EverWear™
Composite Ceramic

CHECKPOINT
PUMPS & SYSTEMS

EverWear™ is a composite ceramic material thermo-chemically bonded to specific areas on a part, typically plunger ODs and head cylinder IDs. Individual ceramic particles are sub-micron in size and consist of mixtures of selected ceramic materials bonded together and to the substrate. Porous after the initial formation of the ceramic, EverWear™ is densified using ceramic precursor chemicals and corrosion resisting chemicals. When thermochemically converted into ceramic and corrosion protection in situ, the densification processes form additional bonds and mass within the initial ceramic body. Each densification cycle fills some of the remaining porosity until a fully-dense, non-porous, corrosion-resistant ceramic coating has been created.

BOND STRENGTH

EverWear™ develops a bond into the substrate through the formation of a spinel-like interphase between the ceramic coating and the metal surface. Part of the thermo-chemical reaction causes the substrate metal atoms to migrate into the ceramic coating during initial processing. The bond strength to the substrate is in excess of 10,000 PSI.

DENSITY

EverWear™ is an almost totally dense (98%) ceramic coating and is unique in that it has no open porosity. Its processing completely seals off this open porosity, making the part impervious to chemical attack.

HARDNESS

The EverWear™ coating particle hardness range measures from 1,000 to 2,850 Vickers. When measured microscopically, the composite hardness is between 1,000 and 1,850 Vickers. In sliding-wear applications, the surface wears as a result of the hardest component, chromium oxide, which has a hardness of 2,850 Vickers.

RESULTS

The unique combination of particle hardness, chemical bonding, and lack of porosity result in a coating that is unparalleled in wear-resistance in corrosive environments. This has been proven in the field by the coating's use down-hole, in hot 30% $CaCl_2$ (Calcium Chloride) and in pumps running hot 90% H_2SO_4 (Sulfuric Acid). The life expectancy of parts used in these applications are now measured in years instead of weeks.

- 0.002 - 0.003" thick
- Hardness range 1000-1850 Vickers
- Chemically bonded
- Extremely wear-resistant
- Resistant to thermal cycling/shock
- Ultra-fine grain size
- Surface finish adjustable from 5 - 60 Rms.
- Low friction
- Better resistance to corrosives
- Stands up to 30% $CaCl_2$, 90% H_2SO_4

TECHNICAL DATA

- Hardness: 1,000-1,850 Vickers
- Bond Mechanism: Chemical
- Bond Strength : Over 10,000 PSI
- Thickness: 0.002-0.003 inches
- Coefficient of Friction: 0.22 - 0.23 against fiber
- Corrosion Resistance: +560 hours in hot $CaCl_2$ (no damage)

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TECHNICAL DATA

EverWear™ coating is generally compatible with chemicals that have a pH value between 3-10, subject to the details noted in the below table.

CHEMICAL / CORROSION TYPE	PROTECTION PROVIDED BY COATING?	NOTES
Salt Corrosion: Halides, e.g., Calcium Chloride, Sodium Chloride, Zinc Fluoride	Yes	Salts are assumed to be in aqueous solution. Concentration does not affect coating.
Other salts: Phosphates, Sulfates, Nitrates	Yes	Aqueous solutions. Various cations, e.g., sodium, calcium, magnesium, iron (II), iron (III), aluminum, and mercury.
Strong Bases, e.g., Sodium Hydroxide, Potassium Hydroxide, Barium Hydroxide	No	Possible use below pH of approximately = 10.
Weak bases, e.g., Ammonium Hydroxide, Organic Bases	Yes	Dilute solutions OK. No pH limit.
Organic solvents, polar and nonpolar, e.g., alcohols, phenols, ketones, aldehydes, fuels, etc.	Yes	Interaction similar to that of glass toward these substances.
Weak acids, e.g., Acetic, Butyric, Nitrous, Sulfurous, Phosphorous, All organic acids	Yes, except for Hydrofluoric Acid (HF).	Concentration is not an issue. Aqueous solutions assumed.
Strong acids, e.g., Sulfuric, Hydrochloric, Perchloric, Nitric	Yes, but see note.	Because of H^+ diffusion, some substrates work better than others. A test piece advisable.
Bleaches, e.g., Calcium and Sodium Hypochlorites	Yes	Chemically inert toward coating constituents.
Sulfides, e.g., Mercury and Hydrogen Sulfide	Yes	Aqueous Hydrogen Sulfide not absorbed by coating.
Acid rain and atmospheric oxidation due to oxygen and ozone	Yes	Acid rain constituents are primarily aqueous nitrogen and sulfur oxides. See 6 above. Coating is inert toward oxygen and ozone.