GF Machining Solutions

3DS
EDM for mould texturing

U. Maradia, M. Boccadoro / 11/09/2019
GF Machining Solutions
Complete solutions provider

Leader in machine tools, Automation solutions and Customer Services for the production of molds, dies and high value-added metal parts.

Headquartered in Switzerland, with presence in over 50 locations worldwide.
Value-Added Solutions across Market Segments

Aerospace

ICT

Automotive

Medical

Electronics

Energy
Unique Technology Portfolio

Milling

EDM

Laser

Additive Manufacturing

Micromachining

Spindles

Tooling and Automation

Digital Transformation
GF Machining Solutions

EDM

Electrical Discharge Machining

Spark Erosion
The history

1900-1920

High speed steel

1920-1940

Tungsten Carbide

1943

Non conventional machining
shaped our lives
By making sparks…

Well, that’s one way…
Electric discharge
Crater erosion

Electricity is another!
Electric discharge
our tool is plasma
with high energies in µs - ns scale...

Transistor type

Capacitor type

Source: ETH Zurich
Modern generators apply sparks at 1.2MHz

Source: ETH Zurich
The EDM generators evolution

<table>
<thead>
<tr>
<th>WEDM generator</th>
<th>1960</th>
<th>1980</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency (%)</td>
<td>8</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td>Cutting speed (mm²/min)</td>
<td>7</td>
<td>20</td>
<td>550</td>
</tr>
<tr>
<td>(inch²/min)</td>
<td>0.011</td>
<td>0.031</td>
<td>0.85</td>
</tr>
</tbody>
</table>

What does 8% efficiency mean?

For example: 7000 machines working 12 hours/day waste 500 MWh (about 100'000 CHF) a day!!!
Tomeo: IPG + ISPG concept

GFMS Patent EP 2 842 678
We made the history of EDM

1953 first EDM machine
1969 first CNC wire cutting machine
1973 conical cut
1974 planetary erosion
1978 generators for sinking machines with high efficiency
1980 30 mm²/min cutting rate for cutting machines
1990 170 mm²/min cutting rate for cutting machines
1993 artificial intelligence (fuzzy logic, neural networks)
1995 300 mm²/min cutting rate for cutting machines
2003 Hyperspark technology for sinking machines
2008 zero wear for die sinking machines
2013 iGap Technology, 3DS Modulation of the EDM craters
2016 Tomeo WEDM and DS (Generator «without» cables)
2019 Spark Track (discharge location sensor)

.... And we'll continue to be protagonist!
we interact with parts through the surfaces...through...

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Function</th>
</tr>
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<tbody>
<tr>
<td><img src="image1.png" alt="Appearance Image" /></td>
<td><img src="image2.png" alt="Function Image" /></td>
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</table>
Crater manipulation

Source: Koshy et al., 2019, CIRP GA2020
Aesthetics

Standard VDI  Mirror polish  Dark surface
**Function**

- **Coating for wear resistance**
- **Structuring for lubrication**
- **Texturing for dies and moulds**

Source: Klink et al. RWTH Aachen
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3DS Mould texturing
Die Sinking EDM

By some estimates, about 50% application of DS EDM is to machine moulds for plastic injection moulding

Consumer products  
Medical, packaging  
Automotive  
ICT, Electronics
Injection moulding
Productivity

- Productivity is mainly affected by cooling phase, to allow successful part demoulding

- To ease demoulding
  - Polishing
  - Coating
  - Polymer additives
  - …

Source: http://biomerics.com/engineering/scientific-injection-molding/process-development/
A texture to ease demoulding

Surface topography tailored for easy demoulding
**3DS success stories**

**Lauer Hartz GmbH (Lüdenscheid)**
- Considerably reduced diesel effect for injection of Grilon BG50 s – PA6 GF50 (Glass fibre 50%)
- Mould cleaning:
  - Standard VDI: after every 4.5 hours
  - 3DS: after 10 hours of operation, cleaning not necessary

**Bernd Richter (Wipperfürth)**
- Lower ejection forces are required for 3DS leading to lower ejection pressure, reducing the cycle time by 50%

Anti-scratch function is improved thanks to 3DS technology
Better plastic robustness against wear
3DS confirmed benefits

Reduced cooling time

Anti-scratch surfaces

Mould cleaning
Standard 3DS

Less diesel effect
But, the science needed to be explored
You are most welcome to visit us...

Losone-Locarno-Ascona, Ticino, Switzerland
Acknowledgements

Innovation Fund Denmark

Swiss Confederation

Innosuisse – Swiss Innovation Agency
Thank you for your attention