



Ask

Dr. Galv



**Q:** How does chromate quenching protect galvanized rebar from concrete?

**A:** Chromate solutions are applied to hot-dip galvanized rebar to prevent a reaction that can occur between the zinc metal of the galvanized coating and the wet concrete. When embedding HDG in concrete, you should be aware of the reaction between galvanized rebar and wet concrete, why the reaction is a concern, and how chromates prevent the reaction from occurring.

When galvanized rebar is added to concrete, a reinforced concrete system is created. The rebar strengthens the concrete. The bond strength of the rebar to the concrete is critical for developing the overall strength of the reinforced concrete system. When the bond strength decreases, so too does the strength of the reinforced concrete system.

When cement is mixed with water to create concrete, calcium hydroxide is produced. The wet concrete is then poured over galvanized rebar to create a reinforced concrete system. The calcium hydroxide from the concrete then reacts with the zinc metal of the galvanized coating to produce calcium hydroxyzincate and hydrogen. This reaction will continue until the concrete dries.

The concern in the reaction between wet concrete and galvanized steel is hydrogen evolution. Hydrogen between the concrete and galvanized rebar decreases the bond strength of the rebar to the concrete, and thereby weakens the strength of the reinforced concrete system.

Certain types of chromates can prevent the reaction between the galvanized coating and the wet concrete, which thereby

decreases or eliminates the evolution of hydrogen. Without the hydrogen, decreased bond strength is no longer a concern. Solutions with a chromate content of 100-200 ppm (equivalent to 50-100 ppm of chromium six), have been shown to adequately prevent the reaction between galvanized rebar and wet concrete.

In addition to quenching galvanized rebar in a chromate solution, there are other ways to achieve the required level of chromates necessary for preventing the reaction between wet concrete and galvanized rebar. Some types of cement naturally contain the necessary amounts of chromium. In addition, chromium can be added directly to the concrete mix to achieve the necessary level of chromates.

It is important to note some studies have shown concerns about hydrogen evolution are not as relevant as once thought. One study showed hydrogen evolution occurs for a much shorter duration of time than initially thought, which means less hydrogen evolution. Another study showed hydrogen evolution occurs not at the interface of the concrete and galvanized coating, but at the iron-zinc alloy layer of the galvanized coating, which means hydrogen evolution would not affect the bond strength of galvanized rebar to concrete.

For more information about using galvanized rebar to reinforce concrete, please contact the AGA Technical Department at 720-554-0900 x 21.