Fine particle shot media

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FPSP (Fine Particle Shot Peening) has been mainly developed in Automobile Industry in Japan and applied to a number of steel parts.

**[FPSP]**
- Media size: \( d < \) less than 1/10
- Media: non-metallic shot
- Speed: high velocity (up to 200 m/s)

**[Property]**
- Good tribological property
- Good fatigue property
Fatigue life is strongly affected by crack initiation position. Fatigue life cycle by surface crack initiation is one or more shorter than subsurface crack initiation.
FPSP fatigue data (open hole coupon)

Fatigue test results of Plate with f8mm hole

Average number of 3 samples at fracture (tension-tension R=0.1)

- 4340 @620MPa
- Ti-6-4 @540MPa
- 7075 @200MPa

FPSP improved Fatigue property of all types of materials
Low Sodium Glass Beads (AMS 2431/10) : suitable size for FPSP

<table>
<thead>
<tr>
<th></th>
<th>Nominal Sizes, Millimeters</th>
<th>Nominal Sizes, Mesh</th>
<th>Sieve Size, Maximum 0.40%</th>
<th>Sieve Size, Mesh</th>
<th>Sieve Size, Minimum</th>
<th>Maximum % of broken or angular beads</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mesh</td>
<td>Mesh size [mm]</td>
<td>Max. 5% Retained</td>
<td>Max. 15% Passing</td>
</tr>
<tr>
<td>FC100</td>
<td>0.125/0.180</td>
<td>120/80</td>
<td>70</td>
<td>0.212</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>FC120</td>
<td>0.106/0.150</td>
<td>140/100</td>
<td>80</td>
<td>0.180</td>
<td>100</td>
<td>140</td>
</tr>
<tr>
<td>FC200</td>
<td>0.063/0.090</td>
<td>230/170</td>
<td>140</td>
<td>0.106</td>
<td>170</td>
<td>230</td>
</tr>
<tr>
<td>FC300</td>
<td>0.045/0.063</td>
<td>325/230</td>
<td>200</td>
<td>0.075</td>
<td>230</td>
<td>325</td>
</tr>
<tr>
<td>FC400</td>
<td>0.038/0.053</td>
<td>400/270</td>
<td>230</td>
<td>0.063</td>
<td>270</td>
<td>400</td>
</tr>
<tr>
<td>FC600</td>
<td>0.010/0.038</td>
<td>-/400</td>
<td>325</td>
<td>0.045</td>
<td>400</td>
<td>-</td>
</tr>
</tbody>
</table>

Desired range for FPSP

Bead size (µm)
FPSP media (Characteristics and shape)

➢ Composition
  CaO : 21-25% , Al$_2$O$_3$ : 12-15% , B$_2$O$_3$ : 4-8% , MgO : 0.8-1.2%
  Na$_2$O+K2O : 0.3-1% , SiO$_2$ : Balance
➢ Density  2.6 (same as Glass beads)
➢ Appearance smooth surface and spherical shape

- FPSP=covered with **dimples**.
- **Surface roughness** after FPSP is the same or less.
- **Residual stress** at the surface after FPSP is about 160MPa, while that of SP is about 190MPa.

**FPSP using low sodium glass beads leads to**
- **Good tribological property**
- **Good fatigue property**
Saturation point for using low sodium glass beads is faster than that of other media unless otherwise required high intensity.
**FPSP media (consistency test)**

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Image 1 cycles</th>
<th>Image 5 cycles</th>
<th>Image 10 cycles</th>
<th>Image 20 cycles</th>
</tr>
</thead>
</table>

**Low sodium glass beads (FC200, 63/90μm)**

- FC200 are keeping within 5% in broken media even after 20 cycles.
- AGB-9 are broken by impact and exceed to 5% in broken media after 5 cycles.

**Glass beads (AGB-9)**

**FPSP machine (suction type),**
compressed air 0.25MPa
Al alloy target
Low sodium glass beads have less consumption rate than that of glass beads.

Glass beads do not keep uniform shot flow after 5 cycles.
➢ Fine particle shot peening (FPSP) shows good fatigue property due to high compressive stress at very near surface and smooth surface without shot peened flow or machined flow.

➢ Low Sodium Glass Beads (AMS 2431/10) are suitable size for FPSP.

➢ shortened peening time and uniform shot flow even small media

➢ Low sodium glass beads have less consumption rate than that of glass beads.