The WPC Treatment

Fine Particle Peening

WPC TREATMENT (Fine Particle Peening) is a shot peening method that improves the mechanical property of metal products. It was jointly developed by Fuji Manufacturing Co., Ltd. and Fuji Kihan Co., Ltd. (Japan Patent No. 1594395, Heat treatment method for surface finishing of the metal products.)

WPC differs from conventional shot peening in that conventional shot peening sprays ferrous media 600 – 800 µm in diameter at a velocity of 70 – 80 m/s, whereas WPC sprays a much harder and finer media of 40 – 200 µm in diameter at a velocity of 200 m/s. Consequently, quick heating and cooling are repeated and a heat-treatment and forging effect with a small-dimpled surface is created.

The Merits of WPC Treatment

The main cause of metal product failure is fatigue. There are many cases where a minute crack occurs on the outermost layer, then it grows and leads to failure. WPC treatment provides a highly compressive residual stress close to the surface layer, and restrains the progression of the cracks at the surface by improving surface roughness and effectively raising the fatigue limit. WPC will lower repair costs due to fatigue failure. WPC improves the fatigue life of components without making them larger and even lowers energy costs and materials usage in some cases since the size and weight of the parts can be reduced.

WPC treatment creates a hard surface that improves abrasion resistance. A lubricant is usually used on the sliding parts of metal products. Under certain conditions, a lubricant dries up and friction occurs. The WPC treatment creates small dimples that hold the lubricant, making a near no-contact state, reducing the oil temperature and preventing friction. When WPC treatment is applied on engine parts and other sliding parts, the slide resistance is lower, increasing the power and providing higher fuel efficiency, and shortening the initial engine running-in period.

WPC treatment improves chip flow around the cutting tools and lowers the meshing sound between the surfaces of gear teeth. It also prevents burns and scratches.

The Mechanism of WPC Treatment

Figure 1 shows the depth direction distribution of the residual stress of the carburized and quenched SCM420 to which conventional shot peening treatment and WPC treatment were applied respectively.

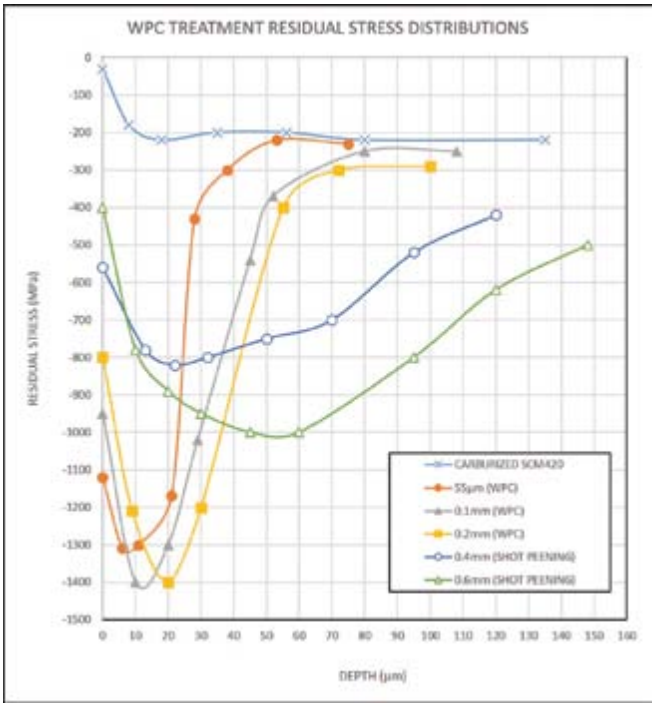

Figure 1.

Whereas residual stress peak is -800 to -1000 MPa in the case of shot-peening, WPC can provide a higher residual stress of -1300 to -1400 MPa. Shot peening has a depth of 20 – 60 µm, and WPC shows 5 – 20 µm. WPC provides high residual stress on the surface layer, and a beneath-the-surface depth of 20 µm. There is a similar trend in the hardness.

Moreover, WPC uses smaller particles than conventional shot peening and they form smaller dimples. For example, when we applied shot peening and WPC treatment on SUS430 under the same conditions, roughness was Ry=45 µm in the case of shot peening, but in the case of WPC, it was Ry=15 µm, or one-third the roughness of shot peening. Surface hardness for both was HV350.

MoS_2 and the WPC Treatment

Solid lubricants such as Molybdenum Disulfide (MoS_2) can be utilized as media in the WPC process to embed MoS_2 into the product surface. The MoS_2 shot process sprays fine powders of MoS_2 at a high speed against aluminum and other low melting-point materials. The process forms a MoS_2 layer, which does not include a binder, on the outer layer of

Figure 2. A piston, automotive gear, connecting rod and coil spring that have received the WPC treatment. The MoS_2 shot process was applied to the piston skirt.

the product. This solid lubricating layer has an improved frictional resistance than a MoS_2 coating with a binder. The MoS_2 shot process is used on pistons' skirt parts, other automotive components, and bearing metal.

Proven Results

The following are a few examples of the proven results obtained by Fuji Manufacturing:

- 14 times the life improvement for gears (SCM)
- Over 10 times the life improvement for torsion bars (SCM)
- 10 times the life improvement for pumps (SK)
- 5 times the life improvement for cutting tools of high-speed steel
- 5 times the life improvement for a die cast (SKD)
- Over 5 times the life improvement for shafts (SCM)
- 4 times the life improvement for SKD11 punches

Future Prospects for WPC Treatment

WPC treatment is effectively used for automotive components and other metal components. It even extends the life of cutting tools and metal molds. This is the technology that can reduce friction, improve lubricity, and contribute to energy and resource savings by improving the surface strength of metals without making components larger and heavier.

For more information on the WPC treatment, visit www.fujimfg.co.jp/english/wpc.html.