SFS intec SFS intec, Inc. Wyomissing, PA	LABORATORY TEST REPORT Date: **8/10/04** No: **3891. 04** Test: **Corrosion** By: **J. Souders**

SCOPE:

Test the performance of fasteners in ACQ, CCA, and SPF lumber.

TEST MATERIAL:

1) SFS #10 Pancake head clip screw
2) SFS #9 Woodgrip
3) SFS #14 Dekfast e-coated
4) 8p galvanized nail
5) Competitor #10 HiLo
6) Competitor #10
7) SFS #10 HiLo Woodgrip (electrozinc)
8) SFS #10 HiLo Woodgrip (mechanical zinc)
9) SFS #14 self-driller
10) SFS #9 Bi-metal Woodgrip
11) SFS #14 Dekfast Trimrite stainless
12) various SFS 410 stainless fasteners

(1) ea - 2”x4”x24” ACQ, CCA, and SPF lumber samples
(3) - 2”x4”x24” 26 gage G90 galvanized sheet metal panels

EQUIPMENT:

Kesternich cabinet – set up for DIN 50017 continuous moist heat testing.

TEST METHOD:

8 fasteners of each variety were driven through the 26 gage sheet metal into each of the wood samples. If applicable, washers were used on (4) of the (8) fasteners.

Test fasteners in Kesternich cabinet per DIN-50017. 100% humidity at 104°F: continuous humidity, no drying cycle.

Fasteners were checked at approximately 15-day intervals by removing only the top row of fasteners (one each: washered and unwashered). The condition of the fastener surface was recorded by percentages of white rust (zinc oxide), darkening (hydroxide formation) and red rust (iron oxide). The fasteners were then re-installed.

At 154 days, the second row of fasteners was removed. The condition of the fastener surface was recorded by percentages of white rust (zinc oxide), darkening (hydroxide formation) and red rust (iron oxide).

TEST DATA:

See attached spreadsheet and digital photographs.

BACKGROUND:

Fasteners are often used in environments that, over time, can degrade fastener life through elements such as corrosion. It is generally undesirable for fasteners to be compromised by corrosion as it can have a catastrophic effect on the combined structure of the applied system.

When untreated steel is exposed to moisture, it is well known that it "rusts". This rust is iron oxide. The base element of steel, iron (Fe) is most stable as an oxide and therefore most commonly found in nature as such. Iron reacts easily with water to form iron oxide. At a site of active corrosion, several layers of iron products are formed as the iron oxidizes. First is ferrous hydroxide, then ferritic hydroxide, hydrous ferrous ferrite, and finally iron oxide. They present themselves in layers from the base metal to upper surface of the oxide deposit. The iron oxide displays the commonly seen orange-brown rust color, and so does ferritic hydroxide. The ferrous hydroxide is greenish-black, as also the hydrous ferrous ferrite.

In order to discourage the corrosion of steel, some products such as fasteners are protectively plated with zinc. Zinc coating protects the steel by being more chemically reactive than the iron component. Since zinc has a much higher electro-negative potential than iron, it tends to lose electrons easily. The presence of water as an electrolyte encourages Zinc to go into solution as Zn^{2+} before iron will. As it does so, it frees its electrons, which react with any available aqueous iron ions to form iron as a solid. The presence of free electrons further discourages iron from going into solution. Once in solution, the aqueous zinc ions are then free to react with oxygen, forming zinc oxide. This zinc oxide layer offers a protective barrier as well. Supplying this sacrificial layer of material (such as zinc) is also known as "cathodic protection".

Further protection can be gained by applying additional coatings over the Zinc plating, such as SFS intec applied "dip spin" paint or top spray. Protection can also come from alternate coatings (other than Zinc) such as "E-coat" (an electrically-deposited paint process).

OBSERVATION:

The top row of fasteners was removed and observed at approximately 15-day intervals. These fasteners are labeled in the pictures as "removed at 15-day interval". During this observation, it is clear that the fasteners installed into ACQ lumber have degraded beyond those installed in the other lumbers. Over all product tested, many more fasteners in the ACQ lumber reached 100% red rust than in either of the other materials. These fasteners had reached 100% red rust when the same fasteners were just beginning to red rust in the other lumbers.

The second row of fasteners was removed and documented at the 154-day mark. These fasteners are labeled as "removed at 154 days". It can be seen that the corrosion had progressed further in the ACQ lumber as well. The fasteners installed in ACQ had much heavier oxidation and hydroxide deposits than the other lumbers. Though, none of the fasteners in the undisturbed state exhibit the amount of degradation present in the group of fasteners removed at the 15-day intervals.

Comparing the results of these two tests, it is realized that the interval-observed fasteners have undergone a much more rapid degradation than the undisturbed fasteners. Several have experienced thread diameter degradation of 10% to 15%. It is believed that due to repeated removal and re-installation, the protective surface treatments and oxidation have become stripped from the surface of the fasteners. By stripping these coatings, the fasteners lost protection at a much higher rate and thus degraded faster. Therefore, the second row of fasteners is more indicative of a true test, though the interval-observed fasteners are very likely to be a good representation of an accelerated, prolonged test.

One peculiar observation with CCA and ACQ treated lumbers, was the deposition of copper on the fasteners. This was unexpected, and seemed to present before the darkening of the hydroxide formation stage.

CONCLUSION:

Fasteners in this test were installed in various lumbers and exposed to a moist environment for a period of 154 days. Observation reveals a clearly discernable increase in corrosion for fasteners installed in the ACQ lumber over CCA and SPF lumbers. It can be concluded that the additives in the ACQ lumber accelerate fastener corrosion compared to CCA and SPF lumbers.