بررسی تجربی و عدیدی فرآیند جدید اطلاعی محدودشده با قابلیت حصول کاهش ضخامت بیسیار بالا

محتویات مقاله

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چکیده

ایجاد نیروی فشار در فرآیندهای محدودشده با قابلیت حصول کاهش ضخامت بیسیار بالا ممکن است باعث بهبود کارایی فرآیندهای مرحله‌ای می‌شود. در این نکته از مدل‌سازی FEM و پژوهش ایمنی شیب‌سازی یک‌بخشی فرآیندهای استفاده شد.

Experimental and numerical investigation of a new constrained ironing process with capability of extra high thickness reduction

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ABSTRACT

Ironing is a conventional metal forming process for producing thin walled cans with uniform thickness components manufactured from deep drawn cups. The most important drawback of the conventional ironing is that the lower thickness reduction ratio (TRR) requires annealing process and multi stage ironing. Recently, a new ironing process named constrained ironing was presented by the current authors to achieve an extra TRR to solve the conventional ironing problems. This process which is based on the compressive stresses minimizes formability problems and higher thickness reduction ratio is achievable in constrained ironing process while it is tensile in the conventional ironing method. Thus compressive stress components minimize formability problems and higher thickness reduction ratio is achievable in the new ironing method. Moreover, experimental results showed that the tensile strength and hardness increased after constrained ironed of the deep drawn cup.

۱- مقدمه

آلوتکسی یکی از فرآیندهای نیروی فشاری است که به همراه فرآیندهای فشاری دیگر از جمله دیسپلای نیز به روش‌های بطور گرم یا سردی و بطور محدودست. این فرآیندها باعث بهبود کارایی فرآیندهای مرحله‌ای می‌شوند. در این نکته از مدل‌سازی FEM و پژوهش ایمنی شیب‌سازی یک‌بخشی فرآیندهای استفاده شد.

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**Fig. 1** A schematic of a) conventional ironing and b) constrained ironing.

1. Thickness Reduction Ratio (TRR)
2. Kampuš and Nardin
3. Delarbre and Montmitonnet
4. Tirosh
5. Shirazi
6. Khodsetan
7. Khodsetan
8. Shirazi
9. Tirosh
10. Delarbre and Montmitonnet
11. Thickness Reduction Ratio

Phrases:
- *A schematic of a) conventional ironing and b) constrained ironing.*
- *Thickness Reduction Ratio (TRR).*
- *Khodsetan.*
- *Shirazi.*
- *Tirosh.*
- *Delarbre and Montmitonnet.*

**Figure 1:**
- a) shows a conventional ironing method where the ironing force is applied directly to the fabric, causing it to be flattened and smoothed.
- b) demonstrates constrained ironing, where the fabric is held in place by a die, ensuring a controlled and uniform ironing process.

**Legend:**
- **Punch**
- **Die**
- **Cup**

**Description:**
- The diagrams illustrate the difference between conventional ironing and constrained ironing, highlighting the role of the punch, die, and cup in each process.
- In conventional ironing (a), the ironing force is applied directly to the fabric without any additional constraints.
- In constrained ironing (b), the fabric is held in place by a die, ensuring a more controlled ironing process.

**Note:** The diagrams are used to demonstrate the effectiveness of constrained ironing in reducing the thickness of the fabric compared to conventional ironing, as evidenced by the Thickness Reduction Ratio (TRR).
Table 1 The pure Al properties and process parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Young's modulus</td>
<td>70 GPa</td>
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<td>Poisson's ratio</td>
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<tr>
<td>Tensile strength</td>
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Fig. 2 The models of a) deep drawn cup, b) conventional ironed cup, c) constrained ironed cup with 30% TRR and d) 80% TRR

Fig. 3 Load-displacement curves of the finite element simulation and experiment

- 3. SHEBAYE A CHABRI

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The contour of axial stress for (a) constrained and (b) conventional ironing.

Fig. 5

Fig. 4 Equivalent friction coefficient FEM simulation with the experiment.

Fig. 3
Fig. 6 Deep drawn and ironed cup

Fig. 7 Optical microscope images of a) annealed sample, b) and c) ironed sample

Fig. 8 Engineering stress-strain curves of deep drawn and ironed cups
مراجع


![شکل 9](image1)

**شکل 9** خواص مکانیکی نمونه ایال شده نمونه ایال شکل‌های حاکم می‌باشد

![شکل 10](image2)

**شکل 10** توزیع خاتم در دیواره فنجان گل می‌باشد


