Liquid nitrogen in aluminum extrusion: Temperature Control System and Die Cooling.
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S.A.I. S.r.l., a company leader in the realization of software to manage the entire aluminum extrusion process, and SIAD S.p.A., a company leader in the production, distribution and sales of industrial gases, are cooperating to promote the application of liquid nitrogen in the aluminum extrusion process. In particular Isothermal Extrusion SAI (I.E.S.), the top product of SAI, allows to control the cooling rates by using liquid nitrogen into the die.

The main features of the temperature process control system are:
- automatic closed loop which enables consistent and precise control of process temperatures and press speed;
- the recipe database that allows each operator to run the press by using the “Best Practices Standards” to improve the process performance;
- data recording that makes analysis and optimization of the recipes, identification of process bottlenecks and implementation of process improvements easier.

The main advantages of the I.E.S. are:
- billet time extrusion reduced. This results in a productivity gain up to 30%.
- better surface finish and improved product quality, fewer defects and reduced scrap rates;
- consistent process performances optimized by the temperature process control system;
- process and production data that consent operation improvement.

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The goal is to increase quality and productivity by improving the process performance according to the “Best Practices Standards”.

The most important parameters analyzed by the I.E.S. process are:
- profile temperature;
- billet temperature;
- cooling rate;
- die temperature;
- billet length;
- extruded length;
- run out length;
- number of billets.

**Liquid nitrogen die cooling and I.E.S. system**

The liquid nitrogen dosed by the I.E.S. system generates several advantages:
- **Increased extrusion speed** according to the aluminum alloys.
- **Improved quality surface:**
  - limited profile oxidation at the die exit;
  - dimensional quality improved;
  - scrap rate reduced;
  - optical appearance improved.
- **Increased die life:**
  - protection of die and backer from overheating and deformation;
  - oxides formation reduced.
- **Reduced press down time.**

The liquid nitrogen die cooling module increases press speed up to 30%, reduces nitrogen consumption up to 40% (referred to a manual control system), increases die life by ≈ 20% and improves surface finish.

**TEST RESULT**

<table>
<thead>
<tr>
<th>Alloy: 6068L</th>
<th>Profile Type: Tube</th>
<th>35 mm diameter</th>
<th>3 mm thickness</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Speed</th>
<th>From 13 to 15 m/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Liquid Nitrogen</td>
<td>26 m/min</td>
</tr>
<tr>
<td>Managed by SAI Isothermal Extrusion</td>
<td></td>
</tr>
</tbody>
</table>

Figure shows I.E.S. system results in optimizing the liquid nitrogen die injection.
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