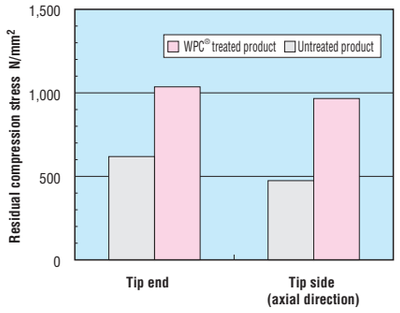
[PRODUCTS DATA] WPC® TREATMENT AND HW COATING PUNCHES

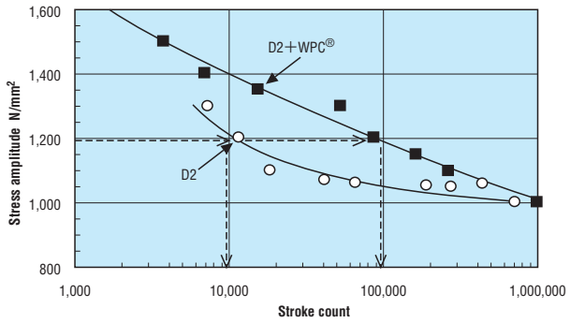
■Features of WPC®-treated punches

1. Improved fatigue strength

WPC® treatment involves colliding fine particles approximately 0.04～0.2 mm in size with the metal surface at speeds of 100 m/s or more, generating high residual compressive stress in the area close to the surface of the punch (**Fig. 1**). This improves the fatigue strength of the punch, **yielding a high resistance to tip breakage and chipping** (**Fig. 2**). Fig. 2 shows an example. When a load of 1,200 N/mm^2 is repeatedly applied to the tip, the possibility of breakage occurs at approximately 10,000 strokes with D2, however with D2+WPC® treatment, the number of strokes rises to approximately 100,000. (Because the results shown in Fig. 2 differ from those of an actual punching test, use them only as an approximate guide.)



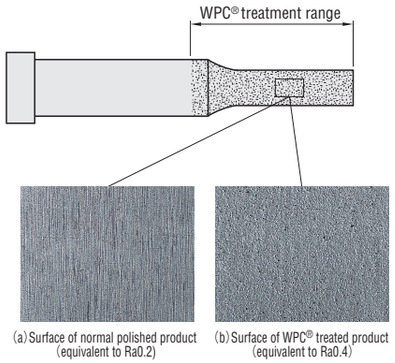
［Fig. 1］ Surface residual compression stress due to WPC® treatment
Punch material: D2



［Fig. 2］ Improvement in fatigue strength due to WPC® treatment
Load conditions: Pulsating load, test piece: φ4.61 HRC

2. Improved seizure resistance

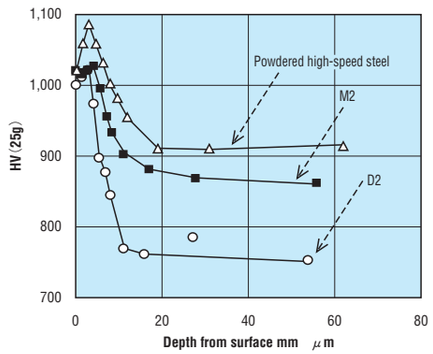
In the case of an ordinary polished finish, streaks in the direction of the polishing are left on the surface.In contrast, fine convex and concave surface irregularities are formed on a surface that is treated with WPC® (**Fig. 3**). Because the minute concave portions serve to trap oil, a WPC®-treated surface is more resistant to losing its oil film than an ordinary polished surface, **improving its resistance to seizure**.



［Fig. 3］ Surface comparison of normal polished product and WPC® treated product

3. Improved wear resistance

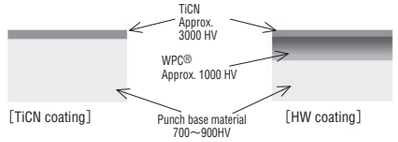
The WPC® treatment improves surface hardness through the effects of work hardening, **improving the wear resistance of the punch.**
Because the hardness of a WPC®-treated punch gradually increases moving from the inside of the punch toward the surface (**Fig. 4**), there is no loss of toughness in the punch base material.



［Fig. 4］ Hardness distribution near the surface of a WPC® treated product
Measured using a micro-Vickers hardness tester.

■Features of HW coating

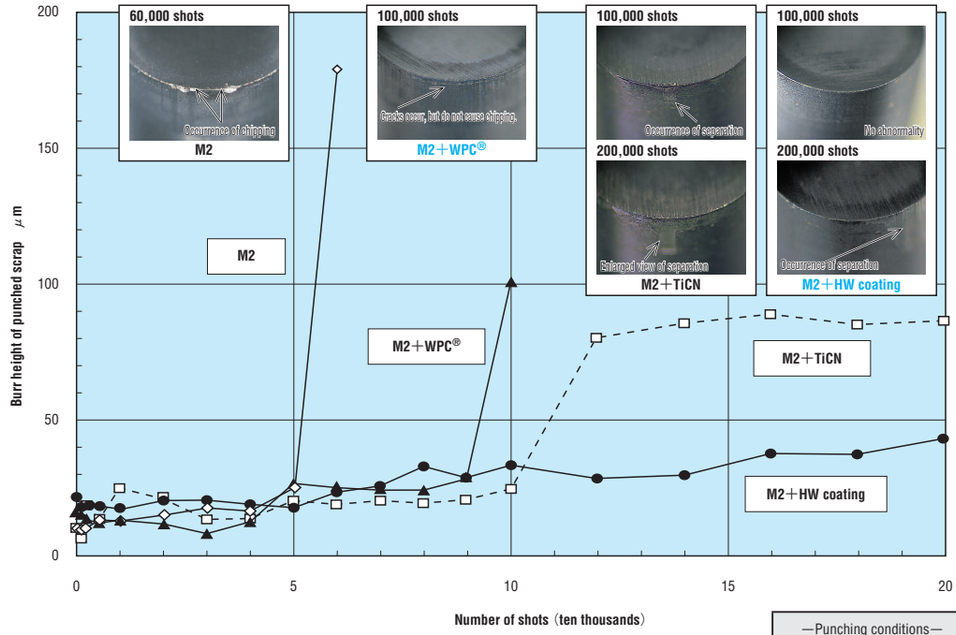
With conventional TiCN treatment, there was the problem of coating separation that sometimes occurred under conditions when high stress was applied to the punch. It is thought that this problem occurred when a punch base material of relatively low hardness was deformed, and the very hard coating film was unable to follow this deformation. With the HW coating, the base material of the punch is strengthened by WPC® treatment, improving the adhesive performance of the TiCN film. The HW coating is a new kind of surface treatment which combines the excellent wear resistance of the TiCN coating with the inherent high fatigue strength of the WPC® treatment.



［Fig. 5］ Models of HW coating and TiCN coating

［Reference Data］ Punching life span test using conventional products

■304 punching life span test



［Fig. 6］ Change in burr height with increasing punch count, and appearance of punch tip

—Punching conditions—
Workpiece material: 304, t=1mm, HV180
Clearance: 7.5% on one side
Punched shape: φ5.0 mm
Punching speed: 200 spm

If the maximum allowable burr height is assumed to be 100 μm, a WPC®-treated punch is capable of nearly double the number of punch shots as an untreated punch. In addition, it was also found that whereas an untreated punch started to chip at the edges of the tip at 60,000 shots, the punch treated with WPC® showed no significant chipping even at 100,000 shots. These results confirm the improvement in punch tip fatigue strength resulting from the WPC® treatment.

Both the TiCN coating punch and the HW coating punch were able to withstand a minimum of 200,000 punching shots. However when the two punch tips are compared, we find that while coating film separation and an increase in burr height began at 100,000 shots with the ordinary TiCN coating punch, with the HW coating punch, there was absolutely no separation at 100,000 shots and the burr height remained at a low level up to 200,000 shots. These results confirmed that the HW-coated punch exhibits superior performance even when used on difficult-to-machine materials such as 304.