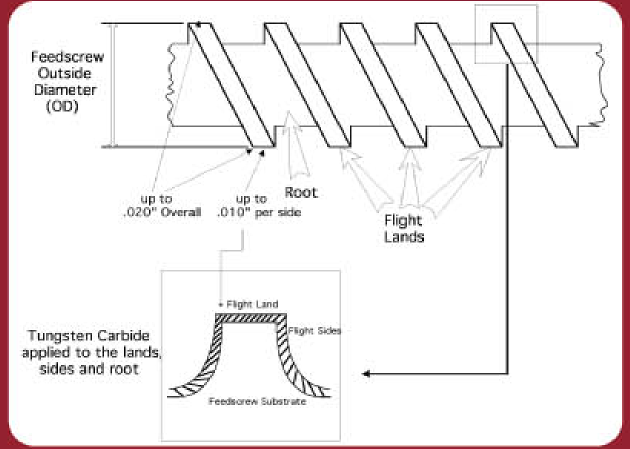
The Concept

Extreme Coatings™ utilizes emerging thermal spray technologies to apply extremely wear and corrosion resistant protective coatings to any size injection molding or extrusion feed screw. The technology produces crack free coatings with hardness values ranging from 30-70 Rc and thickness' from 001"-.030". Proprietary compositions of hard carbides, ceramics, and alloys are incorporated to achieve abrasion and corrosion resistant characteristics unmatched by conventional hardfacing alloys. This process completely eliminates the necessity for chrome plating, flame hardening, or nitriding, as the entire screw surface is encapsulated, including the root, flight sides and flight lands.



We offer a variety of root and flight side surface finishes from +/-140 RMS to our 16-32 RMS mirror finish, which rivals chrome plating in appearance. We finish grind the screw outside diameter to dimension and have the capability to strip coated screws for rebuild when worn.

The coatings are excellent for screws exposed to filled resins, rubbers, or other abrasive compounds. Specific corrosion resistant coatings are available that eliminate the need to fabricate components from costly alloy materials. The application process requires no preheat or post heat procedures and component temperatures rarely exceed 350° F. This low heat input helps prevent distortion and minimizes costly straightening or machining requirements. Screw preparation for coating requires an undercut during rebuilding or manufacturing to accept the coating thickness desired.

Another unique feature of this process is the capability to rebuild CPM (1) screws, provided wear is limited to approximately .015" per side or .030" overall.

(1) "CPM" is a registered trademark of Crucible Specialty Materials


Grit blast surface preparation


Application of coating material


As-sprayed coating +/-140 RMS

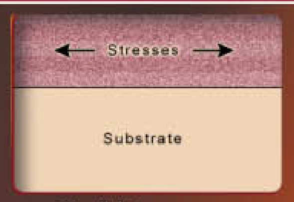

Diamond Polish


Mirror finish 16/32 RMS

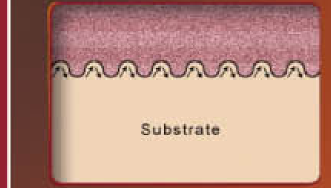

Final QC inspection


Final inspection

Surface Preparation



Parallel stresses on smooth substrate



Stresses over roughened surface tend to cancel

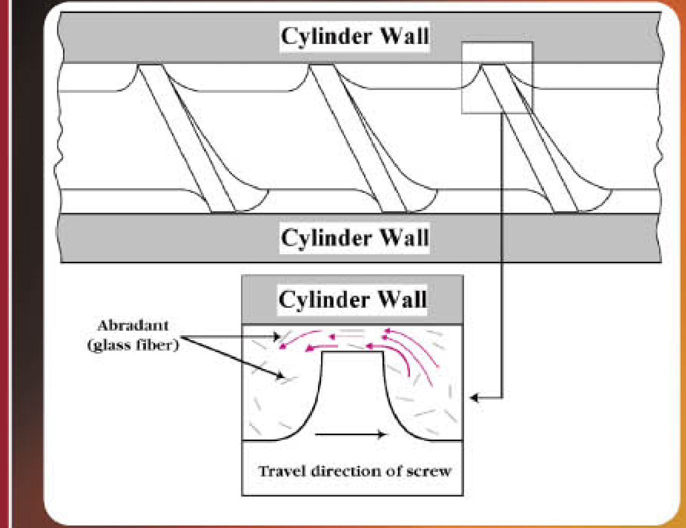
Surface preparation is critical in any thermal spray operation. Coating adhesion and coating quality are directly related to the cleanliness and roughened profile of the substrate surface. The coating material and substrate type are major factors determining what surface preparation is necessary to achieve consistent bonding.

Surface roughening:
- Provides compressive surface stresses
- Provides interlocking surface laminations (layers)
- Increases the bond area
- Decontaminates and deoxidizes the surface

Internal stresses from shrinkage can develop in thermal spray coatings and these stresses increase with increasing coating thickness. Hard metals and ceramics typically have more severe internal stresses. Surface roughening reduces this stress by dividing the internal stresses into smaller components which cancel each other. As layers are folded up and down coating strength is improved.

The Value

A tight tolerance between the feed screw and barrel of an injection molding machine is of vital importance to the production efficiency of the machine and the quality of the parts produced. The principles of plasticizing in an injection molding machine are almost identical to those of an extruder.



Encapsulating a plastic injection molding or extrusion feed screw with a wear and corrosion resistant tungsten or chromium carbide coating will reduce your average amortized monthly feed screw costs by up to 50% regardless of the type of polymer being processed. There are two primary modes of wear that cause processing problems in plastic injection molding machines and extruders.

1.) Adhesive wear (metal to metal) is caused as the feed screw flight lands contact the barrel I.D.
2.) Abrasive wear occurs when hard fillers such as fiberglass or Titanium Dioxide are compressed against the screw flight and barrel surfaces causing material removal.

The high concentration of extremely hard tungsten or chromium carbides in our coatings provide adhesive and abrasive wear characteristics unmatched by common hardfacing alloys or tool steels. In most cases, you can expect an encapsulated feed screw to last from two to five times longer than any other feed screw on the market.

What is a feed screw or barrel wear problem?

A wear problem occurs when any screw or barrel, that due to any amount of wear, and without operating parameter modifications, will no longer deliver QUALITY, plasticized resin to the die or mold at the desired out-put rate, within the desired recovery/cycle time, or at the proper head pressure.

Adjusting injection molding or extrusion machine controls to compensate for screw/barrel wear is common practice. It is well known that these adjustments lead to excessive shear heat which in turn can degrade sensitive polymers. Polymer residence time and time at temperature are important considerations when equipment is employed to produce high tolerance parts. Maintaining a like-new tolerance between screw and barrel ensures that quality melt is produced at a consistent, predictable rate.

Quality Melt may be defined as resin that is free of unmelt, was exposed to minimal shear, has seen standard residence time, and is therefore free of degradation.

Degradation - Loss of polymeric physical properties such as compression strength, tensile strength, impact strength, torsional strength, or other tangible or intangible engineered properties.


105 mm feed screw before coating. After 3 months of 40% glass filled Nylon


The same screw with carbide coating after 10 months in the same process


No feed screw geometry is too complex!

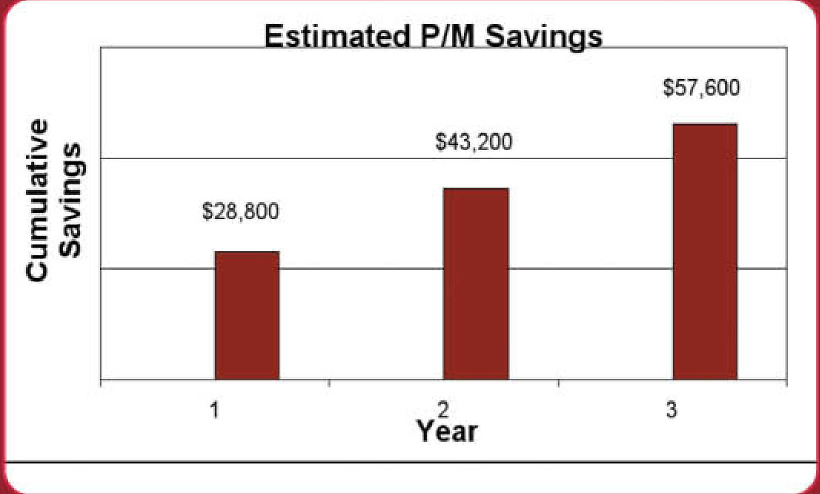
Production Efficiency Advantage Factor

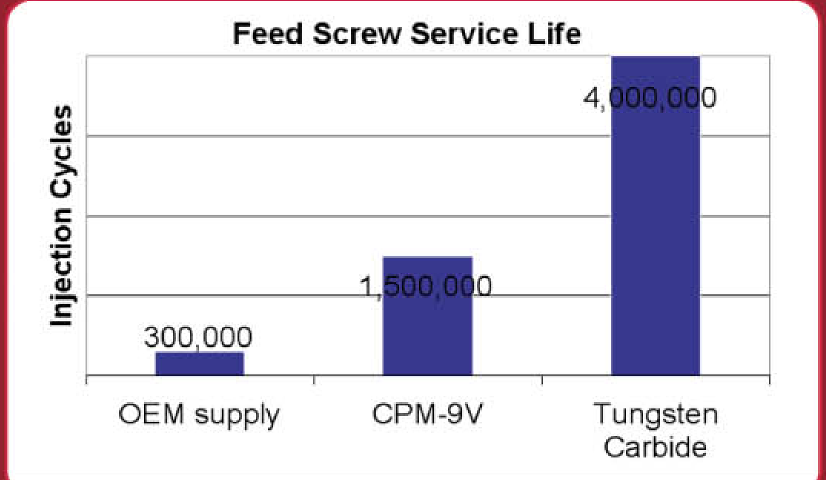
Production efficiency suffers dramatically as the clearance between screw and barrel increases. While it can be difficult to determine, an estimate of the cost of production inefficiency will highlight the relatively fast return on an investment in Extreme Coatings.

Quantifying the cost of inefficiency on a per machine of per month basis we define as the Production Efficiency Advantage Factor or PEAF. This value is typically a reduction is screw or barrel expense. Carbide encapsulation can postpone feed wear better than any other process on the market today. Extreme Coatings industry specific approach makes this technology valuable through an understanding of the PEAF of a process and the cost per month of component parts.

Examples of PEAF

An injection molder with 100 machines, 30 of which run glass filled Nylon, PBT and LCP materials. The small screws (25 mm) make small precision parts on a fast cycle. Screws are replaced at .008"-.010" wear as component part quality and cycle time are impacted. CPM-9V tool steel feed screws provide 1.5 million cycles while carbide coated screws provide four (4) million cycles. Annual Preventive Maintenance (P/M) includes feed screw measurements every six months. Improved reliability and predictable wear from carbide coating has reduced semi-annual P/M's to every 18 months or two (2) million cycles.





At $60/hr for skilled labor, 8 hrs to P/M a machine and two P/M operations per year this yields $960 in annual maintenance cost per machine. With 30 machines this is over $28,000 per year in direct labor cost savings. The annual machine downtime equates to about 150,000 cycles of saleable product not produced.

An extruder processing a highly filled (>80%) material repairs or replaces a feed screw when output rate became uneconomical at about .030" of wear. With a hardfaced and chrome plated screw, this much wear occurred in 50-60 days. A tungsten carbide coated feed screw was installed and processed for 210 days until it reached the same output rate reduction. The carbide coated screw provided a three-fold increase is service life, however, this coated screw produced more than four times as much product as the previous HF/chrome feed screw. A solid example of the value that minimizing wear can have on a close-tolerance system. This is a prime example of what we term PEAF!