INTEGRATED CAE/CAD/CAM SYSTEM OF *PLASTIC INJECTION MOLD*

AUTHORS:

DAVID Alexandra-Laura - 1 CFMAC
GULACSI Cristina-Ștefania - 1 CFMAC
PRADA Gabriel - 1 CFMAC
SIMOTA Indru-Lucian - 1 CFMAC
TĂMĂȘAN Mihai - 4 TCM

IMT Oradea
2023
Romania

FACULTY OF MANAGERIAL AND TECHNOLOGICAL ENGINEERING
DEPARTMENT OF INDUSTRIAL ENGINEERING

KEY WORDS

Plastic injection mold, CAE, CAD, CAM, Creo Parametrics, EMCO CAM Concept.

1. THE PLASTIC PART TO BE MANUFACTURED

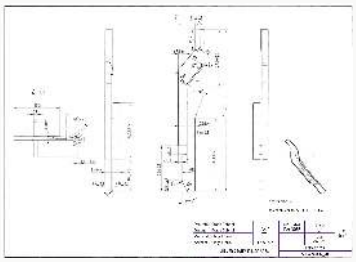

Fig. 1. 2D drawing of the plastic part

Fig. 2. 3D model of the plastic part

2. COMPUTER-AIDED ENGINEERING (TECHNICAL CALCULATION REPORT)

NUMBER OF CAVITIES

$$G_i = \frac{N}{Cm} * 100\ [\%]$$

Where:

G_i = injection machine usage [%]

N = 70 000 = anual production [parts/year]

C_m = average capacity of injection machine [parts/year]

$$C_m = \frac{z*h*i*3600}{t_c}\ [\text{parts/year}]$$

Where:

z = 248 = working days in a year [days]

h = 8 = number of hours in a shift [hours]

i = 3 = number of shifts

t_c = 28 = cycle time [seconds]

→ $C_m = \frac{248*8*3*3600}{28} = 765\ 257$ parts/year

→ $G_i = \frac{70\ 000}{765\ 257} * 100 = 9.14\%$

In order to not overcomplicate the mold, the number of cavities will be 2.

INJECTION SYSTEM

$$m_i = \rho_i * V_i\ [g]$$

Where:

m_i = part/network mass [g]

ρ_i = 1.36 g/cm³ = density of the plastic material [g/cm³]

V_i = part/network volume [cm³]

V_p = 0.907 cm³ = part volume

V_r = 1.051 cm³ = network volume

→ m_p = 2*1.36*0.907 = 2.46 g

→ m_r = 1.36*1.051 = 1.43 g

To calculate what percent the injection network represents in the total injected mass, we will apply the following formula:

$$k_p = \frac{m_r}{m_r + m_p} * 100\ [\%]$$

→ $k_p = \frac{1.43}{1.43+2.46} * 100 = 36.76\%$

Because the annual production is just 70 000 parts, there is no need for a hot runner system.

INJECTION POINT

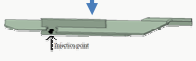

Fig. 3. Injection point

PARTING PLANE

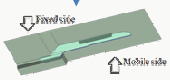

Fig. 4. Parting plane

INJECTION NETWORK

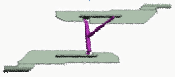

Fig. 5. Injection network

COOLING SYSTEM

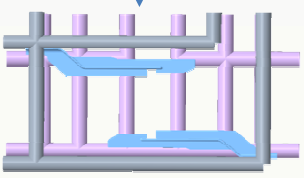

Fig. 6. Cooling system

EJECTION SYSTEM

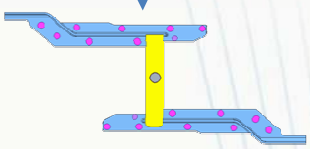

Fig. 7. Ejection system

3. COMPUTER-AIDED DESIGN (ACTIVE ELEMENTS DESIGN)

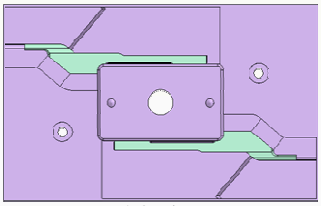

Fig. 8. Cavity

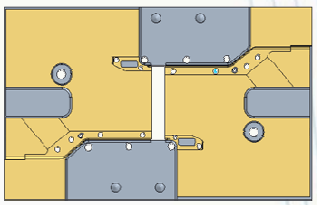

Fig. 9. Core

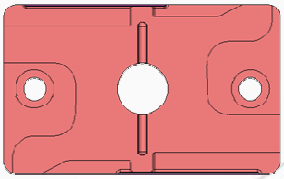

Fig. 10. Cavity insert

Fig. 11. Gate insert

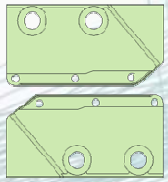

Fig. 12. Core insert

4. COMPUTER-AIDED DESIGN (STANDARD AND NONSTANDARD ELEMENTS DESIGN)

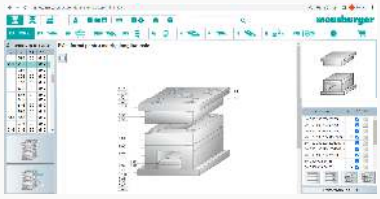

Fig. 13. Meusburger assistant for mold configuration

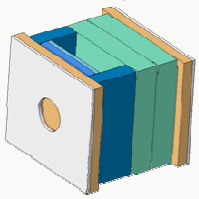

Fig. 14. 3D model of the configurated mold

The nonstandard elements will require modifications of their 3D model. In the figures 13 and 14 there is an example of such modifications done to the ejector carrier plate.

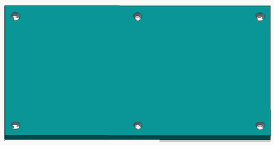

Fig. 15. Ejector carrier plate before modifications

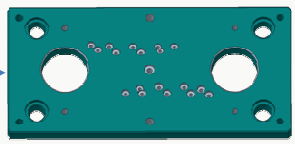

Fig. 16. Ejector carrier plate after modifications

5. COMPUTER-AIDED DESIGN (3D MODEL OF THE ASSEMBLY DESIGN)

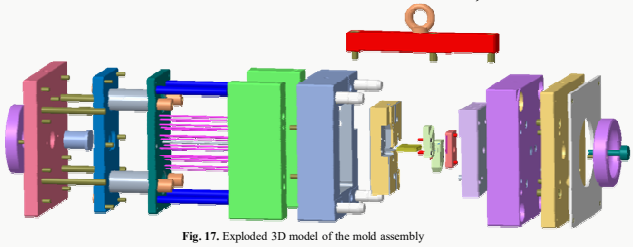

Fig. 17. Exploded 3D model of the mold assembly

6. COMPUTER-AIDED DESIGN (2D DRAWINGS)

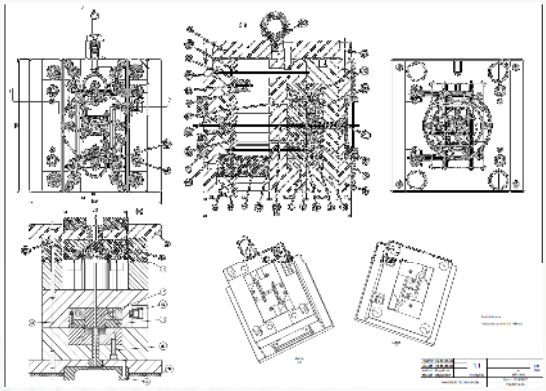

Fig. 18. 2D drawing of the mold assembly

7. COMPUTER-AIDED MANUFACTURING

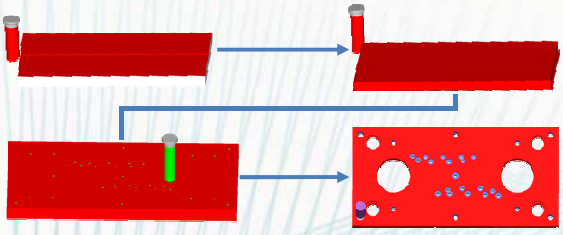

Fig. 19. Ejection carrier plate manufacturing simulation

8. CONCLUSIONS

The plastic injection molding industry reached a very high level of automation. This paper tried to present how all the processes involved in mold manufacturing are automated: the calculation process (CAE) is realized using specialized software, the design of the mold (CAD) is done using CAD programs and assistants from different mold makers and suppliers and the manufacturing process (CAM) is executed using CAM software and CNC machines. The next step in the plastic injection molding industry is introducing sensors in order to monitor the parameters inside the cavity of the mold (especially temperature and pressure). This would make the injection process reach a higher degree of automation.

9. BIBLIOGRAPHY

1. **Sereș I.**, *Matrițe de injectat*, Ed. Imprimeriei de vest, Oradea, 1999.
2. https://ecom.meusburger.com/fpl_menu/index.asp?rnd=&emos_sid=AYtbbMG0JCZN4TrUfefHgc_0cjShi3sC&emos_vid=AYtbbMG0JCZN4TrUfefHgc_0cjShi3sC
3. ***Caiet de sarcini pentru proiectarea matrițelor**, Documentație SC Plastor SA, 2018

COORDINATORS: Prof. dr. ing. BLAGA Florin
Ing. AGUD Mihai, SC Plastor SA