CORTEC Laboratories
4119 White Bear Parkway, St. Paul, MN 55110 USA
Phone (651) 429-1100, Fax (651) 429-1122
Toll Free (800) 4-CORTEC, E-mail info@cortecvci.com
Internet http://www.cortecvci.com

To: Paolo Rossi
From: Mike Prenosil
Date: November 13, 2003
Subject: Cortec Additives versus Zinc Phosphate

Dear Paolo,

Cortec has done considerable work comparing zinc phosphate and modified zinc phosphate pigments against or with Cortec's additives. Cortec has corrosion inhibitors designed specifically for waterborne applications and inhibitors for solvent based coatings. I would like to discuss each of these areas separately.

There are two types of waterborne corrosion inhibitors: flash rust inhibitors and long term inhibitors. Cortec's flash rust inhibitors are M-435, M-240, and M-111. They are not designed to compete with zinc phosphate since they are used only to prevent rusting during the initially drying of the coating.

The best long term waterborne corrosion inhibitors are M-119LV, M-380, and M-381. M-119LV can be used in most water based coatings to improve the corrosion protection. If there is a relatively high level of carboxylate groups in the latex, M-380 or M-381 can be used to significantly improve the corrosion protection. M-380 contains ammonia and tends to kick out a number of latices. M-381 has no ammonia and is essentially a combination of M-119LV and M-380 with a flash rust inhibitor. Specific examples are given below:

Example 1
A customer wanted to improve corrosion resistance using an acrylic latex coating containing zinc phosphate. The addition of 2.5% M-381 improved the coating significantly.

Coating	**Test/Hours**	**Film Thickness**	**Scribe (1) Corrosion**	**Non-Scribe (2) Corrosion**
Zinc Phosphate	Salt Spray/20	32.5 microns	9	4
+ 2.5% M-381	Salt Spray/ 20	32.5 microns	10	9
Zinc Phosphate	Humidity/150	30 microns	N/A	2
+2.5% M-381	Humdity/150	30 microns	N/A	8

There was a significantly improvement using 2.5% M-381. The coating would probably be equal or better using only 2.5% M-381 and no zinc phosphate; but the customer did not require this information.

Example 2
Another customer wanted Cortec to compare a styrene acrylic latex modified zinc phosphate coating with one using a Cortec additive.

Coating	**Test/Hours**	**Film Thickness**	**Scribe Corrosion**	**Non-Scribe Corrosion**
Mod.Zn Phosphate	S.Spray/1000	65 microns	6	6
1% M-119LV	S.Spray/1000	60 microns	8	8

Again with this much higher quality coating, a significant improvement in salt spray resistance was noted. The customer did not mention what % modified zinc phosphate was added.

Example 3

Cortec ran a direct comparison using Akzo latex USPD 590-37 in a clear coating:

Coating	**Test/Hours**	**Film Thickness**	**Scribe Corrosion**	**Non-Scribe Corrosion**
2% Mod.Zn Phosphate	S.Spray/345	30 microns	7	3
3% M-381	S.Spray/345	30 microns	7	8

The non-scribe corrosion was significantly better using M-381 than the modified zinc phosphate.

Example 4

Cortec also tested Reichhold's Arlon 847-2-42 using Cortec's M-119LV.

Coating	**Test/Hours**	**Film Thickness**	**Scribe Corrosion**	**Non-Scribe Corrosion**
2% Mod Zn Phosphate	S.Spray/144	37.5 microns	9	7
2% M-119LV	S.Spray/144	37.5 microns	10	9

Cortec's M-119LV out performed the modified zinc phosphate again.

Solvent based coatings require different Cortec additives. M-5365 and M-168 are the recommended corrosion inhibitors to use. M-5365 has shown to be superior in head to head studies against zinc phosphate. M-5365 is particularly good when used in VT alkyds and straight alkyds. Several examples are given below:

Example 5

A customer in Europe wanted to reduce zinc oxide from 5.5% to less than 2.5% in an alkyd coating.

Coating	**Test/hours**	**Film Thickness**	**Scribe Corrosion**	**Non-Scribe Corrosion**
5; 5% Zn phosphate	Salt Spray/240	50 microns	9	9
2.47% Zn Phos.+2%M-5365	Salt Spray/240	50 microns	8	9
2% M-5365	S.Spray/240	57.5 microns	9	8

In this case, Cortec was not only able to reduce to zinc phosphate to below 2.5%, but also eliminated it completely with M-5365 without significantly reducing salt spray resistance.

Example 6

A U.S. customer wanted to eliminate modified zinc phosphate in an alkyd coating with one containing a Cortec corrosion inhibitor.

Coating	**Test/hours**	**Film Thickness**	**Scribe Corrosion**	**Non-Scribe Corrosion**
Mod.Zn Phosphate	Salt Spray/460	47 microns	7	8
4% M-5365	S.Spray/460	45 microns	9	7

Cortec's M-5365 was superior to the modified zinc phosphate. However, the level of M-5365 had to be increased to 4%.

Summary: In general Cortec additives perform very well against zinc phosphate and modified zinc phosphate corrosion inhibitors. They can also be used in clear coatings, whereas zinc phosphate causes the coating to haze. In most cases, the optimum level of Cortec corrosion

inhibitor was not determined and even better results could be obtained by running a ladder study or a designed experiment.

(1) Scribe Corrosion (millimeters creep from scribe)

Millimeters	**Rating**
0	10
0 to 0.5	9
0.5 to 1.0	8
1.0 to 2.0	7
2.0 to 3.0	6

(2) Non-Scribe Corrosion

Area Failed %	Rating
0	10
0 to 1	9
2 to 3	8
4 to 6	7
7 to 10	6
11 to 20	5
21 to 30	4
31 to 40	3
41 to 55	2