Energy Efficient Injection Molding Operation

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Edison

April 17, 2003

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Consultek
INJECTION MOLDING MACHINE EFFICIENCIES

By

Babu Joseph
Southern California Edison Company
April 17, 2003
Machine Types

- HYDRAULIC MACHINES
  - FIXED VOLUME PUMPS
  - VARIABLE VOLUME PUMPS
  - VARIABLE SPEED PUMPS

- SEMIHYDRAULIC MACHINES
  - HYBRID MACHINES
  - PARTIAL ELECTRICS

- ALL ELECTRIC MACHINES
## Energy Efficiency

- **EFFICIENCY - KWH / KG OF POLYSTYRENE**
- **1 KWH / KG = 45.4 KWH / 100 POUNDS**

### Hydraulic

<table>
<thead>
<tr>
<th></th>
<th>FIXED</th>
<th>V.V / V.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>KWH / KG</td>
<td>0.82 TO 1.25</td>
<td>0.45 TO 0.65</td>
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</table>

### Semi-Hydraulic

- **SEMIHYDRAULIC**

<table>
<thead>
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<th>HYBRIDS / PARTIAL ELECTRICS</th>
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<tbody>
<tr>
<td>KWH / KG</td>
<td>0.4 TO 0.6</td>
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### All Electric

- **ALL ELECTRICS**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>KWH / KG</td>
<td>0.2 KWH / KG</td>
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</table>
Machine Size and Production Rate

- EFFICIENCY IMPROVES AS PRODUCTION RATE IMPROVES

550 TON MACHINE:  *(Milacron Data)*

<table>
<thead>
<tr>
<th>Prod. Rate (POUNDS/HR)</th>
<th>HYDRAULIC</th>
<th>ALL ELE.</th>
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<tbody>
<tr>
<td>100</td>
<td>38 KWH/100 LBS</td>
<td>16 KWH/100 LBS</td>
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<td></td>
<td>0.84 KWH/KG</td>
<td>0.35 KWH/KG</td>
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<tr>
<td>500</td>
<td>24 KWH/100 LBS</td>
<td>10 KWH/100 LBS</td>
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<tr>
<td></td>
<td>0.22 KWH/KG</td>
<td>0.53 KWH/KG</td>
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## CONTROLLED STUDIES BY SCE

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<tr>
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<th>HYD</th>
<th>ALL ELE</th>
<th>HYD</th>
<th>ALL ELE</th>
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<tr>
<td><strong>390 TON</strong></td>
<td>39.6 KW</td>
<td>11.9 KW</td>
<td>18.7 KW</td>
<td>4.7 KW</td>
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<tr>
<td></td>
<td>465 GR/SH</td>
<td>465 GR/SH</td>
<td>173 GR/SH</td>
<td>173 GR/SH</td>
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<tr>
<td></td>
<td>105 LBS/HR</td>
<td>130 LBS/HR</td>
<td>50 LBS/HR</td>
<td>44 LBS/HR</td>
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<tr>
<td></td>
<td><strong>0.83</strong> KWH/KG</td>
<td><strong>0.199</strong> KWH/KG</td>
<td><strong>0.929</strong> KWH/KG</td>
<td><strong>0.21</strong> KWH/KG</td>
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</table>
## Preliminary Injection Molder Monitoring Results

<table>
<thead>
<tr>
<th>Machine</th>
<th>Type</th>
<th>SP Usage</th>
<th>Shot Wt (g)</th>
<th>Cycle Usage (Wh)</th>
<th>Cycle Time (Sec)</th>
<th>Capacity (Tons)</th>
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</thead>
<tbody>
<tr>
<td>CB390</td>
<td>V V</td>
<td>0.63</td>
<td>660.5</td>
<td>416.3</td>
<td>42.56</td>
<td>390</td>
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<tr>
<td>CB500</td>
<td>V V</td>
<td>0.444</td>
<td>1658</td>
<td>736</td>
<td>55.86</td>
<td>500</td>
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<tr>
<td>F101</td>
<td>Std</td>
<td>1.22</td>
<td>56.7</td>
<td>68.32</td>
<td>11.0</td>
<td>170</td>
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<tr>
<td>F102</td>
<td>Std</td>
<td>1.22</td>
<td>53.9</td>
<td>65.85</td>
<td>12.4</td>
<td>170</td>
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<tr>
<td>F103</td>
<td>Std</td>
<td>0.97</td>
<td>79.4</td>
<td>77.31</td>
<td>12.9</td>
<td>200</td>
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<tr>
<td>F114</td>
<td>V V</td>
<td>0.55</td>
<td>99.1</td>
<td>8.8</td>
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<tr>
<td>F210</td>
<td>V V</td>
<td>0.51</td>
<td>187.1</td>
<td>95.46</td>
<td>15.5</td>
<td>350</td>
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<tr>
<td>ME-1</td>
<td>Std</td>
<td>0.83</td>
<td>465</td>
<td>385.10</td>
<td>35.0</td>
<td>390</td>
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<tr>
<td>ME-2</td>
<td>AE</td>
<td>0.199</td>
<td>465</td>
<td>92.48</td>
<td>28.0</td>
<td>390</td>
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<tr>
<td>NIM-1</td>
<td>Std</td>
<td>0.829</td>
<td>173</td>
<td>161.2</td>
<td>31</td>
<td>220</td>
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<tr>
<td>NIM-2</td>
<td>AE</td>
<td>0.21</td>
<td>173</td>
<td>141.4</td>
<td>27.2</td>
<td>240</td>
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<tr>
<td>SP1</td>
<td>Std</td>
<td>0.91</td>
<td>25.0</td>
<td>22.8</td>
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<tr>
<td>SP3</td>
<td>Std</td>
<td>1.04</td>
<td>52.0</td>
<td>54.3</td>
<td>37.2</td>
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<tr>
<td>SP4</td>
<td>AE</td>
<td>39.54</td>
<td>3.0</td>
<td>119.8</td>
<td>125.0</td>
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<tr>
<td>SP8</td>
<td>Std</td>
<td>1.72</td>
<td>9.0</td>
<td>15.4</td>
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<td>F301</td>
<td>Std</td>
<td>1.58</td>
<td>55.0</td>
<td>87.1</td>
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<tr>
<td>F302</td>
<td>Std</td>
<td>1.60</td>
<td>47.0</td>
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<tr>
<td>F312</td>
<td>Std</td>
<td>1.47</td>
<td>59.4</td>
<td>87.1</td>
<td>12.9</td>
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</tr>
</tbody>
</table>
All Electric Molding Machines

- Technology developed in early 1980 in Japan
- Introduced in USA by Milacron in 1985 at NPE
- Initially available in 50 to 150 tons sizes only
- Today up to 2000 ton all-electric machines available
- Term All-Electric implies use of servomotors on both clamp and injection end
- 10 to 20% higher in cost
- Over 30 machine manufacturers offer all-electric machines

- #1 advantage.....Energy Savings
All Electric Molding Machines

- Energy savings form 25% to 60%
- Repeatability, Accuracy, Consistency
- No hydraulic oil...clean
- No cooling water cost
- Quiet
- Low maintenance

- Higher cost
- Torque related issues...Long Hold times...PVC
- Unscrewing molds?
- Core Pulls?
# Energy Savings

## 5 yr extrapolation

### Comparison of Running Costs EC65 vs F60

<table>
<thead>
<tr>
<th>MODEL</th>
<th>EC65 vs F60</th>
<th><strong>Comparison of Running Costs</strong></th>
<th><strong>Difference of running cost.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Condition</td>
<td>Parts Weight(g)</td>
<td>Resin Cycle(s)</td>
<td>1st Year</td>
</tr>
<tr>
<td>Electricity</td>
<td>Use</td>
<td>Electricity Cost</td>
<td>1st Year</td>
</tr>
<tr>
<td>Hyd</td>
<td>14</td>
<td>3,003</td>
<td>19,362</td>
</tr>
<tr>
<td>All Electric</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Difference in Cost</td>
<td>3,200</td>
<td>16,056</td>
<td>16,468</td>
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<tr>
<td>Oil</td>
<td>Use</td>
<td>Oil Cost ($)</td>
<td>1st Year</td>
</tr>
<tr>
<td>Hyd</td>
<td>34</td>
<td>814</td>
<td>0</td>
</tr>
<tr>
<td>All Electric</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Difference in Cost</td>
<td>814</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Oil Cooling</td>
<td>Use</td>
<td>Water Cost ($)</td>
<td>1st Year</td>
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<tr>
<td>Hyd</td>
<td>16</td>
<td>648</td>
<td>1,944</td>
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<tr>
<td>All Electric</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Difference in Cost</td>
<td>648</td>
<td>1,944</td>
<td>3,240</td>
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<tr>
<td>Condition of Running Time</td>
<td>24</td>
<td>30</td>
<td>12</td>
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</table>

### TOSHIBA MACHINE

### Comparison of Running Costs EC390 vs MODEL

<table>
<thead>
<tr>
<th>MODEL</th>
<th>EC390 vs Hyd390</th>
<th><strong>Comparison of Running Costs</strong></th>
<th><strong>Difference of running cost.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Condition</td>
<td>Parts Weight(g)</td>
<td>Resin Cycle(s)</td>
<td>1st Year</td>
</tr>
<tr>
<td>Electricity</td>
<td>Use</td>
<td>Electricity Cost</td>
<td>1st Year</td>
</tr>
<tr>
<td>Hyd</td>
<td>17</td>
<td>4,303</td>
<td>19,362</td>
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<tr>
<td>All Electric</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Difference in Cost</td>
<td>4,286</td>
<td>16,350</td>
<td>16,468</td>
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<tr>
<td>Oil</td>
<td>Use</td>
<td>Oil Cost ($)</td>
<td>1st Year</td>
</tr>
<tr>
<td>Hyd</td>
<td>43</td>
<td>774</td>
<td>2,370</td>
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<tr>
<td>All Electric</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Difference in Cost</td>
<td>774</td>
<td>2,370</td>
<td>3,872</td>
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<tr>
<td>Condition of Molding</td>
<td>Running Hours</td>
<td>Day</td>
<td>Month</td>
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<td>Oil</td>
<td>2.45 k/h</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Water</td>
<td>0.06 k/h</td>
<td>0</td>
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</tbody>
</table>

### TOSHIBA MACHINE
Basic Design of EC Machine

AC Servo Motor for Clamp

Geared Motor for Die Height Adjustment

AC Servo Motor for Ejector

Geared Motor for Nozzle Touch

Resin

Heater

AC Servo Motor for Charge

AC Servo Motor for Injection
Hybrid Molding Machines

- Electric motor to drive the screw, hydraulic on clamp end
- Faster cycles (Clamp open and close speed)
- Faster Injection for thin walled parts
- Less power consumption than Hydraulic machines
## Suppliers of electric and hybrid injection molding machines

<table>
<thead>
<tr>
<th>Company</th>
<th>Electric</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arburg (860) 667-6500</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Battenfeld (401) 823-0700</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Demag Ergotech (440) 876-6455</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Dima (562) 408-6899</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Engel (519) 836-0220</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Ferromatik Milacron Europe (513) 458-8286</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Ferromatik Milacron NA (513) 536-2351</td>
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<td>x</td>
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<tr>
<td>Fortune/Victor (732) 214-0700</td>
<td>x</td>
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<tr>
<td>Himaco (Brazil) +55 (51) 582-8000</td>
<td>x</td>
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</tr>
<tr>
<td>HPM (419) 946-0222</td>
<td>x</td>
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<tr>
<td>Husky (905) 951-5050</td>
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<tr>
<td>JSW (847) 427-1100</td>
<td>x</td>
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<tr>
<td>Kawaguchi (847) 520-5314</td>
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<tr>
<td>Krauss-Maffei (859) 283-0200</td>
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<tr>
<td>Maruka/Toyo (630) 953-1707</td>
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<tr>
<td>Meiki (847) 439-4450</td>
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<tr>
<td>MHI/Mitsubishi (630) 693-4880</td>
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<tr>
<td>Mir (978) 537-4792</td>
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<tr>
<td>Netstal (978) 772-5100</td>
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<td>Negri Bossi (905) 761-0831</td>
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<td>Nilgata (630) 875-0202</td>
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<td>Nissei (714) 693-3000</td>
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<td>Plastimatix (248) 478-2100</td>
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<tr>
<td>Rutil (Italy) +39 (0331) 816711</td>
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<td>Sandretto (724) 775-4255</td>
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<td>Sodick (847) 759-6720</td>
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<td>Sumitomo (770) 447-5430</td>
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<td>Toshiba (847) 709-7202</td>
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<td>Ube (734) 741-7000</td>
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<td>Van Dorn Demag (440) 876-8960</td>
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<tr>
<td>Welltec (219) 262-5007</td>
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<tr>
<td>Woojin Selex (714) 521-5280</td>
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Source: Plastics machinery & auxiliary magazine
<table>
<thead>
<tr>
<th></th>
<th>Electric</th>
<th>Hybrid</th>
<th>Toggle/ Hydraulic</th>
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<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>Best</td>
<td>Better</td>
<td>Good/Poor</td>
</tr>
<tr>
<td><strong>Accuracy/Repeatability</strong></td>
<td>Highest</td>
<td>High</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Cleanliness</strong></td>
<td>Excellent</td>
<td>OK</td>
<td>poor</td>
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<tr>
<td><strong>Noise</strong></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>Low???</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>Use of existing molds</strong></td>
<td>Low adaptability</td>
<td>Easy</td>
<td>Easy</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
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</tbody>
</table>
Energy savings With Variable Speed Drives

According to Plastics Technology, the hydraulic pump-motor(s) account for 80% of the total energy usage on an injection molding machine.

Even during periods of low hydraulic demand a maximum fixed-volume flow is produced. An example of the wasted energy at low demands is during the cooling stage of the cycle. During this cooling stage of the cycle, the motor(s) only need 20% rpm. **The fixed-speed system wastes considerable amounts of energy by making inefficient use of the hydraulic pump-motor(s).**

The motor conversion, from fixed-speed to variable-speed, enables the open loop injection molding process to be dependent on the demand for hydraulic fluid power. In return, there is a reduction in the use of kilowatt (kW) energy.

**The basic concept of the system is simple: if the machine does not need the oil, don't pump it in the first place.**
Energy Savings
Van Dorn 75 ton Toggle

75.7% Savings

Nissei 235 ton with Power Miser

8.12 kWh
Without Power Miser

3.36 kWh
With Power Miser

Savings: 4.76 kWh 98.6%
When do VSD’s Make Sense..........?

When AC drive systems are installed on the right machines, running the right jobs, the results can be tremendous

- Manufactures in areas with high electrical costs
- Long cooling times
- Large machines
- Older machines
- Jobs such as large PVC fittings
Identifying Opportunities

• Injection Molding Machines – Blow Molding Machines – Extruders
• Cooling Tower Fans – Tower & Chilled Water Pumps
• Air Compressors
• Mechanical control of process Speed, temperature or pressure.
• Varying system requirements based on production loading.

Source: Magnum, LLC
Machines with Built-in VSD?

- Available as optional equipment
- Engel
- Van Dorn
- Dongshin
Energy savings with Auxiliary Equipment

Auxiliary equipment account for 20% of the total energy consumption

- Dryers
- Grinders
- Mold heaters
- Chillers
- Water Management
Material Drying

Energy consumption

- Large electric heaters (Process & regeneration)
- Oversized blowers
Energy Savings Measures

• Use of hot return air for desiccant regeneration
  • Example…Moton Luxor line of Dryers

• Use of sensors and controls
  • Lower drying temperature when not in use

• Honeycomb rotary bed
  • Crystallized molecular sieves baked on to drying wheel
  • Efficient moisture absorption
  • Low air pressure (smaller bower)
  • Faster drying time
  • No dust

• Low pressure dryer (Vacuum dryer)
  • At low pressure boiling point drops to 133° F
  • Low temperature and vacuum removes moisture faster

• Compressed air – no desiccant dryer
  • Uses hot and compressed air to remove moisture
  • No regeneration heaters
Exceptional Drying Accuracy, Efficiency, and Reliability

The LUXOR dryer’s twin desiccant design, with closed-loop cool-down and dew-point controlled bed switching, delivers consistently low (-40°F) dew points.

LUXOR’s stationary desiccant beds mean fewer moving parts and higher reliability.

Motan’s touch-screen controller provides the operator with the ultimate in operating and troubleshooting diagnostics. Add to this the positive-seating bed-switching valves and stationary desiccant beds and you have the industry’s most maintainable dryer.

ATN
Drying for too long at high temperatures may lead to thermal degradation with some plastics. The MOTAN patented ATN function monitors the material throughput against the drying time and lowers the drying temperature to prevent damage during low throughput situations. This saves heat energy and keeps the material dry until the throughput rises. The ATN system senses when production resumes, and will automatically ramp temperatures up to provide efficient modulation of process temperatures, based on material usage.

Motan’s ETA-process® Reduces Operating Costs

The patented ETA-process® was developed by Motan to gain maximum utilization of the heat developed in drying. The ETA-process® heat recovery system uses the exhausted heat from the drying bin to preheat the process air coming from the dryer. Less energy is used to increase the temperature of the process air, resulting in significant reductions in operating costs (see chart below).

An additional advantage is the preliminary heat reduction of the air returning to the dry-air generator, thereby in most cases eliminating the need for an after-cooler.

ETA-process® Energy Savings

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Savings (kWh)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS, POM, TPE</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td>PBT, POM, PM</td>
<td>32%</td>
<td></td>
</tr>
<tr>
<td>PC, PPA, POM</td>
<td>22%</td>
<td></td>
</tr>
</tbody>
</table>

8000 Operating Hours
Electricity Cost = $0.10/kWh
Energy Savings Measures

• Natural Gas dryers
  Use of Natural gas for process heat and regeneration

• Insulated Hoppers and Hoses
  Study shows loss of 1 to 15 °F per foot of hose

• Central Drying
• Use of sensor to switch beds
• Infrared drying with cool air
• Microwave drying
• Electromagnetic heating

Source: Regency Sales/Pneu-Con
Granulators

• Shut-down method (Watt Wattcher From IMS co.)
• Voltage reduction method (Performance Controller\MPG)
• RPM reduction

Current (amps) with and without Controller

With the controller in operation, amps consumed while grinding various materials and the phase unbalance has been dramatically reduced.

50% reduction in Power consumption
Energy efficient Granulators

- Low RPM granulators
- Low RPM 2 stage screenless granulators (Bi-Cutter)
  - 10 x 13 grinder using 1 HP motor at 15/45 RPM
- Grinders equipped with energy efficient motors
- Grinders equipped with carbon steel blades

Bi-Cutter by Size Reduction Specialist

SMS granulators with deflection wedge & 3 bed knives
Mold Heaters

• Energy efficient motors
• Pulse cooling technology

Thermolators add heat to control the mold

PulseCooling removes heat to control the mold

Energy savings from reduction or elimination of thermolators
Pulse Cooling dynamics

- Good Mold Fill
- No opposing cooling during injection
- Start Injection
- Cooling Valve on
- Plastic melt Cool off slope
- Cool off slope
- Water warms up
- Heat Gradient dissipation during cure time
- Cooling Valve Fully On
- Cooling Valve off
- Start Injection
Chillers

- High efficiency scroll compressors Vs. traditional semi-hermatic
- Winter cooler…use of cool outside air
- Power consumption in direct proportion to cooling load
- Variable speed drive
Energy savings from proper Water Management

Points to Consider at the Machine

Is the supply pressure adequate (50 psi min)
Is the return pressure at least 40 psi less than the supply
Adequate pipe sizing for the number of machines in service
Is the GPM flow adequate to cool the molds properly
Is there an adequate number of valves on each manifold
Are the supply/return manifolds in close proximity to the mold
Are the valves properly sized

Source: Pulse cooling-West
Insulation Blankets

- Fast Start up
- Even Heat Profile
- Personnel Protection
- Extended Heater Band Life

30% energy savings

Drool protection Disk or cover

200 Ton Milacron
Common Sense Approach

- Hot Runners Molds
- Long hold times……Gate freeze studies
- Multiple ejection
- Parts on the floor
- Material on the floor
- Insulated Dryer hoppers
- Leaky Dryer and air Hose
- Oil leaks
- End of jobs….turn off power
Where to find more information?

http://www.fasti.at
http://www.energysolutionscenter.org/PlasticsSuite/www/chillers/chillers.htm
http://www.cometauxiliary.com/article7.html
http://www.imscompany.com/default.htm
http://www.insul-vest.com/purge-away.htm
http://www.oekutec.de/ird-oekutec-de/presse-e-kunstst1.htm
http://www.maguire.com/products/dryers.htm
http://www.powerefficiencycorp.com/home/welcome.shtml
http://www.srscorp.com
http://www.pneu-con.com/
http://www.matsuiamerica.com/
http://www.magnumllc.com
http://www.pma-magazine.com/articles/2002/September/01
http://www.pma-magazine.com/articles/2002/November/4
http://www.pma-magazine.com/articles/2002/March/02
http://www.plasticstechnology.com/articles/200110cu4.html
http://www.immnet.com/articles?article=602
http://www.immnet.com/articles?article=581
http://www.immnet.com/articles?article=478
Where to find more information?

www.motan.com
www.pulsecooling.com
www.dri-air.com
www.novatec.com
http://www.powermiser.com/
Energy Incentives

- SPC program .....Old Vs. New
- Express Efficiency.....Motors, Lighting etc.
- Savings by Design.....New additions, New Plants
Standard Performance Contract

A Southern California Edison
2003 Energy Efficiency Incentive Program
PROPOSED
2003 SPC
GENERAL DESCRIPTION

• Pay-for-Performance
  – Participant installs energy-efficient equipment resulting in energy [kWh] savings
  – SCE pays a flat cents-per-kWh-saved incentive

• Applicant
  – Customer may self-sponsor, or
  – A 3rd Party may apply on behalf of customer
2003 SPC COMPARISONS TO EE

• Incentive Basis
  – SPC: Cents per kWh saved
  – EE: Dollars per “widget” installed

• Installation of Equipment
  – SPC: After application is approved
  – EE: Prior to application submission

• Eligible Measures
  – SPC: General list of measures
  – EE: Specific list of measures
2003 SPC
PROGRAM ELIGIBILITY

• Customer
  – Business Customers in SCE service territory
  – Pays PGC or DSM surcharge on utility bill

• Measures
  – Retrofits or replacements only
  – In general, eligible if: useful life > 5 years, energy savings can be estimated, and tools are required to install the measure

• Express Efficiency Eligibility
  – Projects eligible under SCE 2003 Express Efficiency program are not eligible for SPC
2003 SPC
INCENTIVE LEVELS

- Lighting Measures
  - 5 cents per kWh saved
- AC & Refrigeration Measures
  - 14 cents per kWh saved
- Motors & Other Equipment
  - 8 cents per kWh saved
- Total Funding Available for Incentives
  - $10.8 million
  - 30% [$3.24MM] limit for lighting incentives
2003 SPC TIMELINES

• Anticipated Implementation Date: 2\textsuperscript{nd} qtr 2003
  – Program Manual and forms will be available upon implementation
  – CD may be ordered via website
  – Website: www.scespc.com

• Application Submittal Deadline 12/31/03
• Project Installation Deadline 6/1/04
2003 SPC RESOURCES

- Website  www.scespc.com
- Your SCE Account Representative
- Phone
  - General questions:  800-736-4777
  - Technical questions:  626-302-1724
- E-mail
  - SPC@sce.com
Save the Energy

Don't waste it!