Inorganic Zinc Silicates

Introduction

Inorganic zinc primers (zinc silicates) are well known for providing excellent corrosion protection and are used in a number of roles.
To a wide extend they are used like other primers and in general Hempel's Technical Guidelines are also applicable to this family of products. However due to their unique nature there are some additional aspects to be aware of. Hempel's zinc silicates consist in 2 component products where one component (zinc dust) is solid and the binder is inorganic humidity curing silicate.
This guideline presents the most important aspects applicators of inorganic zinc silicates may face with before, during and after product application.

Safety

Use adequate personal safety equipment and follow sound procedures. Apply only in well-ventilated areas. Observe safety labels on packaging and paint containers and consult Hempel's Safety Data Sheets for the products to be applied.

Scope

Hempel's range of zinc silicate primers comprise a number of products with varying curing characteristics and zinc content to cover most needs.
Hempel's most widely used zinc silicate primers includes

- Hempel's Galvosil 15700
- Hempel's Galvosil Fibre 15750
- Hempel's Galvosil 15780
- Hempel's Galvosil 15790
- Hempaprime Ultimate 850 (15711)

and others.

Zinc silicate primers are most commonly used as primers in 3 layer systems for corrosion protection in highly aggressive environments. Furthermore certain zinc silicate primers may be applied as tanks linings in a single layer. See Hempels Chemical Protetion Guide https://cpg.hempel.com/ for more information.

The main purpose of this Technical Guideline is to give practical information (not already detailed in PDS) about handling and application of liquid paint as well as about curing and overcoating.

Surface preparation

For optimum performance, the following is recommended: All welding seams must have a surface finish which ensures that the quality of the paint system will be maintained in all respects. Holes in welding seams, undercuts, cracks, etc. should be avoided. If found, they should be remedied by welding and/or grinding. All steel work must comply with ISO 8501-3:2006, preparation grade P3. The steel must be of first class quality and should not have been allowed to rust more than corresponding to grade B of ISO 8501-1:2007. Local areas showing rust grade C must be subject to extended inspection of salt contamination. Deeply corroded steel may be difficult to protect with a zinc silicate. All steel work (including welding, flame cutting, grinding) must be finished before the surface preparation begins.

Liquid paint

Mixing:

Do not open packings until immediately before use. The entire content of the two packings must be used for each batch to ensure a correct mixture. Leftovers in the packings cannot be used later. Protect product against moisture until application is completed.

Stirring

- Before mixing, shake or stir the LIQUID part very thoroughly.
- Pour the zinc dust slowly into the LIQUID part with constant mechanical stirring. Continue stirring until the mixture is free of lumps. Maintain constant agitation of the mixture until batch is depleted, to keep the mixture homogeneous without zinc settling.

- Ensure that paint is filtered through a screen, 250 – 160 µm (60 - 80 mesh) before mixed paint arrive to the nozzle.

Application

The spray gun should be kept at a distance of 30-50 cm from the surface. Hold the spray gun at a right angle to the surface, making even, parallel passes with about 50% overlap. Besides the correct spray technique the amount of thinner added must be carefully adjusted to secure optimum film formation.
Select small nozzles (small orifice and small fan angle) for spray application of complicated structures, while bigger nozzles may be used for regular surfaces.
The wet film thickness must be checked immediately after application, but it can only be used as a rough guidance because of the fast drying.
In the case of a high level of thinning and long stops in application, it may be necessary to recirculate the mixed paint to avoid settlement of zinc particles in the spray hoses.

Thinning
The amount of thinning necessary will depend upon prevailing conditions: Temperature, humidity, wind/ventilation, method of spraying, spray equipment, etc. The normal thinning range is: 0-10%. The coating must be wet and smooth just after application. Besides correct spray technique, the amount of thinner added must be selected securing this optimum film formation. Too little thinning will typically lead to dry-spray and too much thinning to sagging and settling of zinc particles in the can or in the spray hoses. Hempel's Thinner 0870M can be used to accelerate curing, when airless spray application is used. This may increase the tendency for mud cracking. Hempel's Thinner 0870M is not allowed to be used when Hempel's silicate primers are used as a tank coating.

Dry spray
Dry spray indicates poor film formation and can cause product failures.
Recommended minimum surface temperature is 0°C/32°F. The maximum recommended surface temperature is approx. 40°C/104°F. Higher steel temperatures are acceptable provided dry-spray is avoided by extra thinning and proper spray application (reducing pressure and distance of gun to the substrate). In extreme cases a reduction of the dry film thickness may also be necessary.
In warm climates it is recommended to carry out application during night-time.
Any dry-sprayed areas must be smoothened by scraping with a spatula (rounded corners) or by light sandpapering or by using a cleaning sponge ("3M", "Scotch-brite" type). After vacuum cleaning as necessary, the smoothened areas are applied with a highly thinned coat of the zinc silicate primer. If working conditions ask for it some hours may elapse between the first and the second coat provided that the relative humidity is kept constantly low, but it is recommended to finalize the application as soon as possible and within the same working shift.

Curing (effect of humidity)

Inorganic silicates cures through a reaction with humidity. Thus curing speed depends on relative humidity, (steel) temperatures and air circulation. In confined spaces, surfaces must be ventilated. However, avoid ventilators blowing directly onto the freshly applied paint.

The curing time can be reduced at low humidity by:

- Hosing down the surface with water 1-2 hours after application and keeping the surface constantly wet until curing is complete. Use clean fresh water.
- Accelerating the curing by adding Hempel's Accelerator & Thinner 0870M.

Solvent rub before overcoating
The coating must be fully cured before taking into use and before overcoating The state of curing should be checked according to ASTM D4752 with a resistance rating of minimum 4 (slight amount of zinc on cloth after 50 double rubs) . Methyl Ethyl Ketone (MEK) may be substituted by Hempel's Thinner 08700 for the test.

Overcoating

Mist coat /flash coat as a sealer
Non-weathered zinc silicate coatings are porous and popping may occur in the subsequent coat(s). One way to reduce the risk of popping is to apply a so called mist coat or flash coat to seal the porosity. This is typically done by spraying a very thin coat of diluted epoxy coating. The amount should be just enough to saturate the porosity without building any measurable DFT. Spray a very thin film as the first pass, let the air escape and allow enough time for the solvent to evaporate. Then apply the remainder of the subsequent coat. Certain epoxy barrier

coatings are not suitable for this technique even after dilution. In such case a dedicated sealer product such as Hempel's Sealer 05990 may be used.

Cleaning
The cleaning before overcoating depends on the condition of the surface:

- Intact zinc silicate surface with sporadic formation of "white rust" (zinc corrosion products).
  - Remove oil, grease, dirt, etc. by detergent wash.
  - Remove "white rust" by high pressure fresh water cleaning 200-350 bar (2900-5000 psi) at a nozzle-to-surface distance of 15-20 cm (6-8").
  - If the surface is only slightly contaminated, corresponding to 1-2 months of exposure in a mildly corrosive environment, hosing down of the surface with fresh water and scrubbing with stiff brushes (nylon) may be sufficient and more practical. Check that the coating is through dry before overcoating.

- Zinc silicate surface with significant formation of "white rust" which cannot be removed as described above.
  - Remove oil, grease, dirt, etc. by detergent wash.
  - Abrasive blast sweep to remove "white rust", followed by vacuum cleaning to remove abrasives and dust.
  - Restore the zinc silicate layer by applying a fresh coat as necessary.

- Damaged areas, burns, weld spatters, etc.
  - Remove oil, grease, dirt, etc. by detergent wash.
  - Remove weld spatters.
  - Abrasive blasting to min. Sa 2½, followed by thorough removal of abrasives and dust by vacuum cleaning.
  - Restore the zinc silicate layer by applying a fresh coat of the specified zinc silicate product.

Application as tank lining (only valid for certain products according to Hempel's Chemical Protection Guide)

When used as a tank coating, Hempel's zinc silicate primers are typically specified in 1 x 100 micron/1 x 4 mils - minimum 90 micron/3.6 mils. To achieve a correct film formation within these limits, it is recommended to apply two coats "wet-in-almost- dry": Apply one coat and apply the second coat within 15-30 minutes before the first coat has turned grey but is still dark. When following this procedure, Hempel's zinc silicate primers must be thinned in order to avoid too high film thicknesses. Too high film thicknesses on welds in corners must be smoothened by a flat brush, approximately 1" wide. When coating tanks, it is of the outmost importance to avoid dry-spray, which is a typical indication of poor film formation. Poor film formation of a one-coat tank coating system may result in premature failure.

For a tank coating specification the specified film thickness should be controlled according to the 90-10 rule, i.e. 90% of the dry film thickness measurements must be equal to or greater than the specified film thickness and of those below the specified film thickness, no measurements must be lower than 90% of the specified film thickness. For narrow frames, girders and similar areas not being very accessible the film thickness could be controlled according to the 70-30 rule.

Too high dry film thickness, i.e. above approximately 125 micron/5 mils dry, should be avoided due to the risk of mud cracking or peeling. Hempel's Thinner 0870M is not allowed to be used when Hempel's zinc silicate primers is used as a tank lining.

Visual detection of damaged spots of the metallic grey, flat surface of zinc silicates is very difficult. It is therefore essential that the process of surface preparation and paint application is well planned and carried out by trained operators backed by a high level of quality control resulting in the fewest possible number of holidays and damage.

Full curing for cargo loading: Before tanks are taken into use, the coating must be fully cured (The coating will be fully resistant according to the Chemical protection guide.) This can be secured by low pressure hosing/washing the tanks with (fresh) water 2-3 times after ordinary curing. By using the tank washing equipment, the normal ½ hour cycle is applied with half a day to one day between washings. Let the tanks remain wet between the washing.

Porous substrates (Cast iron):

Inorganic zinc silicates are not suitable for porous substrates like cast iron.

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