Environmental impact estimation of molds & dies manufacturing

Key impact factors

- Manufacturing contribution
- Dominant in life cycle cost
- Milling and EDM are the biggest time consumers
- Use phase electricity consumption

Limitations in the EDM operation

- Electric constraints
  - Discharge current defines removal performance
  - Machining performance is inconsistent to machining depth

Analysis of EDM impact

- Tool-path based estimation
  - Short tool paths cause more time and energy consumption.
  - Machine structure affects energy consuming characteristics.

Analysis of milling impact

- Operation-level energy consumption
  - CAM-based simulation can provide more reliable environmental impact analysis of milling and EDM processes.
  - Mold making impact can be estimated and reduced by mold engineers.

Future works

- More processes like grinding and w-EDM will be included.
- Factory level utilities need consideration.

Importance of molds & dies

- For product developers
  - Increasing environmental concern
    - Regulations and customer needs

- For mold makers
  - Global market of $65B in 2008 (ISTMA)
  - Influence on various products
    - (Injection molding product in EU €42.6B 2009)

Limitations in the milling operation

- Mechanical constraints
  - Finite acceleration/deceleration capacity
  - Different energy consuming characteristics

- Tool path constraints
  - Limited feed speed availability
  - Electric constraints

- Tool path influence on processing time
- Tool path influence on energy consumption

Analysis of milling impact

- CAM-based information management
- Inventory for machine tools and process data
- Process characteristics with operation parameters
- Data driven analysis of environmental impact

Approach

- CAM-based simulation can provide more reliable environmental impact analysis of milling and EDM processes.

Analysis of EDM impact

- Discharge condition considered estimation
  - High depth/area ratio increases time and energy consumption.
  - Two distinct ranges with different M.R.R.s exist.
  - Optimal flushing condition minimizing energy consumption exists.