003:** 20-118
[11]Jinjun Ma. *Plastic Mould Design*. China Science and Technology Press, **1994:** 69-132
[12] Liu Jie-qun, Chen Lu-wang, Liu Jin-long. *Journal of Chemical and Pharmaceutical Research*, **2013,** 5(9): 362-371.
[13] Lingfeng LI, Changhui XU, Yunxia Chen, *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(9): 555-562
[14]Zhao Xi, Zhang Zhimin, Zhang Baohong. *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(9): 549-554.
[15] Bengquan Wen. Metallic Materials Data Handbook. **2009**; 44-45