Design of the die shape for indirect extrusion of Mg alloy with Al coating

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Due to their high strength-to-weight ratio and good recyclability, Mg alloys have attracted much attention in the aerospace, automotive and telecommunication equipment industries. However, the use of the Mg alloys has been limited due to their extremely poor corrosion resistance. In order to solve this problem, much effort has been devoted to the development of the technique for Al coating on Mg alloys. A new coating process of Mg alloys by indirect extrusion was devised and the feasibility of this process was investigated [1]. Figure 1 depicts a schematic illustration of the equipment for the hot extrusion. The objective of the present work is to optimize the extrusion parameters for this process by means of numerical simulations of metal flow using finite element code. We performed compression test as a plastometric tests in a temperature range of 250-350 °C and a strain rate range of 0.01-1 s⁻¹. The specimens with dimensions of φ 8×10 mm were used. We determined rheological properties of the Mg alloy on the basis of the test results using inverse analysis [2]. From the analysis we applied the following flow stress model proposed by Gavrus et al. [3]: \[ \sigma_p = \sqrt{3} \left[ WA \varepsilon^b \exp \left( \frac{D}{T} \right) + (1 - W)E \exp \left( \frac{1}{T} \right) \right] \left( \sqrt{3} \varepsilon \right)^c \] where \( \sigma_p \): flow stress, \( W \): gas constant, \( T \): temperature in K, \( \varepsilon \): strain, \( A \): coefficients. These coefficients were determined by using the inverse analysis and are shown in Table 1. Figure 2 exhibits the comparison between the measured and calculated forces. Optimization problem was formulated with the homogeneity of coating layer thickness, which was used as a goal function. Shape of the die was set as a variable. Results of simulations were compared with the experimental data of [1]. The best process parameters were proposed.
Table 1 Coefficients in the equation for the AZ80 alloy obtained from the inverse analysis.

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REFERENCES

