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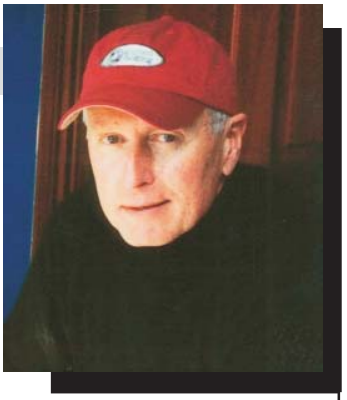

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Coated Bolts Can Improve Constructability

Constructability is all about devising products and procedures that save money, time, or both on a construction site. It usually results from a collaborative effort between the project engineers and suppliers, and usually is the result of innovative thinking about unusual solutions to usual problems.

An example of innovative thinking is the "Squirter" DTI that, yes, costs a little more, but enables faster and more efficient bolting installation and inspection. Squirters were originally developed in response to DTI users who complained about the labor involved in using feeler gages. The ease of visual inspection by looking at the appearance of the squirted silicone make feeler gages almost completely unnecessary. Since Squirter DTIs save about 20% of field bolting manhours, which would cost more than the Squirters add, the constructability of the project is improved.

Figure 1: Squirter DTIs came out of construction concerns

A recent ASME paper on the recognized constructability improvements that derive from Squirter DTIs on HRSG and SCR structural steelwork has been written (ref. 1).

Constructability can also be improved by coating the structural bolts. We've seen EPC contractors such as Fluor, Bechtel, Shaw, Foster-Wheeler, project owners such as Southern Company, Duke Power, AEP, Progress Energy, or even trade and general contractors such as Alstom, Granite, Howe/Baker, TIC (The Industrial Company), take a close look at coating their bolts because they can save cost later.

Why would coating bolts make sense in some situations?

1. Cleaning and painting of bare steel bolts in the field is likely to be difficult, expensive, and in some cases, not feasible.

2. The plain bolts, after stuffing in the holes, are expected to sit out in the weather for an extended period of time and get dried out and rusty, making correct tightening difficult or impossible.

3. Release or retightening of the bolt within the foreseeable future is necessary (wind turbine support shafts).

4. Atmospheric corrosion is expected to be aggressive.

Let's look at the problems that coating a bolt may entail:

1. The thread fit between nut and bolt will be affected, and must be accommodated by overtapping the nut if necessary. Overtapped nuts can strip prematurely if not properly controlled. Xylan coating to over 14 microns makes a small overtap necessary, for instance.

2. Assembly problems will develop if the coating thickness uses up too much of the fit tolerance between the bolt and nut.

3. Some coatings, especially those containing a lot of PTFE, like Teflon, can reduce the friction coefficient to the point where the likelihood of thread stripping under ordinary preloads becomes a probable failure mode.

4. Cost. You can't coat a bolt for free. Galvanizing a 3/4" x 3" bolt might cost 25% of the plain bolt cost, $0.50 vs $0.62. Dacromet coating will cost about the same. Xylan coating will be double or triple that.

Case History: Dacromet Coated A490 Bolts for Boeing Delta IV Frangible Box

The Delta Heavy Lift EELV rocket is the second most powerful payload booster in the U.S., next to the space shuttle. Before launch it is held down by several large connection devices called "Frangible boxes," each containing 16 dacro-met coated 1-1/2" A490 bolts, and DTIs. As the rocket ignites, the boxes are explosively blown apart, allowing the rocket to disconnect from the launch pad. The bolts and DTIs are dacromet coated so they can be easily undone after sitting out in the salt atmosphere for a year on the coast of Florida. The nice thing about dacromet is that no nut overtapping is required.

Figure2: Dacromet Coating Boeing Bolt

Figure 3: EELV Delta IV Rocket

Figure 4: Delta Coated Stud

Case History: Delta Coated M36 10.9 Wind Turbine Bolts and M30 Studs

Delta, one of the "zinc/aluminum flake" thin-film coatings, combined with a lubricious top coat, has the ability to protect against corrosion, to smooth out the highly variable torque resistance a bit, and make retightening possible even in marine environments after months and months in service. It also helps maintain a workable torque/tension relationship during the assembly of wind turbine generators.

Case History: Dacromet and Lubricant Pre-Treatment of A490 Bolts for Power Plants

A490 bolts in power plants cannot be galvanized under the RCSC Specification, because of the potential for hydrogen embrittlement and subsequent fracture during service, and so they are most often used in the uncoated condition. And yet when installed in large complex frames, they must be left to weather for months, sometimes before final tightening. Not only is the final tightening made extremely difficult because of the rust on the bolts, field cleaning and painting is expensive. Applied Bolting recommended that the bolts be dacromet coated before shipping to site, making their installation much easier, and eliminating the necessity of field painting altogether. The cost of dacromet coating was US $1.25 each, and the estimated savings in field labor was at least US $5.00 each.

Figure 5: Power plants use hundreds of thousands 1-1/8" A490 Bolts

Case History: Xylan Coated Bolts for Aluminum Smelter

Ten-thousand tonnes of steelwork for smelter buildings more than a kilometer long, were fabricated and painted white in China. The steel was then shipped to a remote salt water fjord in NE Iceland, called Reydarfjordur, and was to be assembled with about 500,000 unpainted bolts (!) shipped from North America and England. The erected steel was intended to be field cleaned and painted. Constructability concerns highlighted the problems of labor availability and the inclement Icelandic weather which would make it very difficult to do this field painting properly. Zinc coated bolts were not thought compatible with the free HF ions in the aluminum mill atmosphere.

The client's engineer suggested coating the bolts with an epoxy paint, but that proved infeasible. Applied Bolting recommended Xylan coating, essentially a

fluoropolymer applied over a cleaned and phosphate-coated substrate, such as used on studs in the offshore platform piping business. The Xylan coating selected was applied to only 14 microns, but even with that thin a coating it was found necessary to overtap the nuts .2 mm for good fit.

The cost to apply Xylan turned out to be about 2/3rd of the hardware cost again, but even at that cost the overall savings by avoiding field painting was "substantial" according to the EPC contractor. And in an environment like the Iceland seacoast, the Xylan kept the bolts in very good condition as they were shipped, stuffed, and tightened, and no field painting is to be done.

Figure 6: Iceland Xylan Coated Bolts

Ref 1: Squirter™ DTIs Make SCR/HRSG Bolting Easy*, Proceedings of IJPGC'02;*
2002 International Joint Power Generation Conference, Phoenix, AZ, USA, June 24-26, 2002;
ASME Paper No. IJPGC2002-26018;
Wayne Wallace, M. Eng., President, Applied Bolting Technology Products, Vermont, USA;
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Figure 7: Iceland Fjardaal Project Xylan Coated Bolt/DTI

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